FINAL, REV. 2

Coal Combustion Waste Impoundment

Round 5 - Dam Assessment Report

Southwestern Electric Power Co - Welsh Plant
(Site No 5-016)

Primary Ash Pond
Secondary Ash Pond
Active Bottom Ash Storage Pond

AEP Welsh Plant
Pittsburg, TX

Prepared for:

United States Environmental Protection Agency
Office of Resource Conservation and Recovery

Prepared by:

Dewberry & Davis, LLC
Fairfax, Virginia

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INTRODUCTION, SUMMARY, CONCLUSION AND RECOMMENDATIONS

The release of over five million cubic yards of coal ash from the Tennessee Valley Authority's Kingston, Tennessee facility in December 2008, which flooded more than 300 acres of land, damaging homes and property, is a wake-up call for diligence on coal combustion waste disposal units. A first step to prevent such catastrophic failure and damage is to assess the stability and functionality of ash impoundments and other units, then quickly take any needed corrective measures.

This assessment of the stability and functionality of the Southwestern Electric Power Company's (AEP) Welsh Plant's coal combustion waste (CCW) management units is based on a review of available documents and on the site assessment conducted by Dewberry personnel on June 30, 2010. We found the supporting technical information to be complete (Section 1.1.3). As detailed in Section 1.2 there are several recommendations that may help to maintain a safe and trouble-free operation.

In summary, the Welsh Generating Station Ash Ponds are each rated SATISFACTORY for continued safe and reliable operation. We note that one recent study showed a 10-ft movement of the Secondary Ash Pond embankment.

PURPOSE AND SCOPE

The U. S. Environmental Protection Agency (EPA) is embarking on an initiative to investigate the potential for catastrophic failure of Coal Combustion Surface Impoundments (i.e. management units) from occurring at electric utilities in an effort to protect lives and property from the consequences of a dam failure or the improper release of impoundment contents. The EPA initiative is intended to identify conditions that may adversely affect the structural stability and functionality of a management unit and its appurtenant structures (if present); to note the extent of deterioration (if present); status of maintenance and/or a need for immediate repair; to evaluate conformity with current design and construction practices, and to determine the hazard potential classification for units not currently classified by the management unit owner or by a state or federal agency. The initiative will address management units that are classified a Less-than-Low, Low, Significant or High Hazard Potential ranking. (For Classification, see pp. 3-8 of the 2004 Federal Guidelines for Dam Safety.)

In March 2009, the EPA sent letters to coal-fired electric utilities seeking information on the safety of surface impoundments and similar facilities that receive liquid-borne material that store or dispose of coal combustion waste. This letter was issued under the authority of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Section 104(e), to assist the Agency in assessing the structural stability and functionality of such management units, including which facilities should be visited to perform a safety assessment of the berms, Dams, and dams used in the construction of these impoundments.

EPA asked utility companies to identify all management units, such as surface impoundments or similar dammed or bermed structures and landfills receiving liquid-borne materials, that store or dispose of coal-combustion residuals or by-products, including, but not limited to, fly ash, bottom ash, boiler slag, and flue gas emission control residuals. Utility companies responded with information on the size, design, age, and the amount of material placed in the units so that EPA could gauge which management units had or potentially could rank as having High Hazard Potential. The USEPA and its contractors used the following definitions for this study:

> *"Surface Impoundment or impoundment means a facility or part of a facility which is a natural topographic depression, man-made excavation, or Dammed area formed primarily of earthen materials (although it may be lined with man-made materials), which is designed to hold an accumulation of liquid wastes or wastes containing free liquids, and which is not an injection well. Examples of surface impoundments are holding, storage, settling and aeration pits, ponds, and lagoons."*

For this study, the earthen materials could include coal combustion residuals. EPA did not provide an exclusion for small units based on whether the placement was temporary or permanent. Furthermore, the study covers not only waste units designated as surface impoundments, but also other units designated as landfills which receive free liquids.

EPA is addressing any land-based units that receive fly ash, bottom ash, boiler slag, or flue gas emission control wastes along with free liquids. If the landfill is receiving coal combustion wastes with liquids limited to that for proper compaction, then there should not be free liquids present and the EPA did not seek information on such units which are appropriately designated a landfill.

In some cases coal combustion wastes are separated from the water, and the water containing minimum levels of fly ash, bottom ash, boiler slag, or flue gas emission control wastes are sent to an impoundment. EPA is including such impoundments in this study, because chemicals of concern may have leached from the solid coal combustion wastes into the waster waters, and the suspended solids from the coal combustion wastes remain.

The purpose of this report is to evaluate the condition and potential of waste release from **management units that have or have not been rated for hazard potential classification**. A two-person team reviewed the information submitted to EPA, reviewed any relevant publicly available information from state or federal agencies regarding the unit potential hazard classification (if any) and accepted information provided via telephone communication with a management unit representative.

This evaluation included a site visit. EPA sent two engineers, one licensed in the State of Texas, for a one-day visit. The two-person team met with the technical and management representatives of the management unit(s) to discuss the engineering characteristics of the unit as part of the site visit. During the site visit the team collected additional information about the management unit(s) to be used in determining the hazard potential classifications of the management unit(s). Subsequent to the site visit the management unit owner provided additional engineering data pertaining to the management unit(s).

Factors considered in determining the hazard potential classification of the management unit(s) included the age and size of the impoundment, that quantity of coal combustion residuals or by-products that were stored or disposed in the these impoundments, its past operating history, and its geographic location relative to down gradient population centers and/or sensitive environmental systems.

This report presents the opinion of the assessment team as to the potential of catastrophic failure and reports on the condition of the management unit(s). The team considered criteria in evaluating the dams under the National Inventory of Dams in making these determinations.

<u>LIMITATIONS</u>

The assessment of dam safety reported herein is based on field observations and review of readily available information provided by the owner/operator of the subject coal combustion waste management unit(s). Qualified Dewberry engineering personnel performed the field observations and review and made the assessment in conformance with the required scope of work and in accordance with reasonable and acceptable engineering practices. No other warranty, either written or implied, is made with regard to our assessment of dam safety.

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1.0 CONCLUSIONS AND RECOMMENDATIONS

1.1 CONCLUSIONS

Conclusions are based on visual observations from our one-day site visit and review of technical and historical documentation provided by Welsh Plant personnel.

1.1.1 Conclusions Regarding the Structural Soundness of the Management Unit(s)

Primary Ash, Secondary Ash, and Active Bottom Ash Storage Ponds– The dam embankments performed without incident from original construction in 1977; except the down gradient slopes of the Secondary Ash Pond. Slope stability and seepage analyses for the embankments were performed and were provided for review. There have been several site investigations and stability evaluations performed on the management units over the years. Most recently, two Geotechnical Investigation Reports by ETTL Engineers & Consultants Inc., one dated June 21, 2010 and the other dated June 22, 2010 were provided for review and are included in Appendix C. The first report indicates the presence of shallow surface sloughing on the east side of the Secondary Ash Pond. The second report indicates subsequent movement of the Secondary Ash Pond embankment approximately 10 feet into the lake. The second report indicates that test pits encountered sub-grade soils more varied with higher strength clays and lower strength sands within the failure surface than initially assumed. Based on the recent movement of the Secondary Embankment and the finding of unanticipated soil conditions in the failure area, the structural soundness of that embankment is in question. As the Primary Ash Pond and Secondary Ash Pond are understood to have been constructed concurrently, similar concerns exist for the Primary Ash Pond. See Dewberry's assessment in Section 7.3.

There is no comparable structural stability analyses for the Active Bottom Ash Pond. The embankments and spillway of the Active Bottom Ash Pond appear to be structurally sound based on Dewberry engineer team observations during the site visit. The geotechnical data indicates that embankment and subgrade soils are not at significant risk of liquefaction during a design earthquake less than 0.2 g. Because of the generally low consequences of failure of these dams, performing detailed seismic stability analyses and liquefaction studies does not appear to be warranted at this time.

The outlet structures appear to be in sound and stable condition with no visual evidence of significant deterioration; they should be satisfactory for continued service.

1.1.2 Conclusions Regarding the Hydrologic/Hydraulic Safety of the Management Unit(s)

Primary Ash, Secondary Ash, and Active Bottom Ash Storage Ponds– Hydrologic/hydraulic analyses of the ash basins were provided for review in a report for American Electric Power, signed December 29, 2010, by an engineer with Freese and Nichols (referred to herein as the Freese and Nichols Report). On the basis of the critical studies and investigations provided in the Freese and Nichols report, the assessors have determined the hydrologic/hydraulic safety of the dams and Management Units be rated SATISFACTORY.

Available area topographic maps indicate a small, up gradient, off-site drainage area west – southwest of the Primary Ash Pond. Dewberry was informed that drainage from west of the plant site has been diverted away from the site as part of a roadway improvement project. The topographic knoll south of the Primary Ash Pond was excavated as part of plant site development. The drainage area for the Primary Ash, Secondary Ash, and Active Bottom Ash Storage Ponds are approximately 100, 4.2, and 20 acres, respectively. It was reported during the onsite inspection that for each pond drainage area, runoff is essentially limited to the limits of the ponds. This statement should be verified.

Additionally, the Primary Ash, Secondary Ash, and Active Bottom Ash Storage Ponds discharge and overflow into the Welsh Reservoir, which serves as a cooling water reservoir for the generating plant. The storage capacity of the Welsh reservoir is greater than 15,000 ac ft (from conservation level to three (3) feet of freeboard below top of Dam). The summation of the storage for the three ponds is 614 ac ft. *The reservoir has sufficient capacity to contain the total storage of all ponds even if a catastrophic failure were to take place*.

1.1.3 Conclusions Regarding the Adequacy of Supporting Technical Documentation

Supporting technical documents are limited. Original design documentation and drawings for each pond were provided and can be found in Appendix B. Subsequent technical documents and plans were available and are sufficient to verify the adequacy of the pond storage, outlet structures and structural stability of the embankments. For these low dams with generally low consequences of failure, sufficient information was provided to make an assessment.

1.1.4 Conclusions Regarding the Description of the Management Unit(s)

Primary Ash, Secondary Ash, and Active Bottom Ash Storage Ponds embankments - Descriptions provided are appropriate and sufficient.

Appendix C contains drawings and a technical report on the slope repair. ETTL Engineers and Consultants Inc. inspected a slope failure and provided two geotechnical engineering reports on recommended corrective measures.

The recommended repairs consist of:[1]

1. Installation of sheet piles extending beyond the failure surface on both ends by a minimum of 10 feet.
2. Cut the slope back behind the failure surface above the pile wall.
3. Scarify the subgrade, adjust the moisture content to optimum ±3 % and recompact to a minimum of 95% of standard proctor (ASTM D698).
4. Rebuild slope with Select Fill as described below:
    a. Place subsequent lifts of select fill in thin, loose layers not exceeding nine inches in thickness to the desired rough grade and compact to a minimum of 95% of standard proctor density (ASTM D698) at a moisture content within a range of optimum to optimum +3%.
    b. Conduct in-place field density tests at a rate of one test per 3,000 square feet for every lift with a minimum of 2 tests per lift.

1.1.5 Conclusions Regarding the Field Observations

Primary Ash, Secondary Ash, and Active Bottom Ash Storage Ponds – The embankment dams appear well maintained, safe, and structurally sound. There are no apparent indications of unsafe conditions. The visible parts of the embankment dams and outlet structures were observed to have no signs of overstress, significant settlement, shear failure, or other signs of instability, although in areas of the Primary Ash Pond visual observations were severely hampered by the presence of thick vegetation and lack of accessibility. No seepage was observed.

The embankment dams appear well maintained, safe, and structurally sound for the Secondary Ash Storage Pond with the exception of a slope failure repair under construction. No other indication of scarps, sloughs, or excessive settlement or slope movement was observed during our site visit.

1.1.6 Conclusions Regarding the Adequacy of Maintenance and Methods of Operation

Primary Ash, Secondary Ash, and Active Bottom Ash Storage Ponds **-** Maintenance and methods of operation are adequate. Other than repairs described above there was no evidence of repaired embankments or prior releases observed during the field assessment.

[1] ETTL Engineers and Consultants Inc. Slope Failure Repair Report - see Appendix C: ETTL Reports for detailed description

1.1.7 Conclusions Regarding the Adequacy of the Surveillance and Monitoring Program

Primary Ash, Secondary Ash, and Active Bottom Ash Storage Ponds – The surveillance program is generally adequate. The informal daily drive-by inspections by plant personnel and quarterly formal inspections by AEP Welsh engineers are of sufficient frequency and should continue. Informal visual inspections of the spoil bank along the bank with the Welsh Reservoir are currently conducted from a boat by plant personnel. Internal inspection of the outlet structures should be performed at a frequency of at least once every five (5) years and documented.

Additionally, the Texas Commission on Environmental Quality conducts annual inspections of the NPDES permitted facility which include an inspection of the embankments, berms intake and outfall structures. Copies of the most recent reports are included in Appendix D.

1.1.8 Classification Regarding Suitability for Continued Safe and Reliable Operation

Primary Ash, Secondary Ash, and Active Bottom Ash Storage Ponds – The facilities are considered SATISFACTORY for continued safe and reliable operation.

1.2 RECOMMENDATIONS

1.2.1 Recommendations Regarding the Structural Stability

It is recommended that AEP monitor the slopes and embankments of the Primary Ash and Secondary Ash Management Units. This is based on the embankment failure of a section of the Secondary Ash Pond and the findings presented in the 22 June 2010 geotechnical report. The scope of the recommended monitoring system is outlined in Section 1.2.7.

It is recommended that AEP perform a slope stability analysis of the Active Bottom Ash Storage Pond.

1.2.2 Recommendations Regarding the Hydrologic/Hydraulic Safety

Primary Ash, Secondary Ash, and Active Bottom Ash Storage Ponds – With the generation of the Freese and Nichols report, no recommendations are warranted at this time.

1.2.3 Recommendations Regarding the Supporting Technical Documentation

Structural stability documentation for the Active Bottom Ash Storage Pond was not provided; this documentation is needed.

1.2.4 Recommendations Regarding the Description of the Management Unit(s)

Primary Ash, Secondary Ash, and Active Bottom Ash Storage Ponds- None appear warranted at this time.

1.2.5 Recommendations Regarding the Field Observations

Primary Ash Pond and Secondary Ash Pond Dam – None appear warranted at this time.

1.2.6 Recommendations Regarding the Maintenance and Methods of Operation

Primary Ash, Secondary Ash, and Active Bottom Ash Storage Ponds– Information presented in the June 2010 geotechnical engineering reports indicates that the Primary Ash Pond and Secondary Ash Pond embankments have localized areas subject to slope failures related to water entering the embankment. Dewberry recommends that any cracks observed during routine inspections be repaired and sealed to prevent rainwater from entering the embankments.

1.2.7 Recommendations Regarding the Surveillance and Monitoring Program

Primary Ash and Secondary Ash – Due to the slope failure on a portion of the down gradient side of the Secondary Ash Pond, Dewberry recommends installing a slope monitoring system. As the Primary Ash Pond was constructed together with the Secondary Ash Pond, the recommendation for a slope monitoring system applies to both ponds.

The recommended slope monitoring system should provide for measurement of vertical and lateral movements of critical areas of the embankments. A network of benchmarks for elevation measurements combined with slope inclinometers installed at the crest, mid slope and near the embankment toe will provide important data needed to monitor slope stability.

Active Bottom Ash Storage Ponds– No additional recommendations for the surveillance and monitoring program appear warranted at this time.

1.2.8 Recommendations Regarding Continued Safe and Reliable Operation

Primary Ash, Secondary Ash, and Active Bottom Ash Storage Ponds – No additional recommendations for continued safe and reliable operation appear warranted at this time.

1.3 PARTICIPANTS AND ACKNOWLEDGEMENT

1.3.1 List of Participants

*Andrew J. Cueto, PE, PMP - Engineer, Dewberry
*Cleighton Smith, Engineer - Dewberry
*Mr. Max Diaz - Plant Environmental Coordinator, AEP Welsh
*W. Greg Carter, PE - AEP Welsh
*James W. Long Jr. - Maintenance Supervisor, AEP Welsh
*Kelly G. Spencer, CPSS, PG - Lead Plant Envr. Coordinator, AEP Welsh
Tommy J. Slater, PE - Plant Manager, AEP Welsh
Brett Dreger – AEP Geotechnical Engineer

*Participated in field dam inspections.

1.3.2 Acknowledgement and Signature

We acknowledge that the Welsh Plant coal combustion residue management units referenced herein were assessed as of June 30, 2010.

Andrew J. Cueto, PE, PMP 11-07-10
Registered, TX 68920

STATE OF TEXAS
ANDREW JOHN CUETO
68920
REGISTERED PROFESSIONAL ENGINEER

Cleighton Smith, PE

2.0 DESCRIPTION OF THE COAL COMBUSTION WASTE MANAGEMENT UNIT(S)

2.1 LOCATION AND GENERAL DESCRIPTION

The Welsh Power Plant is physically located off of SH11 at 1187 CR 4865, approximately two miles northwest of the Town of Cason and one and one half miles north of State Highway 11 in Titus County, Texas. The AEP Welsh Power Plant is a coal fired facility. Low sulphur, sub-bituminous coal is brought to the facility by rail from the Powder River Basin in Wyoming. The plant is composed of three generating units (1, 2, and 3) that are 528 MW Westinghouse turbine generators and Babcock & Witcox coal-fired boilers. Unit 1 of the Welsh Plant Boiler # 1 (W - 1) began operation in 1977, Boiler # 2 (W-2) began operation in 1980 and Boiler #3 (W-3) began operation in 1982. The facility has not changed from its core operations, but it has been modified to reduce emissions, through equipment and/or operational changes. At this facility, electrostatic precipitators and bag-house filter systems remove particulate matter, and Special burners are used in the boiler system to hold down the formation of nitrogen oxide (NOx).

Two wastes are generated by the combustion of coal, bottom ash and fly ash, both of which are Class 2 Industrial Waste. Fly ash is the light non-combustible particulate matter that rises in the combustion gasses. The fly ash is collected from the bag-house and contained in silos. The ash is then either sold by AEP as a cement manufacturing product, or managed in Unit 001 (Old Ash Storage Area). Currently about half of all fly ash is bought and marketed by AEP. Bottom ash is the larger and heavier non-combustible particles that stay on the bottom of the furnaces. The bottom ash slurry is collected in the Primary and Secondary Ash Settling Ponds (Unit 004). These settling ponds are currently dredged about once per year. This dredged ash is managed in Active Bottom Ash Pond.

Welsh Power Plant has wastewater facility coverage under the Texas Pollutant Discharge Elimination System (TPDES) permit WQ0001811000. The facility is currently permitted to discharge metal cleaning wastes and treated domestic wastewater. This outfall discharges into the secondary ash pond before entering into Welsh Reservoir. Once the effluent enters the Welsh Reservoir, it flows to Swauano Creek, then to Big Cypress Creek below Lake Bob Sandlin in Segment No. Segment No. 0404 of the Cypress Creek Basin.

The Primary Ash Settling Pond functions as a settling basin for wastewater containing bottom and economizer ash slurry. The impoundment encompasses an area of 98.1 surface acres and has a total storage capacity of 307.4 acre feet. The maximum height of the impoundment is 40 feet. The impoundment was designed by a professional engineer (P.E.) and was constructed under the supervision of a P.E. The unit went into service in 1977 at plant start-up. The impoundment has a natural clay liner. The embankment is classified as a cross valley dam. Design documents indicate it was constructed of select fill with a high clay content. There have not been any known spills or un-permitted releases from the unit within the last ten years.

The Secondary Ash Settling Pond functions as a settling basin for wastewater containing a bottom and economizer ash slurry. The impoundment encompasses an area of 4.5 surface acres and has a total storage capacity of 36.9 acre feet. The maximum height of the impoundment is 25 feet. The impoundment was designed by a P.E. and was constructed under the supervision of a P.E. The unit went into service in 1977 at plant start-up. The impoundment has a compacted clay liner. Effluent from the impoundment is regulated under the facility's TPDES permit. Effluent flows through outfall 003 into the onsite discharge canal before entering into Welsh Reservoir There have not been any known spills or un-permitted releases from the unit within the last ten years.

The Active Bottom Ash Storage Pond is predominately used for the disposal of bottom ash and economizer ash. The impoundment encompasses an area of 20 surface acres, with a total storage capacity of 270 acre feet. The impoundment is currently at approximately 60% capacity. The current life of the impoundment before future expansion is predicted to be approximately 3 years. The maximum height is 34.6 feet. The impoundment was designed by a P.E. and was constructed under the supervision of a P.E. The unit went into service in 2000. The impoundment is lined with a compacted clay and a synthetic liner. The embankments were designed to be constructed of select fill with a high clay content. There have not been any known spills or un-permitted releases from the unit within the last ten years. Ground water monitoring data did not indicate the unit poses a current threat to groundwater.

2.2 SIZE AND HAZARD CLASSIFICATION

The Welsh Power Plant impoundment Dams (dams) are not regulated for dam safety by a federal or state agency, and currently do not have federal or state hazard classifications. All ash ponds are regulated by the Texas Commission on Environmental Quality through its NPDES permit.

The Texas Commission on Environmental Quality classifies dams for size based on the larger of the height of the dam or the maximum storage capacity.

Table 2.1 TAC §299.13 SIZE CLASSIFICATION		
Category	**Impoundment: Maximum Storage (Acre-Foot)**	**Height (Ft.)**
Small	Equal to or Greater than 15 & Less than 1,000 Equal to or Greater than 50 & Less than 1,000	Equal to or Greater than 25 & Less than 40 Greater than 6 & Less than 40
Intermediate	Equal to or Greater than 1,000 & Less than 50,000	Equal to or Greater than 40 & Less than 100
Large	Equal to or Greater than 50,000	Equal to or Greater than 100

In each case all the AEP Welsh Ponds would be classified as small structures based on **30 TAC §299.13.** [2]

The Hazard Potential Classification System for Dams is based on the probable loss of human life and the potential for economic losses, environmental damage, and/or disruption to lifelines caused by failure of mis-operation of a dam or its appurtenances. This Hazard Potential Classification System for Dams recognizes that the failure or mis-operation of any dam or water-retaining structure, no matter how small, represents a potential danger to downstream life and property. Whenever there is an uncontrolled release of stored water, there is always the possibility, regardless of how unexpected, of someone being in the path of the discharge. However, postulating every conceivable circumstance that might remotely place a person in the potential inundation zone should not be the basis for determining the appropriate classification level. This system considers improbable loss of life to exist where persons are only temporarily in the potential inundation area.

Dams assigned the high hazard potential classification are those where failure or mis-operation will probably cause loss of human life. [3]

TABLE 2.2 Hazard Potential Classification	Loss of Human Life	Economic, Environmental, Lifeline Losses
Low	None expected	Low and generally limited to owner
Significant	None expected	Yes
High	Probable. One or more expected	Yes (but not necessary for this classification)

Primary Ash Pond Dam – Maximum dam height is 40 feet, according to furnished information. The total storage capacity is approximately 307.4 acre-feet. Other physical data are summarized in Table 2.1. The dam currently has an undetermined hazard potential rating. Based on storage capacity, the Primary Ash Pond Dam has a Small Size Classification. Failure of this structure could release wastes directly or indirectly into the Welsh Reservoir Cooling Lake. A release may disrupt power generation and cause minor environmental damage. The release would be contained within Welsh Reservoir due to the extensive storage capacity in comparison to the capacity of the ponds. The failure would not likely cause loss of life. Therefore, the Primary Ash Pond Dam should be given a Low Hazard Potential Classification.

Secondary Ash Pond Dam – Maximum dam height is 25 feet, according to furnished information. The total storage capacity is approximately 36.9 acre-feet. Other physical data are summarized in Table 2.2. The dam currently has an undetermined hazard potential rating. Based

[2] Texas Commission on Environmental Quality; Chapter 299 - Dams and Reservoirs; SUBCHAPTER B: DESIGN AND EVALUATION OF DAMS §§299.11 - 299.17; Effective January 1, 2009

[3] Federal Guidelines For Dam Safety: Hazard Potential Classification System For Dams: U.S. Department Of Homeland Security Federal Emergency Management Agency October 1998 - Reprinted January 2004

on storage capacity, the Secondary Ash Pond Dam has a Very Small Size Classification. Failure of this structure could release directly or indirectly into the Welsh Reservoir Cooling Lake. A release may disrupt power generation and cause minor environmental damage. The release would be contained within Welsh Reservoir due to the extensive storage capacity in comparison to the capacity of the ponds. The failure would not likely cause loss of life. Therefore, the Secondary Ash Pond Dam should be given a Low Hazard Potential Classification.

Active Bottom Ash Storage Pond Dam – Maximum dam height is 36.5 feet, according to furnished information. The total storage capacity is approximately 270 acre-feet. Other physical data are summarized in Table 2.3. The dam currently has an undetermined hazard potential rating. Based on storage capacity, the Active Bottom Ash Storage Pond Dam has a Small Size Classification. Failure of this structure could release directly or indirectly into the Welsh Reservoir Cooling Lake. A release may disrupt power generation and cause minor environmental damage. The release would be contained within Welsh Reservoir due to the extensive storage capacity in comparison to the capacity of the ponds. The failure would not likely cause loss of life. Therefore, the Active Bottom Ash Storage Pond Dam should be given a Low Hazard Potential Classification.

Pertinent physical data are presented in the following Table 2.3.

Table 2.3: Summary of Dam Dimensions and Size *

	Primary Ash Pond Dam	Secondary Ash Pond Dam	Active Bottom Ash Storage Pond Dam
Dam Height	40’	25'	36.5'
Crest Width	60’	30'	8’
Length	~1200’	~1400’	~4000’
Side Slopes (inside)	3:1	3:1	3:1
Side Slopes (outside)	3:1	3:1	3:1
Hazard Classification*	Low	Low	Low

* *Based on available information provided by AEP personnel during onsite inspection.*

2.3 AMOUNT AND TYPE OF RESIDUALS CURRENTLY CONTAINED IN THE UNIT(S) AND MAXIMUM CAPACITY

The amount of CCW residuals currently stored in the units and maximum capacities are summarized in Table 2.4.

The Primary Ash Settling Pond functions as a settling basin for wastewater containing bottom and economizer ash slurry. The impoundment encompasses an area of 98.1 surface acres and has a total storage capacity of 307.4 acre feet. The maximum height of the impoundment is 40 feet.

The unit went into service in 1977 at plant start-up. There have not been any known spills or un-permitted releases from the unit within the last ten years. An estimated 30,000 cubic yards are currently stored in the impoundment. The impoundment is dredged approximately once every 18 months.

The Secondary Ash Settling Pond functions as a polishing pond for wastewater discharged from the Primary Ash Pond. The impoundment encompasses an area of 4.5 surface acres and has a total storage capacity of 36.9 acre feet. The maximum height of the impoundment is 25 feet. The unit went into service in 1977 at plant start-up. Effluent flows through Outfall 001 into the onsite discharge canal before entering into Welsh Reservoir There have not been any known spills or un-permitted releases from the unit within the last ten years. At the time of the current investigation, the impoundment had approximately 12 feet of freeboard. There were no signs of seepage from the unit. An estimated 7,200 cubic yards are currently stored in the impoundment. AEP notes that minimal sediment reaches and is stored in this pond, and that the majority of volume is water.

The Active Bottom Ash Storage Pond is predominately used for the storage of bottom ash and economizer ash. The bottom ash storage pond encompasses an area of 20 surface acres, with a total storage capacity of 270 acre feet. The bottom ash storage pond is currently at approximately 60% capacity. The current life of the pond before future expansion is predicted to be approximately 3 years. The maximum height is 36.5 feet. The unit went into service in 2000. The pond is lined with a compacted clay and a synthetic liner. There have not been any known spills or un-permitted releases from the unit within the last ten years.

Table 2.4: Amount of Residuals and Maximum Capacity of Unit*

	Primary Ash Pond	Secondary Ash Pond	Active Bottom Ash Storage Pond
Surface Area (acre)	98.1	4.5	20
Current Storage Volume (acre-feet)	230.6	31.4	108
Total Storage Capacity (acre-feet)	307.4	36.9	270

**Based on data in AEP Welsh's response Texas Commission on Environmental Quality annual inspection*

2.4 PRINCIPAL PROJECT STRUCTURES

2.4.1 Earth Embankment Dam

The perimeter dam and cross dam embankments are constructed of compacted earth fill. At the time of the current investigation, each impoundment had approximately six to eight feet of freeboard. There were no signs of seepage below the dams. The dams are covered in grassy vegetation with no significant trees on the structure.

The source and type of soils used for earth fill is unknown. However, AEP contracted with ETTL Engineers & Consultants Inc. of Tyler, Texas to perform an Investigation of Existing Ash Storage Ponds Embankment and Geotechnical on June 21, 2010 (copy provided in Appendix C). 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 Primary and Secondary Ash Ponds were investigated. Two borings were drilled to 30 feet deep at the native soil level and five borings were drilled to 50 feet deep in the crests of the embankments (Appendix C). The fill material in the containment berm consists primarily of stiff to hard lean clay (CL), fat clay (CH) and medium dense clayey sand (SC) overlying the native soils which consist primarily of stiff to hard lean clay (CL) and fat clay (CH) with intermittent layers of medium dense to very dense clayey sand (SC) and silty sand (SM). The western borings (B-6 and B-7) have a thick layer of very dense silty sand (SM) which is apparently the native surface soil near the previous creek bed. Atterberg Plasticity Indices of the tested soils ranged from 9 to 44.

Table 2.5– Permeability Test Results

Boring	Depth (ft)	Unit Weight (pcf)	Permeability (cm/sec)
B-2a	13’ - 15’	141.5	2.9 x 10-8
B-2b	33’ - 35’	128.2	7.0 x 10-8
B-3	8’ - 10’	132	7.4 x 10-8
B-4	8’ - 10’	124.4	1.9 x 10-8
B-5	23’ – 25’	125.5	5.0 x 10-7
B-6	28’ – 30’	124.8	4.3 x 10-5

All embankment slopes must be stable with respect to shear failure through the embankment and the foundation strata. The existing slopes are standing with no obvious slope failures with the exception of the surface sloughing in the east side of the secondary ash pond. Therefore, all slopes must have a Factor of Safety above 1. However, the Factor of Safety for long term stability should be a minimum of 1.5 for all new construction. This study was conducted to assure that the embankments meet the minimum Safety Factors.

2.4.2 Outlet Structures

Primary Ash Pond – The outlet for the Primary Ash Pond is a 48" Concrete Stop-Log structure. The pond effluent flows into the Secondary Ash Pond. Welsh personnel control the water surface elevation and flow out of the pond via a 12" Stop Logs. There is one piezometer at the crest of the embankment. Also the pond has an emergency spillway. Inspection of the structure revealed that it was in good condition and well maintained. Figure 2-1 is a photo of the structure.

Figure 2-1: Primary Ash Pond Outlet

Secondary Ash Pond – The outlet for the Secondary Pond is a 48" sharp crested rectangular weir. The pond effluent flows into the Welsh Reservoir. Welsh personnel control the water surface elevation and flow out of the pond via 12" Stop Logs. There are three piezometers located on the crest of each of the three dikes and a flow chart meter at the discharge. Also the pond has an emergency spillway. Inspection of the structure revealed that it was in good condition and well maintained. Figure 2-2 is a photo of the structure.

Figure 2-2: Secondary Ash Pond Outlet

Active Bottom Ash Storage Pond – The outlet for the Secondary Pond is an 18" HDPE pipe. The pond effluent flows back via a gravity feed into Primary Ash Pond. Welsh personnel do not control the water surface elevation and flow out of the pond. The pond serves as a de-watering unit for dredge out of the Primary pond. Inspection of the structure indicated that it was in good condition and well maintained. Figure 2-3 is a photo of the structure which includes an area used as a stilling basin prior to the outlet.

Figure 2-3: Active Bottom Ash Storage Pond Outlet

2.5 CRITICAL INFRASTRUCTURE WITHIN FIVE MILES DOWN GRADIENT

A regional map showing Welsh Power Plant and ash ponds in relationship to “critical” infrastructure is shown in Figure 2-4. “Critical” infrastructure includes facilities such as schools and hospitals. .

Figure 2-4: Aerial View of Ash Ponds and Welsh Reservoir

Failure of any of these impoundment structures could release directly or indirectly into the Welsh Reservoir Cooling Lake. A release may disrupt power generation and cause minor environmental damage. However a release would be contained within Welsh Reservoir due to the extensive storage capacity in comparison to the capacity contained within the ponds. Therefore, risk to “critical” infrastructure is insignificant.

3.0 SUMMARY OF RELEVANT REPORTS, PERMITS AND INCIDENTS

3.1 SUMMARY OF REPORTS ON THE SAFETY OF THE MANAGEMENT UNIT(S)

Primary Ash Pond – Quarterly inspections are conducted by AEP Welsh. For the period January 2009 through April 2010, no major problems were observed. No significant deterioration was indicated in the documentation reviewed. Mr. Carter, the facility's senior engineer, performs regular safety assessment of the impoundments yearly, and determined the unit was a low hazard. At the time of the current investigation, the impoundment had approximately six feet of freeboard. There were no signs of seepage below the Dams. The Dam is covered in grassy vegetation with no significant trees on the structure. An estimated 30,000 cubic yards are currently stored in the impoundment. The impoundment is dredged approximately once per year.

Secondary Ash Pond – Quarterly inspections are conducted by AEP Welsh. A slope failure was noted in late 2009 with significant deterioration to the north outside embankment. Mr. Carter, the facility's senior engineer, immediately retained a soils engineer to investigate the slough and recommend remediation, which was underway during the site visit. At the time of the current investigation, the impoundment had approximately six feet of freeboard. There were no signs of seepage below the Dams. The Dam is covered in grassy vegetation in the undisturbed areas with no significant trees on the structure.

Active Bottom Ash Storage Pond – Quarterly inspections are conducted by AEP Welsh. For the period January 2009 through April 2010, no major problems were observed. No significant deterioration was indicated in the documentation reviewed. The pond is predominately used for the disposal and dewatering of bottom ash and economizer ash. The unit encompasses an area of 20 surface acres, with a total storage capacity of 270 acre feet. The unit is currently at approximately 60% capacity. The current life of the unit before future expansion is predicted to be approximately 3 years.

The unit went into service in 2000. The bottom ash storage pond is lined with a compacted clay and a synthetic liner. There have not been any known spills or un-permitted releases from the unit within the last ten years. There were no signs of seepage from the unit. The embankments are covered in grassy vegetation with no significant trees on the structure with the exception of some minor woody bushes. At the time of the current investigation, the impoundment had approximately 12 feet of freeboard.

3.2 SUMMARY OF LOCAL, STATE AND FEDERAL ENVIRONMENTAL PERMITS

The facilities at the AEP Welsh are regulated for water quality by the Texas Commission on Environmental Quality. Groundwater monitoring/sampling is conducted at a number of points (water-quality wells) around the units. The Primary Ash, Secondary Ash, and Active Bottom Ash Storage Ponds are currently regulated under NPDES Permit No. IWD 1811 (Appendix D –

TCEQ Documents). This permit was effective on February 5, 2004 and expires on February 1, 2011. The outfall discharges into the secondary ash pond before entering into Welsh Reservoir. Once the effluent enters the Welsh Reservoir, it flows to Swauano Creek, then to Big Cypress Creek below Lake Bob Sandlin in Segment No. Segment No. 0404 of the Cypress Creek Basin.

3.3 SUMMARY OF SPILL/RELEASE INCIDENTS (IF ANY)

Primary Ash Pond- There has been no reported spill/release incident at this basin.

Secondary Ash Pond- There has been no reported spill/release incident at this basin.

Active Bottom Ash Storage Pond- There has been no reported spill/release incident at this basin.

4.0 SUMMARY OF HISTORY OF CONSTRUCTION AND OPERATION

4.1 SUMMARY OF CONSTRUCTION HISTORY

4.1.1 Original Construction

Some construction records were made available and can be found in Appendix B. Therefore what can be determined from the provided documentation is that both the primary and secondary ponds were constructed at the same time in 1974 and were designed by a professional engineer registered in the State of Texas. There were drawings and specifications that detailed the following:

1. Clearing and grubbing of all topsoil and organic material below proposed ponds,
2. Placement and type of select (clay) fill for both pond liner and embankments,
3. Field density test requirements and testing results.

Primary Ash Pond – The basin was constructed in a natural ravine and low, swampy area located between the plant coal storage on the north side and high ground used for ash by-product storage to the south. The basin was lined with a clay liner.

Secondary Ash Pond – The basin was formed within a low, swampy area, with a shared common Dam with the Primary Ash Pond bounding the north side, high ground used for ash by-product storage to the west, and the perimeter dam confining the east and south sides. The basin was lined with a clay liner.

Active Bottom Ash Storage Pond – The basin was formed within a high ground area, with a perimeter dam surrounding the entire perimeter. The basin was lined with a clay liner and a synthetic HDPE liner.

4.1.2 Significant Changes/Modifications in Design since Original Construction

Primary Ash Pond – There have been no significant changes/modifications in design since the original construction of the basin.

Secondary Ash Pond – There have been no significant changes/modifications in design since the original construction of the basin. Note that the northern dam is undergoing repairs.

Active Bottom Ash Storage Pond – There have been no significant changes/modifications in design since the original construction of the basin.

4.1.3 Significant Repairs/Rehabilitation since Original Construction

Primary Ash Pond – There have been no significant repairs/rehabilitation made to this basin since the original construction.

Secondary Ash Pond – Note that the northern dam is undergoing repairs. Appendix C contains drawings and a technical report on the slope repair. ETTL Engineers and Consultants Inc. first inspected the berm in October 2009 during the initial slope stability work and then again during the slope failure repairs on May 7, 2010. The slough reportedly occurred sometime during the week of September 13, 2009 and a 4.1 inch rainfall was recorded on September 14, 2009. In October of 2009, over 17 inches of rain was recorded, which delayed the repairs and caused the slope to move again.

Repairs consisted of:[4]

1. Installation of sheet piles extending beyond the failure surface.
2. Cut the slope back behind the failure surface above the pile wall.
3. Adjust, the moisture content of the subgrade to optimum ±3 % and recompact to a minimum of 95% of standard proctor (ASTM D698).
4. Rebuild slope with Select Fill

Active Bottom Ash Storage Pond – There have been no significant repairs/rehabilitation made to this basin since the original construction.

4.2 SUMMARY OF OPERATIONAL HISTORY

4.2.1 Original Operational Procedures

The furnished documents do not include the original operational procedures. The Primary Ash Pond, Secondary Ash Pond, and Active Bottom Ash Storage Pond are man-made basins that were designed and operated primarily for the disposal and dewatering of boiler slag, fly ash and bottom ash. It was reported by AEP Welsh personnel that original operation was much as it is today with respect to the manner in which the ash is transported and disposed, i.e., by sluicing with water into the basin where the ash particles are allowed to settle out. AEP Welsh indicated that there has always been a market for the fly ash and boiler slag.

[4] ETTL Engineers and Consultants Inc. Slope Failure Repair Report - see Appendix C: Embankment Repair for detailed description

4.2.2 Significant Changes in Operational Procedures since Original Startup

No documents were provided to indicate that basic operational procedures have significantly changed since original startup. Mining of the bottom ash for beneficial reuse was started about 20 years ago when a market for the ash was developed.

4.2.3 Current Operational Procedures

The ash basins are operated and monitored for water quality under a TCEQ approved NPDES permit. Two wastes are generated by the combustion of coal, bottom ash and fly ash, both of which are Class 2 Industrial Waste. The fly ash is collected from the bag-house and contained in silos. The ash is then either sold by AEP as a cement manufacturing product, or managed in Old Ash Storage Area. Currently about half of all fly ash is bought and marketed by AEP. The bottom ash slurry is collected in the Primary and Secondary Ash Settling Ponds. These settling ponds are currently dredged about once per year. This dredged ash is managed in the New Active Bottom Ash Storage Pond.

The Primary Ash Settling Pond functions as a settling basin for wastewater containing bottom and economizer ash slurry. Effluent flows through outfall 001 and into a small secondary pond. An estimated 30,000 cubic yards are currently stored in the impoundment. The impoundment is dredged approximately once per year.

The Secondary Ash Settling Pond functions as a settling basin for wastewater containing a bottom and economizer ash slurry. AEP notes that minimal sediment reaches and is stored in this pond, and that the majority of volume is water.

The Active Bottom Ash Storage Pond is predominately used for the dewatering and disposal of bottom ash and economizer ash. The current life of the unit before future expansion is predicted to be approximately 3 years. The unit went into service in 2000.

4.2.4 Other Notable Events since Original Startup

Primary Ash Pond – Based on furnished information and discussions with AEP Welsh personnel, there are no other notable events since original startup of Primary Ash Pond to report at this time.

Secondary Ash Pond – Based on furnished information and discussions with AE P Welsh personnel, there are no notable events. However, the northeastern embankment did have a slope failure which is currently undergoing repairs. There were no releases and the dam itself continued to serve as an effective containment structure. Appendix C contains drawings and a technical report on the slope repair.

Active Bottom Ash Storage Pond – Based on furnished information and discussions with AEP Welsh personnel, there are no other notable events since original startup of Active Bottom Ash Storage Pond to report at this time.

5.0 FIELD OBSERVATIONS

5.1 PROJECT OVERVIEW AND SIGNIFICANT FINDINGS

Dewberry personnel Andrew J. Cueto, PE, PMP and Cleighton Smith collected available data and documents and made field observations during a site visit on June 30, 2010, in company with the participants listed in Section 1.3. The design engineer of record for the Primary Ash Pond, Secondary Ash Pond and Active Bottom Ash Storage Pond was not present or available to assist with answering questions about these basins.

The site visit began at 10:30 AM. Weather conditions during the visit were 88 degrees Fahrenheit, partly cloudy to cloudy, and dry to drizzling. Photographs were taken of conditions observed. Photographs referenced below are contained at the end of this chapter.

The overall visual assessment is that the earthen embankments that impound Primary Ash Pond Secondary Ash Pond and Active Bottom Ash Storage Pond are in SATISFACTORY condition. No visual signs of imminent instability or inadequacy of the principal structures at these basins that would require emergency remedial action were observed. No evidence of past repairs was observed other than the ongoing repair of the north exterior slope of the Secondary Ash Pond. No significant findings were noted. No obvious indications of stability problems, such as large gouges or swaths of overturned trees, etc. were observed.

The observations below pertain mainly to the embankments and outlet works constructed in 1973-74 to form the oldest two ash ponds and 2000 for the Active Bottom Ash Storage Pond.

5.2 PRIMARY ASH POND

5.2.1 Embankment Dam and Basin Area

Crest

The crest around the Primary Ash Pond is approximately 12 feet wide and has access roads incorporated making them accessible with automobiles. The gravel-surfaced crest of the embankment was observed to be in good condition. The west side was observed to be generally wooded and inaccessible. Typical views of the crest around the east embankment are shown in Photos 5-1, 5-2 and 5-3. No major depressions, sags, tension cracks or other signs of significant settlement or mass soil movement were observed, although a slight depression was noted near the middle of the east side Dam. No tension cracks which might suggest soil shear failure were observed in the crest or along the edge of the crest.

Figure 5-1: Crest around East End of Primary Ash Pond with gravel access road way

Figure 5-2: Crest and Exterior Toe around East End of Primary Ash Pond

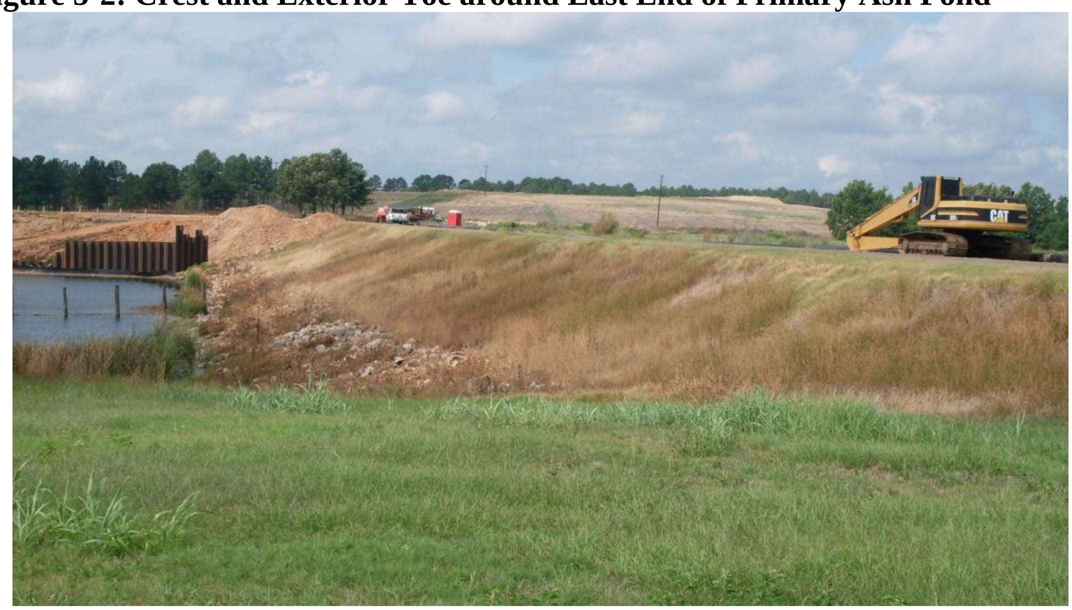


Figure 5-3 Primary Ash Pond Dam – interior slope

Outside Slope and Toe

The outside slope of the east embankment of the Primary Ash Pond is visible in Photo 5-2. As shown, the grass on the outside slope typically was observed to be maintained. The lower part of the outside slope was observed to be submerged by the water in the Welsh Cooling Water Reservoir and is lined with rock rip-rap. No areas of significant erosion were observed. No obvious signs of slumps, slides, bulges, tension cracks, seepage, or animal holes were observed.

Inside Slope and Basin Area

The inside slope of the Primary Ash Pond embankment dam was observed to be generally buried with ash or submerged in water. A view of the inside slope of the east embankment near the southeast corner of the basin is shown in Photo 5-4. The lower part of the inside slope was observed to be submerged by the water. No slumps, slides, or other signs of shear failure were observed in the visible parts of the slopes above the water level. No significant erosion was noted.

Figure 5-4: Interior Toe and Discharge Channel of Primary Ash Pond

Abutments and Groin Areas

No erosion or displacements were observed where the dam ties in to the north and south embankments. No erosion, displacements, or noticeable seepage were observed where the east perimeter dam ties in to high ground at the west end.

5.2.2 Outlet Structures

Overflow Structure

Photo 5-5 shows the top of the overflow structure located near the northwest corner of Secondary Ash Pond. The structure was observed to be in good visual condition. The concrete box surrounding the inlet structure was observed to be in good condition. There was no sign of clogging and the water exiting the outlet was observed to be flowing clear (Photo 5-6).

Figure 5-5: 48" Outlet Box and Discharge Channel of Primary Ash Pond

Figure 5-6: Effluent Inlet from Primary Ash Pond

5.3 SECONDARY ASH POND

5.3.1 Embankment Dam and Basin Area

Crest

The crest around the north, east and southern ends of the Secondary Ash Pond (similar to the Primary Ash Pond) are approximately 12 feet wide and have access roads incorporated making them accessible with automobiles. The gravel-surfaced crest of the embankment was observed to be in good condition. The west side was observed to be generally wooded and inaccessible. Typical views of the crest around the east embankment are shown in Photos 5-7 and 5-8. No major depressions, sags, tension cracks or other signs of significant settlement or mass soil movement were observed, although a slight depression was noted near the middle of the east side Dam. No tension cracks which might suggest soil shear failure were observed in the crest or along the edge of the crest.

Figure 5-7: Crest around East End of Secondary Ash Pond with gravel access roadway

Figure 5-8: Crest and Exterior Toe around East End of Primary Ash Pond

Outside Slope and Toe

The outside slope of the east embankment of Secondary Ash Pond is visible in Photo 5-9. As shown, the grass on the outside slope typically was observed to be maintained. The lower part of the outside slope was observed to be submerged by the water in the Welsh Cooling Water Reservoir and is lined with rock rip-rap. No areas of significant erosion were observed. No obvious signs of slumps, slides, bulges, tension cracks, seepage, or animal holes were observed.

Inside Slope and Basin Area

The inside slope of the Secondary Ash Pond embankment dam was observed to be generally submerged in water or heavily vegetated. A view of the inside slope of the east embankment near the southeast corner of the basin is shown in Photo 5-8. No slumps, slides, or other signs of shear failure other than the failed slope on the northern exterior embankment of the Secondary Ash Pond were observed in the visible parts of the slopes above the water level. No significant erosion was noted.

Abutments and Groin Areas

No erosion or displacements were observed where the Dam ties in to the north, south and west embankments. No erosion, displacements, or noticeable seepage were observed.

5.3.2 Outlet Structures

Overflow Structure

Photo 5-9 shows the overflow structure located near the southwest corner of Secondary Ash Pond. The structure was observed to be in good visual condition.

The concrete box surrounding the inlet structure was observed to be in good condition. There was no sign of clogging and the water exiting the outlet was observed to be flowing clear. Photo 5-10 shows the effluent flowing out of the Secondary Ash Pond. Photo 5-11 shows the emergency spillway area from the Secondary Ash Pond.

Figure 5-9: 48" Outlet Box in the Secondary Ash Pond

Figure 5-10: Effluent Outlet from Secondary Ash Pond

Figure 5-6: Emergency Spillway from Secondary Ash Pond to Welsh Cooling Water Reservoir

5.4 ACTIVE BOTTOM ASH STORAGE POND

5.4.1 Embankment Dam and Basin Area

Crest

The crest around the entire Active Bottom Ash Storage Pond is approximately 8 feet wide and is accessible by foot only. No major depressions, sags, tension cracks or other signs of significant settlement or mass soil movement were observed, although a slight depression was noted near the middle of the east side Dam. No tension cracks which might suggest soil shear failure were observed in the crest or along the edge of the crest.

Outside Slope and Toe

The outside slope of the east embankment of Active Bottom Ash Storage Pond is visible in Photo 5-12. As shown, the grass on the outside slope typically was observed to be maintained. The lower part of the outside slope was observed to have no areas of significant erosion. No obvious signs of slumps, slides, bulges, tension cracks, seepage, or animal holes were observed.

Figure 5-7: Exterior Toe of Active Bottom Ash Storage Pond

Inside Slope and Basin Area

The inside slope of the Active Bottom Ash Storage Pond embankment dam was observed to be generally visible with areas buried by ash dredging waste. A view of the inside slope is shown in Photo 5-13 and Photo 5-14. No slumps, slides, or other signs of shear failure were observed in the visible parts of the slopes above the water level. No significant erosion was noted. Water from the Active Bottom Ash Storage Pond is conveyed by pipe to the Primary Ash Pond (Photo 5-15)

Figure 5-8: Interior Toe of Active Bottom Ash Storage Pond

Figure 5-14: Active Bottom Ash Storage Pond Dam – interior slope

Figure 5-15: 30" HDPE Outlet Pipe Recirculating Supernatant from Active Bottom Ash Storage Pond to Primary Ash Pond

Abutments and Groin Areas

There are no abutments or groins.

5.4.2 Outlet Structures

Overflow Structure

Photo 5-16 shows the interior overflow structure located near the southeast corner of Active Bottom Ash Storage Pond. The structure, an 18' HDPE pipe, was observed to be in good condition.

Figure 5-9: 30" Outlet Pipe from Active Bottom Ash Storage Pond

Emergency Spillway (If Present)

The Emergency Spillway of the Active Bottom Ash Storage Pond is visible in Photo 5-17. As shown, the grass on the outside slope typically was observed to be maintained and not growing in the rock rip-rap. The lower part of the outside slope was observed to have no areas of significant erosion. No obvious signs of slumps, slides, bulges, tension cracks, seepage, or animal holes were observed.

Figure 5-10: Emergency Spillway from Active Bottom Ash Storage Pond

Low Level Outlet

There is no low level outlet.

5.5 ADDITIONAL FIELD PHOTOGRAPHS

Figure 5-11: Secondary Ash Pond Dam – interior slope opposite of repairs

Figure 5-12: Active Bottom Ash Storage Pond Dam – exterior slope

Figure 5-13: Secondary Ash Pond Dam – exterior slope showing ongoing repairs

Figure 5-14: Secondary Ash Pond Dam – exterior slope showing ongoing repairs

Figure 5-15: Maintenance pigging line into Active Bottom Ash Storage Pond

6.0 HYDROLOGIC/HYDRAULIC SAFETY

6.1 SUPPORTING TECHNICAL DOCUMENTATION

6.1.1 Floods of Record

Primary Ash Pond, Secondary Ash Pond, and Active Bottom Ash Storage Pond – Flood record information was provided for these facilities in the Freese and Nichols report. It was also reported by AEP Welsh personnel that the water level in the upper pond (Primary Ash Pond) has never been observed above the top of the walls of the outlet structure. The ash ponds have been in service for 36 years and have experienced many severe rainstorms during that time. AEP Welsh indicated no unusual problems at the pond embankments as a result of such storms during this relatively long period of service.

6.1.2 Inflow Design Flood

The hydrologic/hydraulic analyses provided in the Freese and Nichols report for the ash ponds concluded that the Management Units can hold the Probable Maximum Flood (100-year) event.

The issue of inflow design flood often is not significant for ash ponds that do not receive significant off-site drainage (as reported by AEP personnel during onsite inspection). Usually sufficient freeboard is available to contain 100 percent of rainfall over the basin area from significant storm events, even up to the probable maximum precipitation (PMP), which is a little over 14.2 inches at this location (based on HMR-51, all season PMP for 24-hour duration, <10 mi^2).

6.1.3 Spillway Rating

Primary Ash Pond, Secondary Ash Pond and Active Bottom Ash Storage Pond - No spillway rating was provided for the outlet works at either pond.

6.1.4 Downstream Flood Analysis

Primary Ash, Secondary Ash, and Active Bottom Ash Storage Ponds– No downstream flood analyses was provided in the hydrologic/hydraulic analyses of the ash basins. There have been no apparent issues with safe containment of water in the basins during significant flooding events.

The total drainage area for the Primary Ash, Secondary Ash, and Active Bottom Ash Storage Ponds is approximately 445 acres. Only the Primary Ash Pond receives stormwater outside the limits of the ponds.

Additionally, the Primary Ash, Secondary Ash, and Active Bottom Ash Storage Ponds discharge and overflow into the Welsh Reservoir which serves as a cooling water reservoir for the generation plant. The storage capacity of the Welsh reservoir is greater than 15,000 ac ft (from conservation level to three (3) feet of freeboard below top of Dam). The summation of the storage for the three ponds combined is 614 ac ft. The reservoir has sufficient capacity to contain the total storage of all ponds even if a catastrophic failure were to take place.

6.2 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

Primary Ash Pond, Secondary Ash Pond and Active Bottom Ash Storage – A sufficient analysis of the facility's ability to safely store and pass the inflow design flood was provided by the Freese and Nichols report.

6.3 ASSESSMENT OF HYDROLOGIC/HYDRAULIC SAFETY

Primary Ash Pond, Secondary Ash Pond and Active Bottom Ash Storage – As noted above the ability of the ash basins to safely store and pass the appropriate design flood was demonstrated in the Freese and Nichols report. The hydrologic/hydraulic safety of the ponds is SATISFACTORY.

7.0 STRUCTURAL STABILITY

Two Geotechnical Investigation reports by ETTL Engineers & Consultants Inc., one dated June 21, 2010 and the other dated June 22, 2010 were provided for review and are included in Appendix C. The first report indicates the presence of shallow surface sloughing on the east side of the Secondary Ash Pond. The second report indicates subsequent movement of the Secondary Ash Pond embankment approximately 10 feet into the lake. The second report indicates that test pits encountered subgrade soils that are more varied with higher strength clays and lower strength sands within the failure surface than initially assumed.

7.1 SUPPORTING TECHNICAL DOCUMENTATION

7.1.1 Stability Analyses and Load Cases Analyzed

Primary Ash and Secondary Ash Storage Ponds – ETTL Engineers & Consultants Inc. was contracted to perform a stability analysis of the embankment dams for the Primary and Secondary Ash Ponds. A second study was conducted to develop recommendations for repair of the slope failure of the east embankment. The analyses concluded that:

> *" The existing berm slopes are acceptable if conditions are maintained and the existing surface failure is repaired. A minimum factor of safety of 1.7 in the long term was found on the Primary [Secondary] Ash Pond. Rapid drawdown of the level of water in the lake lowers the predicted overall stability factors of safety to a minimum of 1.4."*

The Bottom Ash Storage Pond has very little water except when the Primary Pond is being dewatered once a year.

7.1.2 Design Properties and Parameters of Materials

Primary Ash, Secondary Ash, and Active Bottom Ash Storage Ponds– Soil design properties and parameters were provided for review and are found in Appendixes B and C.

7.1.3 Uplift and/or Phreatic Surface Assumptions

Primary Ash, Secondary Ash, and Active Bottom Ash Storage Ponds– Phreatic surface assumptions for the embankment dams were not available for review. From visual observations in the field, the phreatic surface does not crop out on the outside slope of the perimeter dam.

7.1.4 Factors of Safety and Base Stresses

Primary Ash, Secondary Ash, and Active Bottom Ash Storage Ponds–
Section 7.1.1 of the ETTL Engineers & Consultants Inc. June 21 report states that the repaired slope will have a minimum factor of safety of 1.7. The recommended static slope safety factor is 1.5 contained in the, "Engineering and Design Manual for Coal Refuse Disposal Facilities," published by the U. S. Department of Interior, Mining Enforcement and Safety Administration (HESA).

A rapid drawdown of the level of water in the lake lowers the predicted overall stability factors of safety to a minimum of 1.4 which is consistent with a recommended minimum factor of safety of 1.2 for similar (Seismic) loading according to the HESA publication

7.1.5 Liquefaction Potential

No liquefaction potential analyses appear to have been performed for the embankment dams that impound the ash ponds. However, ETTL Engineers & Consultants Inc. states, " The native soils are predominantly medium stiff to hard lean and fat clays (CL & CH),medium dense clayey sand (SC) and very dense silty sands (SM). These characteristics taken together with the fact that the site is in a zone of relatively low maximum ground acceleration (<0.2g) indicate a negligible risk of liquefaction".

7.1.6 Critical Geological Conditions and Seismicity

The reviewed documents included information regarding the critical geological conditions and seismicity used in the original design of embankment dams that impound the Primary Ash Pond and Secondary Ash Pond.

Seismicity – The site of the ash basins is in an area of low seismic hazard. Based on USGS Seismic-Hazard Maps for Central United States, dated 2008 (Appendix A), the ponds are located in an area anticipated to experience 0.04g or higher peak ground acceleration with a 2-percent probability of exceedance in 50-years.

ETTL Engineers & Consultants Inc. states that, *Based on the maps and the site coefficients determined for site class D contained in the IBC, parameters as listed below are recommended by the Code:*

Site Coefficients: Fa = 1.60 Fv = 2.40

Maximum Earthquake Spectral Response Acceleration Parameters:
SMS = 0.238 SM1 = 0.158

Design Spectral Response Acceleration Parameters:
SDS = 0.159 SD1 = 0.105.

7.2 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

The ETTL Engineers & Consultants Inc. structural stability documentation was sufficient to determine the adequacy of the safety of the embankments for both the Primary and Secondary Ash Ponds. There was no structural stability documentation for the Active Bottom Ash Storage Pond. This documentation is needed.

7.3 ASSESSMENT OF STRUCTURAL STABILITY

The reviewed documents did not include any information regarding the design loads or the comparison of loads to potential credible loading conditions of the embankment dams impounding Primary Ash, Secondary Ash, and Active Bottom Ash Storage Ponds.

Based on the recent movement of the Secondary Embankment and the finding of unanticipated soil conditions in the failure area, the structural soundness of that embankment is questionable. As the Primary Ash Pond and Secondary Ash Pond are understood to have been constructed concurrently, similar concerns exist for the Primary Ash Pond. In contrast the visual findings are:

- There were no indications of scarps, sloughs (other than the Secondary Ash Pond under repair), depressions or bulging anywhere along the dam;
- Boils, sinks or uncontrolled seepage was not observed along the slopes, groins or toe; and
- The crest appeared free of major depressions and no significant vertical or horizontal alignment variations were observed.

A seismic loading study would confirm whether the Dams could withstand the strong shaking that can be expected if an earthquake occurs in this area. However, the apparent absence of poor foundation soils (based on the limited available subsurface information), low height of the Dams, and satisfactory performance under static loading are favorable indications that the Dams are expected to perform satisfactorily under seismic loading. Therefore the generally low probability of seismic activity and low consequences of failure of these Dams preclude the need for performing detailed seismic stability analyses and liquefaction studies does not appear to be warranted at this time.

The outlet structures appear to be in sound and stable condition with no visual evidence of significant deterioration; they should be satisfactory for continued service.

8.0 ADEQUACY OF MAINTENANCE AND METHODS OF OPERATION

8.1 OPERATIONAL PROCEDURES

Primary Ash Pond – This basin is currently used for storage and disposal of CCW. Ash waste material is pumped into the basin. After sufficient sedimentation time, clarified wastewater is drained to the Secondary Ash Pond.

Secondary Ash Pond – This basin is mainly used as a “polishing” pond, treating discharge water that drains from the Primary Ash Pond. Ash waste material from production operations is not placed in the basin.

Active Bottom Ash Storage Pond – This basin is mainly used as a dewatering basin for dredging from the Primary Ash Pond. Supernatant drains via gravity through an 18” HDPE pipe back to the Primary Ash Pond.

8.2 MAINTENANCE OF THE DAM AND PROJECT FACILITIES

Maintenance of the impounding embankments and outlet works of the Primary Ash Pond, Secondary Ash Pond and Active Bottom Ash Storage Pond is performed as needed, as determined by routine inspections performed by operating personnel. Vegetation on the embankment slopes and crest is mowed or cut twice a year or whenever it becomes necessary.

8.3 ASSESSMENT OF MAINTENANCE AND METHODS OF OPERATION

8.3.1 Adequacy of Operational Procedures

Operational procedures at the Primary Ash Pond, Secondary Ash Pond and Active Bottom Ash Storage Pond appear to be appropriate and adequate.

8.3.2 Adequacy of Maintenance

No major maintenance issues were observed during the site visit and no major maintenance issues were noted from review of dam inspection reports and checklists. Maintenance of the impounding embankments and outlet works of the Primary Ash Pond, Secondary Ash Pond and Active Bottom Ash Storage Pond appears to be adequate other than excessive vegetation as noted in the upper reaches of the Primary Ash Pond.

9.0 SURVEILLANCE AND MONITORING PROGRAM

9.1 SURVEILLANCE PROCEDURES

AEP Welsh operating personnel make daily observations and engineers conduct regular yearly inspections.

Miscellaneous Inspections – TCEQ personnel conduct yearly inspections of the treatment units including the dams.

9.2 INSTRUMENTATION MONITORING

9.2.1 Instrumentation Plan

There is no dam performance monitoring instrumentation in place in the impounding embankments of the Primary Ash Pond, Secondary Ash Pond and Active Bottom Ash Storage Pond. Groundwater monitoring wells have been installed at various locations around the basins for compliance monitoring of groundwater quality.

9.2.2 Instrumentation Monitoring Results

There are no dam performance monitoring instruments and thus no results of dam monitoring.

9.2.3 Dam Performance Data Evaluation

Primary Ash Pond, Secondary Ash Pond Dam and Active Bottom Ash Storage Pond – Not applicable since there are no dam performance data to evaluate. In-depth evaluation of groundwater quality monitoring results is beyond the scope of this structural/stability assessment.

9.3 ASSESSMENT OF SURVEILLANCE AND MONITORING PROGRAM

9.3.1 Adequacy of Inspection Program

Primary Ash, Secondary Ash, and Active Bottom Ash Storage Ponds– The inspection program is generally adequate based on field observations and the data reviewed by Dewberry. However, internal inspections of the outlet structures with a remote camera or by personnel using confined-space procedures should be conducted on a frequency of at least once every 5 years. The inspections of the each embankment should be documented and conducted on a frequency of at least once per year.

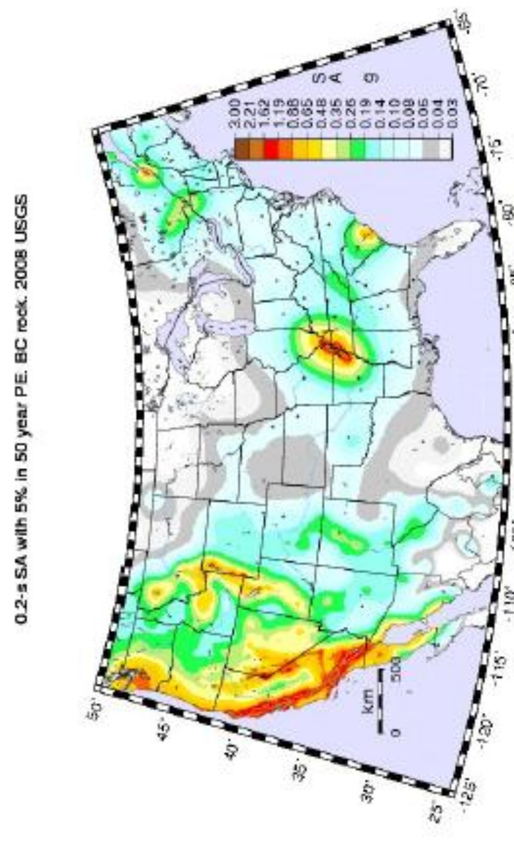
9.3.2 Adequacy of Instrumentation Monitoring Program

Primary Ash, Secondary Ash, and Active Bottom Ash Storage Ponds– There is no dam performance monitoring instrumentation in place. Other than the slope failure on the Secondary Ash Pond, no other visible problem or suspect condition, such as excessive settlement, seepage, shear failure, or displacement was observed in the field. Given the recent occurrence of a slope failure it is recommended that the plant install a slope monitoring system and a regular monitoring program.

APPENDIX A: USGS NATIONAL SEISMIC HAZARD MAPS

APPENDIX A: U.S. GEOLOGICAL SURVEY (USGS) NATIONAL SEISMIC HAZARD MAPS

The U.S. Geological Survey (USGS) National Seismic Hazard Maps display earthquake ground motions for various probability levels across the United States and are applied in seismic provisions of building codes, insurance rate structures, risk assessments, and other public policy. This update of the maps incorporates new findings on earthquake ground shaking, faults, seismicity, and geodesy. The resulting maps are derived from seismic hazard curves calculated on a grid of sites across the United States that describe the frequency of exceeding a set of ground motions.



http://earthquake.usgs.gov/hazards/products/conterminous/2008/maps/us/5hzSA.5in50.usa.jpg 8/3/2010

APPENDIX B: ORIGINAL CONSTRUCTION DOCUMENTS

RKANA

'd. 4-8-74

Reserve Material
North of Bldg. (B)

95.3
78.8
64.6
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SOUTHWESTERN LABORATORIES

CONSULTING ANALYTICAL CHEMISTS AND TESTING ENGINEERS

TEXARKANA

Texarkana Texas April 12,1974 File No.

Report of tests on Soil

To Murray,Link,Thomas & Griffin

Received from Same Date Rec'd. 4-8-74

Identification Marks SWEPCO's Welsh Power Plant

The following samples were taken in order to depict the material available to construct the Ash Pit Dike. Based on the information we have received, it is believed that the higher clay content soils should be used in the core of the dike. We have located some moderate to high plasticity index material lying adjacent to the Ash Pit Dike. The following results were obtained on these materials.

Sieve Sizes % Passing	Gray Clay	Red & Gray Clay
No. 40	100.0	100.0
80	98.9	98.8
100	97.7	98.0
200	97.0	95.2
Liquid Limit	49	48
Plasticity Index	25	24

cc: 2: Murray,Link,Thomas & Griffin
1: Mr. Bill Millard
1: Mr. Emil Rizzio
1: Mr. Ed Bargainear

Lab. No. 14475

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Date Rec'd. 6-3-74

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CONSULTING ANALYTICAL CHEMISTS
AND TESTING ENGINEERS

Texarkana, Texas June 4,1974

Report of tests on Soil

To Murray,Link,Thomas & Griffin

Received from Same Date Rec'd 5-31-

Identification Marks SWEPCO Walsh Power Plant, Cason,Texas

FIELD DENSITY TESTS

No	Location	Percent Moisture	Dry Density Lbs. Cu Ft	Percent Proctor
463	Sta. 7+00 Right of Centerline Primary dike 3' above natural ground	21.0	105.2	96.
464	Sta. 5+75 Right of Centerline Primary dike 2½' above natural ground	22.0	104.3	15.
465	Sta. 4+80 Centerline of primary dike 3' below natural ground	20.1	105.2	96.

Maximum Dry Density at Optimum Moisture 109.4 Lbs. Cu Ft

Optimum Moisture 19.0

cc: 3: Murray,Link,Thomas & Griffin
1: Mr. Emil Rizzio
1: Mr. Bill Millard
1: Mr. Ed Burgainser

Lab No 14730

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UMONT TEXARKANA
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Date Rec'd. 6-4-74

Dry Density Lbs./Cu.Ft.	Percent Proctor
115.7	96.6
115.1	96.1
114.2	95.3

.bs./Cu. Ft.

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CONSULTING ANALYTICAL CHEMISTS
AND TESTING ENGINEERS

Texarkana, Texas June 4,1974 File No.

Report of tests on: Soil

To: Murray,Link,Thomas & Griffin

Received from: Same Date Rec'd 5-30-74

Identification Marks: SWEPCO Welsh Power Plant,Cason,Texas

FIELD DENSITY TESTS

No.	Location	Percent Moisture	Dry Density Lbs. Cu. Ft.	Percent Proctor
460	Sta. 5+70 Centerline of primary dike 5½' above natural ground	19.6	106.3	97.2
461	Sta. 6+00 3½' above natural ground left of primary dike	20.1	105.9	96.8
462	Sta. 7+00 Left of Centerline, primary dike 3' above natural ground	19.2	106.6	97.4

PROCTOR SERIES

Maximum Dry Density at Optimum Moisture 109.4 Lbs. Cu. Ft.

Optimum Moisture 19.0 %

cc: 3: Murray,Link,Thomas & Griffin
1: Mr. Emil Rizzio
1: Mr. Bill Millard
1: Mr. Ed Burgaineer

Lab No. 14729

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PHONE
214-742-8401

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JUN 25 1974
OFFICE OF
W. H. HOLLEY

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FORT WORTH DALLAS HOUSTON MIDLAND BEAUMONT TEXARKANA

CONSULTING ANALYTICAL CHEMISTS AND TESTING ENGINEERS

Texarkana, Texas June 6, 1974 File No.

Report of tests on: Soil

To: Murray, Thomas & Griffin

Received from: Same

Date Rec'd 6-1-74

Identification Marks: SWEPCO Welsh Power Plant-Cason, Texas

FIELD DENSITY TESTS

No.	Location	Percent Moisture	Dry Density Lbs./Cu.Ft	Percent Proctor
466	Sta. 5+50 Rt. Primary Dike 3' Above Natural Ground	22.0	106.1	97.0
467	Sta. 8+00 Lt. Primary Dike 3½ Ft. Above Natural Ground	21.3	105.9	96.8
468	Sta. 7+00 Lt. Primary Dike 3½ Ft. above	20.7	105.1	96.0
469	Sta. 6+00 Rt. Primary Dike 3' above natural ground	20.4	106.4	97.2
470	Sta. 8+00 Rt. Primary Dike 2' Above Natural Ground	20.6	106.6	97.4

PROCTOR SERIES

Maximum Dry Density at Optimum Moisture	109.4	Lbs. Cu. Ft
Optimum Moisture	19.0	%

cc: 3: Murray, Thomas & Griffin
1: Mr. Emil Rismio
1: Mr. Ed Burgaineer
1: Mr. Bill Millard

Lab. No. 14731

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FORM NO. 130-B

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FORT WORTH DALLAS HOUSTON MIDLAND BEAUMONT TEXARKANA

CONSULTING ANALYTICAL CHEMISTS
AND TESTING ENGINEERS

Texarkana, Texas May 23,1974 File No. ____

Report of tests on: Soil

To: Murray,Link,Thomas & Griffin

Received from: Same

Identification Marks: SWEPCO Welsh Power Plant, Cason,Texas

Date Rec'd 5-21-74

FIELD DENSITY TESTS

No.	Location	Percent Moisture	Dry Density Lbs. Cu.Ft.	Percent Proctor
437	Sta. 6+80 Left of Centerline, primary dike 4' above natural ground	19.8	106.3	97.2
438	Sta. 5+20 Centerline of primary dike 4' above natural ground	20.4	106.1	97.0
439	Sta. 7+00 Center of primary dike 4' above natural ground	20.2	105.9	96.8
440	Sta. 8+10 Core of primary dike 4' below natural ground	22.1	104.9	95.9

PROCTOR SERIES

Maximum Dry Density at Optimum Moisture 109.4 Lbs./Cu.Ft.

Optimum Moisture 19.0

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1: Mr. Emil Rizzio
1: Mr. Bill Millard
1: Mr. Ed Burgmaneer

Lab No. 14666

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Don M. Pyland

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ORATORIES

BEAUMONT TEXARKANA

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File No. ____

Date Rec'd. 5-20-74

Dry Density Lbs./Cu.Ft.	Percent Proctor
105.5	96.4
106.2	97.1
106.0	96.9
107.4	98.2
106.5	97.4
105.3	96.3

Lbs./Cu.Ft.

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File No.

Date Rec'd. 5-18-74

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Dry Density Lbs./Cu.Ft.	Percent Proctor
106.2	97.1
104.6	95.6
105.9	96.8

Lbs./Cu.Ft.

%

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FORT WORTH DALLAS HOUSTON MIDLAND BEAUMONT TEXARKANA

CONSULTING, ANALYTICAL CHEMISTS AND TESTING ENGINEERS

Texarkana, Texas May 21,1974 File No.

Report of tests on Soil

To Murray,Link,Thomas & Griffin

Received from Same

Identification Marks SWEPCO Welsh Power Plant, Cason,Texas

Date Rec'd. 5-20-74

FIELD DENSITY TESTS

No.	Location	Percent Moisture	Dry Density Lbs./Cu.Ft.	Percent Proctor
431	Sta. 2+00 Core of primary dike 4' below natural ground	21.1	105.5	96.4
432	Sta. 3+00 Core of primary dike 4' below natural ground	19.8	106.2	97.1
433	Sta. 4+20 core of primary dike 3' below natural ground	20.2	106.0	96.9
434	Sta. 5+50 Centerline of primary 3' above natural ground	19.3	107.4	98.2
435	Sta. 6+00 right of centerline, primary dike 3' above natural ground	20.7	106.5	97.4
436	Sta. 6+10 left of centerline, primary dike natural gound elevation	19.9	105.3	96.3

PROCTOR SERIES

Maximum Dry Density at Optimum Moisture 109.4 Lbs./Cu.Ft.

Optimum Moisture 19.0 %

cc: 2: Murray,Link,Thomas & Griffin
1: Mr. Emil Rizzio
1: Mr. Bill Millard
1: Mr. Ed Bargaineer

Lab No. 14659

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— File No.

Date Rec'd. 5-17-74

Dry Density Lbs./Cu.Ft.	Percent Proctor
105.5	96.4
106.3	97.2
106.0	96.9
105.9	96.8

4 Lbs./Cu. Ft.
0 %

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FORT WORTH DALLAS HOUSTON MIDLAND BEAUMONT TEXARKANA

CONSULTING, ANALYTICAL CHEMISTS AND TESTING ENGINEERS

Texarkana, Texas May 21,1974 File No

Report of tests on Soil

To Murray,Link,Thomas &Griffin

Received from Same

Date Rec'd 5-18-7

Identification Marks SWEPCO, Welsh Power Plant-Cason,Texas

FIELD DENSITY TESTS

No.	Location	Percent Moisture	Dry Density Lbs./Cu.Ft.	Percent Proctor
428	Sta. 7+00 Core of primary dike 2' above natural ground			
429	Sta. 6+80 natural ground core of primary dike	20.7	106.2	97.
430	Sta. 6+80 2' above natural ground right side of primary dike	21.0	104.6	95.
		19.8	105.9	96.8

PROCTOR SERIES

Maximum Dry Density at Optimum Moisture 109.4 Lbs Cu Ft

Optimum Moisture 19.0 %

cc: 2: Murray,Link,Thomas & Griffin
1: Mr. Emil Rizzio
1: Mr. Bill Millard
1: Mr. Ed Burgainer

Lab No 14658

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Rec'd. 5-16-74

ty Ft.	Percent Proctor
	92.4
	95.9
	97.1

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FORT WORTH DALLAS HOUSTON MIDLAND BEAUMONT TEXARKANA

CONSULTING, ANALYTICAL CHEMISTS AND TESTING ENGINEERS

Texarkana, Texas May 21,1974 File No.

Report of tests on: Soil

To: Murray,Link,Thomas & Griffin

Received from: Same — Date Rec'd. 5-17-74

Identification Marks: SWEPCO Welsh Power Plant, Cason,Texas

FIELD DENSITY TESTS

No.	Location	Percent Moisture	Dry Density Lbs./Cu.Ft.	Percent Proctor
424	Sta. 7+00 Natural Ground Elev. Core of Primary Dike			
425	Sta. 6+25 1' below natural ground core of primary dike	21.4	105.5	96.4
426	Sta. 7+10 Below natural ground core of primary dike	20.7	106.3	97.2
427	Sta. 6+75 Right side of primary dike 1' above natural ground	21.3	106.0	96.9
		20.9	105.9	96.8

PROCTOR SERIES

Maximum Dry Density at Optimum Moisture 109.4 Lbs. Cu. Ft.

Optimum Moisture 19.0 %

cc: 2: Murray,Link,Thomas & Griffin
1: Mr. Emil Rizzio
1: Mr. Bill Millard
1: Mr. Ed Bargainer

Lab No. 14657

SOUTHWESTERN LABORATORIES

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Texarkana, Texas May 21,1974 File No.

Report of tests on Soil

To Murray,Link,Thomas & Griffin

Received from Same Date Rec'd. 5-16-74

Identification Marks SWEPCO, Walsh Power Plant, Carson, Texas

FIELD DENSITY TESTS

No.	Location	Percent Moisture	Dry Density Lbs./Cu.Ft.	Percent Proctor
421	Sta. 6+50 Core of Dike 3' below natural ground primary dike	21.0	101.1	92.4
422	Sta. 7+00 Core of Dike 3' Below natural ground primary Dike	22.4	104.9	95.9
423	Sta. 6+50 Retest	20.8	106.2	97.1

PROCTOR SERIES

Maximum Dry Density at Optimum Moisture 109.4 Lbs Cu Ft

Optimum Moisture 19.0 %

cc: 2: Murray,Link,Thomas & Griffin
1: Mr. Emil Rizzio
1: Mr. Bill Millard
1: Mr. Al Burgaineer

Lab No 14656

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CONSULTING ANALYTICAL CHEMISTS AND TESTING ENGINEERS

Texarkana, Texas April 22,1974 File No.

Report of tests on Soil

To

Received from Murray,Link,Thomas & Griffin

Identification Marks Same Date Rec'd. 4-19-74

SWEPCO Welsh Power Plant, Cason,Texas

Sample # 1 Centerline of Dike-Sta. 7+00
Orange Sandy Clay With Iron Ore

% Passing # 40 -- 89.9
% Passing # 60 -- 84.9
% Passing # 100--------------------------------------- 66.5
% Passing # 200--------------------------------------- 49

Atterberg Limits

Liquid Limit--28.0
Plasticity Index------------------------------------12

Sample # 2-Sta. 0+00 N, Sta. ~~0+00~~ West
3+50W
Red Sandy Clay

% Passing # 40-- 99.4
% Passing # 60-- 98.6
% Passing # 100--------------------------------------- 90.0
% Passing # 200--------------------------------------- 71.2

Atterberg Limits

Liquid Limit--36
Plasticity Index------------------------------------ 18

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W. R. HOLLEY

cc: 2: Murray,Link,Thomas & Griffin
1: Mr. Emil Rizzio
1: Mr. Ed Bargaineer
1: Mr. Bill Millard

Lab No 14525

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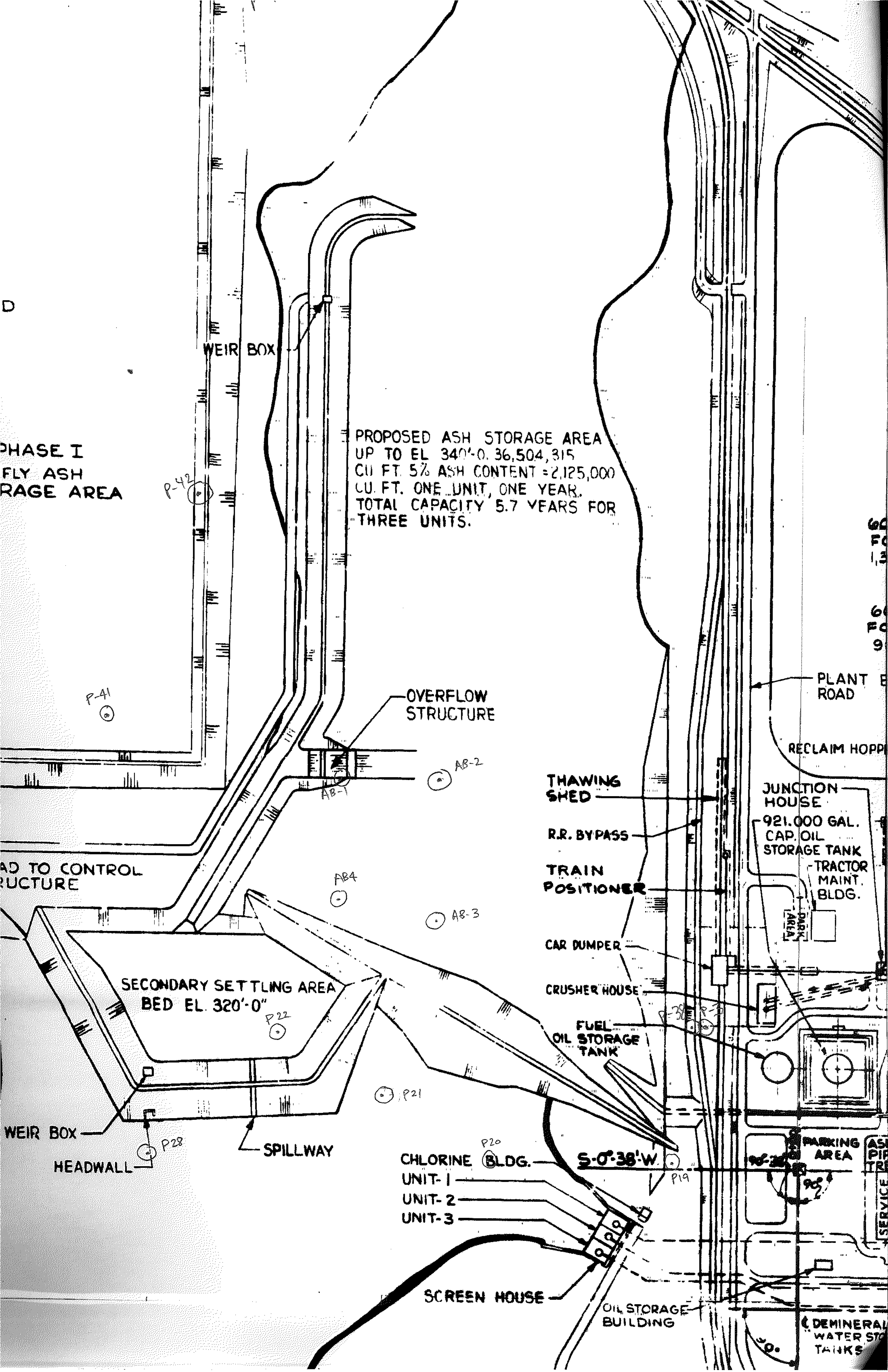
PHASE I
FLY ASH
RAGE AREA
WEIR BOX
PROPOSED ASH STORAGE AREA
UP TO EL 340'-0. 36,504,315
CU FT 5% ASH CONTENT =2,125,000
CU. FT. ONE UNIT, ONE YEAR.
TOTAL CAPACITY 5.7 YEARS FOR
THREE UNITS.
P-42
P-41
OVERFLOW
STRUCTURE
AB-1
AB-2
AB4
AB-3
AD TO CONTROL
RUCTURE
SECONDARY SETTLING AREA
BED EL. 320'-0"
P22
P21
P28
WEIR BOX
HEADWALL
SPILLWAY
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JUNCTION
HOUSE
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CAP. OIL
STORAGE TANK
TRACTOR
MAINT.
BLDG.
PARK
AREA
THAWING
SHED
R.R. BYPASS
TRAIN
POSITIONER
CAR DUMPER
CRUSHER HOUSE
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UNIT-1
UNIT-2
UNIT-3
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P19
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OIL STORAGE
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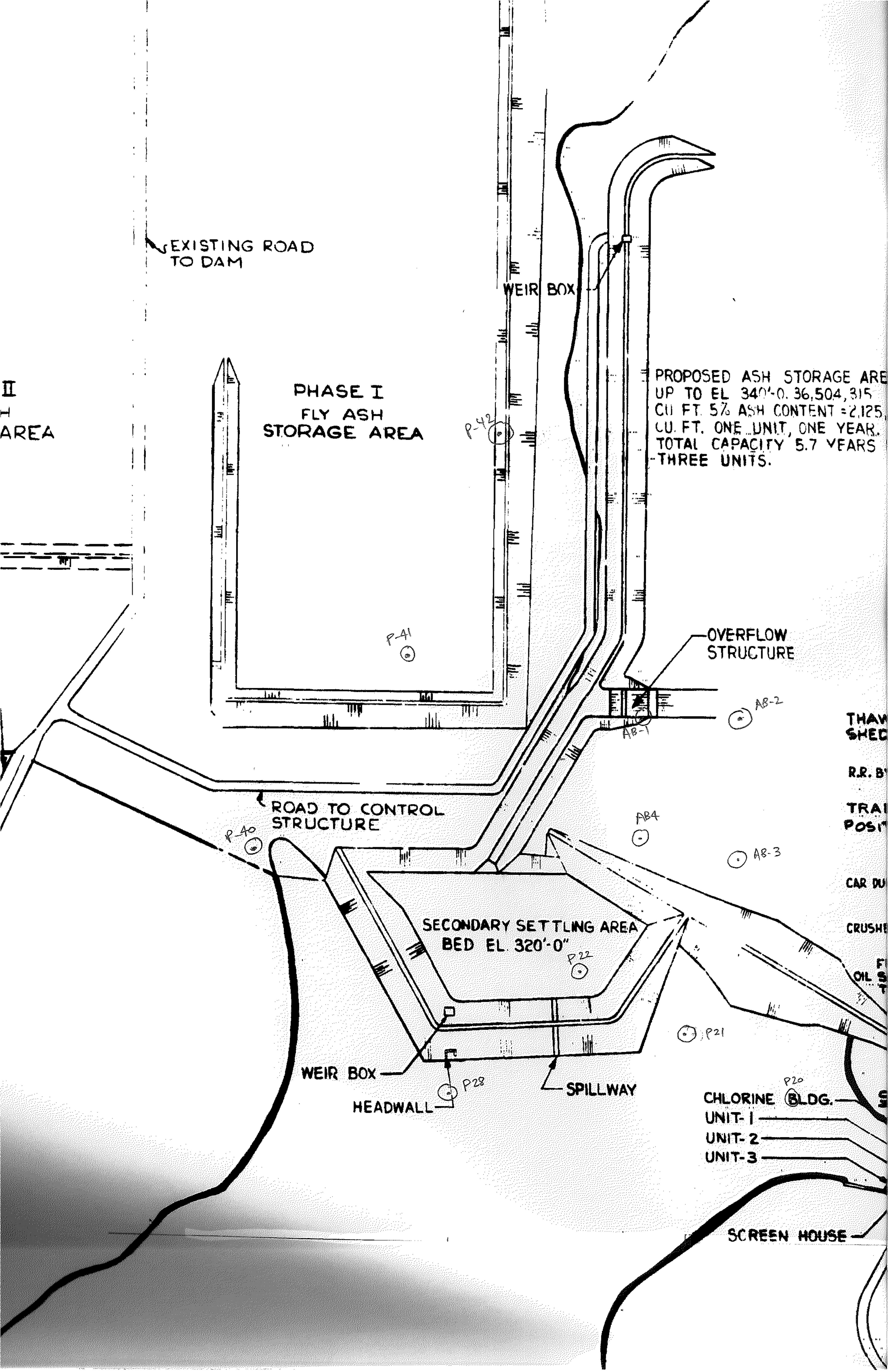
EXISTING ROAD TO DAM
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FLY ASH
STORAGE AREA
WEIR BOX
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P-41
PROPOSED ASH STORAGE ARE
UP TO EL 340'-0. 36,504,315
CU FT. 5% ASH CONTENT = 2,125,
CU. FT. ONE UNIT, ONE YEAR.
TOTAL CAPACITY 5.7 YEARS
THREE UNITS.
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STRUCTURE
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AB4
ROAD TO CONTROL
STRUCTURE
P-40
SECONDARY SETTLING AREA
BED EL 320'-0"
P22
P21
P20
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WEIR BOX
HEADWALL
SPILLWAY
CHLORINE BLDG.
UNIT-1
UNIT-2
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SCREEN HOUSE
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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

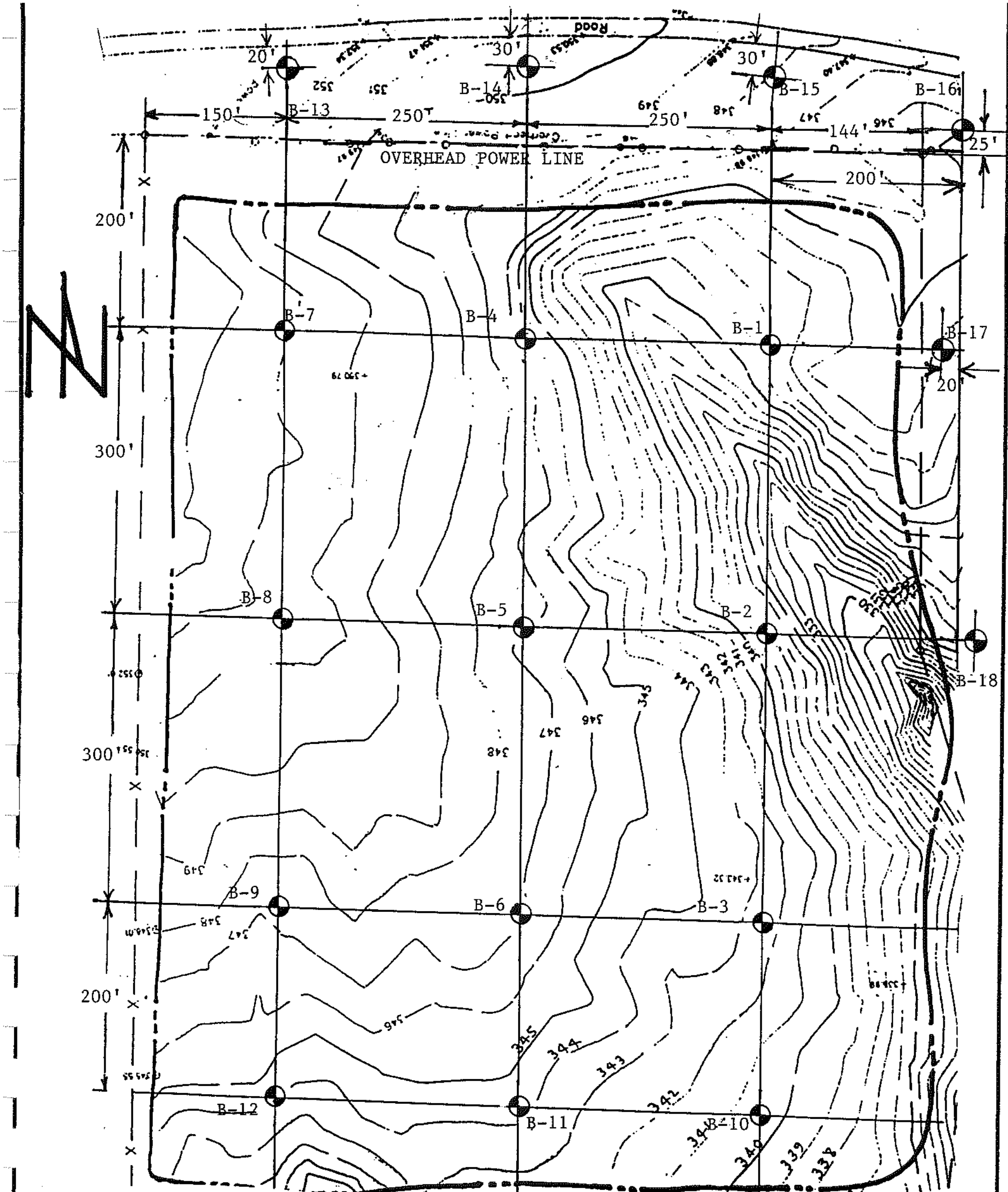
Gene Gardner, P.E.
Geotechnical Manager

STATE OF TEXAS
R. E. GARDNER
56016
REGISTERED
PROFESSIONAL ENGINEER

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.

Depth (FT)	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	Depth
										Six (6) inches of tan clayey sandy silt top soil	0.5
	20					55				Tan to red clayey sandy silt (ML)	
	18		25	18	7						
	14		21	17	4	57				-- Reddish tan	
5											
	10										8.0
	20					63				Tan to gray sandy silt (ML)	
10	26										13.0
	30					30				Tan and gray silty sand (SM)	15.0
15										Bottom of boring	
20											
25											

Column headings also include: SOIL & ROCK SYMBOL; SAMPLE TYPE; N: SPT, BLOWS/FT; T: THD, BLOWS/FT; P: HAND PEN, TSF (FIELD DATA)

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

REMARKS:

000444

MAXIM TECHNOLOGIES, INC.

LOG OF BORING NO. B-2

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

CLIENT: Southwestern Electric Power Company

DATE: 4/6/00

SHEET 1 of 1

LOCATION: Cason, Texas

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) — 4.0
	5			13		NP	NP	NP	61				Tan and tannish gray sandy silt (ML) — 8.0
				11									
				16		20	17	3					Tan and gray clayey sandy silt (ML) — 12.0
	10			22									
				24									Gray sandy silt (ML) — 15.0
	15												Bottom of boring
	20												
	25												

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

REMARKS:

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.

Depth (ft)	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
0.5										Six (6) inches of tan clayey sandy silt topsoil
0.5–4.0	16									Red to tan clayey sandy silt (ML)
	18		23	18	5					
4.0–8.0	16		27	18	9					Red and light tan very sandy silty clay (CL)
	17		31	19	12					
8.0–15.0	12									Tan and gray clayey silty sand (SC)
	13					42				
	19									
15.0–17.0	24					65				Gray and tan sandy silt (ML)
17.0–19.0										Gray and tan silty sand (SM)
19.0										Bottom of boring

Field data columns: Soil & Rock Symbol; Depth (ft); Sample Type; N: SPT, Blows/Ft; T: THD, Blows/Ft; P: Hand Pen, TSF

Sample type legend: TUBE SAMPLE; AUGER SAMPLE; SPLIT-SPOON; ROCK CORE; THD CONE PEN.; NO RECOVERY

REMARKS:

000444

MAXIM TECHNOLOGIES, INC.

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.

DEPTH (FT)	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
	19					50				Tan silty sand (SM)	2.0
	19		27	18	9					Reddish tan silty sandy clay (CL)	
	13					70					
5	15										
	12										10.0
10	20					51				Tan sandy silt (ML)	
	26										15.0
15										Bottom of boring	
20											
25											

FIELD DATA: SOIL & ROCK SYMBOL; DEPTH (FT); SAMPLE TYPE; N: SPT, BLOWS/FT; T: THD, BLOWS/FT; P: HAND PEN, TSF

LABORATORY DATA

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

REMARKS:

000444

MAXIM TECHNOLOGIES, INC.

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: DEPTH (FT)	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	
0–0.5											Six (6) inches of tan clayey sandy silt topsoil	0.5
0.5–6.0		23									Reddish tan silty sandy clay (CL)	
		19		29	19	10						
		19		26	18	8						6.0
6.0–15.0		14									Tan silty sand (SM)	
		15					49					
		18										
		11					34				-- Light tan and gray	15.0
15.0											Bottom of boring	

Sample type legend: TUBE SAMPLE, AUGER SAMPLE, SPLIT-SPOON, ROCK CORE, THD CONE PEN., NO RECOVERY

REMARKS:

MAXIM TECHNOLOGIES, INC.

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.

Depth (ft)	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
0–0.5										Six (6) inches of tan clayey sandy silt topsoil (0.5)
0.5–10.0	18									Tan to red silty sandy clay (CL)
	19		27	18	9					
	17									
	17		28	19	9					
	14									(10.0)
10.0–15.0	17		16	16	NP	53				Reddish tan sandy silt (ML)
										-- Tan
	17									(15.0)
15.0										Bottom of boring

Field data columns: SOIL & ROCK SYMBOL; DEPTH (FT); SAMPLE TYPE; N: SPT, BLOWS/FT; T: THD, BLOWS/FT; P: HAND PEN, TSF

Depth scale: 5, 10, 15, 20, 25

Sample types: TUBE SAMPLE; AUGER SAMPLE; SPLIT-SPOON; ROCK CORE; THD CONE PEN.; NO RECOVERY

REMARKS:

MAXIM TECHNOLOGIES, INC.

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
				16									Reddish tan clayey sandy silt (ML)
	5												
				12		25	18	7					-- Red
				12									
	10			19		22	17	5					-- Red and tan
													11.0
													Tan to gray silty sand (SM)
				22					39				
	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:

000444

MAXIM TECHNOLOGIES, INC.

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.

Depth (ft)	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
		21									Red to reddish tan silty sandy clay (CLS)
		22		34	20	14					
		20									-- Gray and red
5											
		17		34	20	14					-- Red to reddish tan
											8.0
		13									Reddish tan sandy silt (ML)
10		13		NP	NP	NP					
											11.0
											Tan silty sand (SM)
		23									
15		23									
		26		NP	NP	NP	44				
20											20.0
											Bottom of boring
25											

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

REMARKS:

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.

DEPTH (FT)	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
0.5											Six (6) inches of tan clayey sandy silt topsoil
0.5–5.0		16									Tan clayey sandy silt (ML)
		18									
		16		25	18	7					
5.0–9.0		10									Red and reddish tan silty sand (SM)
		12		NP	NP	NP					
9.0–12.0		16		35	20	15					Tan silty sandy clay (CL)
12.0–15.0		22									Tan silty sand (SM)
15.0											Bottom of boring

REMARKS:

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

000444

MAXIM TECHNOLOGIES, INC.

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
				17									Reddish tan silty sandy clay (CL)
				18		31	19	12					
				14		34	20	14					-- Reddish gray to tannish gray
	5			16									-- Tan
				15		28	19	9					-- Reddish tan
	10			17									-- Tannish gray
				20		30	19	11					14.0
													Tan clayey sand (SC) — 15.0
	15												Bottom of boring
	20												
	25												

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

REMARKS:

000444

MAXIM TECHNOLOGIES, INC.

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.

Depth (ft)	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	Depth to bottom
0–0.5										Six (6) inches of clayey sandy silt topsoil	0.5
0.5–4.0	18									Tan to tan gray silty sandy clay (CL)	4.0
	17		29	19	10						
4.0–13.0	16		32	19	13					Gray and tan sandy silty clay (CL)	13.0
	14										
	14		29	19	10						
	16										
13.0–15.0	19		17	16	1					Light tan clayey silty sand (SC)	15.0
15.0										Bottom of boring	

Field data columns: SOIL & ROCK SYMBOL; DEPTH (FT); SAMPLE TYPE; N: SPT, BLOWS/FT; T: THD, BLOWS/FT; P: HAND PEN, TSF

Sample type legend: TUBE SAMPLE | AUGER SAMPLE | SPLIT-SPOON | ROCK CORE | THD CONE PEN. | NO RECOVERY

REMARKS:

000444

MAXIM TECHNOLOGIES, INC.

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.

Depth (ft)	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
0.0–0.5											Six (6) inches of tan clayey sandy silt topsoil
0.5–6.0		18									Reddish tan silty sandy clay (CL)
		20		41	21	20					
		15		37	20	17					
6.0–8.0		14					47				Yellowish tan to tannish gray slightly clayey silty sand (SC)
8.0–13.0		13		36	20	16					Tan and gray sandy silty clay (CL)
		15									
13.0–15.0	▽	15		17	16	1					Tan and gray slightly clayey silty sand (SC)
15.0											Bottom of boring

Sample type legend: TUBE SAMPLE, AUGER SAMPLE, SPLIT-SPOON, ROCK CORE, THD CONE PEN., NO RECOVERY

REMARKS:

MAXIM TECHNOLOGIES, INC.

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

Depth (ft)	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
0–0.5											Six (6) inches of tan clayey sandy silt topsoil (ML)
0.5–20.0		21									Mottled red and tan sandy silty clay (CL)
		21		28	19	9					
		21					74				
5		20		39	21	18					
		19									
10		19		32	19	13					
		18		36	20	16					-- Tan and gray
15		19									
		18									
20.0											Bottom of boring

Sample type key: TUBE SAMPLE; AUGER SAMPLE; SPLIT-SPOON; ROCK CORE; THD CONE PEN.; NO RECOVERY

REMARKS:

000444

MAXIM TECHNOLOGIES, INC.

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.

Depth (ft)	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
0.5										Six (6) inches of tan clayey sandy silt topsoil (ML)
2.0	16		25	18	7					Mottled red and tan clayey sandy silt (ML)
18.0	18		27	18	9					Mottled red and gray sandy silty clay (CL)
	19									
	19		36	20	16					
	20									
	18									
	19		30	19	11					
	21									
20.0	64					70				Tan clayey sandy silt
										Bottom of boring

FIELD DATA: SOIL & ROCK SYMBOL; DEPTH (FT); SAMPLE TYPE; N: SPT, BLOWS/FT; T: THD, BLOWS/FT; P: HAND PEN, TSF

LABORATORY DATA

Sample legend: TUBE SAMPLE; AUGER SAMPLE; SPLIT-SPOON; ROCK CORE; THD CONE PEN.; NO RECOVERY

REMARKS:

MAXIM TECHNOLOGIES, INC.

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.

Depth (ft)	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	Depth
0–0.5										Six (6) inches of tan clayey sandy silt topsoil (ML)	0.5
0.5–10.0	16									Reddish tan silty sandy clay (CL) -- with iron ore nodules -- red and gray mottled	
	16		32	19	13						
	18		33	20	13						
	14										
	12		32	19	13						10.0
10.0–13.0	12					18				Tan fine silty sand (SM)	13.0
13.0–20.0	18									Tan and gray very silty clay (CL)	
	21										
	22		28	19	9					-- With gray silty clay stringers	20.0
20.0										Bottom of boring	

Field data columns: Soil & Rock Symbol; Depth (ft); Sample Type; N: SPT, Blows/ft; T: THD, Blows/ft; P: Hand Pen, TSF

Legend: Tube Sample; Auger Sample; Split-Spoon; Rock Core; THD Cone Pen.; No Recovery

REMARKS:

000444

MAXIM TECHNOLOGIES, INC.

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.

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
0.5												Six (6) inches of tan clayey silty sand topsoil (SC)
			13					61				Reddish tan and gray silty sandy clay (CL)
			16									
			16		32	19	13					
6.0			15		25	18	7					Tan clayey sandy silt (ML)
			19									
			20									
			20					59				
			20									-- With thin clay stringers
			21									
20.0												Bottom of boring

REMARKS:

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

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

Depth (ft)	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
0.5										Six (6) inches of tan clayey silty sand topsoil (SC)
	16					50				Tan clayey silty sand (SC)
	16		25	18	7					
	12									
	10									
	10									
9.0										Tan silty sand (SM)
	17					51				-- With clayey sand pockets
15.0										Bottom of boring

Field data columns: SOIL & ROCK SYMBOL; DEPTH (FT) (scale 5, 10, 15, 20, 25); SAMPLE TYPE; N: SPT, BLOWS/FT; T: THD, BLOWS/FT; P: HAND PEN, TSF

Sample type legend: TUBE SAMPLE; AUGER SAMPLE; SPLIT-SPOON; ROCK CORE; THD CONE PEN.; NO RECOVERY

REMARKS:

000444

MAXIM TECHNOLOGIES, INC.

LOG OF BORING NO. B-18

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

CLIENT: Southwestern Electric Power Company

DATE: 4/18/00

SHEET 1 of 1

LOCATION: Cason, Texas

SURFACE ELEV: ~~336.0~~ 338.72

DRILLING METHOD(S): Auger

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

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
				15					35				Tan silty sand (SM) with red and gray clay lumps	
				15										
				11										
	5			10										8.0
				14					42				Gray silty sand (SM)	
	10			19										
				24					82					15.0
	15												Bottom of boring	
	20													
	25													

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

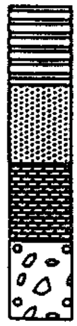
REMARKS:

MAXIM TECHNOLOGIES, INC.

000444

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.

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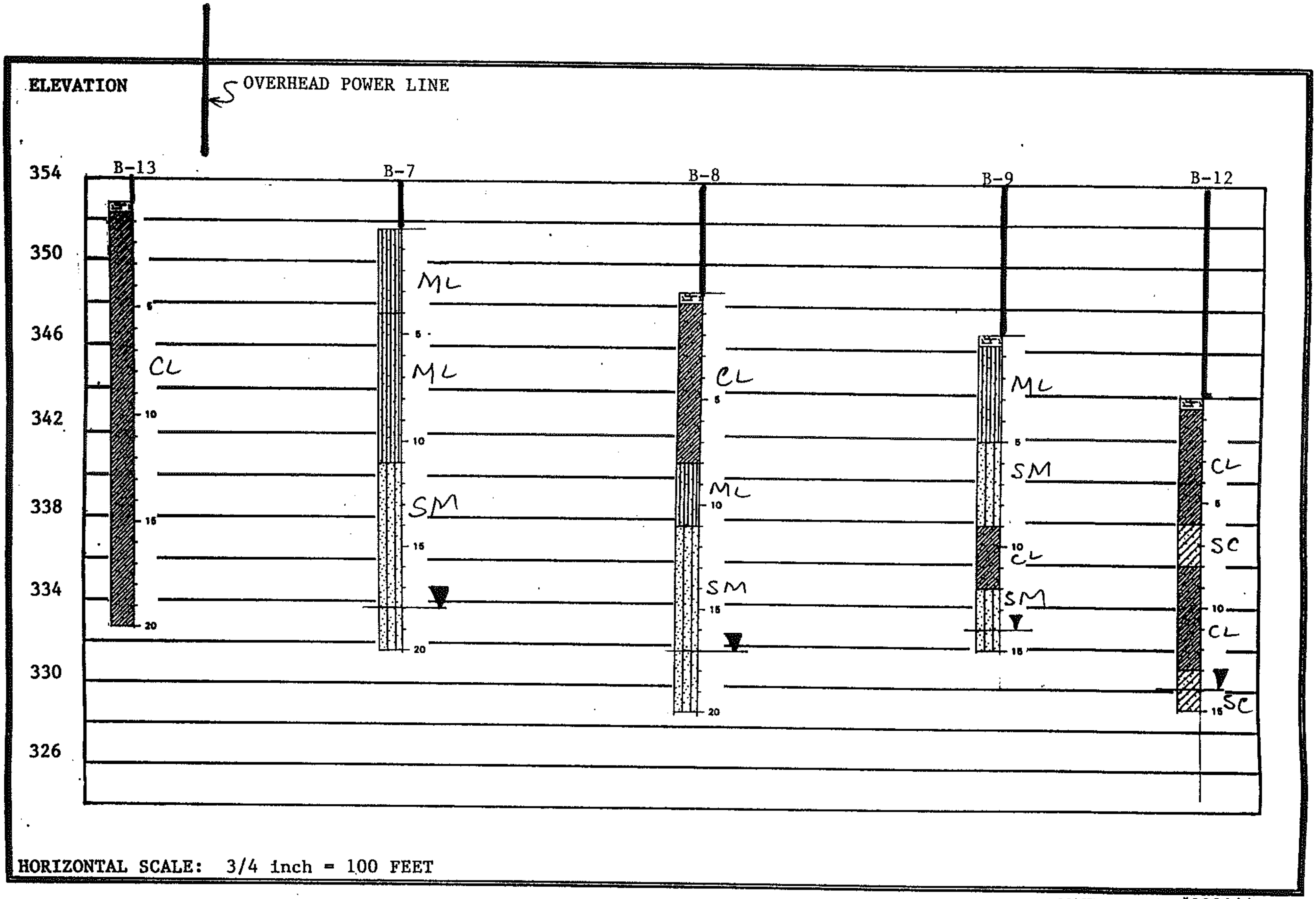

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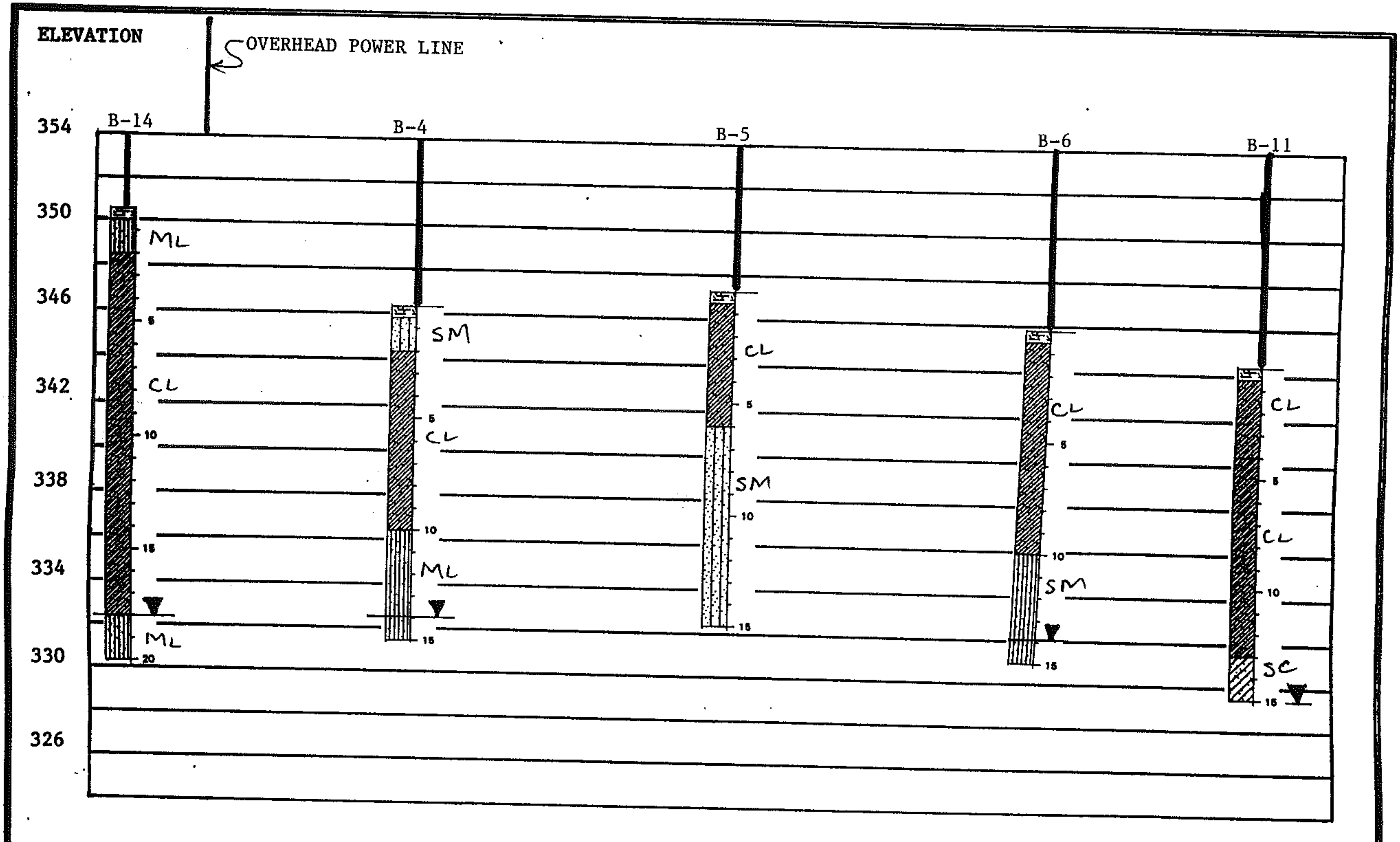
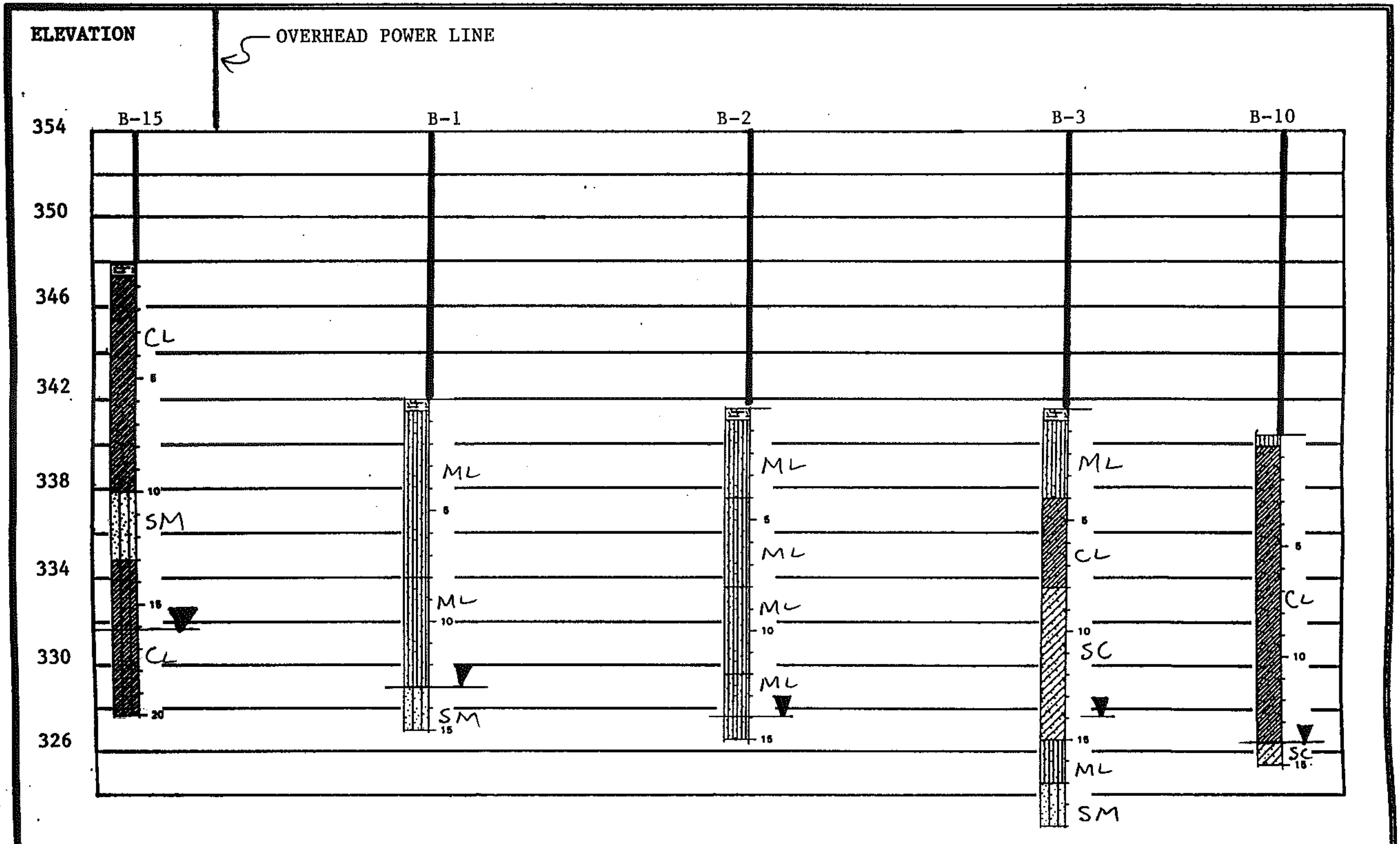


HORIZONTAL SCALE: 3/4 inch = 100 FEET



HORIZONTAL SCALE: 3/4 inch = 100 FEET

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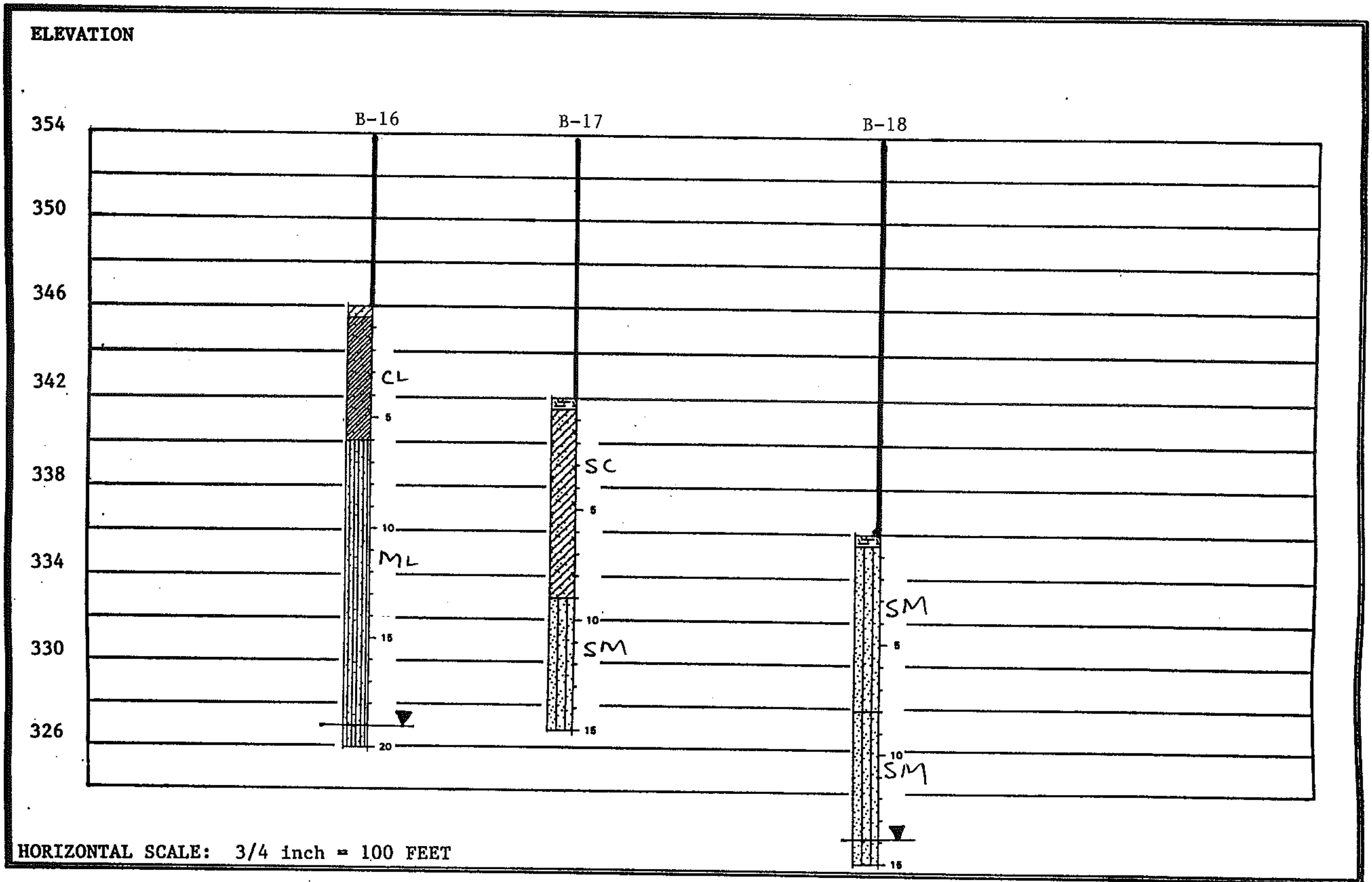

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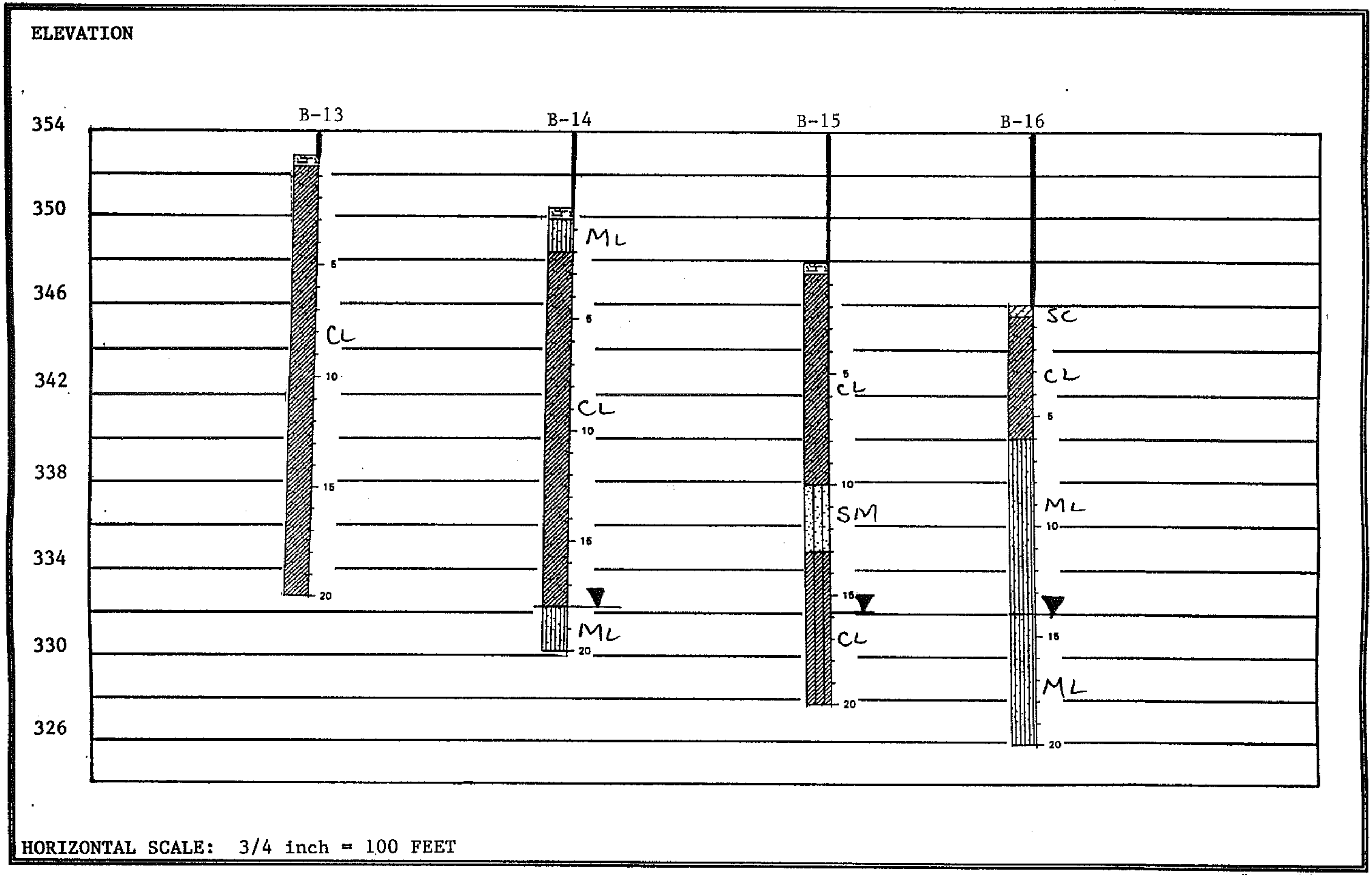

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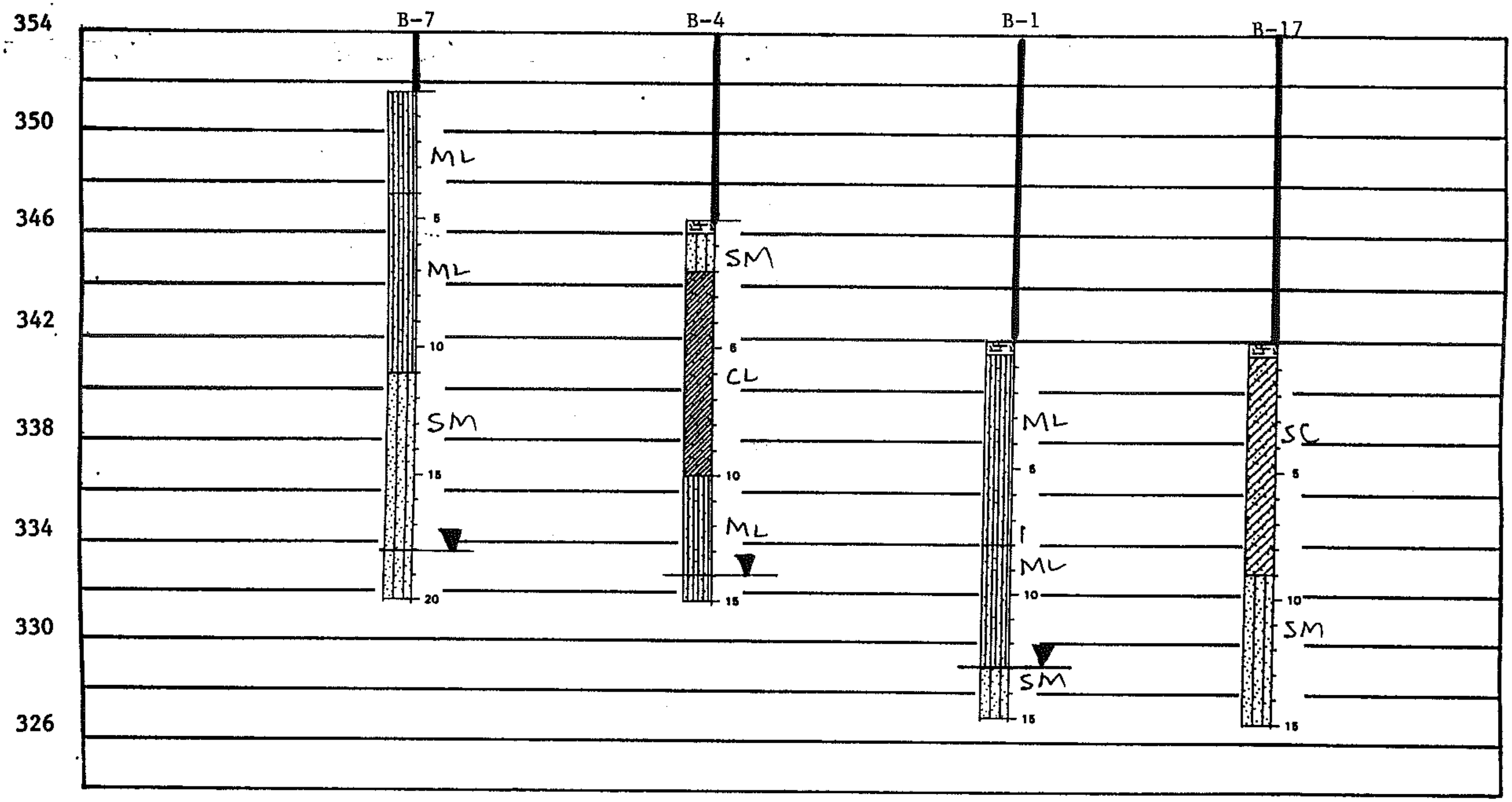
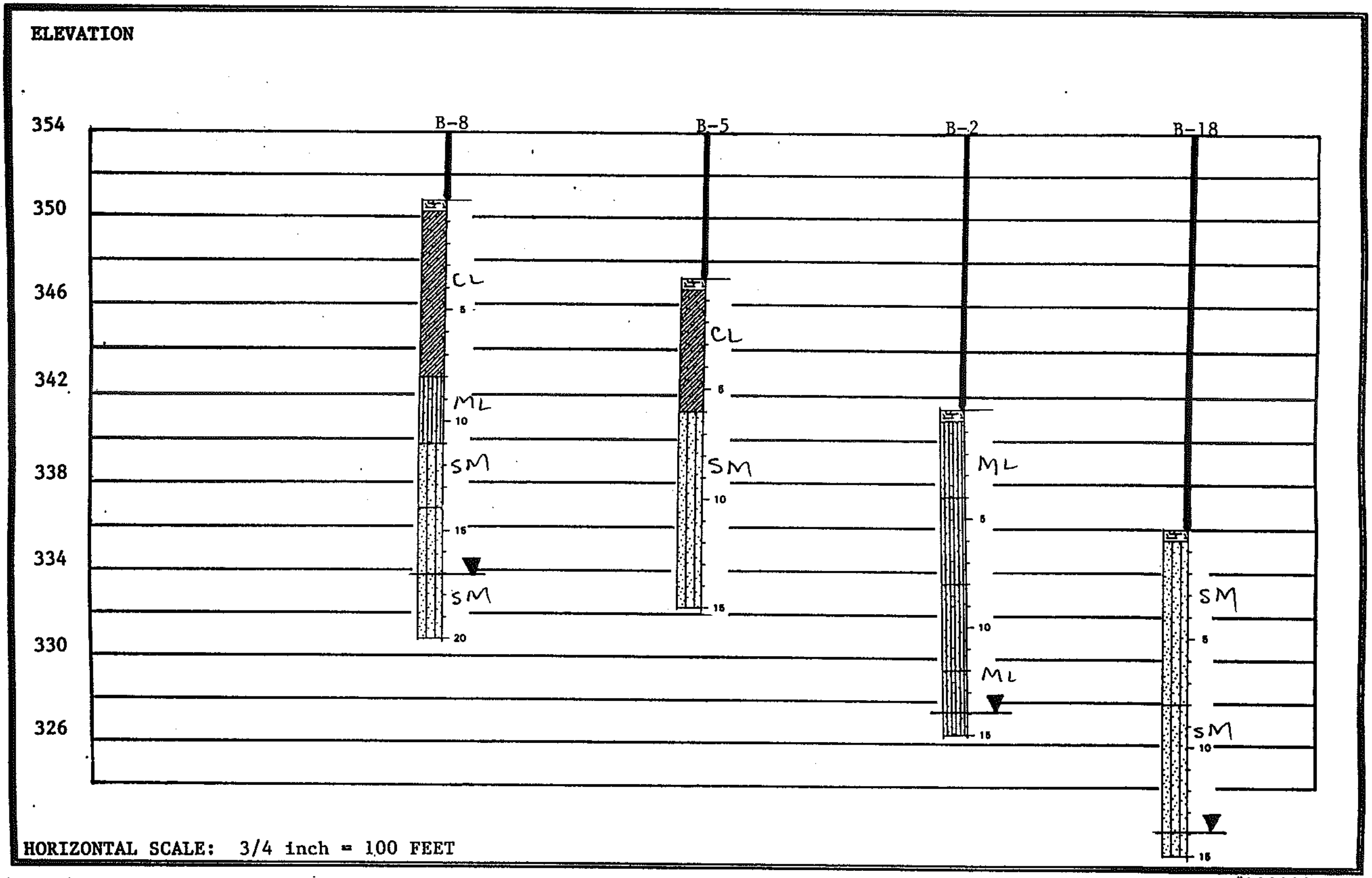
ELEVATION



HORIZONTAL SCALE: 3/4 inch = 100 FEET



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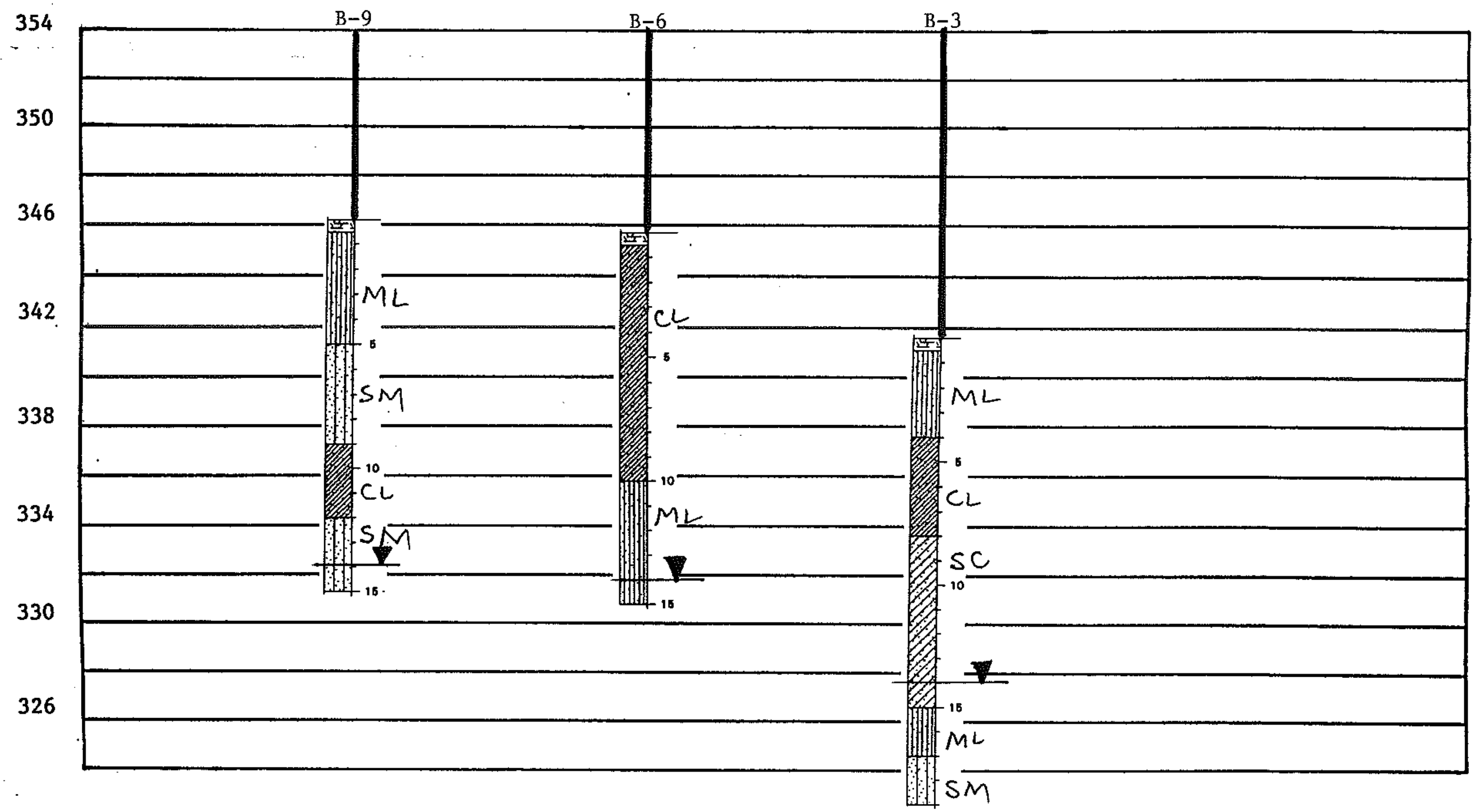

HORIZONTAL SCALE: 3/4 inch = 100 FEET

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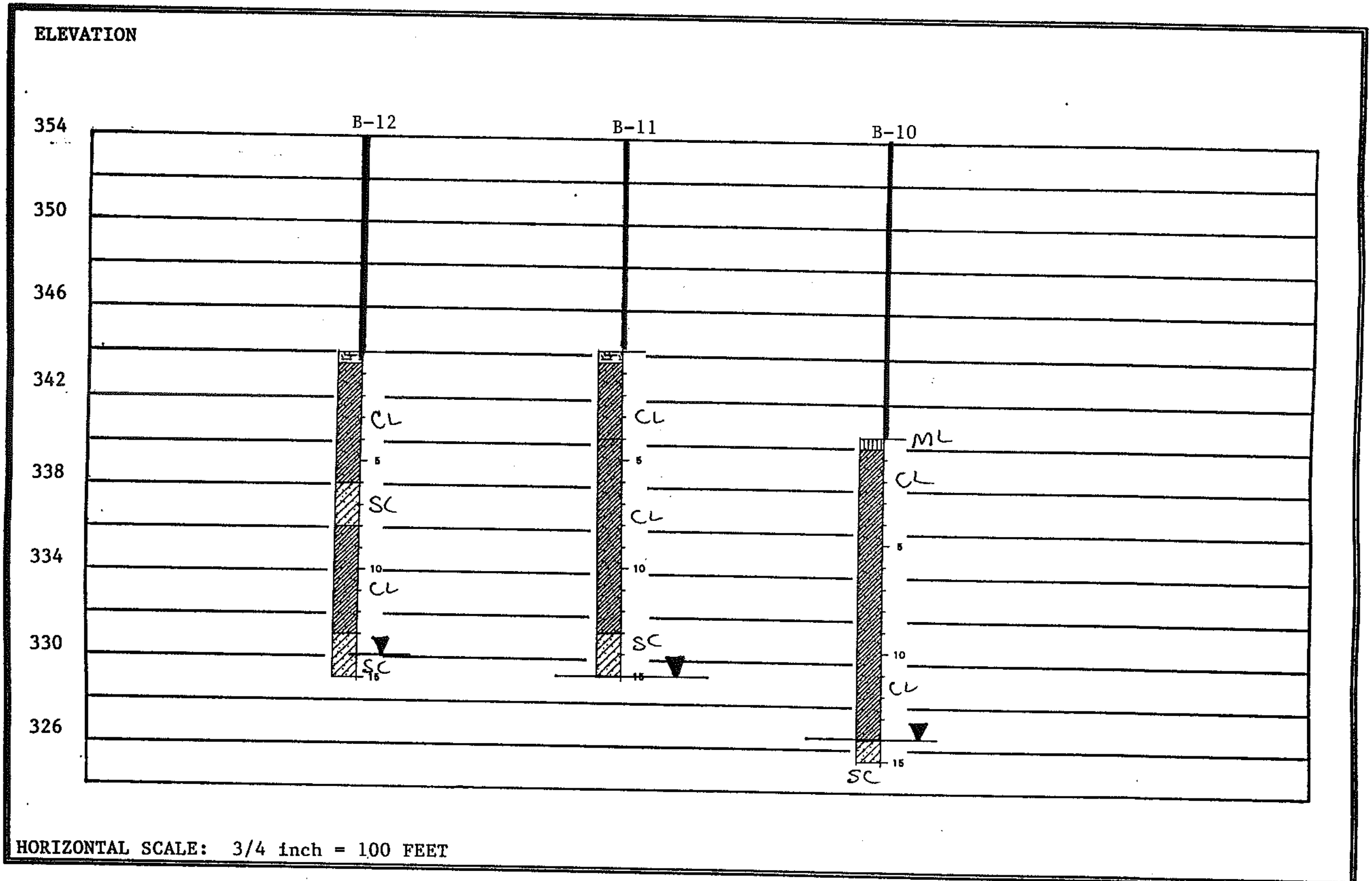

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McClelland engineers, inc. / geotechnical consultants

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

Clarence J. Ehlers, P.E.
Project Manager

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

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

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

DEPTH, FT	DESCRIPTION OF MATERIAL (SURF. EL: 342.8')	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT – WATER CONTENT, % – LIQUID LIMIT	-#200, %
0–4	Tan sandy silt	3-6-5			
4–8	Very stiff red & light gray sandy clay with ferrous nodules	11-18-35			
8–30	Red silty fine sand				50 (at 10)
	-with clay seams and pockets and sandstone nodules, 13' to 19'	10-9-10			16
	-gray below 18'	7-24-22			21
	-with lignite seams, 24' to 26'	9-17-33			
	-with sandstone layer, 28' to 29.5'				
30–42	Hard gray clay -with silt partings and seams	18-23-43			
		17-40-60/3"			
		33-60/6"			
42–46.5	Gray sandy silt with organic pockets and seams	33-48-60/5"		Non-Plastic	
46.5–50	Hard brown and gray clay with sand pockets and partings	24-42-60/6"	109	2.0	65

(Continued on next page)

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PLATE 2

Form 106-2 (57) Job No. 73-085

LOG OF BORING NO. P-1 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, %, LIQUID LIMIT	-#200, %
50–66	Gray silty fine sand				
54		42-60/5"			
59		31-60/6"		Non-Plastic	
64		40-60/6"			
66–75	Hard gray clay -with sandy silt partings and pockets to 70.5' -with sandstone seams and layers below 70.5'				
69		25-38-60/5"			

COMPLETION DEPTH: 75'
DATE: April 26, 1973

DEPTH TO WATER IN BORING: 8.0'
DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 2a

Form 106-1 (57) Job No. 73-085

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	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	-#200, %
0–5	Very stiff red and tan sandy clay -with sand pockets and seams at 2.5' to 5'	1-1-3 8-9-10			
5–23	Red silty fine sand -with sandy clay pockets and seams to 15' -with ferrous nodules to 16' -with light gray clay seams, 9' to 15' -sandstone layer, 16.5' to 17' -gray below 17' -lignite layer, 21' to 23'	16-13-16 4-5-7 9-14-18			28
23–33	Very stiff gray clay -with sand pockets and seams to 25' -with silt partings, seams, & pockets below 25'	11-14-13 7-14-18		1.35+	
33–36	Gray fine sand				
36–42	Hard gray clay with sand pockets and partings	15-32-60/4"		4.0	
42–50	Gray silty fine sand -with clay pockets to 49' -clayey sand layer, 48.5' to 49'	20-30-60/3" 28-60/6"			

(Continued on next page)

Chart scales: 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

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

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 (0.2–1.4); PLASTIC LIMIT, WATER CONTENT, %, LIQUID LIMIT (10–70)	-#200,%
50–66			Gray silty fine sand				
54		X		29-46-60/3"			
59		X		29-37-60/3"			24
			-with clay pockets, 61.5' to 64'				
64		X		22-31-60/3"			
66–74.5			Hard gray clay with sand pockets and mica				
			-sandstone layer, 68' to 68.5'				
69		X		16-24-48		2.8 ⊗→	
74		X		33-60/3"			

COMPLETION DEPTH: 74.5'
DATE: April 28, 1973

DEPTH TO WATER IN BORING: 13.3'
DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 3a

Form 108 (57) Job No. 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

SURF. EL: 329.4'

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT
Stiff red clay with sand pockets and seams -with ferrous partings, 3.5' to 4.5'			
Red silty fine sand with ferrous nodules and sandy clay seams and partings -with sandstone nodules, 8' to 13' -with sandstone layer, 14' to 15' -with coarse sand and gravel, 18.5' to 19'			
Hard gray clay -with sand pockets to 28' -with silt partings and pockets below 28'		99	4.2, 3.3, 4.6
Gray silty fine sand with clay pockets and seams	35-50/6"		
Hard gray sandy clay with sand pockets		110	
Gray silty fine sand -lignite layer, 49.5' to 50'			

(Continued on next page)

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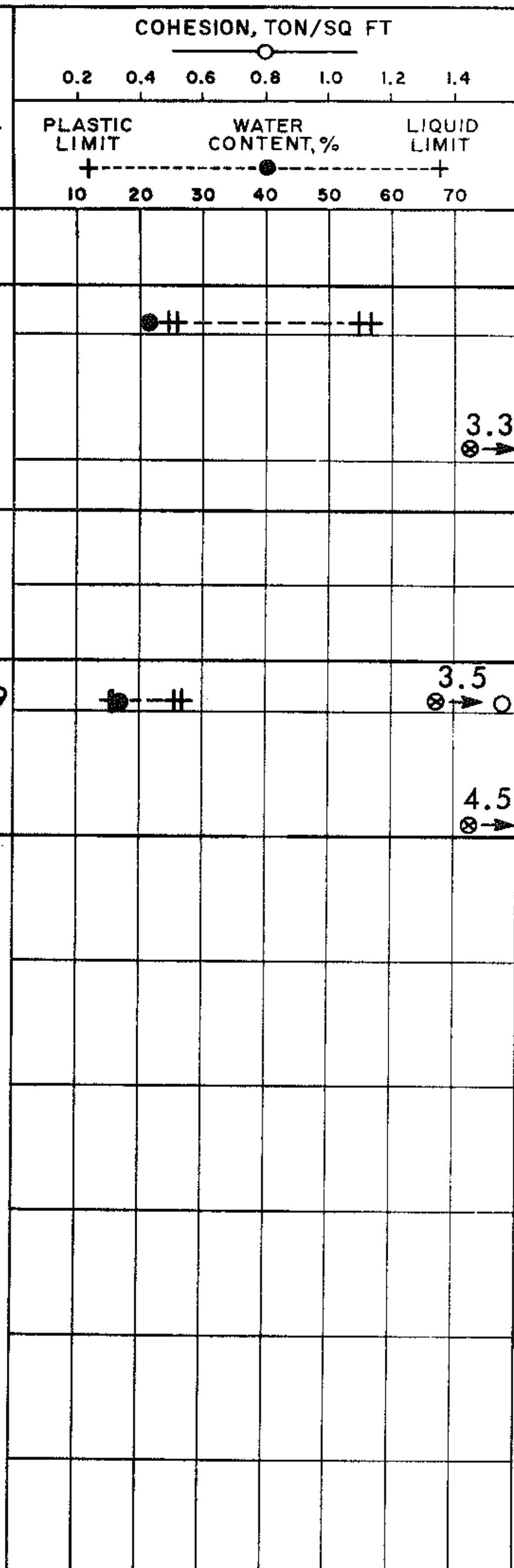
Form 108-3 (57) Job No. 73-085

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

WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	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"	
70–75	Hard gray sandy clay -with silt pockets to 70'		109



COMPLETION DEPTH: 75'
DATE: April 17, 1973

DEPTH TO WATER IN BORING: 10.4'

DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 4a

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

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	-#200,%
0–2	Tan silty fine sand			
2–10	Very stiff red and tan very silty clay -with sand pockets to 4' Stiff red and tan very sandy clay -with sandstone seams and nodules, 6' to 8.5'		112	
13–18	Tan and light gray silty fine sand with clay seams and pockets and scattered gravel			48 70
18–25	Stiff tan and light gray sandy clay with sand and ferrous seams -gray below 23.5'	13-6-10		
25–33	Gray silty fine sand with sandstone nodules	18-50/9"		
33–43	Very stiff gray clay -with sandy silt pockets, partings, and seams to 43'	11-14-25 17-50/8"		
43–50	Gray silty fine sand -clayey fine sand, 46' to 53'	43-50/5"	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

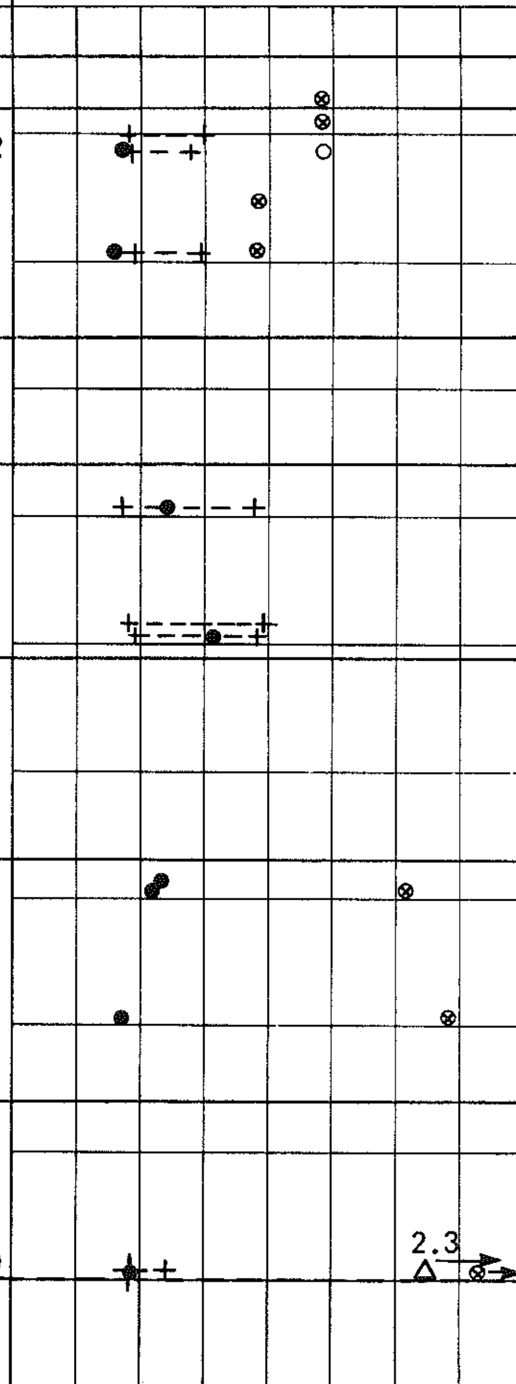


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PLATE 5

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

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

WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT
	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"		
85				1.35+
90				1.35+
95				1.35+
100				1.35+

Cohesion scale: 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

COMPLETION DEPTH: 100'
DATE: March 28, 1973

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

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PLATE 5a

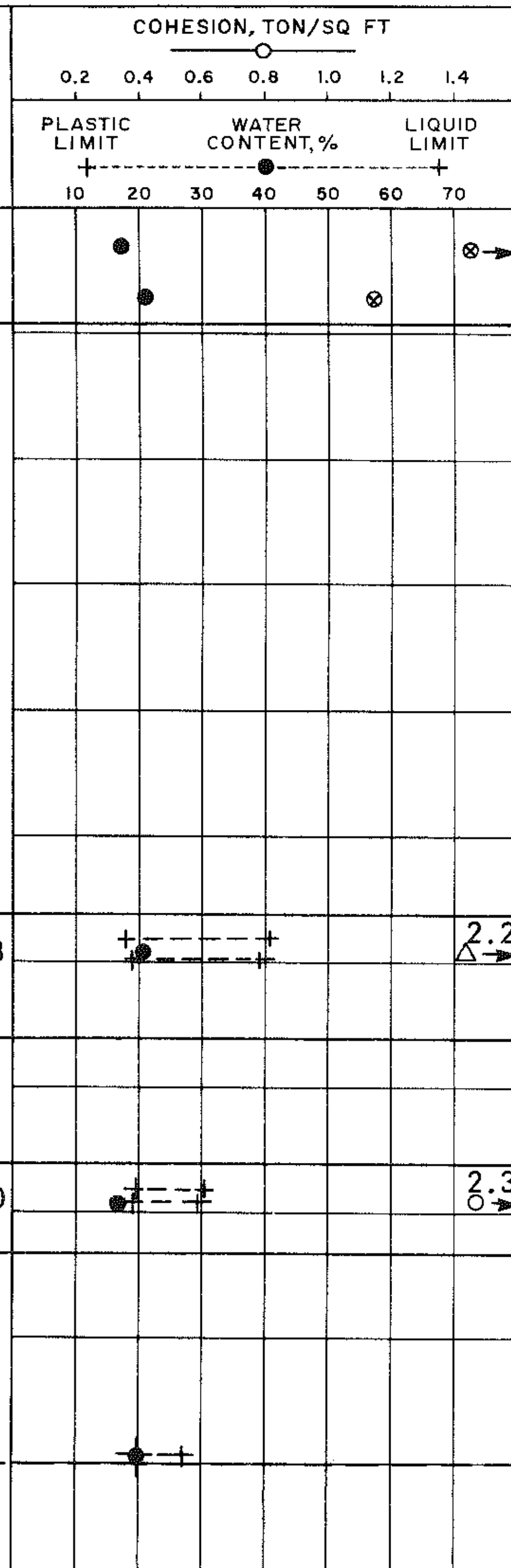
LOG OF BORING NO. P-5

WELSH POWER PLANT
CASON, TEXAS

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

SURF. EL: 344.1'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	-#200, %
0–4.5	Very stiff red & tan very sandy clay -with sandstone nodules to 2.5' -with ferrous deposits, 2' to 4'			
4.5–28	Red and tan silty fine sand with light gray clay partings, pockets and seams -with sandstone nodules to 23' -tan, 13' to 23' -with ferrous partings and seams, 17' to 23' -gray below 23' -gray clay, 23' to 23.5'	10-20-23		32 33
28–33	Hard gray sandy clay with sand pockets and partings		103	
33–38	Gray silty fine sand -with clay pockets and seams to 35'			
38–41.5	Hard gray sandy clay		110	
41.5–50	Gray clayey fine sand	30-50/6"		



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

WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	-#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					

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

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

Form 10 Job No. 73-085

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	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT
0–7	Fill: Tan and light gray clay, intermixed with sandy silt			
7–15.5	Very stiff tan & light gray clay -with sand partings and ferrous nodules to 10' -with sand pockets to 15' -sandstone layer, 15' to 15.5'			1.35+ 1.35+ 1.35+
15.5–23	Gray silty fine sand with sandstone nodules			
23–27	Very stiff clay with sand pockets			
27–36	Gray silty fine sand with clay seams and pockets	14-50/8" 22-100/5"		
36–43	Very stiff gray silty clay with silt partings and pockets			
43–46	Gray sandy silt with clay seams	15-56/12"		
46–49	Hard gray clay with silt seams and partings			
49–	Gray silty fine sand	26-20/6"		

(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

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Form 108-5 (57) Job No. 73-085

LOG OF BORING NO. P-6 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 – 1.4); PLASTIC LIMIT, WATER CONTENT, %, LIQUID LIMIT (10 – 70)
	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 -with lignite partings and seams to 66.5' -with silty sand partings & pockets below 66.5'	30-53/6" 36-58/6"		1.35+
70–75	Gray silty sand with sandy clay seams			
80	Gray cemented sand -with sandstone seams and layers to 78.5'	31-100/7"		1.35+
85–90	Hard gray sandy clay with sand pockets and mica	53-87/6" 100/9"		1.35+
95–100	Gray sandy silt with mica	40-60/3" 42-100/5"		

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 (57) 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

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
	SURF. EL: 352.8'		
0	Tan silty sand		
	Stiff red and tan sandy clay -very sandy at 4'		
8	Tan silty fine sand -with sandstone nodules to 10' -with clay pockets to 15' -tan and light gray at 18'		
20.5	Stiff light gray clay with sand pockets and partings -with ferrous nodules and seams to 30'		91
	-very stiff gray sandy clay with sand seams and pockets below 33'		
38.5	Gray clayey fine sand with sandstone nodules and clay pockets	12-50/4"	
48	Very stiff gray sandy clay		
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

McCLELLAND ENGINEERS

PLATE 8

Form 108-5 1971 Job No. 73-085

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

WELSH POWER PLANT

CASON, TEXAS

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 – 1.4); PLASTIC LIMIT, WATER CONTENT, %, LIQUID LIMIT (10 – 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: 25.0' Caved at: 74'

DATE: April 23, 1973

McCLELLAND ENGINEERS

PLATE 8a

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

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

SURF. EL: 346.5'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	-#200,%
0–1	Tan & light gray clayey fine sand			
1–12	Stiff tan sandy clay -with ferrous nodules and sand pockets to 8' -red and tan at 6'			
12–36	Light gray silty fine sand with clay seams -with ferrous nodules to 20.5' -red, 29' to 33.5'	11-21-22		32 20 31
36–46	Very stiff gray sandy clay with silt partings and pockets -with sandstone seams, 39' to 42'			
46–50	Gray silty fine sand			

(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

1.35+

McCLELLAND ENGINEERS

PLATE 9

LOG OF BORING NO. P-8 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	-#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 sand-stone 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				

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

COMPLETION DEPTH: 100'
DATE: April 8, 1973

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

McCLELLAND ENGINEERS

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

LOG OF BORING NO. P-9

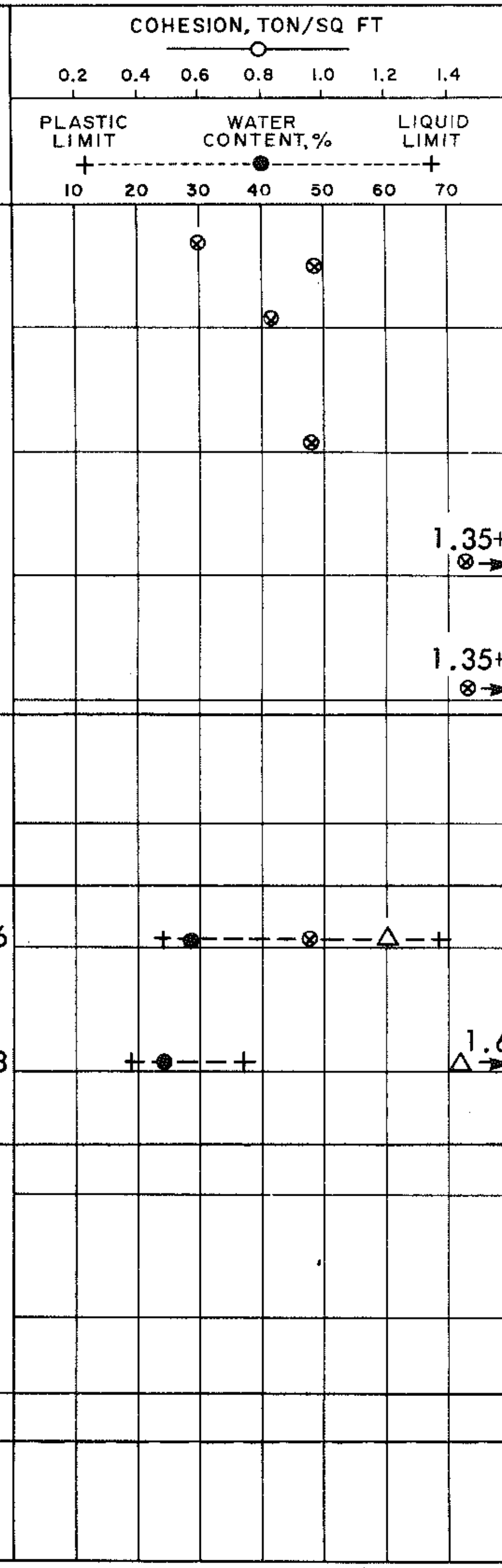
WELSH POWER PLANT

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
0–20	Stiff red and tan sandy clay -becomes very stiff by 13'		
20–27	Tan fine sand	8-10-15	
27–37	Very stiff light gray clay -with silt partings to 30' -gray sandy clay with sand pockets and partings below 33'		96 98
37–48	Gray silty fine sand with gray clay seams and partings	15-33-50/3" 15-50/7"	
48–	Very stiff gray sandy clay with silt partings -with sand pockets to 50'	10-50/8"	



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McCLELLAND ENGINEERS

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

LOG OF BORING NO. P-9 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT
55	Very stiff gray sandy clay -with sandy silt seams below 53'		103	1.35+
60	Gray fine sand			
65	Stiff gray sandy clay -with sand pockets to 68'			
70	Tan clayey fine sand with clay seams and layers			
75	Hard gray clay			1.35+
80	-with sand seams below 78'			1.35+
85–90	Gray silty fine sand	50/5"		
95	Hard gray sandy clay	26-50/5"		
100	Gray sandstone layer			

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

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

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

LOG OF BORING NO. P-10

WELSH POWER PLANT
CASON, TEXAS

TYPE: 3" thin-wall-tube & 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	COHESION, TON/SQ FT
0–8	Very stiff red and tan clay with sand pockets			1.35+
8–23	Red and tan fine sand -slightly clayey to 13' -with sandstone nodules, 14' to 15' -with ferrous deposits, 19' to 20'			
23–27.5	Light gray sandy silt -with sand pockets and seams	3-5-5		
27.5–41.5	Tan silty fine sand -with ferrous seams at 34' -gray with clay seams below 36.5'	6-3-5 10-16-26		
41.5–50	Very stiff gray sandy clay with silt partings and seams		102 105	1.7 1.35+

(Continued on next page)

MCCLELLAND ENGINEERS

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

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 (0.2–1.4); PLASTIC LIMIT, WATER CONTENT, %, LIQUID LIMIT (10–70)
			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
			-shaley clay seams, 63' to 63.5'			1.35+
65						
70			Gray silty fine sand -with clay seams to 78' -with lignite seams at 68'			
75				50/3"		
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+
						1.35+
100						

(Continued on next page)

McCLELLAND ENGINEERS

PLATE 11a

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	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT
100–110	Hard gray clay -with sand pockets below 100'			
110–134	Gray silty fine sand -with clay seams and pockets to 128'	50/6" 50/5"		
	-light gray at 128'	50/3"		
134–145	Hard gray clay, slightly silty -with silt partings to 138.5'			1.35+
145–148	Soft gray silty clay -with rock cuttings to 148'			
148–157	Hard gray shaley clay			1.35+
157–164	Light gray silty sand			
164–172	Hard gray clay with silt partings and pockets			1.35+
172–184	Hard brown and tan lignite			1.35+
184–198.5	Hard gray clay with silt partings			1.35+ 1.35+

Plastic limit / Water content, % / Liquid limit scale: 10, 20, 30, 40, 50, 60, 70. Cohesion scale: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4.

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

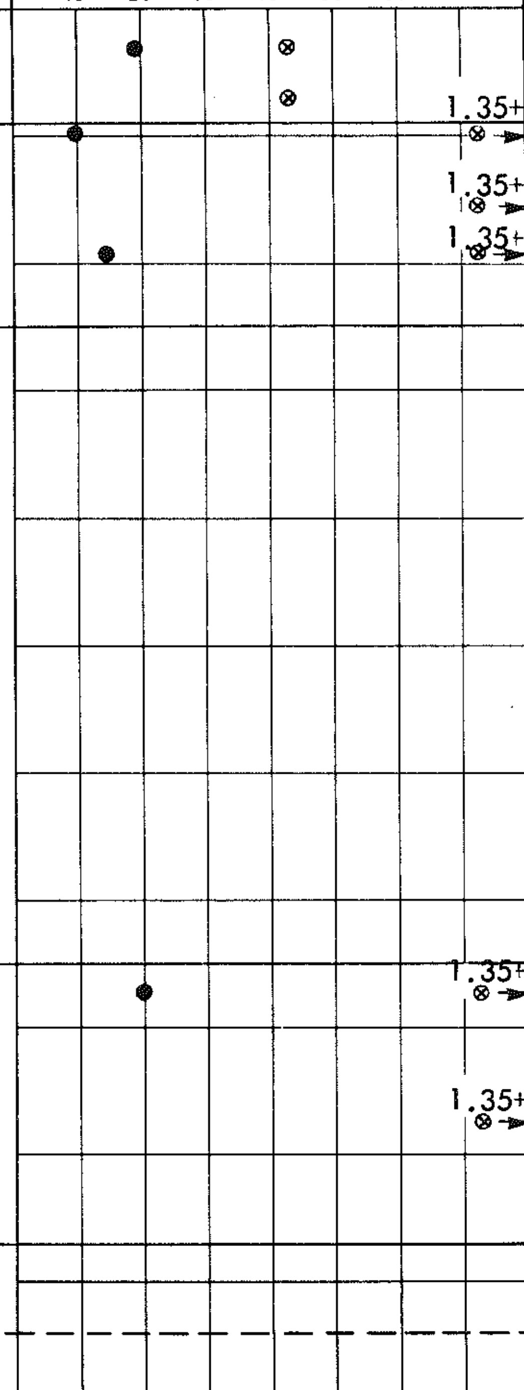
TYPE: 3" thin-wall-tube & 2" split-barrel & 3" Denison barrel LOCATION: See Plate 1

SURF. EL: 342.2'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
0–4.5	Stiff tan and light gray clay, slightly sandy with ferrous and organic matter and sand pockets		
4.5–12.5	Very stiff tan and light gray sandy clay -with ferrous and organic matter to 6' -tan at 6'		
12.5–37.5	Tan fine sand -with ferrous partings and seams to 18' -with clay seams to 30' -sandstone layer, 19' to 19.5'	28-50/2"	
		6-50/10"	
	-gray below 27'		
		10-13-25	
	-ferrous and sandstone seams, 34' to 34.5'		
37.5–48.5	Hard gray clay -with silt partings to 40' -with sand pockets below 43.5'		
48.5–	Gray clayey fine sand		

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



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McCLELLAND ENGINEERS

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

LOG OF BORING NO. P-11 (Cont'd)

WELSH POWER PLANT
CASON, TEXAS

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT
Gray clayey fine sand			
Hard gray clay with silt partings			1.35+
Gray silty fine sand with lignite and clay seams	50/4" 50/6"		
Hard gray clay with sandy silt partings and traces of mica	24-50/7"		
Hard gray sandy clay with sand pockets			1.35+ 1.35+ 1.35+
Hard gray silty clay -with silt seams and partings to 99'			1.35+
Gray and light gray silty sand -with clay partings to 99'			

DEPTH, FT: 55, 60, 65, 70, 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

COMPLETION DEPTH: 100'
DATE: April 8, 1973

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

McCLELLAND ENGINEERS

PLATE 12a

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

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 (0.2–1.4); PLASTIC LIMIT / WATER CONTENT, % / LIQUID LIMIT (10–70)	- # 200, %
0–18	Stiff red and tan sandy clay -with sand pockets and seams to 8' -very stiff below 4'	20-25-18 (15')		1.35+	
18–23	Red and tan clayey fine sand with sand and clay pockets		114		
23–50	Red and tan silty fine sand	9-10-12 (25')			
	-with ferrous seams and deposits, 29' to 33'	15-14-15 (30')			36
	-tan, 33' to 38'				
	-gray with clay seams below 38'	36-42/6" (40')			
		20-42-50/4" (45')			37
	-sandstone, 48' to 50'				

(Continued on next page)

McCLELLAND ENGINEERS

Form 10 Job No. 73-085

LOG OF BORING NO. P-12 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	- # 200, %
52–58	Gray silty fine sand				
58–78	Gray clayey fine sand with sand pockets	20-42-50/4"			56
					53
78–93	Gray fine sand				
	-with clay seams to 84'				
		100/4"			2
		100/6"			
	-sandstone below 92.5'			1.35+	
93–100	Hard gray sandy clay with sand pockets	24-50/7"			
				1.35+	

Cohesion scale: 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

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 (0.2–1.4) / PLASTIC LIMIT – WATER CONTENT, % – LIQUID LIMIT (10–70)	-#200, %
0–2	Firm tan and light gray clay				
2–12	Very stiff tan and light gray sandy clay -with silt pockets and partings below 8'				
12–39	Tan silty fine sand				21
					32
	-with coarse sand layer at 23.5'	23-50/4"			
		2-6-11			21
	-gray below 34' -with gravel layer at 35.5'				
39–42	Hard gray clay	23-50/10"			
42–50	Gray silty fine sand				20

(Continued on next page)

Form 108-… Job No. 72-1085

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

WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	−#200, %
52–57.5	Gray silty fine sand				38
57.5–60	Hard gray clay with silt partings			1.35+	
60–69	Gray silty fine sand with lignite seams and mica	50/3"			

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	7-9-13			
	-with ferrous deposits to 14'				
	-with clay seams below 14'	9-12-17			24
	-gray below 17'				
		22-25-23			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)

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

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

McCLELLAND ENGINEERS

Job No. 73-085

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

WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	-#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 ⊗→	

Cohesion scale: 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

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	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT – WATER CONTENT, % – LIQUID LIMIT
0–5	Tan clayey sand	1-1-3		
5–8	Firm tan and light gray sandy clay with ferrous deposits	2-2-3		
8–12	Stiff light gray clay with ferrous seams and partings			
12–15	Gray silty fine sand	17-24-37		
15–22	Gray clayey sand -with clay pockets to 18'	15-24-60/4"		
22–50	Gray silty fine sand	28-60/6"		
		29-54-60/3"		
		24-54-60/2"		
	-with clay pockets, 39' to 44'	19-60/6"		
	-fractured sandstone layer, 44' to 45.5'	21-53-60/3"		
47–50	Hard gray clay with sand pockets and partings	14-26-48		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

SURF. EL: 323.6'

Note Scale Change (at 40 ft)

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / WATER CONTENT, %	- # 200, %
Stiff red and light gray clay with sand partings and pockets -with ferrous nodules, 2' to 6'	3-3-6			
Tan silty fine sand with light gray clay seams and pockets	12-16-27			28
Hard gray clay -with silt partings to 20'			3.8	
-brown, 18.5' to 19'	14-25-33		3.0	
-with sand pockets & partings, 23' to 25'		106	4.0	
-with silt partings & pockets, 28' to 30'	12-19-23		4.0	
Gray silty fine sand	31-36-60/3"			
Hard gray sandy clay with sand pockets	10-21-60/5"			
Gray silty fine sand	21-60/6"			30
	26-60/5"			
	32-60/5"			21
-sandstone layer, 57' to 57.5'	21-46-60/3"			

Chart scales: 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

COMPLETION DEPTH: 60'
DATE: April 29, 1973

DEPTH TO WATER IN BORING: 11.6'

DATE: May 3, 1973

PLATE 17

McCLELLAND ENGINEERS

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

LOG OF BORING NO. P-22

WELSH POWER PLANT
CASON, TEXAS

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

DEPTH, FT	DESCRIPTION OF MATERIAL (SURF. EL: 338.1')	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT
0–4	Stiff red and light gray sandy clay	4-4-7		1.6
4–46	Hard light gray and tan clay -with ferrous deposits to 10' -with sand pockets and partings to 18' -with silt partings, 7' to 28' -with vertical ferrous seams at 13.5' -gray below 16' -with lignite seams, 22' to 23' -with sand seams and pockets, 28' to 46' -sandstone layer, 38.5' to 39'	5-8-10 12-16-46 10-21-31	99 116	2.1 2.1 2.9 3.0 3.8 4.5
46–50	Hard gray sandy clay with sand pockets and seams	16-27-60/4"		

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

COMPLETION DEPTH: 50'
DATE: April 30, 1973

DEPTH TO WATER IN BORING: 1.2'

DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 18

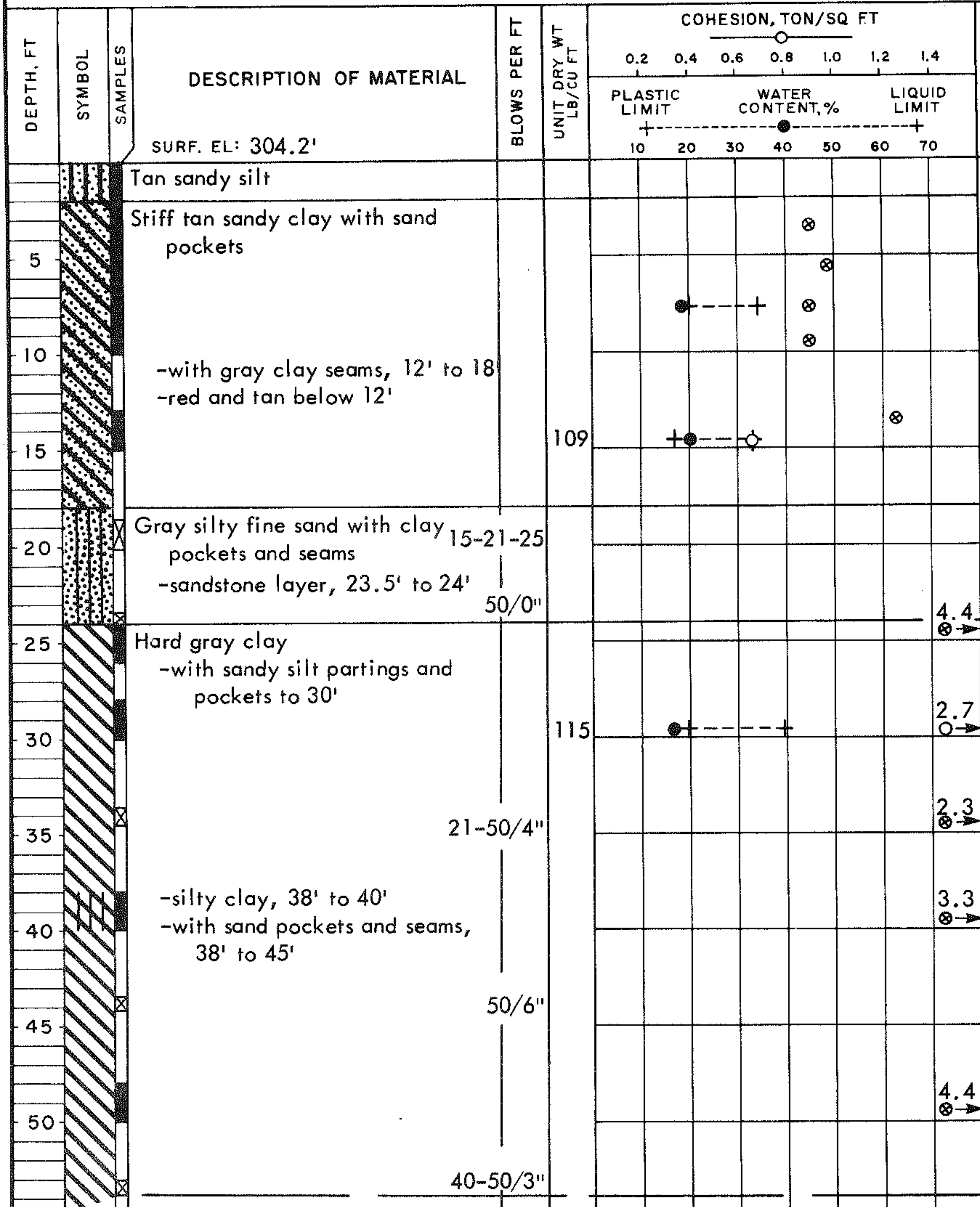
Form 108-1 (57) Job No 73-085

LOG OF BORING NO. P-23

WELSH POWER PLANT
CASON, TEXAS

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

DEPTH, FT	DESCRIPTION OF MATERIAL (SURF. EL: 304.2')	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	-# 200,%
0	Tan sandy silt				
1	Stiff tan sandy clay with sand pockets -with gray clay seams, 12' to 18' -red and tan below 12'		109		60
18	Gray silty fine sand with clay pockets and seams -sandstone layer, 23.5' to 24'	15-21-25 50/0"		4.4	24
24	Hard gray clay -with sandy silt partings and pockets to 30' -silty clay, 38' to 40' -with sand pockets and seams, 38' to 45'	21-50/4" 50/6" 40-50/3"	115	2.7 2.3 3.3 4.4	



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

SURF. EL: 357.8'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / WATER CONTENT, %	-#200,%
0	Tan sandy silt				60
					64
5	Stiff gray and red sandy clay with sand pockets				
	-with gray clay seams to 8'			2.7	
	-very stiff red and tan below 7'			4.1	
10					
	-with red fine sand seams and layers below 13'	8-17-16		1.2	
20	Tan silty fine sand				
25	-with ferrous nodules, 24' to 24.5'	11-10-10			32
30		18-23-18			
35	-with ferrous partings, 34' to 35'	21-50/9"			16
40		28-50/8"			
45	-with organic partings, 43' to 45.5'				
	-gray below 43'	8-14-20			
	-with clay seams, 49' to 54'	14-50/6"			
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

McCLELLAND ENGINEERS

PLATE 20

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

LOG OF BORING NO. P-25 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT; PLASTIC LIMIT / WATER CONTENT, % / LIQUID LIMIT	-#200,%
	Tan silty fine sand				
55		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					

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

WATER CONTENT, %: 10 20 30 40 50 60 70

COMPLETION DEPTH: 74.5'
DATE: April 21, 1973

DEPTH TO WATER IN BORING: 5.3'
DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 20a

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

LOG OF BORING NO. P-26

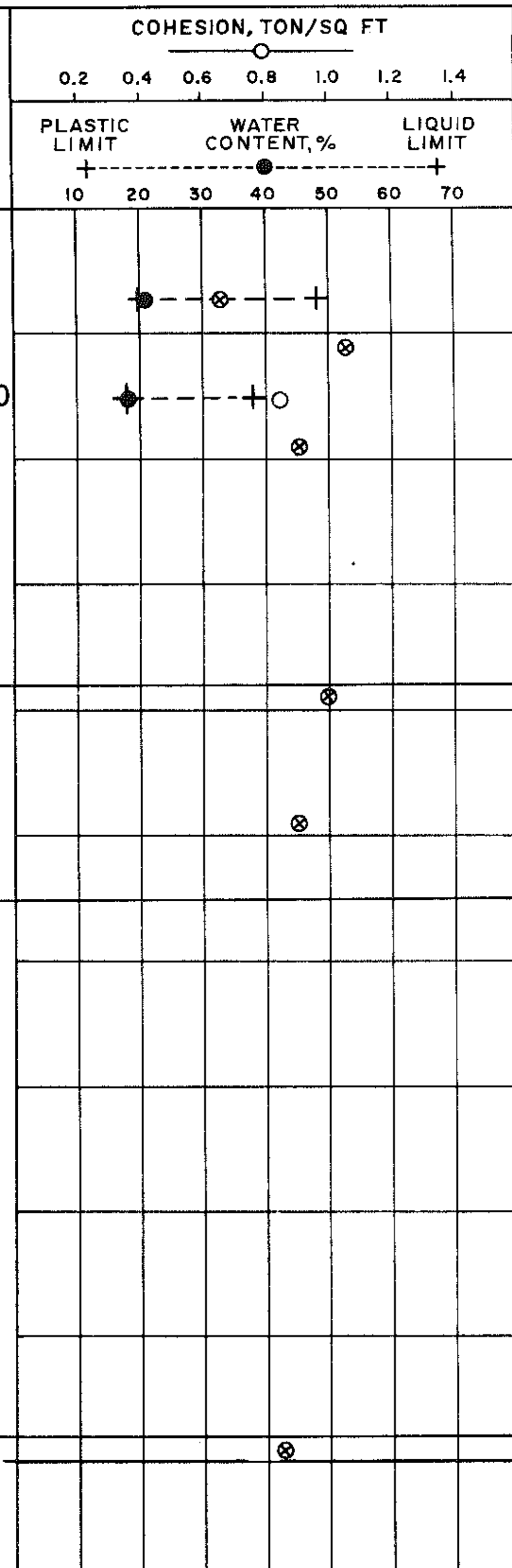
WELSH POWER PLANT
CASON, TEXAS

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

SURF. EL: 346.2'

Depth, ft	Description of Material	Blows per ft	Unit dry wt lb/cu ft	-#200, %
0–18	Stiff tan sandy clay with sand pockets and seams			
	-with ferrous deposits, 4' to 10'			
	-red and tan below 6'		110	66
	-red fine sand layer, 13.5' to 14'	15-29-20		
	-with ferrous nodules below 14'			
18–28	Very stiff light gray and brown clay with ferrous partings and sand partings, seams and pockets			
	-gray below 24'	10-13-17		
28–59	Tan fine sand with clay seams and pockets	4-13-25		6
		28-35-15		
		6-4-7		27
		16-19-26		
		10-31-22		4
		10-10-25		
59–60	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

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

LOG OF BORING NO. P-28

WELSH POWER PLANT
CASON, TEXAS

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

SURF. EL: 332.7'

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	-#200,%
Tan silty fine sand				
Very stiff tan and light gray sandy clay				
Tan fine sand -with light gray clay seams below 7.5'	13-18-17			
	15-22-44			6
Very stiff red and light gray clay with sand and silt pockets and partings -hard below 18'			4.0	
			4.3	
	13-18-22		3.3	
-sandstone layer, 32.5' to 33'			4.2	
	20-35-60/5"			
Hard gray sandy clay	12-18-40			
Hard gray clay with silt partings and seams	13-22-32			

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

Depth, ft: 5 10 15 20 25 30 35 40 45 50

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

LOG OF BORING NO. P-30

WELSH POWER PLANT
CASON, TEXAS

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

DEPTH, FT	DESCRIPTION OF MATERIAL (SURF. EL: 355.3')	BLOWS PER FT	UNIT DRY WT LB/CU FT
0–8	Stiff tan sandy clay -red and light gray below 6'		
8–12	Tan and light gray silty fine sand with clayey sand seams	30-50/6"	
12–18	Hard tan clay with ferrous partings		
18–24	Tan and light gray clayey sand	13-10-13	
24–25	Red and tan silty fine sand		

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

3.0

COMPLETION DEPTH: 25'
DATE: April 18, 1973

DEPTH TO WATER IN BORING: 19.0'
DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 23

Form 108-1 (57) Job No 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

DEPTH, FT	DESCRIPTION OF MATERIAL (SURF. EL: 358.1')	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT, WATER CONTENT, %, LIQUID LIMIT (10–70)
0–5.5	Stiff red silty clay -with sandy silt pockets to 2' -firm at 2'			
5.5–17	Hard tan and light gray sandy clay with sand pockets -with ferrous nodules below 14.5'		116	2.6, 2.2, 2.8
17–25	Red silty fine sand with clay seams and ferrous partings	10-13-17		

Depth scale: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50

COMPLETION DEPTH: 25'
DATE: April 18, 1973

DEPTH TO WATER IN BORING: 16.0'

DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 24

Form OP-(47) Job No. 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

SURF. EL: 354.7'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT
0–9	Stiff tan sandy clay with sand pockets -very stiff below 7'			
9–13	Red and tan silty fine sand with sandy clay pockets			
13–22	Hard tan and light gray clay with sand pockets -with ferrous pockets and sandy clay seams to 15'	12-19-27		2.5 2.3
22–25	Red silty fine sand with ferrous partings and clay seams	13-50/9"		

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

COMPLETION DEPTH: 25'
DATE: April 18, 1973

DEPTH TO WATER IN BORING: 14.7'

DATE: May 3, 1973

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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	-# 200,%
0–8	Stiff red and tan sandy clay with sand pockets and ferrous pockets				
8–12	Red and tan sandy silt with sand pockets				64
12–41	Red silty fine sand with ferrous nodules and pockets				
	-with sandy clay seams and pockets to 30'	7-15-27			11
	-tan and light gray, 19' to 38'	16-17-30			14
		28-28-50			
		11-14-22			
	-with ferrous layer, 34.5' to 35'	14-77/12"			28
	-gray with clay seams below 38'	12-40-48			
41–46	Hard gray clay	22-50/2"		1.35+	
46–49	Gray silty fine sand	50/4"			

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

COMPLETION DEPTH: 49'
DATE: April 13, 1973

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

McCLELLAND ENGINEERS

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	COHESION, TON/SQ FT	-#200, %
0–5	Very stiff red and tan clay				
5–15	Red and tan silty fine sand -with sandstone and red and light gray sandy clay below 8'	4-11-15 13-22-24			
15–19	Very stiff light gray clay with sand pockets and seams		105	1.7	
19–41	Light gray silty fine sand -tan, 24' to 36' -with clay seams and pockets below 24' -with sandstone nodules, 26' to 38' -gray below 36'	4-6-13 3-5-7 8-5-4 9-14-21			32
41–45	Hard gray sandy clay with silt seams and partings				49

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

COMPLETION DEPTH: 45'
DATE: May 1, 1973

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

McCLELLAND ENGINEERS

73-085

LOG OF BORING NO. P-35

WELSH POWER PLANT
CASON, TEXAS

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

SURF. EL: 341.5'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	-#200, %
0–5	Very stiff red and tan sandy clay				
5–22	Red and tan silty fine sand with sandstone seams and nodules -tan with light gray clay seams below 13' -with ferrous seams and partings, 17' to 19.5'	21-35-50 5-1-3			26
22–33	Hard gray sandy clay -with sand pockets and partings to 25' -with silt partings and pockets below 28'	13-18-26	102	4.5 3.2	
33–37	Gray silty fine sand with clay pockets and seams	8-7-50			
37–42	Hard gray sandy clay with sand pockets and seams		111	4.5	
42–45	Gray clayey sand	12-23-60/4"			

Plot scales: 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

COMPLETION DEPTH: 45'
DATE: May 2, 1973

DEPTH TO WATER IN BORING: 10.9'

DATE: May 3, 1973

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PLATE 28

Form 108-1 (57) 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; PLASTIC LIMIT / WATER CONTENT, % / LIQUID LIMIT	-#200,%
0	Tan silty fine sand				
	Stiff red and tan sandy clay with sand pockets				
9.5	Red and tan silty fine sand	11-14-14			
	-with sandy clay seams to 14'				
14.5	-with ferrous and sandstone nodules, 14.5' to 16'	8-8-8			22
18	-with light gray clay seams, 18' to 20'	10-16-16			
24		3-5-9			
29		8-16-23	26
32	-gray with lignite and clay seams below 32'	7-15-25			
36	Hard gray clay with sand seams and pockets			4.5	
	-with sandstone seams, 39.5' to 40'			4.5	
49	Gray silty fine sand	13-26-60/4"			
53	Hard gray sandy clay	29-60/5"		4.5	
57	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

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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	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, %, LIQUID LIMIT
0–5	Stiff tan silty clay with sand pockets and seams	2-3-5 4-8-9		
5–10.5	Stiff tan and light gray sandy clay with sand seams and pockets and sandstone nodules	3-4-6 6-8-13 4-6-11		
10.5–18.5	Tan silty fine sand -with sandy clay seams and pockets to 13'	8-14-15 8-17-16		
18.5–23.5	Stiff tan and light gray sandy clay	4-3-5		
23.5–38.5	Tan silty fine sand -gray below 32'	9-25-42 10-5-3 9-11-19		
38.5–43	Hard gray clay with sand seams and pockets			3.5
43–45	Gray silty fine sand	8-14-38		

COMPLETION DEPTH: 45'
DATE: May 1, 1973

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

McCLELLAND ENGINEERS

PLATE 30

Form 108-5 (57) Job No. 23-080

LOG OF BORING NO. P-38

WELSH POWER PLANT
CASON, TEXAS

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

LOCATION: See Plate 1

SURF. EL: 328.7'

DEPTH, FT	SYMBOL	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / WATER CONTENT, %	ELEVATION, FT
	J1, UD1	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'	6/10/12			
20	J6, UP1	Stiff Gray Clay - laminated with silt below 20'	18/15/22			
25	J7, J8	- Light Gray sandy silt seam @ 26	8/10/15			
30	J9, UP2		10/14/17			
35	J10	Gray Silty Fine Sand	29/37/60-2"			
	J11		24/34/60-2"			
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)

PRELIMINARY
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Form 108-5 (57) Job No. 73-086

LOG OF BORING NO. P-38 (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 – 1.4); PLASTIC LIMIT, WATER CONTENT, %, LIQUID LIMIT (10 – 70)	ELEVATION, FT
			Hard Gray Sandy Clay				
55				27/39/63-3"			
60				30/45/60-5"			
			-w/lignite layer 63.5'-64.5'				
65			-w/scattered lignite seams, 64.5-67'				
70				27/40-3"			
75				40-6"			
80			-w/clay and sand seams below 79'	40-6"			
				40-4"			
85			Gray Sandy Silt				
			-w/clay seams below 84'				
90				40-5"			
95				40-3"			
100				50/4.5"			

COMPLETION DEPTH: 100'
DATE: July 30, 1973

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

PRELIMINARY
McCLELLAND ENGINEERS

McCLELLAND ENGINEERS

PLATE 3/9

Form 108-5 (57) Job No. [illegible]

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

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 348.6'	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
	UP1		Stiff Red & TAN Sandy Clay				
5	J1		Red Sandy Silt w/clay pockets, 5' to 8'	22/24/39			
	J2			22/24/55			
10	J3			19/31/31			
			- TAN below 13'				
15	J4		- w/gravel, 17'-17.5'	30/37/30			
20	J5		- w/Brown clay seams below 20'	7/14/20			
	J6		Stiff Brown & Light Gray clay w/sandy silt seams				
25	UP2		TAN & Light Gray Silty Fine Sand	7/8/14			
30	J7		- TAN 28.5'-33.5' - w/sandstone Nodules below 28.5	48/60-5"			
35	J8		- TAN & Red 33.5-45 w/Lignite layer, 36' to 36.5'	30/60-6"			
40	J9			14/19/30			
45	J10		- Light Gray below 45	18/21/24			
50	J11		Hard Gray Clay w/sand streaks @50	25/29/60			
			(Continued on next page)				

PRELIMINARY
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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 (0.2–1.4); PLASTIC LIMIT, WATER CONTENT, %, LIQUID LIMIT (10–70)	ELEVATION, FT
	J12		Hard gray Clay				
55	J13		- laminated w/silt, 55' to 70'	30/34/60			
	J14B		-w/silt stone Nodules, 54.5-56				
60	J14A					1.35+	
	J14						
65	J15			27/40-3			
70	J16			24/40-6"			
75				41/5-5"			
80							
85							
90							
95							
100							

PRELIMINARY
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COMPLETION DEPTH: 75'
DATE: July 27, 1973

DEPTH TO WATER IN BORING:
DATE:

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Form 108-5 (57) Job No. 73-085

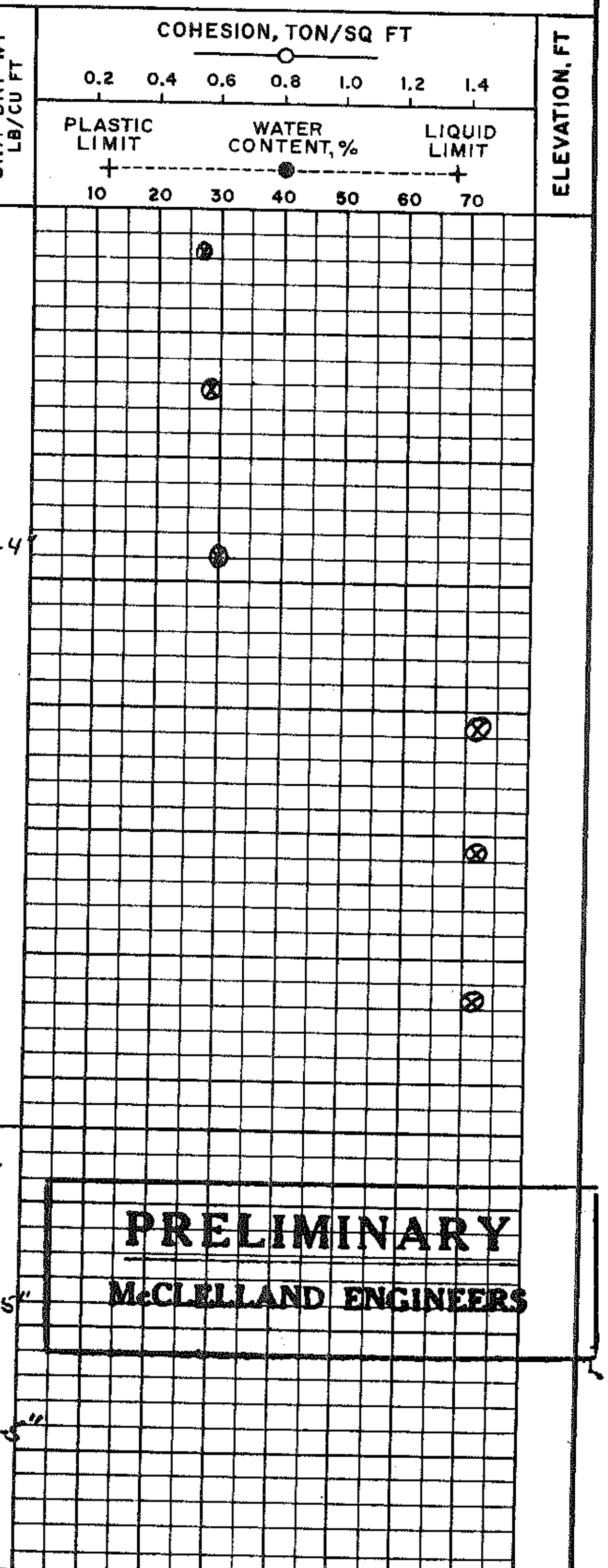
LOG OF BORING NO. P-40

Welsh Power Plant
Cason, Texas

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

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	DESCRIPTION OF MATERIAL (SURF. EL: 341.9')	BLOWS PER FT	UNIT DRY WT LB/CU FT
	UP1	Stiff Light Gray & Red Sandy Clay		
		-w/ferrous deposits 2'-3.5'		
5	J1	-w/ferrous seams 5'-14'	4/6/8	
		- light gray & tan 6.5'-20'		
	UP2			
10	J2	-w/sand seams and pockets below 10'	9/9/11	
	J3		23/28/60-4"	
15		-w/sand layer, 16'-16.5'		
20	J4, UP3	- Dark Gray below 20',	5/9/14	
		- w/organic matter 20.5'-22'		
		- Very Stiff below 21'		
25	J5, UP4		11/16/19	
30	J6, UP5		22/26/30	
35			42/60	
	J7	Gray Silty Fine Sand		
40		w/organic matter 39'-40'	27/60-5"	
45	J8		27/26/60-5"	
50	J9		28/26/60-5"	



PRELIMINARY
McCLELLAND ENGINEERS

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

DEPTH TO WATER IN BORING:

DATE:

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Form 108-5 (57) Job No. 73-085

LOG OF BORING NO. P-41

WELSH POWER PLANT
CASON, TEXAS

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

LOCATION: See Plate 1

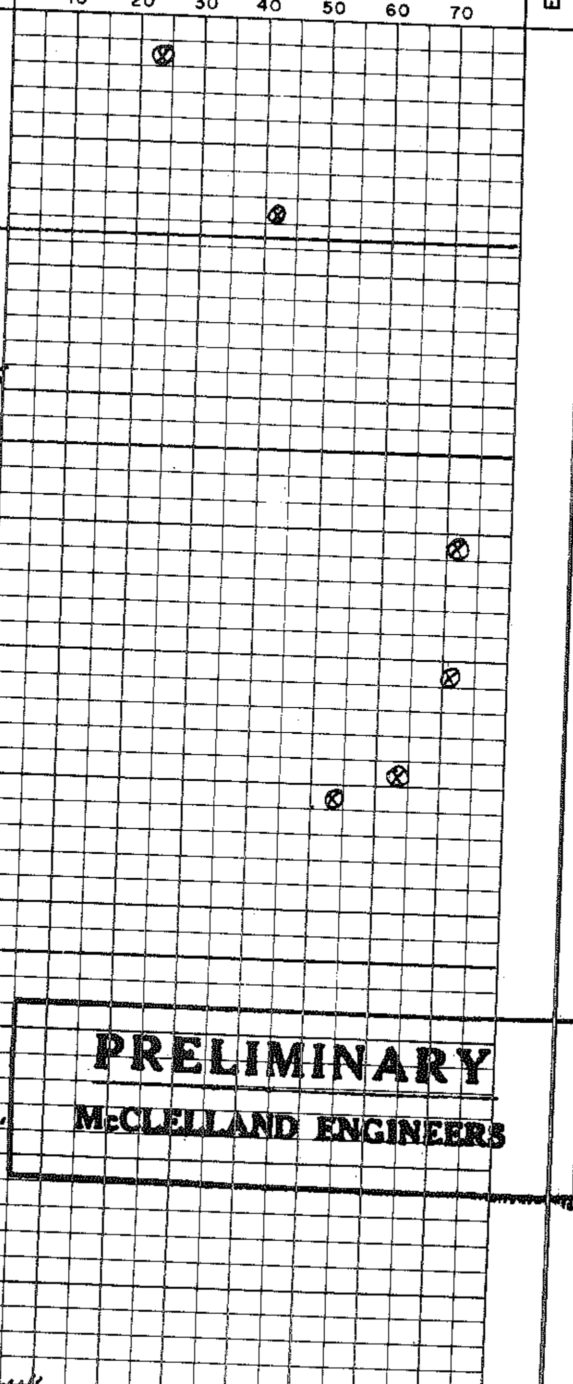
SURF. EL: 347.7'

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/ fervous 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	7/10/13	
	UP4	- w/ silt streaks, 17'-20'		
		- w/ fervous deposits, 20'-21.5'		
25	J5		10/12/12	
	UP5	- Dark Gray below 25'		
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



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

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

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PLATE 34

Form 108-5 (57) Job No.____

LOG OF BORING NO. P-42

WELSH POWER PLANT
CASON, TEXAS

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

LOCATION: See Plate 1

SURF. EL: 349.3'

DEPTH, FT	SYMBOL	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / WATER CONTENT, %	ELEVATION, FT
	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		1.35+	
	UP3	- Brown, 20'-34'				
25	J6	- w/SAND pockets below 25'	10/15/21		1.35+	
	UP4					
30	J7		12/14/17		1.35+	
	UP5					
35	J8	- dark gray w/ mica below 34'	23/40/60-5"			
40	J9	Dark Gray Clayey SAND to Very SANDY CLAY	25/35/60-5"			
45	J10	- w/ organic matter and mica	45/48/60-3"			
50	J11		35/60-5"			
	J12		15/40-5"			

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

PRELIMINARY
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COMPLETION DEPTH: 55'
DATE: July 30, 1973

DEPTH TO WATER IN BORING:

DATE:

McCLELLAND ENGINEERS

LOG OF BORING NO. P-43

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

LOCATION: See Plate 1

SURF. EL: 351.8'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
0	Firm Red & Light Sand Clay		
	- stiff below 3'		
5		3/3/9	
	- with ferrons deposits below 7.5'		
10	Very stiff tan & light gray clay	4/5/7	
15	- Brown & Light Gray, 13'-20'	9/11/15	
	- w/silt seams, 15 - 19'		
	- w/ferrous deposit, 15'-20'		
20		11/16/23	
	- dark gray below 20'		
25	- w/ sand pockets below 20'	15/24/60-5"	
30	Light Gray Sandy Silt, w/ silty clay seams, 30'-36'	13/13/24	
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)

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
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Form 108-5 (57) Job No. 73-085

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
			Dark gray sandy silt				
55		⊠		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							

COMPLETION DEPTH: 75'
DATE: July 31, 1973

DEPTH TO WATER IN BORING:
DATE:

PRELIMINARY
McCLELLAND ENGINEERS

McCLELLAND ENGINEERS

PLATE 36a

Form 108-5 (57) 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

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (SURF. EL: 361.5')	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT – WATER CONTENT, % – LIQUID LIMIT (10–70)	ELEVATION, FT
			Stiff Tan & Red Sandy Clay				
5			-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' -w/ferrous nodules below 20	9/10/14			
25				11/23/39			
30							
35							
40							
45							
50							

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

Form 108-5 (57) Job No. 73085

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 (0.2–1.4) / PLASTIC LIMIT – WATER CONTENT, % – LIQUID LIMIT (10–70)	ELEVATION, FT
	UP1		Stiff red & light gray clay w/ sand pockets				
5	J1			5/7/9			
	UP2						
10	J2		Red Silty fine Sand -w/clay pockets	14/15/20			
15	J3, UP3		Very stiff Light gray clay -w/ ferrous nodules, 14'-18'	5/8/10		1.35+	
	J4		-shale layer, 16 - 16.5	2/8/12			
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

Form Job No. ?-85

LOG OF BORING NO. P-49

WELSH POWER PLANT
CASON, TEXAS

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

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 – 1.4); PLASTIC LIMIT – WATER CONTENT, % – LIQUID LIMIT (10 – 70)	ELEVATION, 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							

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

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PLATE 39

Form 1 Job No. 7_ 785

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

PLATE 40

Form 108-5 (57) 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 (SURF. EL:)	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
			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 41

Form 108-5 (57) Job No. 23-085

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 108-5 (57) Job No. 73-085

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 SURF. EL: 337.5'	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
			TAN Silty Fine Sand			
5			Red & Light Gray Sandy Clay			
10 15			TAN & Red & Light Gray Clay w/Ferrous deposits w/si seams 10-16 - 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:

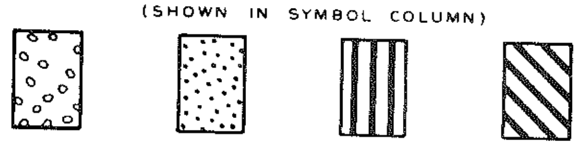
McCLELLAND ENGINEERS

PLATE 43

SYMBOLS AND TERMS USED ON BORING LOGS

SOIL TYPES

(SHOWN IN SYMBOL COLUMN)

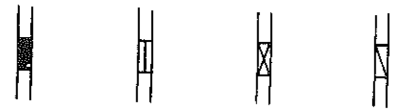


Gravel Sand Silt Clay

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.

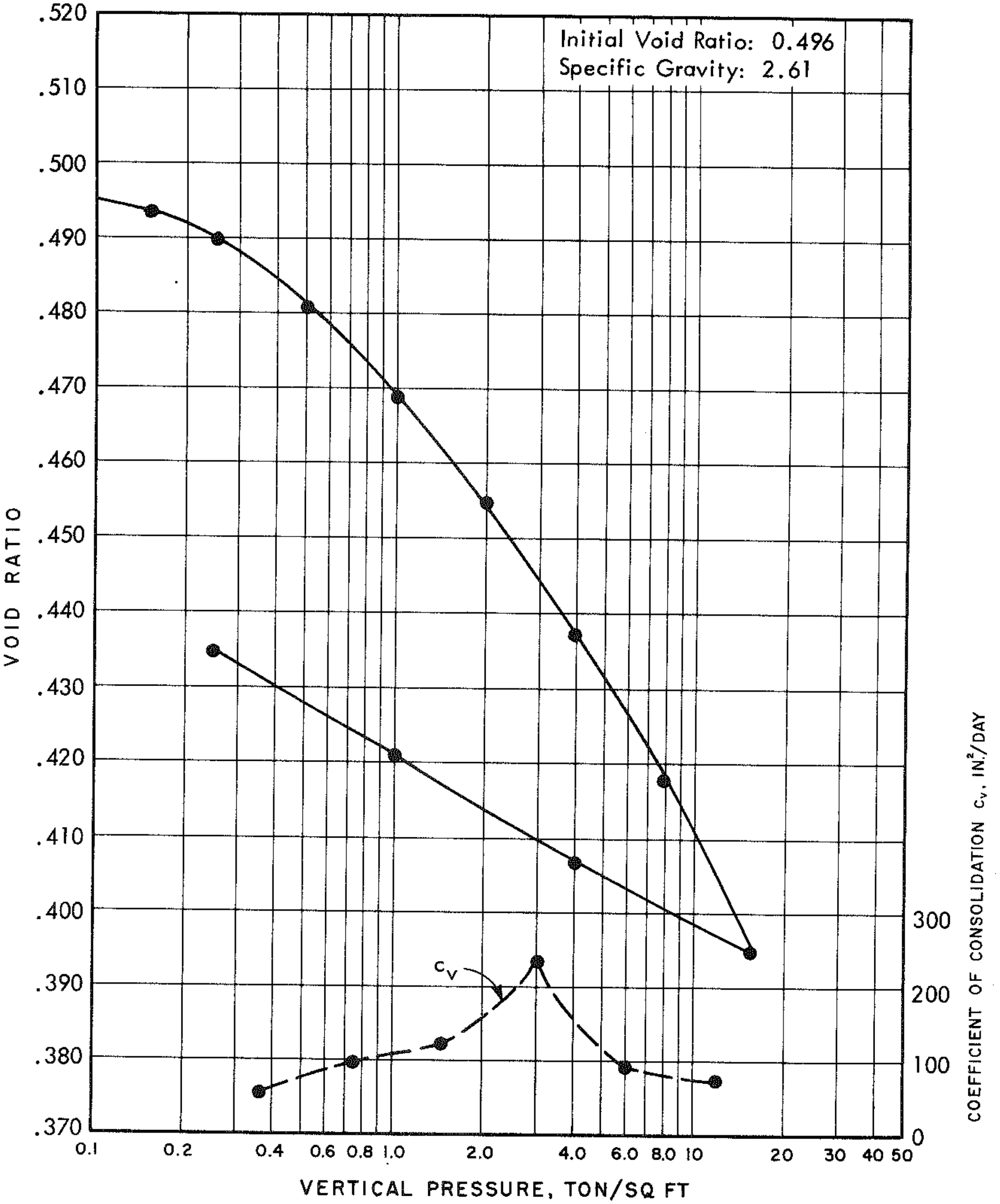
Poorly graded – predominantly of one grain size, or having a range of sizes with some intermediate size missing.

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.

McCLELLAND ENGINEERS

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

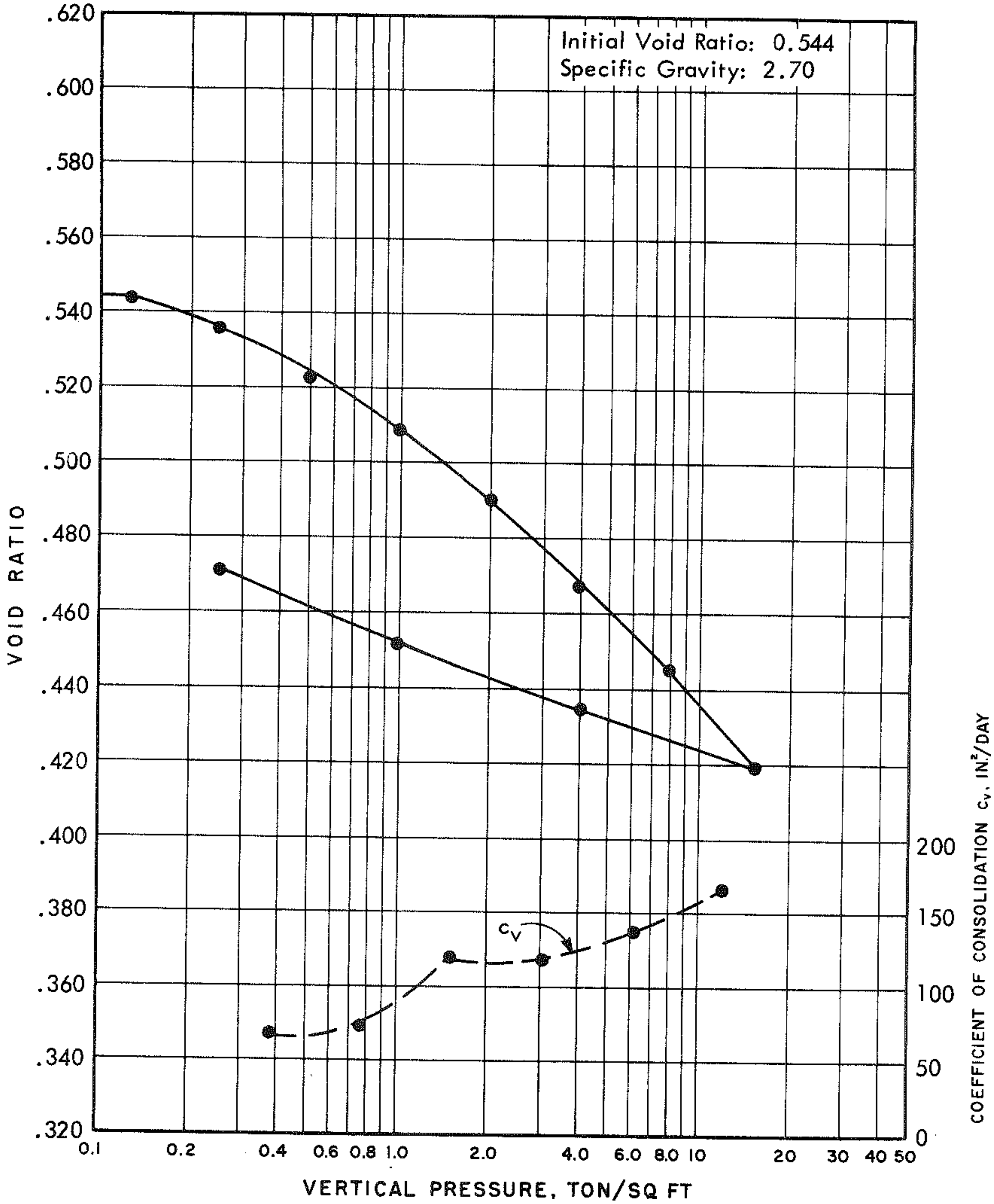
McCLELLAND ENGINEERS

PLATE 45

Form 06-3 57 Job No 23-086

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

Form 0613 57 Job No 73-085

BORING: P-4 DEPTH: 6'

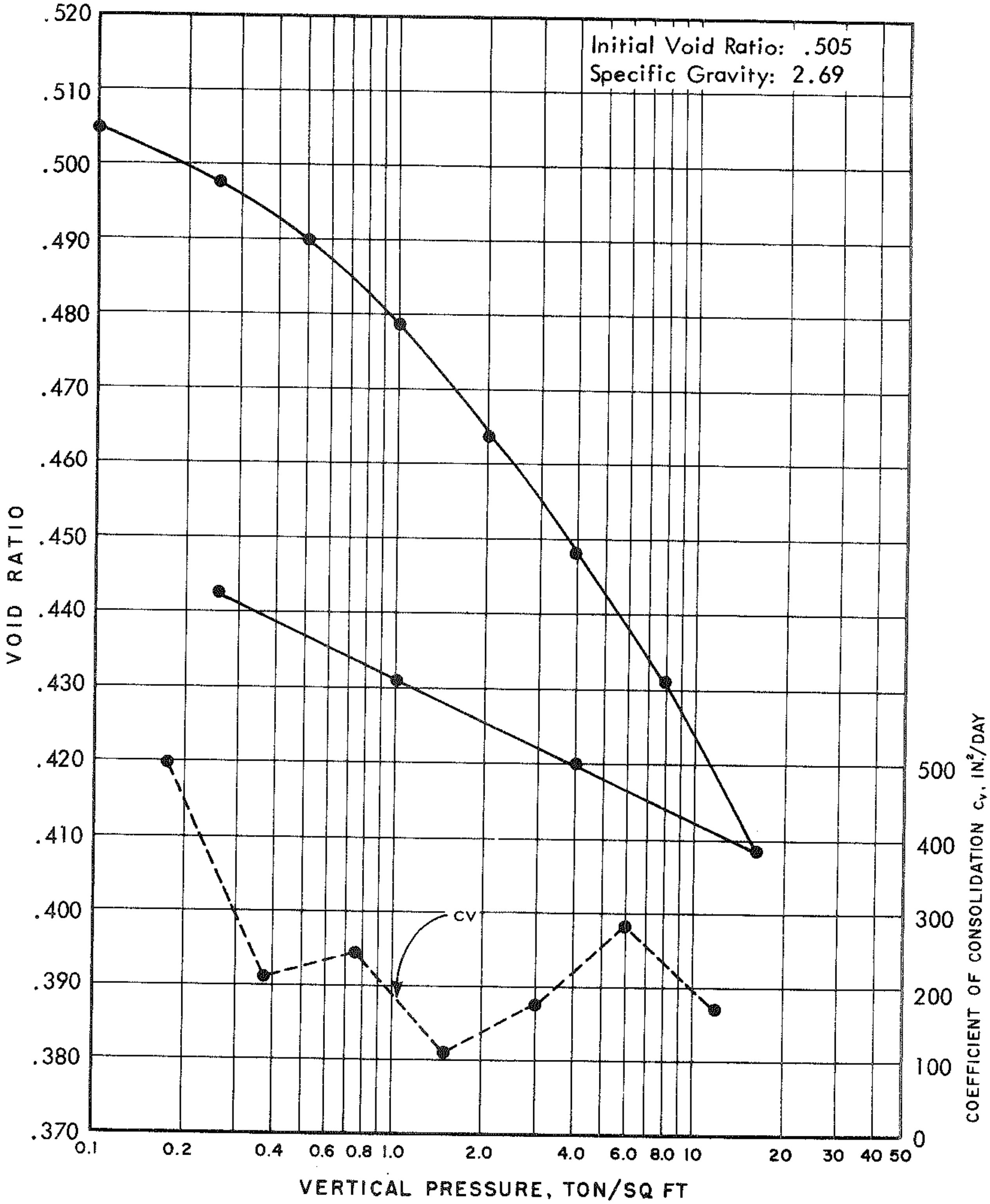
MATERIAL: Stiff red and tan very sandy clay

UNIT DRY WEIGHT: 112 LB/CU FT

WATER CONTENT: 17 %

LIQUID LIMIT: 29

PLASTIC LIMIT: 18



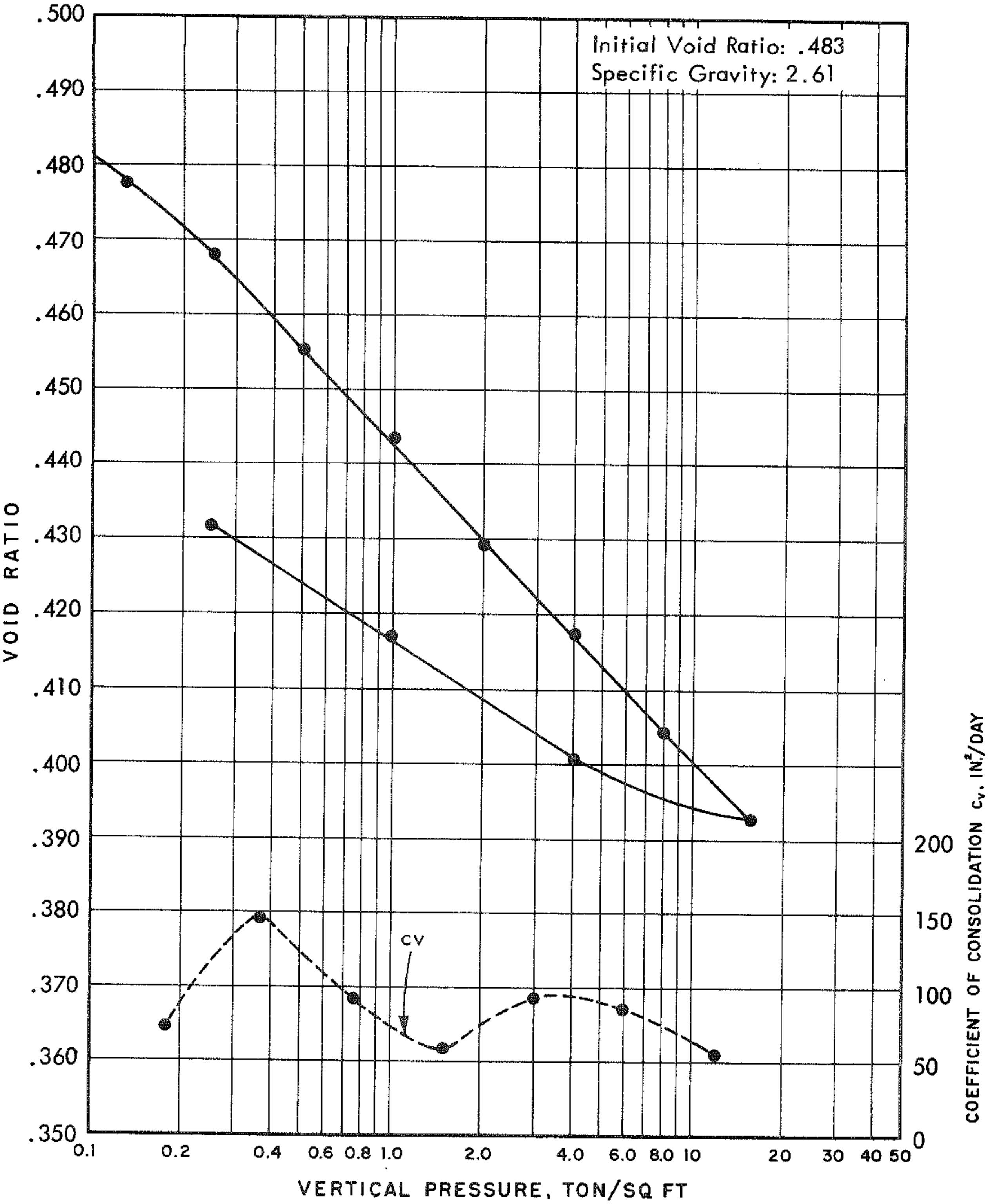
CONSOLIDATION TEST RESULTS

McCLELLAND ENGINEERS

Form 06-3 57 Job No. 73-085

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



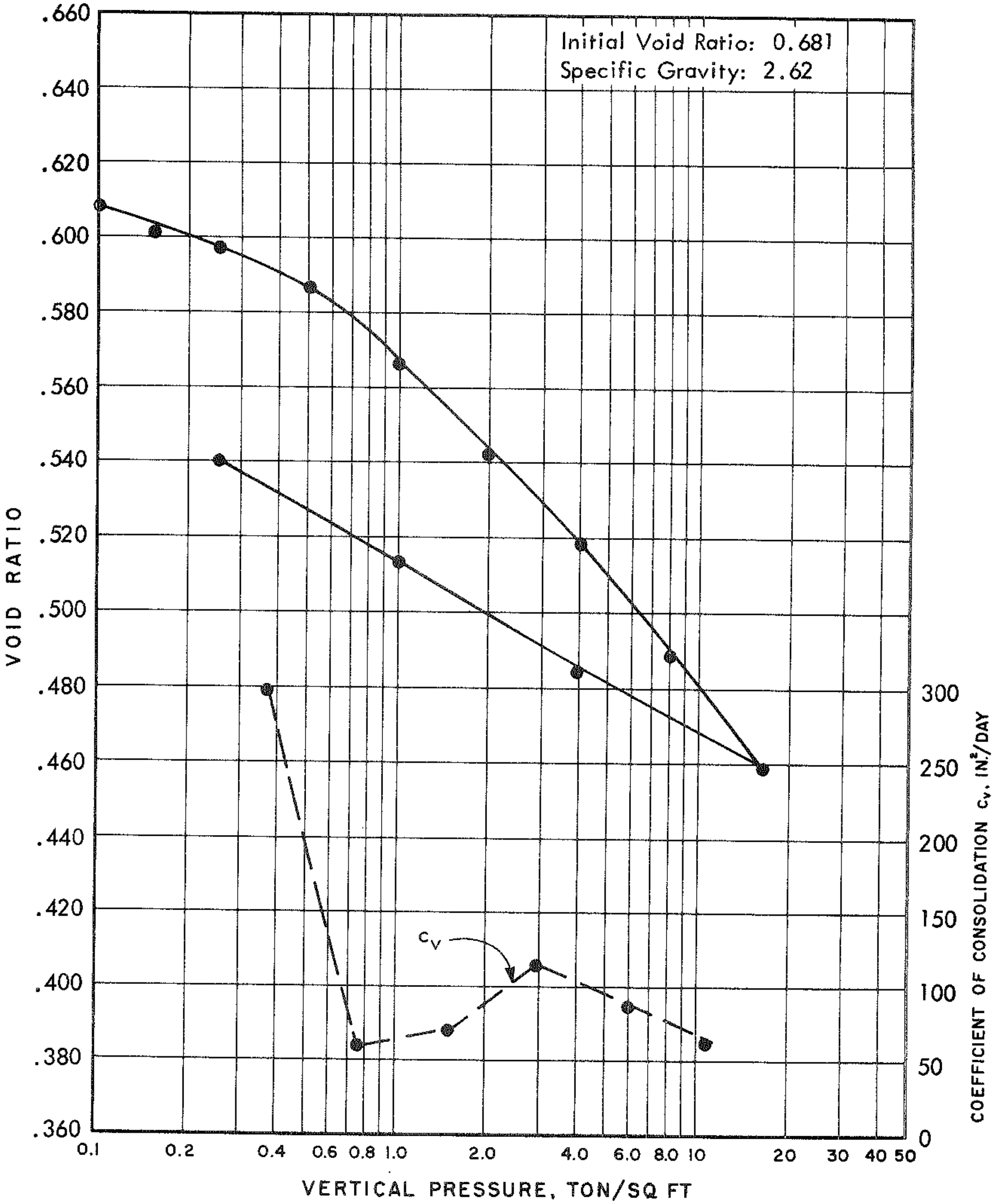
CONSOLIDATION TEST RESULTS

McCLELLAND ENGINEERS

Form 06-3 '57 Job No 73-085-

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'

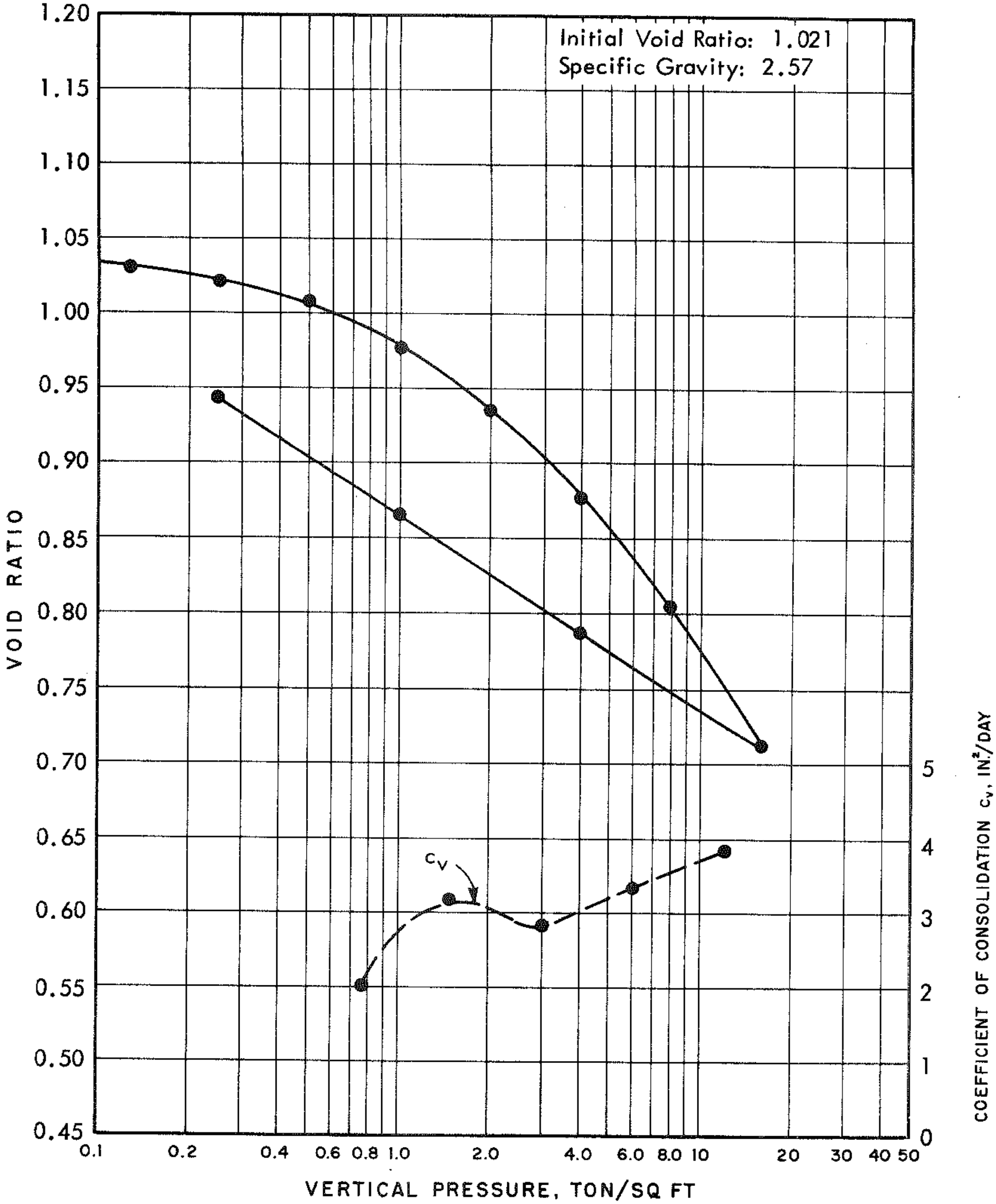
MATERIAL: Stiff light gray clay with sand pockets and ferrous nodules

UNIT DRY WEIGHT: 91 LB/CU FT

WATER CONTENT: 34 %

LIQUID LIMIT: 52

PLASTIC LIMIT: 18



CONSOLIDATION TEST RESULTS

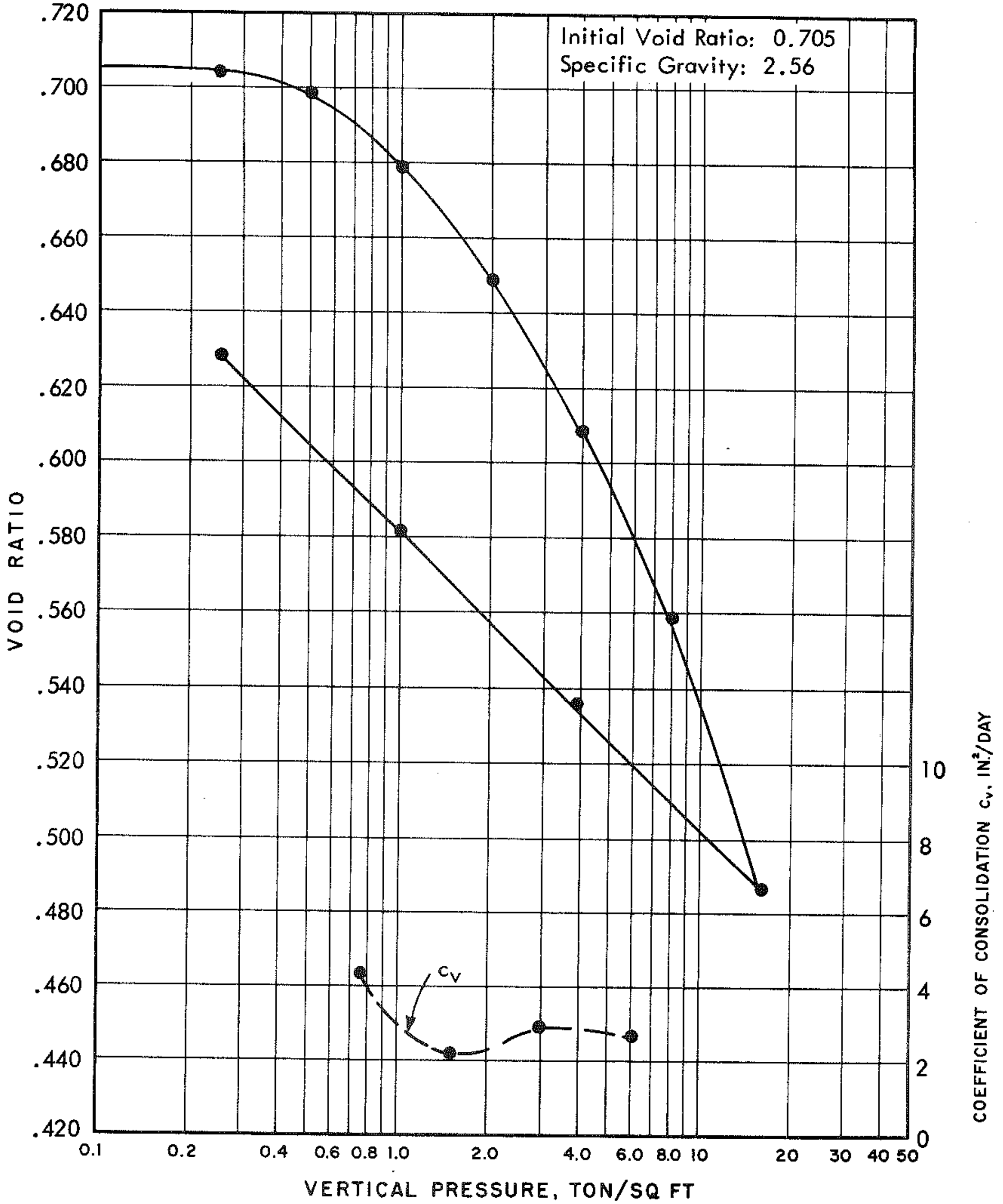
McCLELLAND ENGINEERS

Form 26 3 57 Job No. 73-085

Form 06-3 57 Job No. 23-085

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



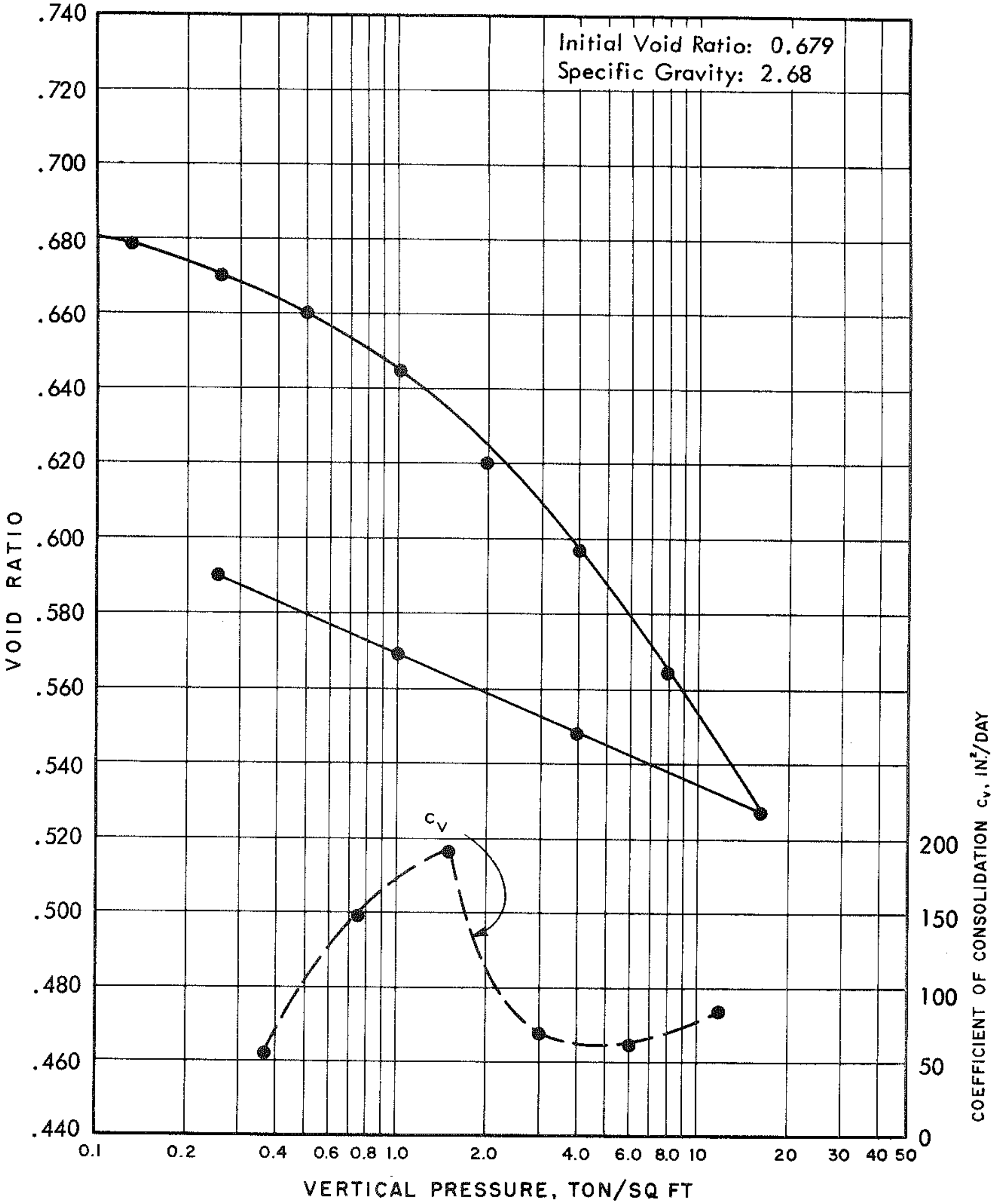
CONSOLIDATION TEST RESULTS

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

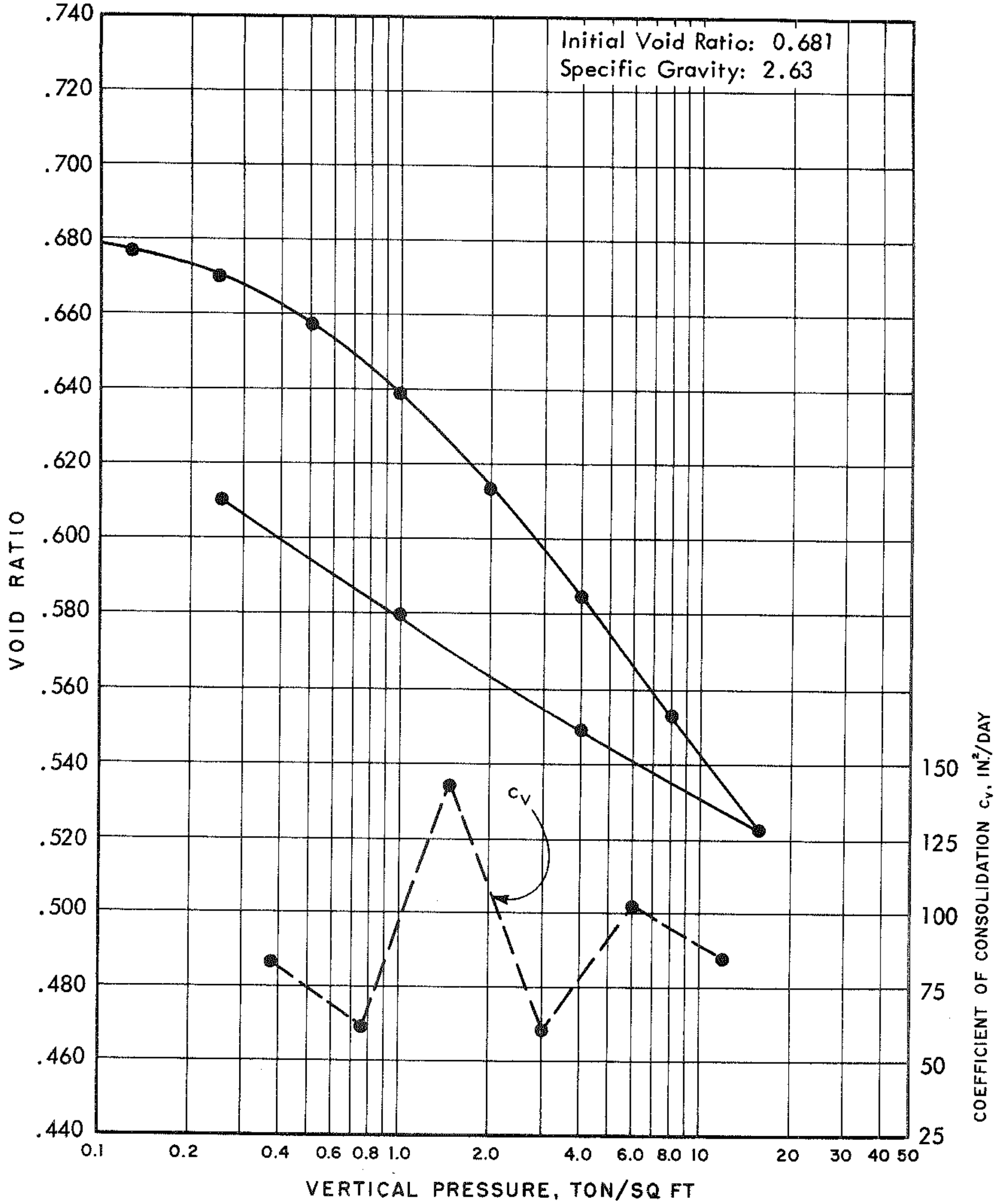
McCLELLAND ENGINEERS

Form 56-3 57 Job No. 73045

Form 06-3 57 Job No. 73085

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

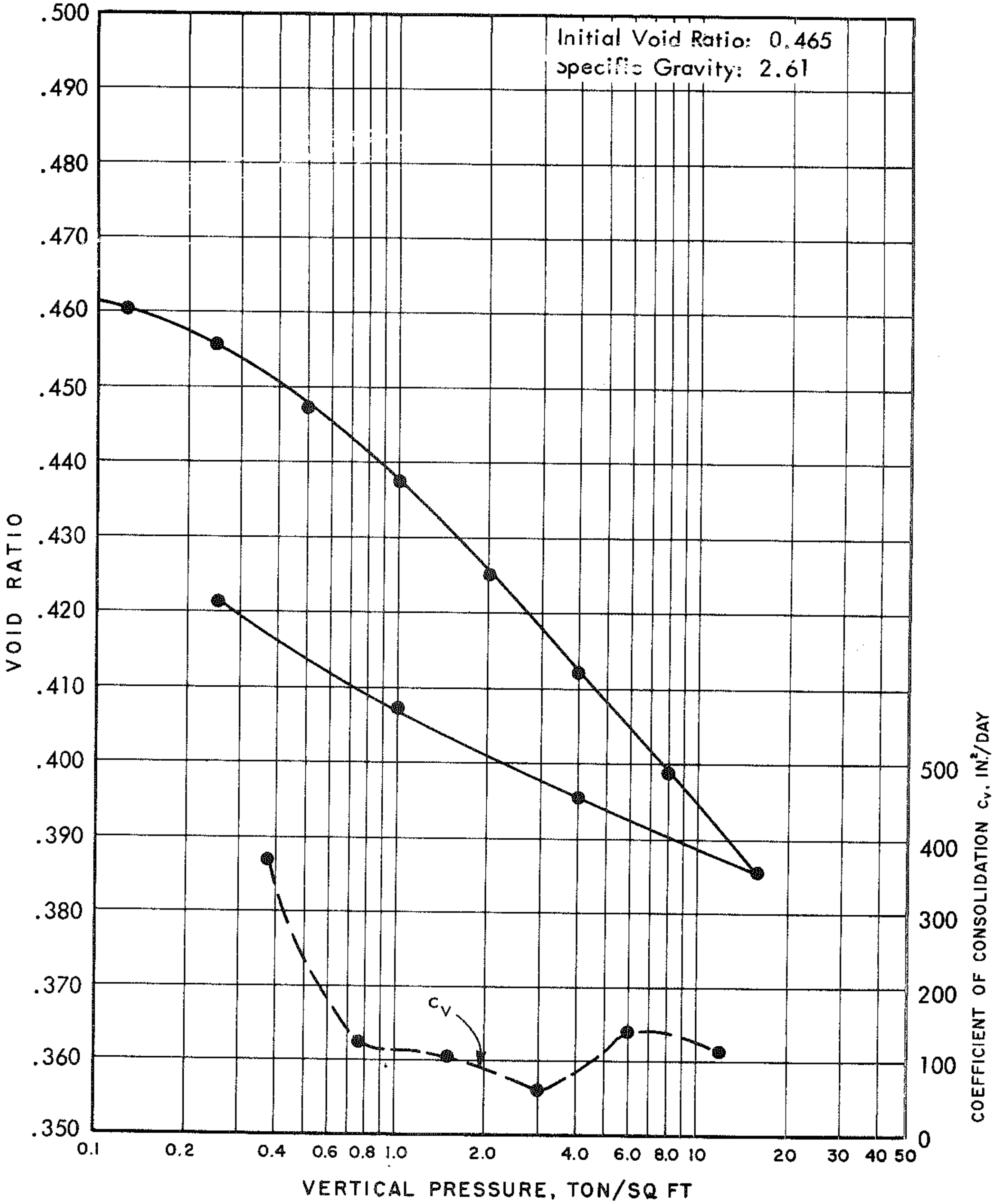
McCLELLAND ENGINEERS

PLATE 53

Form C5 3 57 Job No 73-085

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

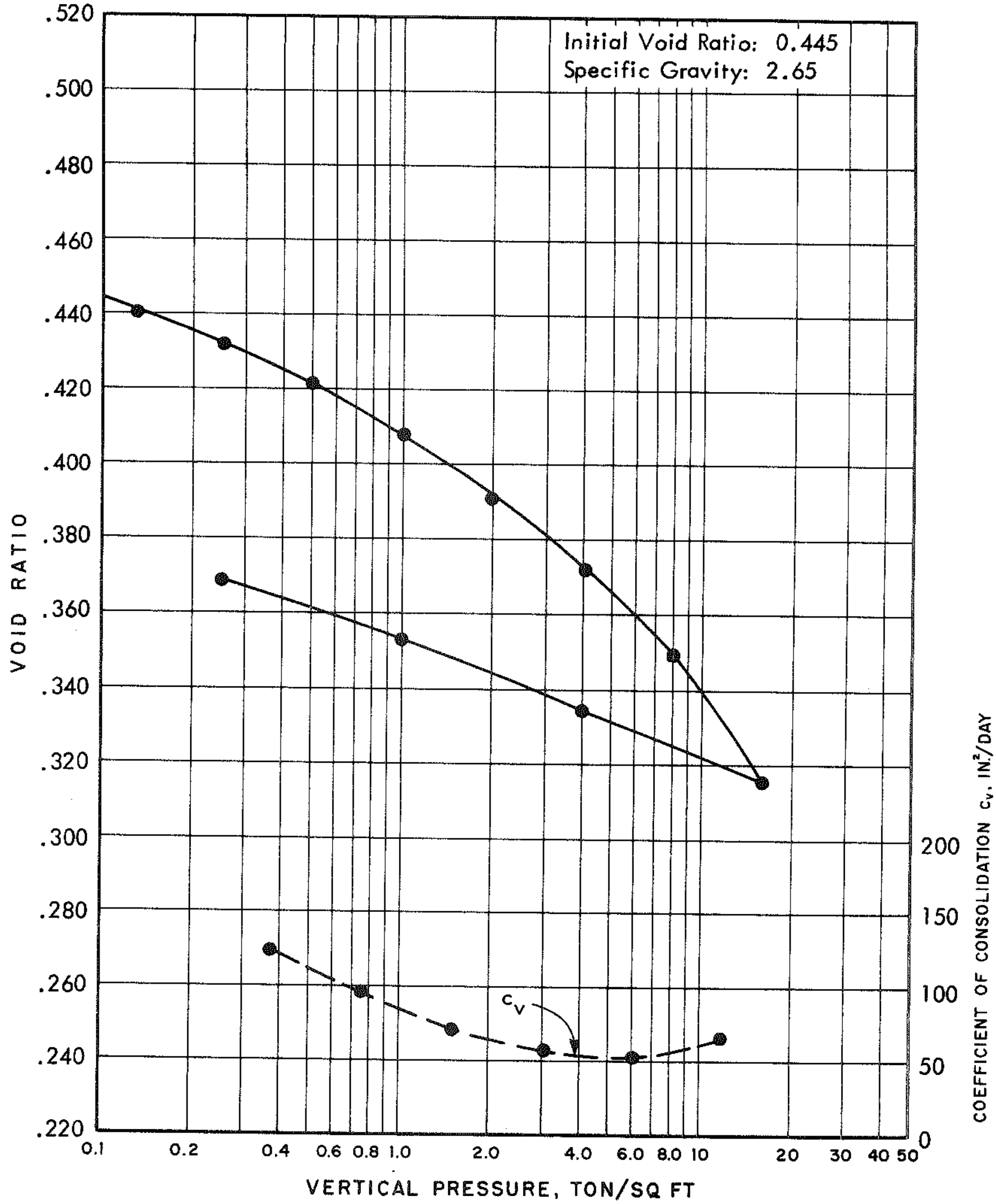


CONSOLIDATION TEST RESULTS

McCLELLAND ENGINEERS

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



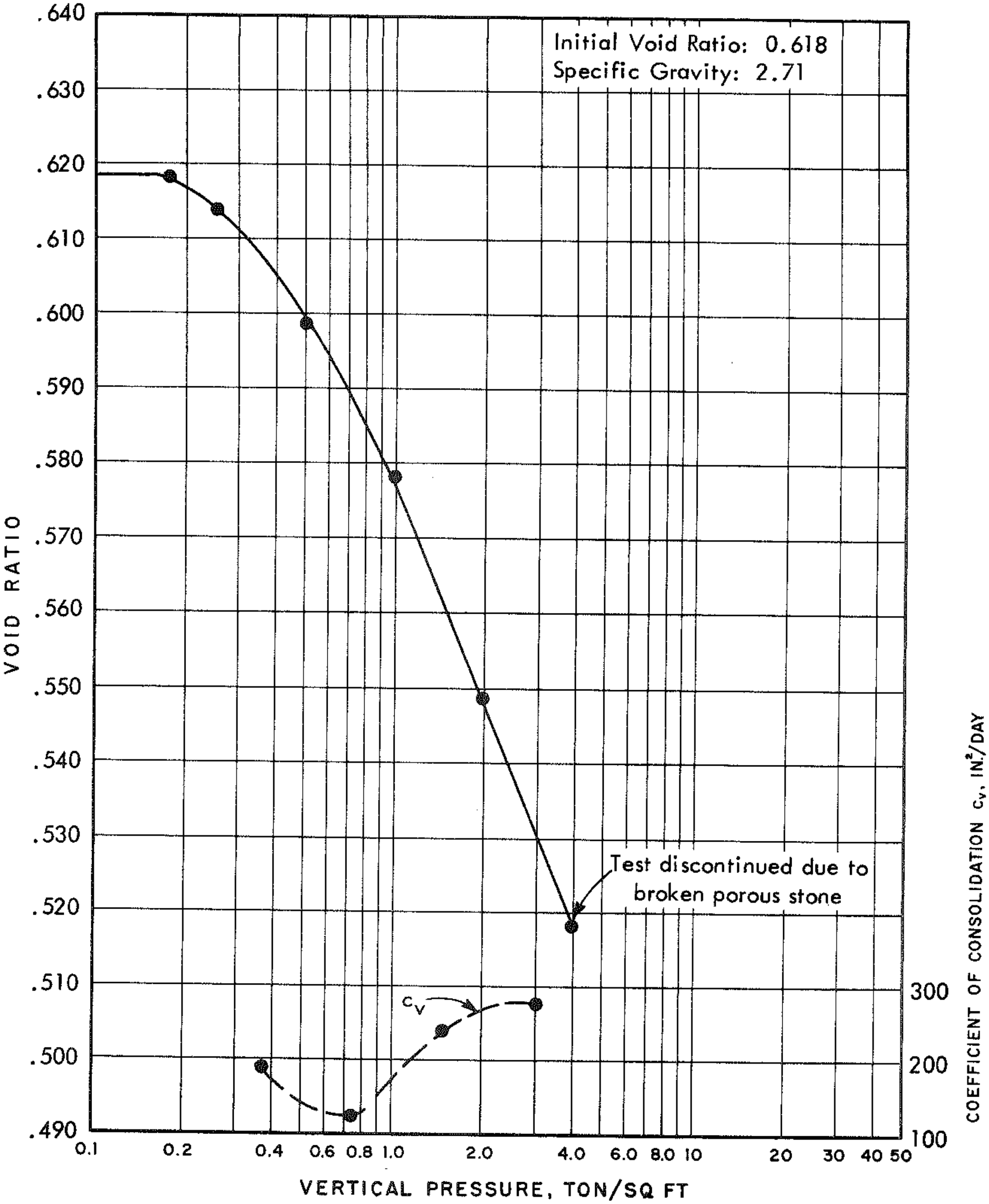
CONSOLIDATION TEST RESULTS

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



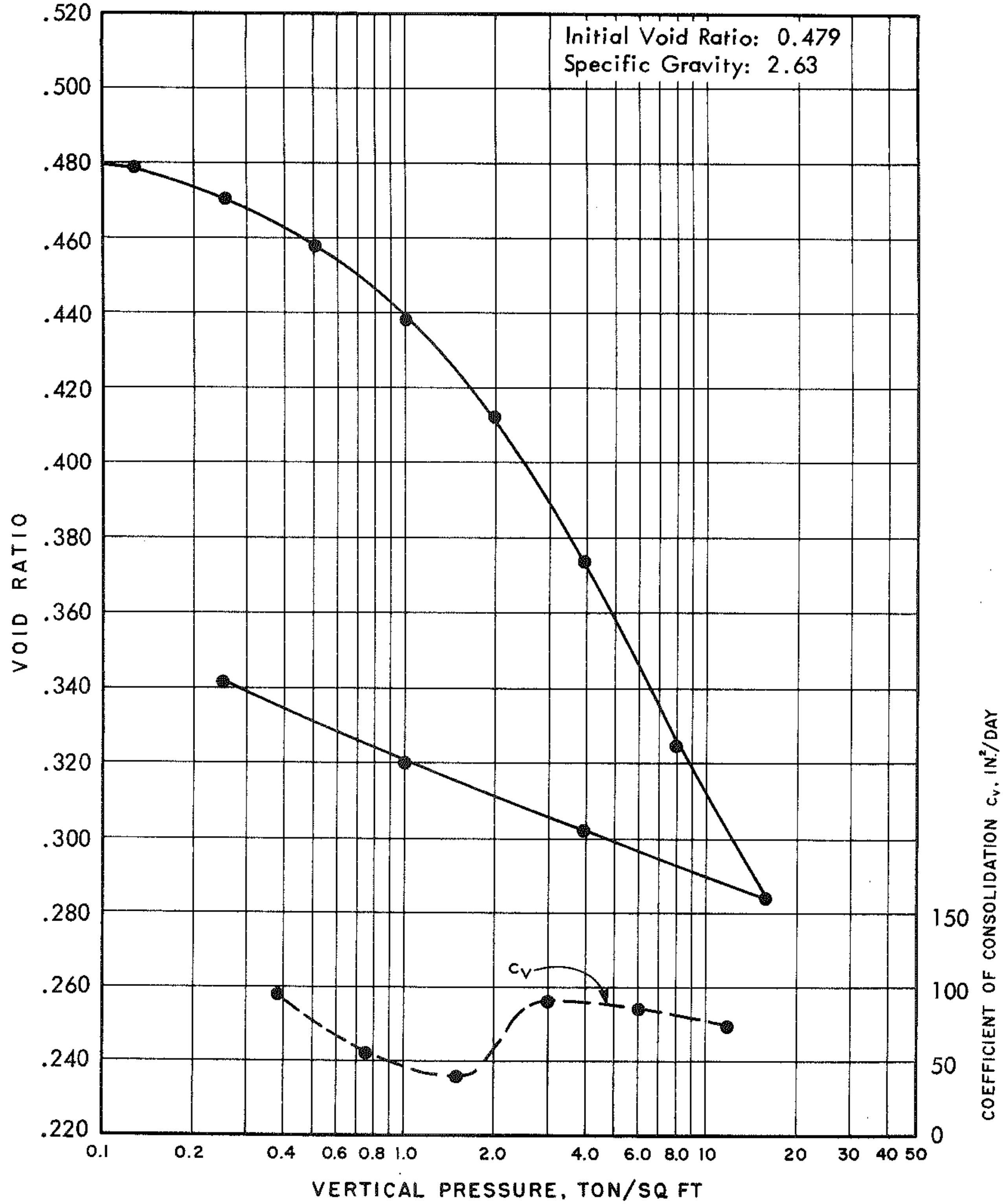
CONSOLIDATION TEST RESULTS

McCLELLAND ENGINEERS

Job No. 73-085

BORING: P-35 DEPTH: 39'
MATERIAL: Hard gray sandy clay with sand pockets

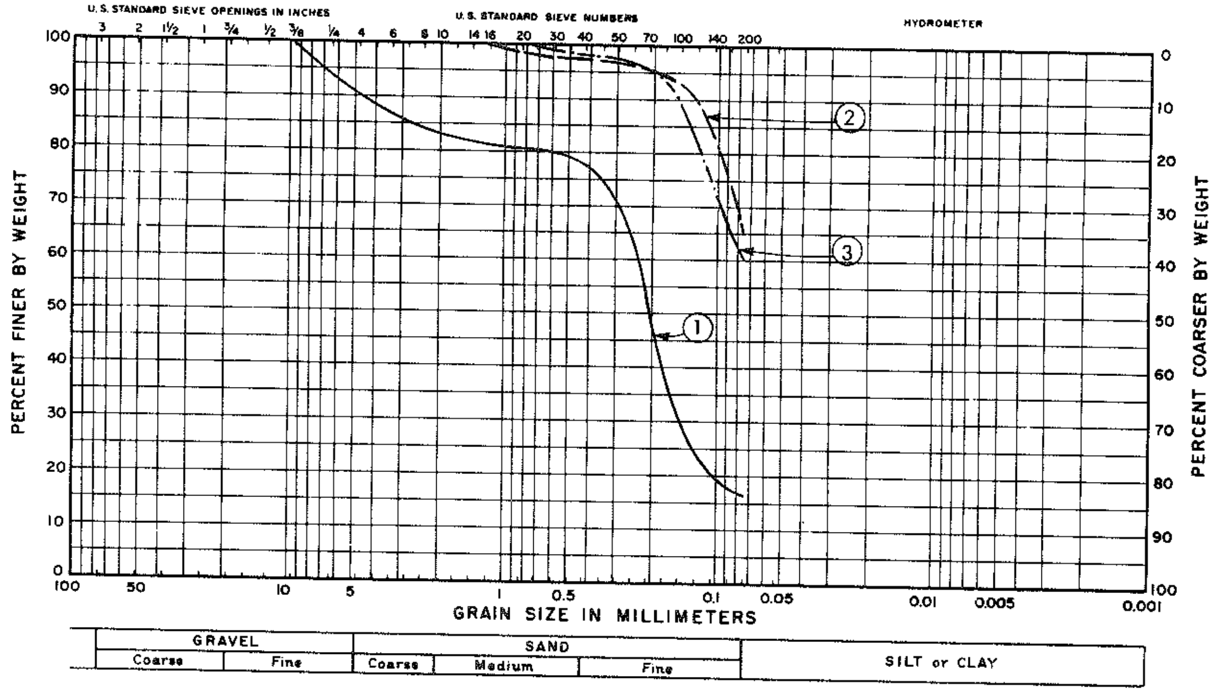
UNIT DRY WEIGHT: 111 LB/CU FT
WATER CONTENT: 18 %
LIQUID LIMIT: 25
PLASTIC LIMIT: 16



CONSOLIDATION TEST RESULTS

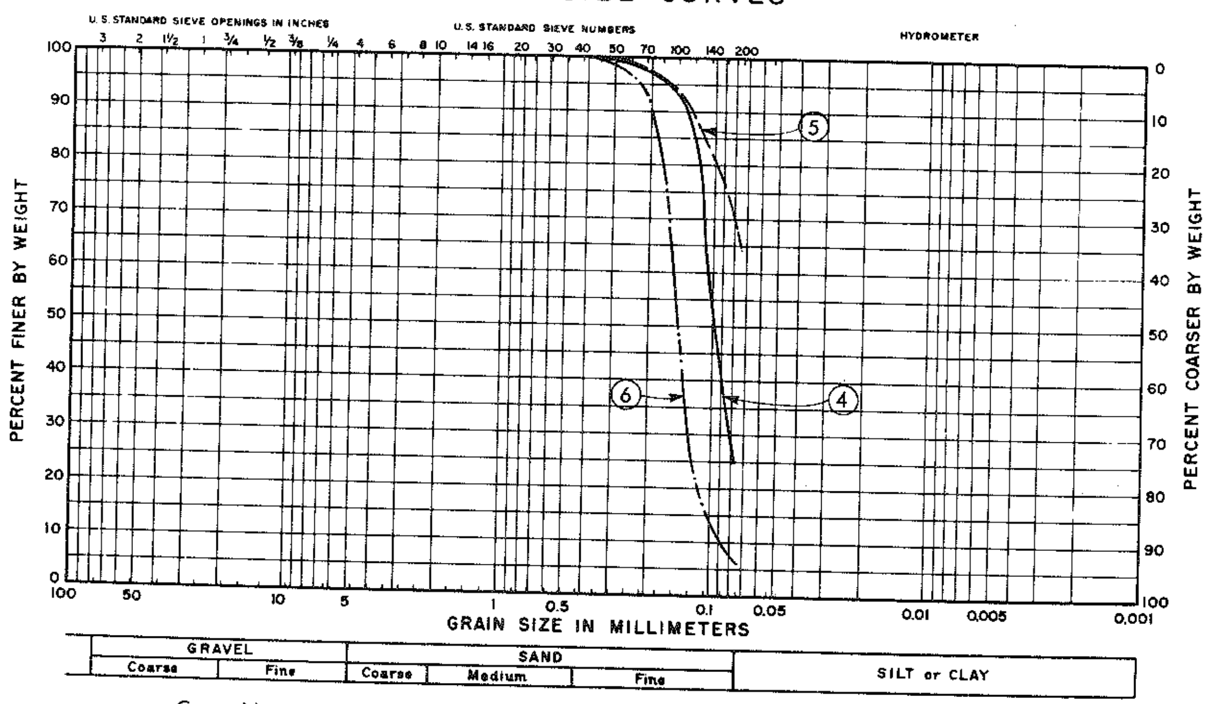
McCLELLAND ENGINEERS

GRAIN SIZE CURVES



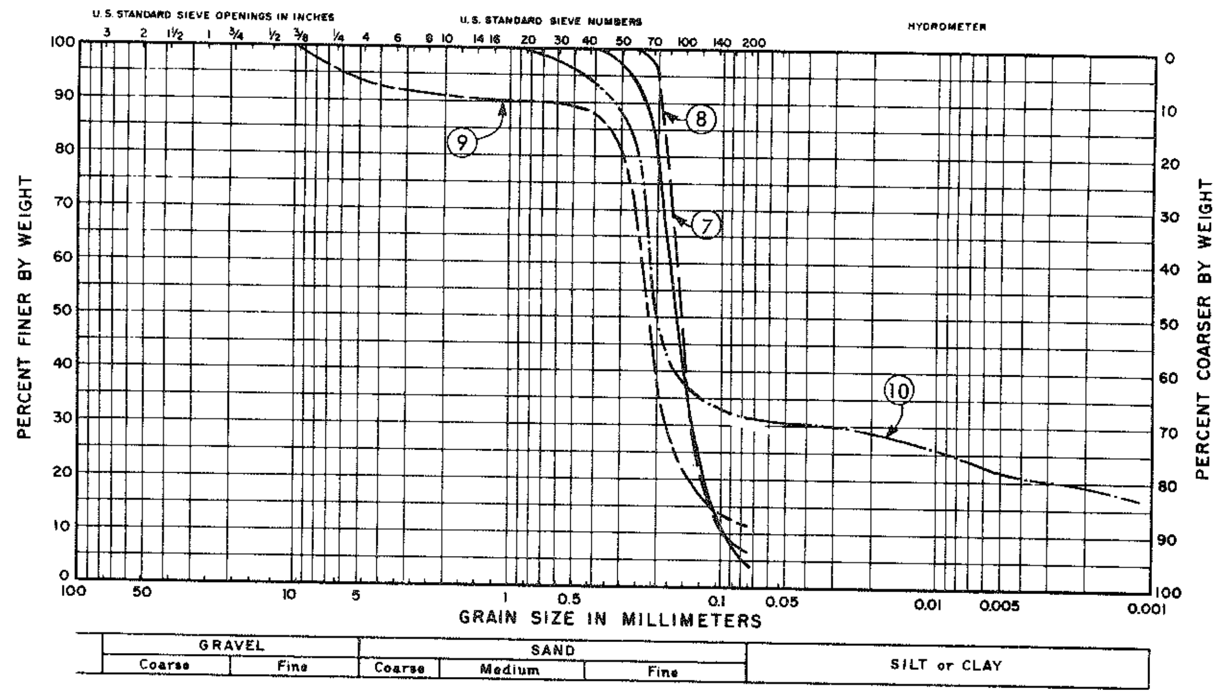
Curve No.	Boring No.	Depth, Ft.	Material
1	P- 1	15	Red silty fine sand with sandstone nodules
2	P- 1	50	Hard brown and gray clay with sand pockets
3	P-23	15	Red and tan sandy clay

GRAIN SIZE CURVES



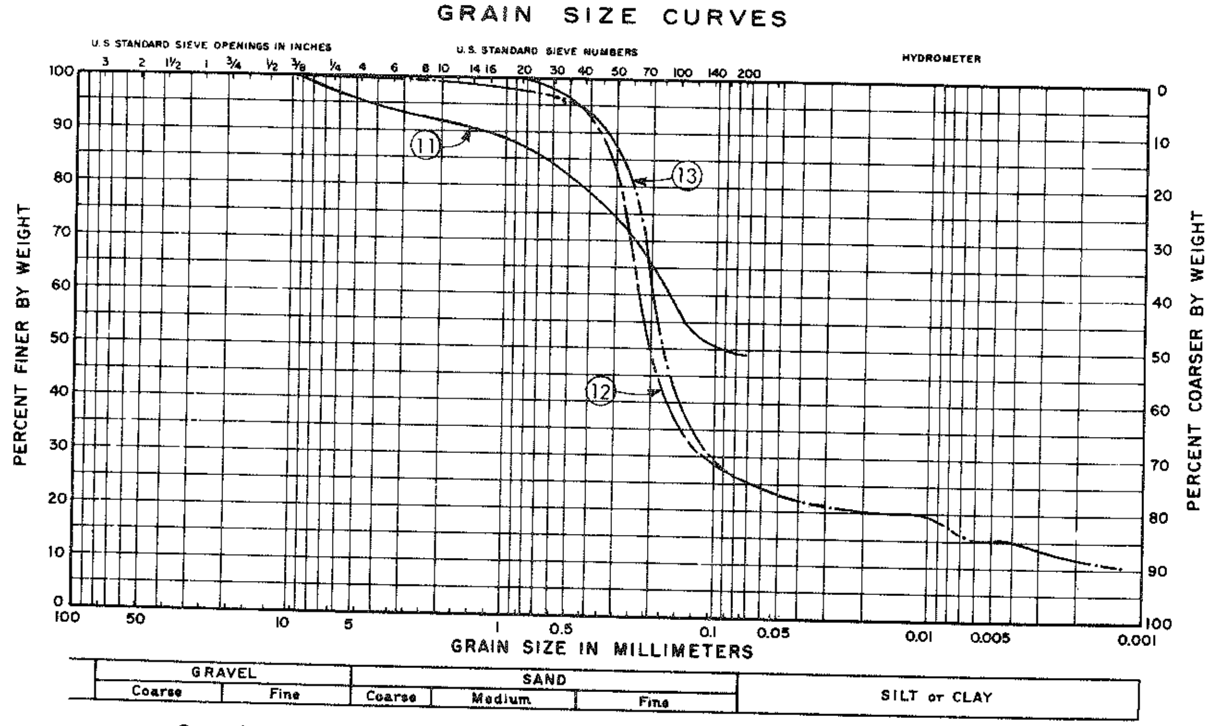
Curve No.	Boring No.	Depth, Ft.	Material
4	P-23	20	Gray silty fine sand
5	P-26	8	Red and tan sandy clay
6	P-26	30	Tan fine sand

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

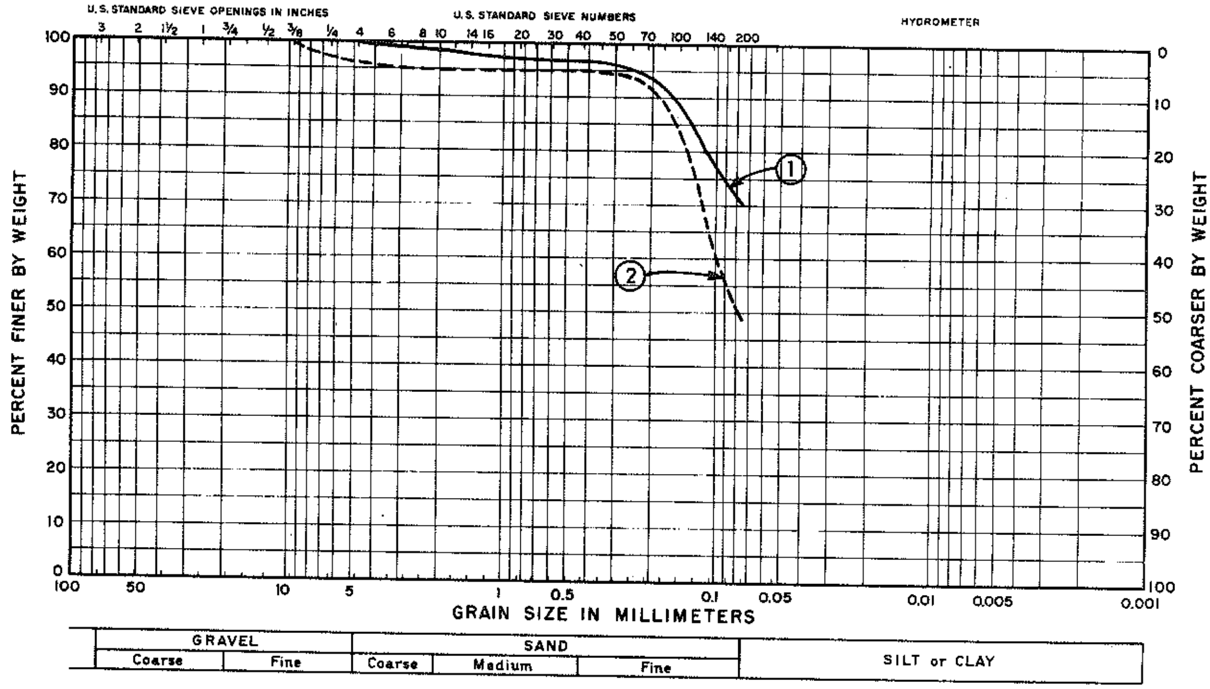


Curve No.	Boring No.	Depth, Ft.	Material
11	P-34	45	Gray sandy clay
12	P-35	20	Tan silty fine sand
13	P-36	30	Red and tan silty fine sand

McCLELLAND ENGINEERS

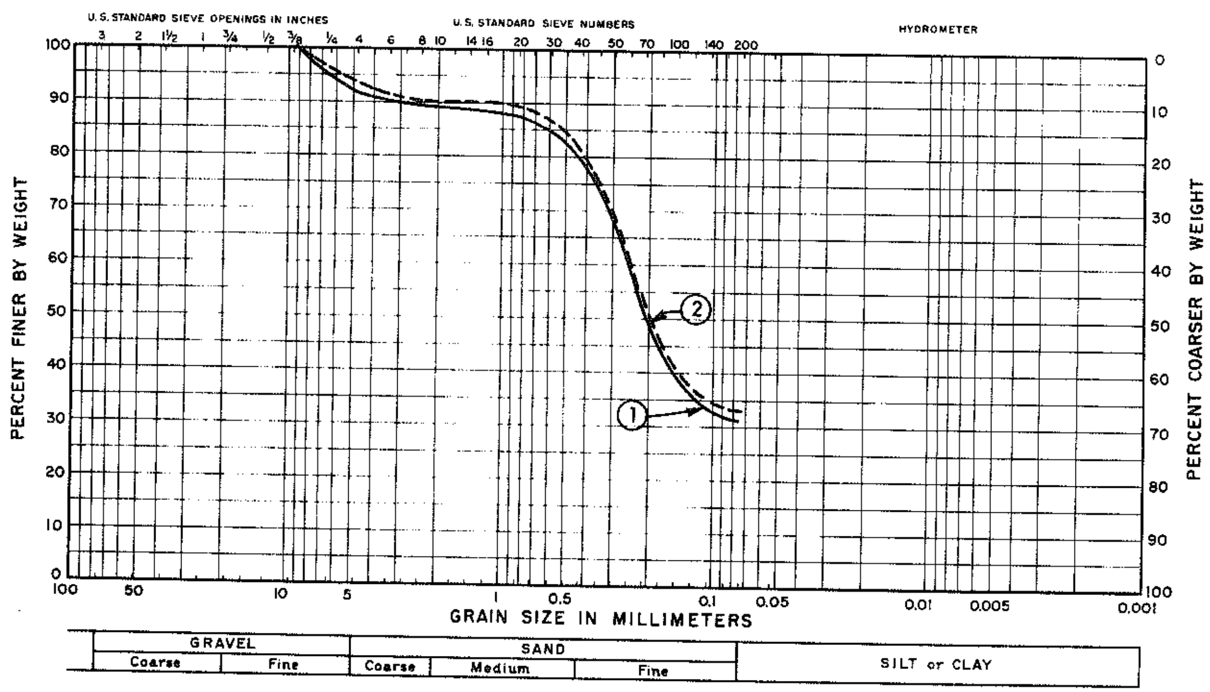
PLATE 59

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

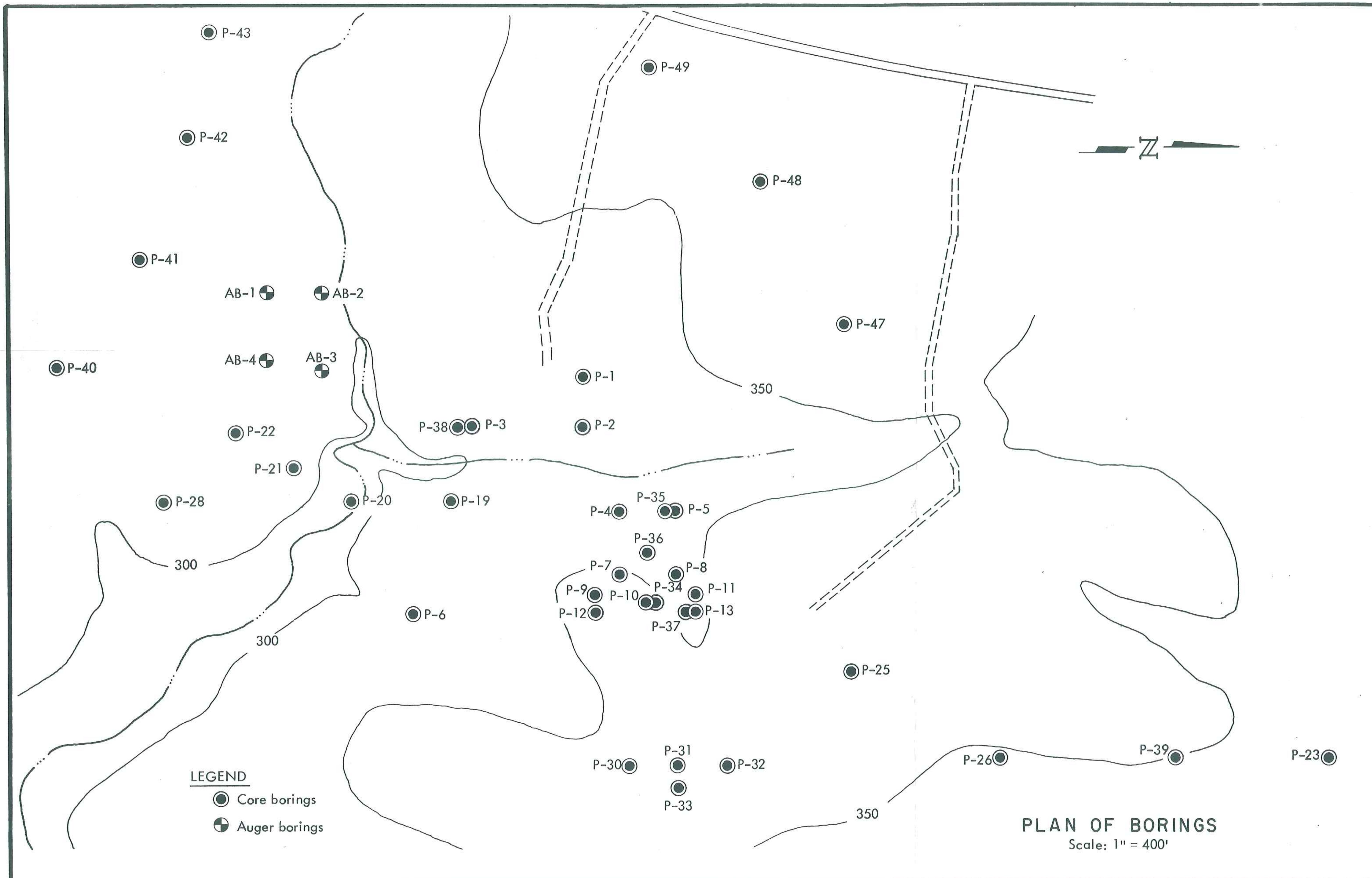
PRELIMINARY REPORT

SOILS INVESTIGATION
WELSH POWER PLANT
CASON, TEXAS

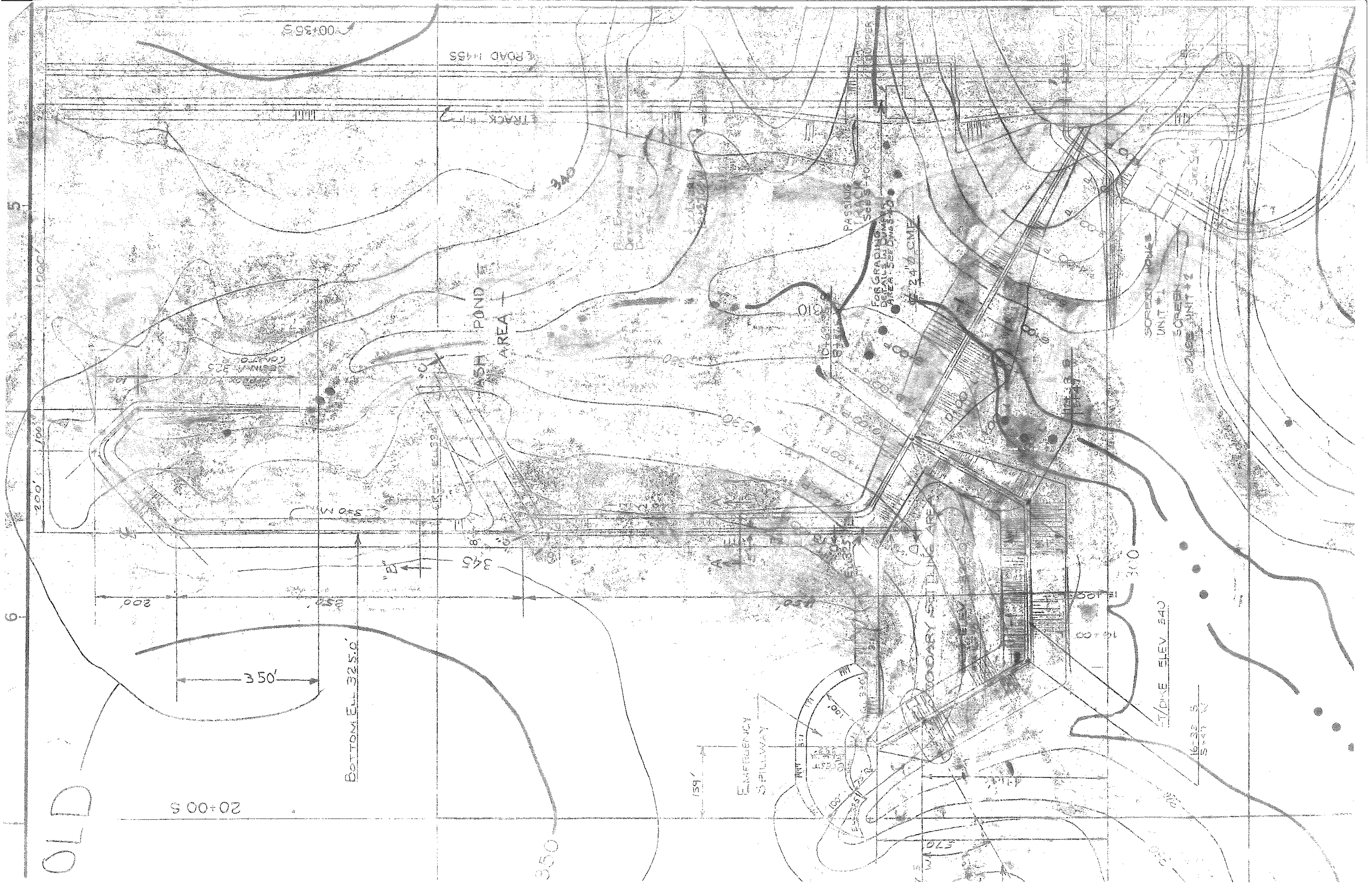
Report to

SOUTHWESTERN ELECTRIC POWER COMPANY
Shreveport, Louisiana

McClelland engineers, inc.
geotechnical consultants



PLAN OF BORINGS
Scale: 1" = 400'



ASH POND AREA
BOTTOM EL 325.0'
350'
EMERGENCY SPILLWAY
T/DIKE ELEV 340
SCREEN HOUSE UNIT #1
SCREEN HOUSE UNIT #2
PASSING TRACK
24" Ø CMP
20+00 S
350
345
340
330
310
300

SOUTHWESTERN ELECTRIC POWER COMPANY

Shreveport, Louisiana

This agreement made this 27th day of August, 1973, by and between Austin Building Company, (hereinafter called the "Contractor"), Dallas, Texas, and Southwestern Electric Power Company, (hereinafter called the "Owner").

WITNESSETH:

(1) This contract is to be performed by Austin Building Company (Contractor), within the State of Texas, and the parties hereto covenant and agree that it is and shall be construed as a Texas Contract, in accordance with the laws of the State of Texas, and the parties hereto shall have all the rights, privileges, remedies and immunities applicable under the laws of said State.

(2) Contractor agrees to complete plant site grading, railroad bed construction, ash pit dikes and related work, and excavation and embankment for Generating Plant area, as set forth in the Specification, at Owner's Welsh Power Plant site located in Titus County, approximately two (2) miles NW of Cason, Texas.

(3) Contractor agrees to do the work in accordance with the Specifications and Drawings attached hereto and made a part hereof. Any changes in the Specifications or Drawings will not be a part of this contract until ordered in writing by the Owner.

(4) Contractor agrees to furnish in good operating condition all construction equipment, tools and supplies necessary to complete the work in the time set forth in paragraph 6.

(5) Contractor covenants, represents, and warrants:

(a) That 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, have been fully met and observed in respect of the manufacture of the materials and equipment or the performance of services covered by this order;

(b) That 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;

(c) That it has caused or will seek to cause the inclusion in contracts with its subcontractors appropriate language requiring said subcontractors to take affirmative, appropriate action to insure compliance with the provisions and requirements set out in paragraph (a) hereof.

(6) Contractor agrees to begin the work within 10 days after this contract is signed and agrees to entirely complete the work in 150 calendar days after the contract is signed.

(7) Owner agrees to pay the Contractor an amount based on the unit prices set forth in the contract; unit prices are as set forth in Contractor's proposal attached hereto and marked EXHIBIT "A". Any work additional to this contract will be considered as an item of extra cost and handled in accordance with the provisions set forth in EXHIBIT "A". Payments will be made monthly as the work is completed, but the total of such payments on account shall at no time exceed ninety percent (90%) of the value of the work completed. Final ten percent (10%) shall be paid upon completion of work and acceptance by Owner.

(8) If Contractor should fail to perform the work, or to comply with the terms and conditions of this agreement and specifications, or should be judged a bankrupt, or make a general assignment for benefit of creditors or if a receiver be appointed for his business, the Owner may, without prejudice to any other right or remedy, and after giving Contractor ten days written notice, proceed to complete the work, and deduct the cost thereof from any monies due or which may become due to Contractor.

(9) It is distinctly understood and agreed the Contractor is an independent Contractor and is in no sense an agent or servant of Owner, the Contractor being responsible to the Owner only for results specified in the contract.

(10) At any time upon notice in writing to Contractor, Owner shall have the right to discontinue any or all work assigned to Contractor.

(11) No termination of a work assignment or of this agreement shall release the Contractor or Owner from any liability or obligation (whether of indemnity or otherwise) which may have attached or accrued previous to or which may be accruing at the time of such termination.

IN WITNESS WHEREOF: The said parties have hereunto subscribed their names in the presence of the undersigned witnesses.

Delba Barry
WITNESS

By: [illegible]

SOUTHWESTERN ELECTRIC POWER COMPANY
Title: Senior [illegible]
[illegible]

AUSTIN [illegible] & CO.

By: [illegible]
Executive Vice President

[illegible] CO.

Title:

ATTEST:

[illegible]

Approved [illegible]

AUSTIN BUILDING COMPANY
GENERAL CONTRACTORS

DALLAS, TEXAS 75221

EXHIBIT "A"
Page 1 of 10

PROPOSAL
Revised August 13, 1973

Southwestern Electric Power Company
P. O. Box 1106
Shreveport, Louisiana 71101

Re: Site Grading
Welsh Power Plant
Cason, Texas

Gentlemen:

We are pleased to submit herewith our proposal for site grading and related work in accordance with your plans and specifications for Welsh Power Plant near Cason, Texas.

We wish to clarify our proposal as follows:

1. We have not included cost of performance bond. If bond is required we would expect to be reimbursed for the premium cost.
2. Our price for installation of the 96" pipe sleeves is based on pipe being delivered by truck to the job site, fully fabricated and coated. We have not included any welding.
3. All concrete prices are for a 5½ sack mix with slag aggregate.
4. Our unit price for rip rap is based on:
   A. Slag and pit run sand for the bedding 4 inches of pit run sand and 6 inches of 1 3/4 to #4 slag.
   B. Rip rap to be as quoted by Mountain Quarry, Dierks, Arkansas.
   Gradation:
   Not more than 15% between 75# to 150#
   Not more than 40 to 45% between 25# to 75#
   Not more than 30 to 45% between 6# to 25#
   Not more than 15% less than 6#
   (Largest dimension = 15 inches)
5. We have included furnishing uncoated CMP pipe-for bituminous coating add $2,230.00

We have available construction equipment and personnel such that work could start within one week and be completed to meet your schedule.

We appreciate the opportunity to submit our proposal for your consideration.

Very truly yours,

Robert A. Fernandez,
Executive Vice President

PROPOSAL

TO

SOUTHWESTERN ELECTRIC POWER COMPANY

For the Contract Construction Work:

Site preparation of the Welsh Power Plant at Cason, Texas: consisting of clearing designated areas, all excavation as called for, construction of controlled compacti embankments, placing of drainage structures, and finish work as specified.

The undersigned, as Bidder, having familiarized himself with the contract documents, specifications and the plans therein referred to and having carefully examined the locations, conditions and materials at the site of the proposed work hereby proposes and agrees that he will furnish all labor, tools, equipment, supervision and materials incidental to construction and will do all work and furnis all materials as required by the plans and specifications in the manner prescribed therein and according to requirements of the Engineer as set forth therein at and for the unit prices for work in place for the following items and quantities:

A. BID SCHEDULE

BASE BID

Item No.	Estimated Quantity	Unit	Description and Unit Price in Words	Unit Price in figures	Amo
1	32	Acre	Clearing designated areas of all growth, trash, debris, etc. above ground surface, the sum of Three Hundred Forty-eight Dollars and No Cents per acre	$ 348.00	$11,136
2.	51	Acre	Clearing as in Item 1, plus grubbing roots, stumps, other objectionable material below ground surface, the sum of Six Hundred Fifty-seven Dollars and No Cents per acre	$ 657.00	$33,507

Item No.	Estimated Quantity	Unit	Description and Unit Prices in Words	Unit Price in figures	Amour
3	180 Acres+	LS	Removing all growth from an area previously cleared and grubbed, the sum of ONE HUNDRED SIXTY Dollars and NO Cents per acre	$160.00	$ 28,800
4	775,000	CY	Excavation of any earth material encountered regardless of type or amount involved, the sum of No Dollars and FIFTY-TWO Cents per cubic yard	$ 0.52	$403,00
5	97,000	CY	Excavation of wide trench Key-way at locations where dikes (or dams) are to be constructed, the sum of No Dollars and FIFTY-FOUR AND ONE-HALF Cents per cubic yard	$ 0.545	$ 52,86
6	100,000	CY	Excavation of 15' bottom width channel from Ash Pond to secondary settling pond area, sum of NO Dollars and SIXTY-SEVEN Cents per cubic yard	$ 0.67	$ 67,000
7	47,000	CY	Stockpile material determined to be "Topsoil" in shaped stockpiles as designated by Engineer, the sum of ______ Dollars and ______ Cents per cubic yard	Paid for in Item No. 4. $______	$______

Item No	Estimated Quantity	Unit	Description and Unit Price in Words	Unit Price in figures	Amour
8	685,000	CY	Construct density controlled embankments to line and grade specified, the sum of NO Dollars and TWENTY-THREE AND FOUR TENTHS Cents per cubic yard	$ 0.234	$ 160,290
9	116,500	YQ	Payment for hauling material from designated sources beyond the 2000 foot free-Haul distance, the sum of NO Dollars and TEN Cents per Yard-Quarter	0.10 $	11,650 $
10	220	LF	Excavation as required, placing to line & grade, and backfilling ground owner furnished conduit, the sum of FORTY FIVE Dollars and NO Cents per linear foot	$ 45.00	$ 9,900
11	2,000	CY	All excavation necessary below plane of normal site grading to place Culvert pipe and/or head-walls, the sum of NO Dollars and FIFTY-NINE Cents per cubic yard	$ 0.59	$ 1,180
12	55	CY	Furnishing concrete, re-inforcing in place, forming all labor, finishing, and back-filling of culvert headwalls, the sum of ONE HUNDRED FIFTY-EIGTH Dollars and NO Cents per cubic yard	$ 158.00	$ 8,690

Item No.	Estimated Quantity	Unit	Description and Unit Price in Words	Unit Price in figures	Amount
13.	270	LF	Furnishing, and placing to line and grade, 72-inch diameter CMP in locations specified, & back-filling, the sum of Fifty-six Dollars and Forty Cents per linear foot	$ 56.40	$ 15,228
14	304	LF	Furnishing, and placing to line and grade, 60-inch diameter CMP in locations specified, & back-filling, the sum of Forty-nine Dollars and Twenty Cents per linear foot	$ 49.20	$ 14,957
15	72	LF	Furnishing, and placing to line and grade, 48-inch diameter CMP in locations specified, & back-filling, the sum of Thirty-six Dollars and Sixty Cents per linear foot	$ 36.60	$ 2,635
16	328	LF	Furnishing, and placing to line and grade, 36-inch diameter CMP in locations specified, & back-filling, the sum of Twenty Dollars and Ten Cents per linear foot	$ 20.10	$ 6,593
17	120	LF	Furnishing, and placing to line and grade, 30-inch diameter CMP in locations specified, & back-filling, the sum of Seventeen Dollars and Seventy Cents per linear foot	$ 17.70	$ 2,124

Item No	Estimated Quantity	Unit	Description and Unit Price in Words	Unit Price in figures	Amount
18	240	LF	Furnishing, and placing to line and grade, 24-inch diameter CMP in locations specified, & backfilling, the sum of Ten Dollars and Ninety-five Cents per linear foot	$10.95	$2,628
19	120	LF	Furnishing, and placing to line and grade, 36-inch x 22-inch CMP (Arch) in locations specified, & backfilling, the sum of Fifteen Dollars and Forty Cents per linear foot	$15.40	$1,848
20	70	LF	Furnishing, and placing to line and grade, 22-inch x 13-inch CMP (Arch) in locations specified, & backfilling, the sum of Nine Dollars and Eighty Cents per linear foot	$ 9.80	$ 686
21	19,000	SY	Furnishing all materials for, and placing a 12" layer of sized rock riprap on a compacted bedding of 6" depth gravel over a 4" compacted sand base, the sum of Eleven Dollars and Eighty-two Cents per square yard	$11.82	$ 224,58[illegible]
22	140,000	SY	Removing material from stockpiles, hauling, spreading, and blading as necessary to place a uniform 4" minimum layer of soil over slopes formed by embankments or excavations, the sum of, No Dollars and Thirteen Cents per square yard	$ 0.13	$ 18,[illegible]

Item No.	Estimated Quantity	Unit	Description and Unit Price in Words	Unit Price in figures	Amou
23	140,000	SY	Seeding, fertilizing, rolling, sprinkling as necessary, and placing asphalt sprayed straw mulch over areas previously spread with salvaged topsoil, the sum of, NO Dollars and SEVENTEEN AND SIX-TENTHS Cents per square yard	$ 0.176	$ 24,640

TOTAL AMOUNT BASE BID
ITEMS 1 THROUGH 23 $ 1,102,137.00

B. COST PLUS

As the WORK progresses, it may be necessary to do minor items of additional work not covered by the unit prices. Contractor agrees to do such work on a "Cost plus" basis, if so authorized by Owner. Owner will pay to Contractor 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. 20 % of 1 and 2.
4. Material.
5. Percentage of Item 4 above for overhead and profit. 10 % of Item 4.

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

   AA. Superintendents (except foremen)
   BB. Field office force
   CC. Use of tools and supplies
   DD. Use of construction equipment originally costing less than $500.00
   EE. Any subcontractors' fees for overhead and profit
   FF. All overhead (including such taxes and insurance generally considered overhead)
   GG. Profit.

6. Bidder shall list all equipment he plans to use on the job originally costing $500.00 or more and shall give an hourly rental rate for cost plus work. This rate shall apply to equipment located on the premises at the time the extra work is done. Said rate shall include insurance, gasoline, oil, and all other expenses for the equipment except operating personnel.

Equipment (Include Type and Size)	Hourly Rental Rate
Scraper Cat 633	34.00
Scraper Cat 631	28.00
Scraper Cat 623	22.00
Scraper Cat 621	17.00
Dozer Cat D-9	31.00

Equipment (Include Type and Size)	Hourly Rental Rate
Maintainer Cat 14	11.00
Compactor	14.00
Water Wagon	15.00

C. The actual quantities may vary from the estimated quantities and Contractor agrees that final payment will be adjusted to the actual quantities of work completed at the above unit prices when unit prices are indicated.

D. The undersigned bidder agrees to commence work within ten (10) days after the date of written notice to commence work, and to substantially complete the work on which he has bid within 150 calendar days.

E. Enclosed with this proposal is a Cashier's or Certified Check for

______________________________ ($__________)

Dollars, or a Bid Bond in the sum of 5% of amount bid

______________________________ ($__________)

Dollars, in the amount of 5% of Contractor's total bid, which it is agreed shall be collected and retained by the Owner as liquidated damages in the event this proposal is accepted by the Owner within thirty (30) days after the date for the reception of bids and the undersigned fails to execute the contract and the required bond with the Owner, under the conditions hereof, within ten (10) days after the date said proposal is accepted; otherwise said check or bond shall be returned to the undersigned upon demand.

F. The undersigned hereby declares that he has visited the site and has carefully examined the Contract Documents relative to the work covered by the above bid.

G. The undersigned bidder acknowledges by signature receipt of the following addenda if any have been received.

Addendum No. 1 ______________________________

Addendum No. 2 ______________________________

Addendum No. 3 ______________________________

Respectfully submitted,

Signature of Bidder

AUSTIN BUILDING COMPANY
Name of Company

(Seal if Bidder is
a Corporation)

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FOR
GENERAL CONDITIONS OF AGREEMENT

3. General Obligations and Responsibilities—Cont'd

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GENERAL CONDITIONS OF AGREEMENT

1. DEFINITIONS OF TERMS

1.01 **OWNER, CONTRACTOR AND ENGINEER.** The OWNER, the CONTRACTOR and the ENGINEER are those mentioned as such in the Agreement. They are treated throughout the Contract Documents as if each were of the singular number and masculine gender. The ENGINEER shall be understood to be the ENGINEER of the OWNER or his duly authorized representative.

1.02 **CONTRACT DOCUMENTS.** The Contract Documents shall consist of the Notice to Contractors (Advertisement), Special Conditions (Instructions to Bidders), Proposal, signed Agreement, Performance and Payment Bonds (when required), Special Bonds (when required), General Conditions of the Agreement, Technical Specifications, Plans, and all modifications there of incorporated in any of the documents before the execution of the agreement.

The Contract Documents are complementary, and what is called for by any one shall be as binding as if called for by all. In case of conflict between any of the Contract Documents, priority of interpretation shall be in the following order: Signed Agreement, Performance and Payment Bonds, Special Bonds (if any), Proposal, Special Conditions of Agreement, Notice to Contractors, Technical Specifications, Plans, and General Conditions of Agreement.

1.03 **SUB-CONTRACTOR.** The term Sub-Contractor, as employed herein, includes only those having a direct contract with the CONTRACTOR and it includes one who furnishes mater- ial worked to a special design according to the plans or specifications of this work, but does not include one who merely furnishes material not so worked.

1.04 **WRITTEN NOTICE.** Written notice shall be deemed to have been duly served if delivered in person to the individual or to a member of the firm or to an officer of the corpor- ation for whom it is intended, or if delivered at or sent by registered mail to the last business address known to him who gives the notice.

1.05 **WORK.** Unless otherwise stipulated, the CONTRACTOR shall provide and pay for all materials, supplies, machinery, equipment, tools, superintendence, labor, insurance, and all water, light, power, fuel, transportation and other facilities necessary for the execution and com- pletion of the work covered by the contract documents. Unless otherwise specified, all mater- ials shall be new and both workmanship and materials shall be of a good quality. The CON- TRACTOR shall, if required, furnish satisfactory evidence as to the kind and quality of mater- ials. Materials or work described in words which so applied have a well known technical or trade meaning shall be held to refer to such recognized standards.

1.06 **EXTRA WORK.** The term "Extra Work" as used in this contract shall be under- stood to mean and include all work that may be required by the ENGINEER or OWNER to be done by the CONTRACTOR to accomplish any change, alteration or addition to the work shown upon the plans, or reasonably implied by the specifications, and not covered by the CONTRAC- TOR'S Proposal, except as provided under "Changes and Alterations", herein.

1.07 **WORKING DAY.** A "Working day" is defined as any day not including Saturdays, Sundays or any legal holidays, in which weather or other conditions, not under the control of the CONTRACTOR, will permit construction of the principal units of the work for a continuous period of not less than seven (7) hours between 7:00 a. m. and 6:00 p. m.

1.08 **SUBSTANTIALLY COMPLETED.** By the term "substantially completed" is meant that the structure has been made suitable for use or occupancy or the facility is in condition to serve its intended purpose, but still may require minor miscellaneous work and adjustment.

2. CONTROL OF WORK

2.01 **LINES AND GRADES.** Unless otherwise specified, all lines and grades shall be fur- nished by the OWNER or his representative. Whenever necessary, construction work shall be suspended to permit performance of this work, but such suspension will be as brief as practicable and the CONTRACTOR shall be allowed no extra compensation therefor. The CONTRACTOR shall give the OWNER or the ENGINEER ample notice of the time and place where lines and grades will be needed. All stakes, marks, etc., shall be carefully preserved by the CONTRACTOR, and in case of careless destruction or removal by him or his employees, such stakes, marks, etc., shall be replaced at the CONTRACTOR'S expense.

2.02 **ENGINEER'S AUTHORITY AND DUTY.** Unless otherwise specified, it is mutually agreed between the parties to this Agreement that the ENGINEER shall supervise all work included herein. He has the authority to stop the work whenever such stoppage may be necessary to insure the proper execution of the contract. In order to prevent delays and disputes and to discourage litigation, it is further agreed that the ENGINEER shall in all cases determine the amounts and quantities of the several kinds of work which are to be paid for under this contract. He shall determine all questions in relation to said work and the construction thereof, and shall in all cases decide every question which may arise relative to the execution of this contract on the part of said CONTRACTOR. The ENGINEER'S estimates and findings shall be the conditions precedent to the right of the parties hereto to arbitration or to any action on the contract and to any rights of the CONTRACTOR to receive any money under this contract; provided, however, that should the ENGINEER render any decision or give any direction which, in the opinion of either party hereto, is not in accordance with the meaning and intent of this contract, either party may file with said ENGINEER within thirty (30) days his written objection to the decision or direction so rendered, and by such action may reserve the right to submit the question so raised to arbitration as herein provided. It is the intent of this agreement that there shall be no delay in the execution of the work, therefore, the written decision or directions of the ENGINEER as rendered shall be promptly carried out, and any claim arising therefrom shall be thereafter adjusted by arbitration as hereinafter provided.

The ENGINEER shall, within a reasonable time, render and deliver to both the OWNER and the CONTRACTOR a written decision on all claims of the parties hereto and on all questions which may arise relative to the execution of the work or the interpretation of the contract, specifications and plans. Should the ENGINEER fail to make such decision within a reasonable time, an appeal to arbitration may be taken as if his decision had been rendered against the party appealing.

Whenever the words "directed", "required", "permitted", "designated", "considered necessary", "prescribed", or words of like import are used, it shall be understood that the direction, requirement, permission, order, designation or prescription, of the ENGINEER is intended, and similarly, the words "approval", "acceptable", "satisfactory", or words of like import shall mean approved by or acceptable or satisfactory to the ENGINEER.

2.03 **SUPERINTENDENCE AND INSPECTION.** It is agreed by the CONTRACTOR that the ENGINEER shall be and is hereby authorized to appoint from time to time such subordinate engineers, supervisors or inspectors as the said ENGINEER may deem proper to inspect the materials furnished and the work done under this agreement, and to see that the said material is furnished, and said work is done in accordance with the specifications therefor. The CONTRACTOR shall furnish all reasonable aid and assistance required by the subordinate engineers, supervisors or inspectors for the proper inspection and examination of the work. The CONTRACTOR shall regard and obey the directions and instructions of any subordinate engineers, supervisors or inspectors so appointed, when such directions and instructions are consistent with the obligations of this Agreement and the accompanying plans and specifications, provided, however, should the CONTRACTOR object to any order by any subordinate engineer, supervisor or inspector, the CONTRACTOR may within six (6) days make written appeal to the ENGINEER for his decision.

2.04 **CONTRACTOR'S DUTY AND SUPERINTENDENCE.** The CONTRACTOR shall give personal attention to the faithful prosecution and completion of this contract and shall keep on the work, during its progress, a competent superintendent and any necessary assistants, all satisfactory to the ENGINEER. The superintendent shall represent the CONTRACTOR in his absence and all directions given to him shall be as binding as if given to the CONTRACTOR. Important directions shall be confirmed in writing to the CONTRACTOR. Other directions shall be so confirmed on written request in each case.

2.05 **CONTRACTOR'S UNDERSTANDING.** It is understood and agreed that the CONTRACTOR has, by careful examination, satisfied himself as to the nature and location of the work, the conformation of the ground, the character, quality and quantity of the materials to be encountered, the character of equipment and facilities needed preliminary to and during the prosecution of the work, the general and local conditions, and all other matters which can in any way affect the work under this contract. No verbal agreement or conversation with any officer, agent or employee of the OWNER, either before or after the execution of this contract, shall affect or modify any of the terms or obligations herein contained.

2.06 **CHARACTER OF WORKMEN.** The CONTRACTOR agrees to employ only orderly and competent men, skillful in the performance of the type of work required under this contract, to do the work; and agrees that whenever the ENGINEER shall inform him in writing that any man or men on the work are, in his opinion, incompetent, unfaithful or disorderly, such man or men shall be discharged from the work and shall not again be employed on the work without the ENGINEER'S written consent.

2.07 **CONTRACTOR'S BUILDINGS.** The building of structures for housing men, or the erection of tents or other forms of protection, will be permitted only at such places as the ENGINEER shall direct, and the sanitary conditions of the grounds in or about such structures shall at all times be maintained in a manner satisfactory to the ENGINEER.

2.08 **SANITATION.** Necessary sanitary conveniences for the use of laborers on the work, properly secluded from public observation, shall be constructed and maintained by the CONTRACTOR in such manner and at such points as shall be approved by the ENGINEER, and their use shall be strictly enforced.

2.09 **SHOP DRAWINGS.** The CONTRACTOR shall submit to the ENGINEER, with such promptness as to cause no delay in his own work or in that of any other Contractor, four copies, unless otherwise specified, of all shop and/or setting drawings and schedules required for the work of the various trades, and the ENGINEER shall pass upon them with reasonable promptness, making desired corrections. The CONTRACTOR shall make any corrections required by the ENGINEER, file with him two corrected copies and furnish such other copies as may be needed. The ENGINEER'S approval of such drawings or schedules shall not relieve the CONTRACTOR from responsibility for deviations from drawings or specifications, unless he has in writing called the ENGINEER'S attention to such deviations at the time of submission, nor shall it relieve him from responsibility for errors of any sort in shop drawings or schedules.

2.10 **PRELIMINARY APPROVAL.** The ENGINEER shall not have the power to waive the obligations of this contract for the furnishing by the CONTRACTOR of good material, and of his performing good work as herein described, and in full accordance with the plans and specifications. No failure or omission of the ENGINEER to condemn any defective work or material shall release the CONTRACTOR from the obligations to at once tear out, remove and properly replace the same at any time prior to final acceptance upon the discovery of said defective work or material; provided, however, that the ENGINEER shall, upon request of the CONTRACTOR, inspect and accept or reject any material furnished, and in event the material has been once accepted by the ENGINEER, such acceptance shall be binding on the OWNER, unless it can be clearly shown that such material furnished does not meet the specifications for this work.

Any questioned work may be ordered taken up or removed for re-examination, by the ENGINEER, prior to final acceptance, and if found not in accordance with the specifications for said work, all expense of removing, re-examination and replacement shall be borne by the CONTRACTOR, otherwise the expense thus incurred shall be allowed as EXTRA WORK, and shall be paid for by the OWNER; provided that, where inspection or approval is specifically required by the specifications prior to performance of certain work, should the CONTRACTOR proceed with such work without requesting prior inspection or approval he shall bear all expense of taking up, removing, and replacing this work if so directed by the ENGINEER.

2.11 **DEFECTS AND THEIR REMEDIES.** It is further agreed that if the work or any part thereof, or any material brought on the site of the work for use in the work or selected for the same, shall be deemed by the ENGINEER as unsuitable or not in conformity with the specifications, the CONTRACTOR shall, after receipt of written notice thereof from the ENGINEER, forthwith remove such material and rebuild or otherwise remedy such work so that it shall be in full accordance with this contract.

2.12 CHANGES AND ALTERATIONS. The CONTRACTOR further agrees that the OWNER may make such changes and alterations as the OWNER may see fit, in the line, grade, form, dimensions, plans or materials for the work herein contemplated, or any part thereof, either before or after the beginning of the construction, without affecting the validity of this contract and the accompanying Performance and Payment Bonds.

If such changes or alterations diminish the quantity of the work to be done, they shall not constitute the basis for a claim for damages, or anticipated profits on the work that may be dispensed with, except as provided for unit price items under Section 5 "Measurement and Payment". If the amount of work is increased, and the work can fairly be classified under the specifications, such increase shall be paid for according to the quantity actually done and at the unit price, if any, established for such work under this contract, except as provided for unit price items under Section 5 "Measurement and Payment"; otherwise, such additional work shall be paid for as provided under Extra Work. In case the OWNER shall make such changes or alterations as shall make useless any work already done or material already furnished or used in said work, then the OWNER shall recompense the CONTRACTOR for any material or labor so used, and for any actual loss occasioned by such change, due to actual expenses incurred in preparation for the work as originally planned.

2.13 RIGHT OF ENGINEER TO MODIFY METHODS AND EQUIPMENT. If at any time the methods or equipment used by the CONTRACTOR are found to be inadequate to secure the quality of work or the rate of progress required under this contract, the ENGINEER may order the CONTRACTOR in writing to increase their safety or improve their character and efficiency, and the CONTRACTOR shall comply with such order.

If at any time the working force of the CONTRACTOR is inadequate for securing the progress herein specified, the CONTRACTOR shall, if so ordered in writing, increase his force or equipment, or both, to such an extent as to give reasonable assurance of compliance with the schedule of progress.

3. GENERAL OBLIGATIONS AND RESPONSIBILITIES

3.01 KEEPING OF PLANS AND SPECIFICATIONS ACCESSIBLE. The ENGINEER shall furnish the CONTRACTOR with an adequate and reasonable number of copies of all plans and specifications without expense to him, and the CONTRACTOR shall keep one copy of the same constantly accessible on the work, with the latest revisions noted thereon.

3.02 OWNERSHIP OF DRAWINGS. All drawings, specifications and copies thereof furnished by the ENGINEER shall not be reused on other work, and, with the exception of the signed contract sets, are to be returned to him on request, at the completion of the work. All models are the property of the OWNER.

3.03 ADEQUACY OF DESIGN. It is understood that the OWNER believes it has employed competent engineers and designers. It is, therefore, agreed that the OWNER shall be responsible for the adequacy of the design, sufficiency of the Contract Documents, the safety of the structure and the practicability of the operations of the completed project; provided the CONTRACTOR has complied with the requirements of the said Contract Documents, all approved modifications thereof, and additions and alterations thereto approved in writing by the OWNER. The burden of proof of such compliance shall be upon the CONTRACTOR to show that he has complied with the said requirements of the Contract Documents, approved modifications thereof and all approved additions and alterations thereto.

3.04 RIGHT OF ENTRY. The OWNER reserves the right to enter the property or location on which the works herein contracted for are to be constructed or installed, by such agent or agents as he may elect, for the purpose of supervising and inspecting the work, or for the purpose of constructing or installing such collateral work as said OWNER may desire.

3.05 COLLATERAL CONTRACTS. The OWNER agrees to provide by separate contract or otherwise, all labor and material essential to the completion of the work specifically excluded from this contract, in such manner as not to delay the progress of the work, or damage said CONTRACTOR, except where such delays are specifically mentioned elsewhere in the Contract Documents.

3.06 **DISCREPANCIES AND OMISSIONS.** It is further agreed that it is the intent of this contract that all work must be done and all material must be furnished in accordance with the generally accepted practice, and in the event of any discrepancies between the separate contract documents, the priority of interpretation defined under "Contract Documents" shall govern. In the event that there is still any doubt as to the meaning and intent of any portion of the contract, specifications or drawings, the ENGINEER shall define which is intended to apply to the work

3.07 **EQUIPMENT, MATERIALS AND CONSTRUCTION PLANT.** The CONTRACTOR shall be responsible for the care, preservation, conservation, and protection of all materials, supplies, machinery, equipment, tools, apparatus, accessories, facilities, all means of construction, and any and all parts of the work, whether the CONTRACTOR has been paid, partially paid, or not paid for such work, until the entire work is completed and accepted

3.08 **DAMAGES.** In the event the CONTRACTOR is damaged in the course of the completion of the work by the act, neglect, omission, mistake or default of the OWNER, or of the ENGINEER, or of any other CONTRACTOR employed by the OWNER upon the work, thereby causing loss to the CONTRACTOR, the OWNER agrees that he will reimburse the CONTRACTOR for such loss. In the event the OWNER is damaged in the course of the work by the act, negligence, omission, mistake or default of the CONTRACTOR, or should the CONTRACTOR unreasonably delay the progress of the work being done by others on the job so as to cause loss for which the OWNER becomes liable, then the CONTRACTOR shall reimburse the OWNER for such loss.

3.09 **PROTECTION AGAINST ACCIDENT TO EMPLOYEES AND THE PUBLIC.** The CONTRACTOR shall take out and procure a policy or policies of workmen's compensation insurance with an insurance company licensed to transact business in the State of Texas, which policy shall comply with the Workmen's Compensation Law of the State of Texas. The CONTRACTOR shall at all times exercise reasonable precautions for the safety of employees and others on or near the work and shall comply with all applicable provisions of Federal, State, and Municipal safety laws and building and construction codes. All machinery and equipment and other physical hazards shall be guarded in accordance with the "Manual of Accident Prevention in Construction" of the Associated General Contractors of America except where incompatible with Federal, State, or Municipal laws or regulations. The CONTRACTOR shall provide such machinery guards, safe walkways, ladders, bridges, gangplanks, and other safety devices as may be required by the ENGINEER as requisite to the prevention of accidents. The CONTRACTOR and his Sureties shall indemnify and save harmless the OWNER and all its officers, agents, and employees from all suits, actions or claims of any character, name and description brought for or on account of any injuries or damages received or sustained by any person or persons or property on account of any negligent act or fault of the CONTRACTOR, his agents or employees, in the execution of said contract, or on account of the failure of the CONTRACTOR to provide necessary barricades, warning lights or signs, and will be required to pay any judgment, with costs, which may be obtained against the OWNER growing out of such injury or damage.

3.10 **PERFORMANCE AND PAYMENT BONDS.** Unless otherwise specified, it is further agreed by the parties to this Contract that the CONTRACTOR will execute separate performance and payment bonds, each in the sum of one hundred (100) percent of the total contract price, in standard forms for this purpose, guaranteeing faithful performance of the work and the fulfillment of any guarantees required, and further guaranteeing payment to all persons supplying labor and materials or furnishing him any equipment in the execution of the Contract, and it is agreed that this Contract shall not be in effect until such performance and payment bonds are furnished and approved by the OWNER.

Unless otherwise approved in writing by the OWNER, the surety company underwriting the bonds shall be acceptable according to the latest list of companies holding certificates of authority from the Secretary of the Treasury of the United States.

Unless otherwise specified, the cost of the premium for the performance and payment bonds shall be included in the CONTRACTOR'S proposal.

3.11 **LOSSES FROM NATURAL CAUSES.** Unless otherwise specified, all loss or damage to the CONTRACTOR arising out of the nature of the work to be done, or from the action of the elements, or from any unforeseen circumstances in the prosecution of the same, or from unusual obstructions or difficulties which may be encountered in the prosecution of the work, shall be sustained and borne by the CONTRACTOR at his own cost and expense.

3.12 **PROTECTION OF ADJOINING PROPERTY.** The said CONTRACTOR shall take proper means to protect the adjacent or adjoining property or properties in any way encountered, which might be injured or seriously affected by any process of construction to be undertaken under this Agreement, from any 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 agrees to indemnify, save and hold harmless the OWNER against any claim or claims for damages due to any injury to any adja- cent or adjoining property, arising or growing out of the performance of the contract; but any such indemnity shall not apply to any claim of any kind arising out of the existence or character of the work.

3.13 **PROTECTION AGAINST CLAIMS OF SUB-CONTRACTORS, LABORERS, MATER- IALMEN AND FURNISHERS OF MACHINERY, EQUIPMENT AND SUPPLIES.** The CON- TRACTOR agrees that he will indemnify and save the OWNER harmless from all claims grow- ing out of the lawful demands of sub-contractors, laborers, workmen, mechanics, materialmen and furnishers of machinery and parts thereof, equipment, power tools, and all supplies, in- cluding commissary, incurred in the furtherance of the performance of this contract. When so desired by the OWNER, the CONTRACTOR shall furnish satisfactory evidence that all obli- gations of the nature hereinabove designated have been paid, discharged or waived. If the CON- TRACTOR fails so to do, then the OWNER may at the option of the CONTRACTOR either pay directly any unpaid bills, of which the OWNER has written notice, or withhold from the CONTRACTOR'S unpaid compensation a sum of money deemed reasonably sufficient to liqui- date any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged, whereupon payments to the CONTRACTOR shall be resumed in full, in accordance with the terms of this contract, but in no event shall the provisions of this sentence be construed to impose any obligation upon the OWNER by either the CONTRAC- TOR or his Surety.

3.14 **PROTECTION AGAINST ROYALTIES OR PATENTED INVENTION.** The CON- TRACTOR shall pay all royalties and license fees, and shall provide for the use of any design, device, material or process covered by letters patent or copyright by suitable legal agreement with the patentee or owner. The CONTRACTOR shall defend all suits or claims for infringe- ment of any patent or copyright rights and shall indemnify and save the OWNER harmless from any loss on account thereof, except that the OWNER shall defend all such suits and claims and shall be responsible for all such loss when a particular design, device, material or process or the product of a particular manufacturer or manufacturers is specified or required by the OWNER; provided, however, if choice of alternate design, device, material or process is allow- ed to the CONTRACTOR, then CONTRACTOR shall indemnify and save OWNER harmless from any loss on account thereof. If the material or process specified or required by the OWNER is an infringement, the CONTRACTOR shall be responsible for such loss unless he promptly gives such information to the OWNER.

3.15 **LAWS AND ORDINANCES.** The CONTRACTOR shall at all times observe and com- ply with all Federal, State and local laws, ordinances and regulations, which in any manner af- fect the contract or the work, and shall indemnify and save harmless the OWNER against any claim arising from the violation of any such laws, ordinances, and regulations whether by the CONTRACTOR or his employees, except where such violations are called for by the provisions of the Contract Documents. If the CONTRACTOR observes that the plans and specifications are at variance therewith, he shall promptly notify the ENGINEER in writing, and any neces- sary changes shall be adjusted as provided in the contract for changes in the work. If the CON- TRACTOR performs any work knowing it to be contrary to such laws, ordinances, rules and regulations, and without such notice to the ENGINEER, he shall bear all costs arising there- from. In case the Owner is a body politic and corporate, the law from which it derives its pow- ers, insofar as the same regulates the objects for which, or the manner in which, or the condi- tions under which the OWNER may enter into contract, shall be controlling, and shall be con- sidered as part of this contract, to the same effect as though embodied herein.

3.16 **ASSIGNMENT AND SUBLETTING.** The CONTRACTOR further agrees that he will retain personal control and will give his personal attention to the fulfillment of this con- tract and that he will not assign by Power of Attorney, or otherwise, or sublet said contract without the written consent of the OWNER, and that no part or feature of the work will be sublet to anyone objectionable to the ENGINEER or the OWNER. The CONTRACTOR further agrees that the subletting of any portion or feature of the work, or materials required in the performance of this contract, shall not relieve the CONTRACTOR from his full obligations to the OWNER, as provided by this Agreement.

4. PROSECUTION AND PROGRESS

4.01 TIME AND ORDER OF COMPLETION. It is the meaning and intent of this contract, unless otherwise herein specifically provided, that the CONTRACTOR shall be allowed to prosecute his work at such times and seasons, in such order of precedence, and in such manner as shall be most conducive to economy of construction, provided, however, that the order and the time of prosecution shall be such that the work shall be substantially completed as a whole and in part, in accordance with this contract, the plans and specifications, and within the time of completion designated in the Proposal; provided, also, that when the OWNER is having other work done, either by contract or by his own force, the ENGINEER may direct the time and manner of constructing the work done under this contract, so that conflict will be avoided and the construction of the various works being done for the OWNER shall be harmonized.

The CONTRACTOR shall submit, at such times as may reasonably be requested by the ENGINEER, schedules which shall show the order in which the CONTRACTOR proposes to carry on the work, with dates at which the CONTRACTOR will start the several parts of the work and estimated dates of completion of the several parts.

4.02 EXTENSION OF TIME. Should the CONTRACTOR be delayed in the completion of the work by any act or neglect of the OWNER or ENGINEER, or of any employee of either, or by other contractors employed by the OWNER, or by changes ordered in the work, or by strikes, lockouts, fires, and unusual delays by common carriers, or unavoidable cause or causes beyond the CONTRACTOR'S control, or by any cause which the ENGINEER shall decide justifies the delay, then an extension of time shall be allowed for completing the work, sufficient to compensate for the delay, the amount of the extension to be determined by the ENGINEER, provided, however, that the CONTRACTOR shall give the ENGINEER prompt notice in writing of the cause of such delay.

4.03 HINDRANCES AND DELAYS. No claims shall be made by the CONTRACTOR for damages resulting from hindrances or delays from any cause (except where the work is stopped by order of the OWNER) during the progress of any portion of the work embraced in this contract. In case said work shall be stopped by the act of the OWNER, then such expense as in the judgment of the ENGINEER is caused by such stoppage of said work shall be paid by the OWNER to the CONTRACTOR.

5. MEASUREMENT AND PAYMENT

5.01 QUANTITIES AND MEASUREMENTS. N[illegible] any kind will be allowed, but the actual measured [illegible] number and weight only shall be considered [illegible]

5.02 ESTIMATED QUANTITIES. [illegible] estimate, is intended to show clearly all work to be done and material to be furnished [illegible] Where the estimated quantities are shown [illegible] ial to be furnished under this contract [illegible] for estimating the probable cost of the work [illegible] work. It is understood and agreed that the actual amount of work to be done and material to be furnished under this contract may differ somewhat from these estimates, and that where the basis for payment under this contract is the unit price method of payment shall be for the actual amount of such work done and the material furnished.

Where payment is based on the [illegible] the CONTRACTOR [illegible] make no claim for damages anticipated profits or otherwise on account of any difference which may be found between the quantities of work actually [illegible] under this contract and the estimated quantities contemplated [illegible] provided, however, that in case the actual quantity of any major item should become as much as 20% more than, or 20% less than the estimated or contemplated quantity for such item, then either party to this Agreement, upon demand, shall be entitled to a revised consideration upon the portion of the work above or below 20% of the estimated quantity.

A "Major Item" shall be construed to be any individual bid item incurred in the proposal that has a total cost equal to or greater than five (5) per cent of the total contract cost, com puted on the basis of the proposal quan[illegible] the [illegible] tract unit prices.

Any revised consideration [illegible] to be determined by agr[illegible]ment between the parties, otherwise by the terms of this Agreement, as provided under "Extra Work."

5.03 **PARTIAL PA MENTS.** On or before the 10th day of each month the ENGINEER shall prepare a statement showing as completely as practicable the total value of the work done by the CONTRACTOR up to and including the last day of the preceding month; said statement shall also include the value of all sound materials delivered on the site of the work that are to be fabricated into the work.

The OWNER shall then pay the CONTRACTOR on or before the 15th day of the current month the total amount of the ENGINEER'S statement, less 10 per cent of the amount thereof, which 10 per cent shall be retained until final payment, and further less all previous payments and all further sums that may be retained by the OWNER under the terms of this Agreement. It is understood, however, that in case the whole work be near to completion and some unexpect- ed and unusual delay occurs due to no fault or neglect on the part of the CONTRACTOR, the OWNER may—upon written recommendation of the ENGINEER—pay a reasonable and equit- able portion of the retained percentage to the CONTRACTOR; or the CONTRACTOR at the OWNER'S option, may be relieved of the obligation to fully complete the work and, thereupon, the CONTRACTOR shall receive [illegible]yment of the balance due him under the contract subject only to the conditions stated under "Final Payment."

5.04 **USE OF COMPLETED PORTIONS.** The OWNER shall have the right to take pos- session of and use any completed or partially completed portions of the work, notwithstanding the time for completing the entire work or such portions may not have expired but such tak- ing possession and use shall not be deemed an acceptance of any work not completed in accord- ance with the Contract Documents. If such prior use increases the cost of or delays the work, the CONTRACTOR shall be entitled to such extra compensation, or extension of time, or both, as the ENGINEER may determine.

5.05 **FINAL COMPLETION AND ACCEPTANCE.** Within ten (10) days after the CON- TRACTOR has given the ENGINEER written notice that the work has been completed, or sub- stantially completed, the ENGINEER and the OWNER shall inspect the work and within said time if the work be found to be completed or substantially completed in accordance with the Contract Documents, the ENGINEER shall issue to the OWNER and the CONTRACTOR his Certificate of Completion, and thereupon it shall be the duty of the OWNER within ten (10) days to issue a Certificate of Acceptance of the work to the CONTRACTOR.

5.06 **FINAL PAYMENT.** Upon the issuance of the Certificate of Completion the EN- GINEER shall proceed to make final measurements and prepare final statement of the value of all work performed and materials furnished under the terms of the Agreement and shall certify same to the OWNER, who shall pay to the CONTRACTOR on or after the 30th day, and be- fore the 35th day, after the date of the Certificate of Completion, the balance due the CON- TRACTOR under the terms of this Agreement, provided he has fully performed his contractual obligations under the terms of this contract. And said payment shall become due in any event upon said performance by the CONTRACTOR. Neither the Certificate of Acceptance nor the final payment, nor any provision in the Contract Documents, shall relieve the CONTRACTOR of the obligation for fulfillment of any warranty which may be required in the Special Condi- tions of the Specifications.

5.07 **PAYMENTS WITHHELD.** The OWNER may on account of subsequently discovered evidence, withhold or nullify the whole or part of any certificate to such extent as may be neces- sary to protect himself from loss on account of:

(a) Defective work not remedied.
(b) Claims filed or reasonable evidence indicating probable filing of claims.
(c) Failure of the CONTRACTOR to make payments properly to sub-contractors or for material or labor.
(d) Damage to another contractor.

When the above grounds are removed or the CONTRACTO.. provides a Surety Bond satis-factory to the OWNER, which will protect the OWNER in the amount withheld, payment shall be made for amounts withheld because of them

5.08 **DELAYED PAYMENTS.** Should the OWNER fail to make payment to the CON-TRACTOR of the sum named in any part il or final statement, when payment is due, or should the ENGINEER fail to issue any statement on or before the date above provided, then the OWNER shall pay to the CONTRACTOR, in addition to the sum shown as due by such state-ment, interest thereon at the rate of six (6) per cent per annum, unless otherwise specified, from date due as provided under "Partial Payments" and "Final Payments", until fully paid, which shall fully liquidate a[illegible] injury to the CONTRACTOR growing out of such delay in payment, but the right is expressly reserved to the CONTRACTOR in the event payments be not promptly made as provided under "Partial Payments" to at any time thereafter treat the contract as abandoned by the OWNER and recover compensation as provided under "Abandonment of Con-tract", unless such payments are withheld in accordance with the provisions of "Payments With-held."

6 EXTRA WORK AND CLAIMS

6.01 **EXTRA WORK.** It is agreed that the CONTRACTOR shall perform all Extra Work under the direction of the ENGINEER when presented with a Written Work Order signed by the ENGINEER, subject, however, to the right of the CONTRACTOR to require a written con-firmation of such Extra Work Order by the OWNER. It is also agreed that the compensation to be paid the CONTRACTOR for performing said Extra Work shall be determined by one or more of the following methods:

Method (A) — By agreed unit prices; or

Method (B) — By agreed lump sum; or

Method (C) — If neither Method (A) nor Method (B) be agreed upon before the Extra Work is commenced, then the CONTRACTOR shall be paid the "actual field cost" of the work, plus fifteen (15) per cent.

In the event said Extra Work be performed and paid for under Method (C), then the pro-visions of this paragraph shall apply and the "actual field cost" is hereby defined to include the cost of all workmen, such as foreman, timekeepers, mechanics and laborers, and materials, sup-plies, teams, trucks, rentals on machinery and equipment, for the time actually employed or used on such Extra Work, plus actual transportation charges necessarily incurred, together with all power, fuel, lubricants, water and similar operating expenses, also all necessary incidental expenses incurred directly on account of such Extra Work, including Social Security, Old Age Benefits and other payroll taxes, and, a rateable proportion of premiums on Performance and Pay-ment Bonds and Maintenance Bonds, Public Liability and Property Damage and Workmen's Com-pensation, and all other insurance as may be required by any law or ordinance, or directed by the ENGINEER or OWNER, or by them agreed to. The ENGINEER may direct the form in which ac-counts of the "actual field cost" shall be kept and the records of these accounts shall be made available to the ENGINEER. The ENGINEER may also specify in writing, before the work commences, the method of doing the work and the type and kind of machinery and equipment to be used; otherwise these matters shall be determined by the CONTRACTOR. Unless other-wise agreed upon the prices for the use of machinery and equipment shall be determined by using 10% per cent, unless otherwise specified, of the latest schedule of Equipment Ownership Expense adopted by the Associated General Contractors of America. Where practicable the terms and prices for the use of machinery and equipment shall be incorporated in the Written Extra Work Order. The fifteen (15) per cent of the "actual field cost" to be paid the CON-TRACTOR shall cover and compensate him for his profit, overhead, general superintendence, field office expense, and all other elements of cost and expense not embraced within the "actual field cost" as herein defined, save that where the CONTRACTOR'S Camp or Field office must be maintained primarily on account of such Extra Work, then the cost to maintain and operate the same shall be included in the "actual field cost".

No claim for Extra Work of any kind will be allowed unless ordered in writing by the EN-GINEER. In case any orders or instructions, either oral or written, appear to the CONTRAC-TOR to involve Extra Work for which he should receive compensation or an adjustment in the construction time he shall make written request to the ENGINEER for written order authorizing such Extra Work. Should a difference of opinion arise as to what does or does not constitute Extra Work or as to the payment thereof, and the ENGINEER insists upon its performance, the CONTRACTOR shall proceed with the work after making written request for written order and shall keep an accurate account of the "actual field cost" thereof, as provided under Method (C). The CONTRACTOR will thereby preserve the right to submit the matter of payment to arbitration as hereinbelow provided.

6.02 **TIME OF FILING CLAIMS.** It is further agreed by both parties hereto that all questions of dispute or adjustment presented by the CONTRACTOR shall be in writing and filed with the ENGINEER within thirty (30) days after the ENGINEER has given any directions, order or instruction to which the CONTRACTOR desires to take exception. The ENGINEER shall reply to such written exceptions by the CONTRACTOR and render his final decision in writing. In case the CONTRACTOR should appeal from the ENGINEER'S decision, any demand for arbitration shall be filed with the ENGINEER and the OWNER in writing within ten (10) days after the date of delivery to CONTRACTOR of the ENGINEER'S final decision. It is further agreed that final acceptance of the work by the OWNER and the acceptance by the CONTRACTOR of the final payment shall be a bar to any claims by either party, except where noted otherwise in the Contract Documents.

6.03 **ARBITRATION.** All questions of dispute under this Agreement shall be submitted to arbitration at the request of either party to the dispute. The parties may agree upon one arbiter; otherwise, there shall be three, one named in writing by each party, and the third chosen by the two arbiters so selected; or if the arbiters fail to select a third within ten (10) days, he shall be chosen by a District Judge serving the County in which the major portion of the project is located, unless otherwise specified. Should the party demanding arbitration fail to name an arbiter within ten (10) days of the demand, his right to arbitrate shall lapse, and the decision of the ENGINEER shall be final and binding on him. Should the other party fail to choose an arbiter within ten (10) days, the ENGINEER shall appoint such arbiter. Should either party refuse or neglect to supply the arbiters with any papers or information demanded in writing, the arbiters are empowered by both parties to take ex parte proceedings.

The arbiters shall act with promptness. The decision of any two shall be binding on both parties to the contract. The decision of the arbiters upon any question submitted to arbitration under this contract shall be a condition precedent to any right of legal action. The decision of the arbiter or arbiters may be filed in court to carry it into effect.

The arbiters, if they deem the case demands it, are authorized to award the party whose contention is sustained such sums as they deem proper for the time, expense and trouble incident to the appeal, and if the appeal was taken without reasonable cause, they may award damages for any delay occasioned thereby. The arbiters shall fix their own compensation, unless otherwise provided by agreement, and shall assess the cost and charges of the arbitration upon either or both parties. The award of the arbiters must be made in writing.

7. ABANDONMENT OF CONTRACT

7.01 **ABANDONMENT BY CONTRACTOR.** In case the CONTRACTOR should abandon and fail or refuse to resume work within ten (10) days after written notification from the OWNER, or the ENGINEER, or if the CONTRACTOR fails to comply with the orders of the ENGINEER, when such orders are consistent with the Contract Documents, then, and in that case, where performance and payment bonds exist, the Sureties on these bonds shall be notified in writing and directed to complete the work, and a copy of said notice shall be delivered to the CONTRACTOR.

After receiving said notice of abandonment the CONTRACTOR shall not remove from the work any machinery, equipment, tools, materials or supplies then on the job, but the same, together with any materials and equipment under contract for the work, may be held for use on the work by the OWNER or the Surety on the performance bond, or another contractor in completion of the work; and the CONTRACTOR shall not receive any rental or credit therefor (except when used in connection with Extra Work, where credit shall be allowed as provided for under Section 6, Extra Work and Claims), it being understood that the use of such equipment and materials will ultimately reduce the cost to complete the work and be reflected in the final settlement.

Where there is no performance bond provided or in case the Surety should fail to commence compliance with the notice for completion hereinbefore provided for, within ten (10) days after service of such notice, then the OWNER may provide for completion of the work in either of the following elective manners:

7.011 The OWNER may thereupon employ such force of men and use such machinery, equipment, tools, materials and supplies as said OWNER may deem necessary to complete the work and charge the expense of such labor, machinery, equipment, tools, materials and supplies to said CONTRACTOR, and expense so charged shall be deducted and paid by the OWNER out of such moneys as may be due, or that may thereafter at any time become due to the CON- TRACTOR under and by virtue of this Agreement. In case such expense is less than the sum which would have been payable under this contract, if the same had been completed by the CONTRACTOR, then said CONTRACTOR shall receive the difference. In case such expense is greater than the sum which would have been payable under this contract, if the same had been completed by said CONTRACTOR, then the CONTRACTOR and/or his Surety shall pay the amount of such excess to the OWNER; or

7.012 The OWNER under sealed bids, after five (5) days notice published one or more times in a newspaper having general circulation in the county of the location of the work, may let the contract for the completion of the work under substantially the same terms and conditions which are provided in this contract. In case any increase in cost to the OWNER under the new contract as compared to what would have been the cost under this contract, such increase shall be charged to the CONTRACTOR and the Surety shall be and remain bound therefor. However, should the cost to complete any such new contract prove to be less than what would have been the cost to complete under this contract, the CONTRACTOR and/or his Surety shall be credited therewith.

When the work shall have been substantially completed the CONTRACTOR and his Surety shall be so notified and Certificates of Completion and Acceptance, as provided in Paragraph 5.06 hereinabove, shall be issued. A complete itemized statement of the contract accounts, cer- tified to by the ENGINEER as being correct, shall then be prepared and delivered to the CON- TRACTOR and his Surety, whereupon the CONTRACTOR and/or his Surety, or the OWNER as the case may be, shall pay the balance due as reflected by said statement, within fifteen (15) days after the date of such Certificate of Completion.

In the event the statement of accounts shows that the cost to complete the work is less than that which would have been the cost to the OWNER had the work been completed by the CONTRACTOR under the terms of this contract; or when the CONTRACTOR and/or his Surety shall pay the balance shown to be due by them to the OWNER, then all machinery, equipment, tools, materials or supplies left on the site of the work shall be turned over to the CONTRAC- TOR and/or his Surety. Should the cost to complete the work exceed the contract price, and the CONTRACTOR and/or his Surety fail to pay the amount due the OWNER within the time designated hereinabove, and there remains any machinery, equipment, tools, materials or supplies on the site of the work, notice thereof, together with an itemized list of such equipment and mater- ials, shall be mailed to the CONTRACTOR and his Surety at the respective addresses designated in this contract, provided, however, that actual written notice given in any manner will satisfy this condition. After mailing, or other giving of such notice, such property shall be held at the risk of the CONTRACTOR and his Surety subject only to the duty of the OWNER to exercise ordinary care to protect such property. After fifteen (15) days from the date of said notice the OWNER may sell such machinery, equipment, tools, materials or supplies and apply the net sum derived from such sale to the credit of the CONTRACTOR and his Surety. Such sale may be made at either public or private sale, with or without notice, as the OWNER may elect. The OWNER shall release any machinery, equipment, tools, materials, or supplies, which remain on the work and belong to persons other than the CONTRACTOR or his Surety, to their proper owners. The books on all operations provided herein shall be open to the CONTRACTOR and his Surety.

7.02 **ABANDONMENT BY OWNER.** In case the OWNER shall fail to comply with the terms of this contract, and should fail or refuse to comply with said terms within ten (10) days after written notification by the CONTRACTOR, then the CONTRACTOR may suspend or wholly abandon the work, and may remove therefrom all machinery, tools and equipment, and all materials on the site of work that have not been included in payments to the CONTRACTOR and have not been wrought into the work. And thereupon the ENGINEER shall make an estimate of the total amount earned by the CONTRACTOR, which estimate shall include the value of all work actually completed by said CONTRACTOR (at the prices stated in the attached proposal where unit prices are used), the value of all partially completed work at a fair and equitable price, and the amount of all Extra Work performed at the prices agreed upon, or provided for by the terms of this contract, and a reasonable sum to cover the cost of any provisions made by the CONTRACTOR to carry the whole work to completion and which cannot be utilized. The ENGINEER shall then make a final statement of the balance due the CONTRACTOR by deducting from the above estimate all previous payments by the OWNER and all other sums that may be retained by the OWNER under the terms of this Agreement and shall certify same to the OWNER who shall pay to the CONTRACTOR on or before thirty (30) days after the date of the notification by the CONTRACTOR the balance shown by said final statement as due the CONTRACTOR, under the terms of this Agreement.

SUPPLEMENTAL GENERAL CONDITIONS

The following Supplemental General Conditions shall supplement, void and amend the "General Conditions" as the case may be. Where any Section of the "General Conditions" is supplemented hereby, all provisions shall be considered as added hereto. Where any Section of the "General Conditions" is amended, voided, or superseded hereby, all provisions of such Section not so specifically amended, voided or superseded shall remain in effect.

Section 1.01 OWNER, CONTRACTOR, ENGINEER - is hereby supplemented as follows: The term "Owner" means Southwestern Electric Power Company, A Delaware Corporation, acting through its duly authorized officials.

The term "Contractor" means the person, form or corporation entering into the Contract with the owner to construct and install the improvements embraced in this Contract.

The term "Engineer" means the Engineer designated by the owner or such other Engineer, Assistant Engineer, Supervisor or Inspector that may be authorized by the owner to act in his behalf.

Section 2.01 LINES AND GRADES - is hereby amended as follows: The owner or his representative shall furnish a system of base lines and bench marks on the property. The contractor shall lay out lines and grades from this existing control and shall be fully responsible for correctness of such lines and grades and for proper execution of work to such lines and grades. Section 3, of Form 1714, Sargent & Lundy's Standard Specification for Earthwork, is hereby referenced as our expanded explanation of this amendment.

Section 2.02 ENGINEERS AUTHORITY AND DUTY - the first two sentences of Section 2.02 are hereby deleted and replaced with the following: "Unless otherwise specified, it is mutually agreed between the parties to this Agreement that the Engineer shall inspect all work included herein. Said inspection shall not relieve the Contractor of his obligations to properly execute the Contract. The Engineer has the authority to stop the work whenever such stoppage in his opinion may be necessary to protect the interest of the Owner and insure the proper execution of the Contract.

Section 2.07 CONTRACTOR'S BUILDINGS - is hereby supplemented as follows: Any temporary construction office building shall be furnished by and remain 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 and shall be arranged and located as directed by the Engineer.

Section 3.00 PROTECTION AGAINST ACCIDENT TO EMPLOYEES AND THE PUBLIC - is hereby supplemented as follows:

INSURANCE

Contractor agrees to indemnify and hold Owner, its officers, agents, and employees harmless from and against any and all claims, demands, suits and judgments for damage to property or injury to or deaths of, persons caused by any act, neglect, omission or fault on the part of Contractor, or on the part of any Subcontractor, arising out of or in any way connected with the work performed under this contract, including all court costs and attorney's fees.

The Contractor shall not commence work under this contract until he has obtained all the insurance required under this paragraph and such insurance has been approved by the Owner, nor shall the Contractor allow any Subcontractor to commence work on his subcontract until the insurance required of the Subcontractor has been so obtained and approved.

The Contractor shall procure and shall maintain during the life of this contract, Workmen's Compensation Insurance for all of his employees to be engaged in the work on the project under this contract, and, in case of any such work sublet, the Contractor shall require the Subcontractor similarly to provide Workmen's Compensation Insurance for all of the latter's employees to be engaged in such work, unless such employees are covered by the protection afforded by the Contractor's Workmen's Compensation Insurance.

The Contractor shall procure and shall maintain during the life of this contract, Contractor's Public Liability Insurance in amounts not less than the following:

Employers' Liability	\$ 25,000.00 each occurrence
Comprehensive General Liability: Bodily Injury	\$ 100,000.00 each person \$ 300,000.00 each occurrence
Property Damage	\$ 100,000.00 each occurrence

Motor Vehicle Liability: Bodily Injury	\$ 100,000.00 each person \$ 300,000.00 each occurrence
Property Damage	\$ 100,000.00 each occurrence
Contractural Liability	Same as above for General Liability

The insurance required hereof for Compensation and Contractor's Liability shall provide adequate protection for the Contractor and his Subcontractors, respectively, against damage claims which may arise from operations under this contract, whether such operations be by the insured or by anyone directly or indirectly employed by him and, also against special hazards, if any, as set forth in the contract.

The Contractor shall furnish the Owner with satisfactory proof of carriage of the insurance required.

Section 5.02 ESTIMATED QUANTITIES - is hereby amended as follows: The second and third paragraphs, (Second paragraph- Where payment is based on the unit prices-----, and Third paragraph- A "Major Item" shall be--------), are hereby deleted. The Contractor shall perform the work as increased or decreased regardless of the amount of variation in the estimated quantities.

Section 6.01 EXTRA WORK - "Method C" and subsequent explanation thereof is hereby deleted. The Cost Plus method as outlined in the proposal is hereby substituted in place of "Method C".

SPECIAL CONDITIONS

0.1 General.

The provisions of this section of the specifications shall govern in the event of any conflict between them and the "General Conditions of Agreement" or "Supplemental General Conditions".

These specifications cover the Plant Site Grading, Railroad Bed Construction, Ash Pit Dikes and Related Work, and Excavation & Embankment for Generating Plant Area as per attached drawing (s) and the following specification. We have attempted to list all major requirements of construction and any requirements not specifically covered by these specifications and/or drawings, but essential to the accomplishment of this project as proposed herein will be considered a part of the contract price to satisfactorily complete this job.

0.2 Drawings

Drawings will show the scope of the work. All such drawings shall be considered as a part of these specifications.

0.3 Site Inspection

Contractor shall carefully examine the site of the work and the adjacent premises, and shall conduct the necessary investigations to inform himself thoroughly as to the facilities for delivery and handling of materials at the site, also to inform himself thoroughly as to all the difficulties involved in the completion of all work in accordance with specifications and drawings. No plea of ignorance of conditions that exist, or of difficulties that may be encountered in the execution of the work will be accepted as an excuse for any failure or omission on the part of Contractor to fulfill in every detail all the requirements of the specifications and drawings, nor will it be accepted as a basis for any claims whatsoever for extra compensation when resulting from failure to make the necessary preliminary examination and investigation.

0.4 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.

0.5 Cleaning Up

The Contractor shall at all times maintain the job site in a clean and orderly manner, and shall currently remove all waste or rubbish caused by his employees (or Subcontractors) work. He shall, within ten days after completion of the work, remove his rubbish, work facilities, surplus materials and construction equipment from the premises. The burning of materials for disposal purposes will be permitted only in such areas as are designated by Owner.

0.6 Work Outside Regular Hours

If the Contractor, or any Subcontractor, desires to carry on work outside the regular hours or on Sundays or holidays, he shall notify the Owner in sufficient time to allow the Owner to make arrangements to inspect the work.

0.7 Policing of Work

The Contractor shall be responsible for such policing of his own material, storage equipment, tools, etc., as he may require. He must take adequate steps to protect his own property and the Owner's property under his care.

0.8 Permits, Licenses and Taxes

The Contractor shall procure and pay for all permits and licenses which may be required by an applicable federal , state or local law, ordinance or regulation and shall upon completion of the work, deliver all such licenses and permits to the Owner. The Contractor shall also pay all applicable taxes as required by law.

0.9 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.

0.10 Reference Specifications.

Where reference is made in these specifications to specifications compiled by other agencies, organizations or departments, such reference is made for expediency and standardization from the material suppliers' point of view, and such specifications referred to are hereby made a part of these specifications.

0.11 Substitution of Materials or Equipment.

Where materials or equipment are specified by a trade or brand name, it is not the intention of the Owner to discriminate against an equal product of another manufacturer, but rather to set a definite standard of quality or performance, and to establish an equal basis for the evaluation of bids. Where the words "equivalent" or "equal to" are used, they shall be understood to mean that the thing referred to shall be the equivalent of, or equal to some other thing, in the opinion or judgment of the Engineer. Unless otherwise specified, all materials shall be the best of their respective kinds and shall be in all cases fully equal to approved samples. Not withstanding that the words "equal to" or other such expressions may be used in the specifications in connection with a material, manufactured article or process, the material, article or process specifically designated shall be used, unless a substitute shall be approved in writing by the Engineer, and the Engineer shall have the right to require the use of such specifically designated material, article or process.

0.12 Coordination with Others

In the event other contractors are doing work in the same area simultaneously with this project the Contractor shall coordinate his proposed construction with that of the other contractors.

0.13 Project Maintenance

The Contractor shall maintain and keep in good repair the improvements covered by these plans and specifications during the life of his contract.

0.14 Price Interpretation

In case of ambiguity or lack of clearness in stating prices in the proposal, the Owner reserves the right to adopt the prices written in words. The main unit prices shall appear only where called for in the Proposal Form and shall not appear elsewhere in the Proposal. Any alternate prices, except as specifically set forth in the Proposal Form, shall be given on a separate page and shall not be included with Bidder's technical or other nonprice data.

0.15 Nondiscrimination in Employment

A. That all applicable provisions of Executive Order No. 11246, 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, have been fully met and observed in respect of the manufacture of the materials and equipment or the performance of services covered by this Contract;

B. That he has taken affirmative action to insure that applicants for employment by him and his employees are dealt with, without regard to race, color, religion, sex, or national origin;

C. That he has caused or will seek to cause the inclusion to contracts with his subcontractors appropriate language requiring said subcontractor to take affirmative, appropriate action to insure compliance with the provisions and requirements set out in paragraph A hereof.

0.16 Right to Reject

The right is reserved to reject any or all proposals.

0.17 Use of Explosives

Use of explosives will be allowed only upon written instructions of the Engineer.

Should the Contractor elect to use explosives in the prosecution of the work, the utmost care shall be exercised so as not to endanger life or property. The Contractor shall at all times be liable for any injuries to persons or property caused by the use of explosives. The Contractor shall notify the proper representative of any public service corporation, any company, or any individual, not less than eight (8) hours in advance of the use of explosives which might endanger or damage their or his property along or adjacent to the work. Whenever explosives are stored or kept, they shall be stored in a safe and secure manner and all storage places be plainly marked "DANGEROUS EXPLOSIVES," and shall be under the care of a competent watchman at all times. Nothing in this section shall be construed as modifying the requirements set forth in Form 1714, paragraphs 5.11 through 5.11.6.

0.18 Measurements for Payment

The Engineer will be responsible for measurement of all quantities for payment. This includes all of the various bid items. Earthwork quantities shall be measured in place by the cross section end area method.

DRAWINGS

The following drawings are attached hereto and form a part hereof.

A. Plant Site Grading

(1) Job Specification for Plant Site Grading
(2) Drawings: WePX-11 S-41
WePX-12 S-44
S-26 S-46
S-40 S-47

B. Railroad Bed Construction

(1) Job Specification for Railroad Bed Construction
(2) Drawings: WePX-13
WePX-14 Sheets 1 and 2
S-44

C. Ash Pit Dikes & Related Work

(1) Job Specification for Ash Pit Dikes & Related Work
(2) Drawings: (Sargent & Lundy)
S-11
S-12
S-13
S-14
S-15R

D. Excavation & Embankment for Generating Plant Area

(1) Job Specification for Excavation & Embankment for Generating Plant Area
(2) Drawings: (Sargent & Lundy)
S-148
S-149

JOB SPECIFICATIONS

FOR

PLANT SITE GRADING
WELSH POWER PLANT

GENERAL DESCRIPTION

The plant site area is presently partially cleared and grubbed. The Contractor is to complete clearing and grubbing and grade the plant site in accordance with the following specification.

1. Clearing and Grubbing

A. Contractor shall clear and grub the area shown on Drawing WePX - 12 of all trees, stumps, brush and perishable materials of whatsoever nature. All roots, stumps, logs, etc., shall be grubbed out to a depth of not less than one (1) foot below ground level.

B. All of these materials shall be disposed of by burning or other approved manner.

C. The Owner retains the right to have certain trees left standing if so desired and Contractor shall take special care in the work around such trees in order to avoid damage to them.

D. A portion of the area shown on Drawing WePX-12 is noted to be an existing field which will require only minor work. This area is not included in the estimated quantity given below.

E. Estimated Quantity: 21 acres.

F. Basis for Payment: Price per acre.

2. Re-Grubbing

A. Approximately 180 acres of the plant site has been cleared and grubbed. This area is shown on Drawing WePX-12.

B. The Contractor shall be required to re-grub this area.

C. Estimated Quantity: 180 acres

D. Basis for Payment: Lump Sum

3. Earthwork

A. Site Grading shall be formed to the section, slopes, and dimensions as shown on the Drawings or as directed by the Owner's Engineer.

B. Sections, slopes, and dimensions may be changed by the Owner's Engineer to conform with special conditions.

C. Excess excavation materials shall be placed in areas as directed by the Owner's Engineer. Excess excavation after placement shall be reasonable level and compacted.

D. While excavation is being done and until the work is finally accepted, the Contractor shall take necessary steps to prevent the loss of material from the plant area. During construction, the area shall be maintained in such condition that it will be well drained at all times.

E. Embankments and fill areas shall, in general, start from a firm base from which muck, vegetation, and other unsuitable material shall have been removed and the base compacted to the density required for fills.

F. Before excavation or any filling operations are performed, the topsoil shall be removed from such areas. This topsoil shall be stockpiled where directed for future use.

G. In certain areas, the fill materials used shall be excavated from borrow areas designated by the Owner or Owner's Engineer. Prior to starting any fill work, the Contractor shall consult with the Owner or Owner's Engineer to determine the source of the fill material. Any fill placed without prior approval from the Owner shall be removed and replaced with approved fill at Contractor's expense. The Contractor's unit price for excavation shall be based on a free haul distance of 2000 feet. In the event that the Contractor is required to haul dirt in excess of the 2000 foot free haul distance he shall be paid at the unit price bid for overhaul per yard - quarter. Item 140 (Overhaul) of the 1972 Texas Highway Standard Specification is hereby referenced as the governing specification. The 2000 foot free haul distance is substituted for the 600 foot free haul distance specification in Item 140. Approval and authorization in writing from the Engineer must be obtained before payment will be made for overhaul.

H. Ditches shall be formed at the bottom of the slopes in cuttings as may be directed. They shall be neatly made, clean of obstructions and the lower ends must diverge sufficiently to prevent erosion.

I. Unless otherwise directed, embankments of earth and any other fill areas shall be built in horizontal layers not exceeding ten (10) inches compacted in depth or as directed by the Engineer. Each layer must be compacted to 90% of maximum Modified Procter density as determined by ASTM D1557.

J. When material varies from optimum moisture content, it shall be treated as follows: when wet, it shall be drained or worked until optimum moisture content is attained. When dry, it shall be sprinkled with water and mixed until optimum moisture content is attained.

K. Embankments and fill areas shall be carried to such height above subgrade and to such increased width as may be deemed necessary to provide for shrinkage, subsidence, and erosion.

L. When embankments are to be placed on sloping ground or against existing embankments, the surface shall be deeply plowed or stepped.

M. The subgrade shall be compact and finished to a true sloped or crowned surface as called for in the plans, thus leaving no depression that will hold water.

N. Estimated Quantities: 543,000 cubic yards excavation

335,000 cubic yards embankments

O. Basis for Payment: Price per cubic yard-excavation
Price per cubic yard-embankment
Price per yard-quarter overhaul

4. Culverts

A. Pipe for culverts shall conform to Section 2-7.3, Galvanized Corrugated metal drainage piping per Sargent and Lundy's Job Specifications (Our Page TS 3 - 17 of Ash Pit Dikes Division 2, Technical Requirements).

B. All culverts shall be bedded, strutted and backfilled in accordance with the manufacturer's recommendations and installed to true line and grade as set by the Engineer.

C. Estimated Quantities:
70 linear feet --- 24"x13" corrugated metal (arch) pipe----14 gauge
84 linear feet ---36"x22" corrugated metal (arch) pipe----14 gauge

116 linear feet	---24" corrugated metal pipe-----------	14 gauge
120 linear feet	---30" corrugated metal pipe----------	12 gauge
328 linear feet	---36" corrugated metal pipe----------	12 gauge
72 linear feet	---48" corrugated metal pipe----------	10 gauge
304 linear feet	---60" corrugated metal pipe ---------	8 gauge

________________ Structural Excavation, Culvert
(No Basis for Estimated Quantity at this time)

D. Basis for Payment

Culvert---Price per linear foot for furnishing and installing each size and type culvert pipe.

Structural Excavation ---Price per cubic yard of structural excavation for culverts.

JOB SPECIFICATIONS
FOR
RAILROAD BED CONSTRUCTION
WELSH POWER PLANT

GENERAL DESCRIPTION

The plant site railroad will consist of approximately 9,700 feet of track from the L & A Railroad spur to the plant loop track with 1,000 feet of passing side track and 10,525 feet of track forming a loop around the plant area.

The Contractor is to perform clearing, grubbing, earthwork, installation of culverts, and slope erosion protection for the complete roadbed in accordance with the following specifications.

1. Clearing and Grubbing

A. Remove from the area to be graded, all trees, brush, shrubs, vines, logs and rubbish.

B. All stumps and roots exceeding two (2) inches in diameter shall be removed to a depth of at least eight (8) inches below subgrade.

C. All these materials shall be burned or disposed of in other approved manner.

D. Holes made by clearing and grubbing shall be refilled with suitable material and compacted to a density approximately that of the adjacent ground.

E. Estimated Quantity ____10____ Acres

F. Basis for Payment: Price per Acre.

2. Culverts

A. Pipe for culverts shall conform to Section 2-7.3, Galvanized Corrugated metal drainage piping per Sargent and Lundy's Job Specifications (Our Page TS 3 - 17 of Ash Pit Dikes Division 2, Technical Requirements).

B. All culverts shall be bedded, strutted and backfilled in accordance with the manufacturer's recommendations and installed to true line and grade as set by the Engineer.

C. Preliminary Engineering studies indicate that the railroad bed construction will necessitate the installation of several large culverts. The size, length and quantity of culverts will be accurately determined prior to the construction of the railroad bed. The size and quantity of the culvert listed in "D" below are based on the preliminary Engineer estimate.

D. Estimated Quantities: Culvert

140 linear feet of 36"x22" corrugated metal (arch) pipe---14 gauge
270 linear feet of 72" corrugated metal pipe--------------8 gauge

________ cubic yard---Structural Excavation, Culvert
(No Basis for Estimated Quantity at this time)

3. Earthwork

A. Excavation and fill final grades shall conform to the grades and shapes as shown on the drawings.

B. While the excavation and filling is being done and until the work is finally accepted, the Contractor shall take the necessary steps to prevent loss of material from the roadway. During construction of the roadway, the roadbed shall be maintained in such condition that it will be well drained at all times.

C. The Contractor shall perform the structural drainage excavation for culverts at the time rough grading is done unless otherwise directed by the Engineer. The Contractor shall dispose of or use the excavated material as directed by the Engineer.

D. The Contractor shall maintain cross fences during construction until such time as the new fencing is completed.

E. The embankments shall conform to lines and grades as shown on the drawings.

F. Embankments and fill areas shall, in general, start from a firm base from which muck, vegetation, and other unsuitable material shall have been removed and the base compacted to the density required for embankments.

G. Embankments shall be formed of selected materials obtained from borrow and excavated areas as herein specified and placed in successive horizontal layers not exceeding ten (10) inches compacted depth, distributed uniformly and thoroughly compacted. Embankments shall be free of all vegetation and other objectionable matter.

H. Before any excavation or filling operations are performed, the topsoil shall be removed from such areas. This topsoil shall be stockpiled where directed for future use.

I. Except where otherwise directed by the Company's Engineer, excavated material shall be so handled, conserved, stored, and placed as to have the least desirable material at the bottom of the embankments; topsoil to be reserved for slopes.

J. When material varies from optimum moisture content, it shall be treated as follows: when wet, it shall be drained or worked until optimum moisture content is attained. When dry, it shall be sprinkled with water and mixed until optimum moisture content is attained.

K. All material placed in embankments shall be compacted to 90% of maximum density Modified Procter as determined by ASTM D-1557.

L. All roots, stumps, and other obstructions in the sides and bottoms of ditches shall be cut to conform to the required cross section and grade.

M. All ditches excavated or formed by the Contractor shall be maintained free from earth, sticks, or other debris until final acceptance.

N. All perishable material resulting from the work shall be disposed of by burning or other approved manner. All other excavated materials shall be placed on the site where and as directed by the Engineer.

O. Materials used in the construction of the embankment for the railroad bed shall conform to the requirements of Sargent and Lundy's Standard Specifications for Earthwork (Form 1714).

P. The Contractor's unit price for excavation shall be based on a free haul distance of 2000 feet. In the event that the Contractor is required to haul dirt in excess of the 2000 foot free haul distance he shall be paid at the unit price bid for overhaul per yard - quarter. Item 140 (Overhaul) of the 1972 Texas Highway Standard Specification is hereby referenced as the governing specification. The 2000 foot free haul distance is substituted for the 600 foot free haul distance specification in Item 140. Approval and authorization in writing from the Engineer must be obtained before payment will be made for overhaul.

Q. Estimated Quantities:

126,000 cubic yards - excavation

104,000 cubic yards - embankment

R. Basis for Payment
Price per cubic yard - excavation
Price per cubic yard - embankment
Price per yard -quarter -overhaul

JOB SPECIFICATIONS
FOR
ASH PIT DIKES
WELSH POWER PLANT

GENERAL DESCRIPTION

The coal fired plant will require an area for storage of ash. A thirty-two (32) acre pit will be utilized as a settling area for ash. A smallor pit will be used as a secondary settling area. The effluent of this secondary will then flow into the main lake.

This specification will cover construction of the containment dikes, grading the secondary settling area, building the innerconnecting canal, and clearing the main ash pit.

JOB SPECIFICATION
WELSH POWER PLANT - UNIT 1
SOUTHWESTERN ELECTRIC POWER COMPANY

ASH PIT DIKES

SCOPE OF WORK

Construction of ash pond DIKES, including clearing, grubbing, placing compacted fill, structures on dike pipes through dike. Wier box complete by others

1-1 WORK FURNISHED AND INSTALLED OR PERFORMED: Contractor shall furnish, fabricate, deliver and unload materials and equipment for, shall store, protect and remove materials and equipment from storage for, and shall install, construct, erect or perform and finish the following WORK:

a. Earthwork, including clearing and grubbing, excavation, backfilling, filling and soil compaction control.

b. Construction of earth dikes along the sides and within the ASH Storage Area.

c. Miscellaneous Construction including concrete work, metalwork, carpentry work, and galvanized corrugated metal pipes.

d. Grass work, including soil preparation, seeding, fertilizing and maintenance.

e. Bedding courses and riprap as shown on the drawing.

1-2 RESPONSIBILITY FOR RESTRICTION OF NATURAL DRAINAGE DURING FILL PLACEMENT:

Contractor shall not place any fill for dikes, etc., across routes of natural drainage until provisions are made to drain surface runoff into drainage ditches forming a part of the WORK.

No surface runoff shall be ponded or restricted to a greater degree than would have occurred naturally either before the beginning of construction or after completion of the WORK, unless approved by Purchaser's representative.

Should ponding or restriction of surface runoff result in water being backed up onto property not owned by Purchaser or onto Purchaser's property where work by other contractors is either under way or completed or where materials or equipment are being stored, all damages resulting therefrom shall be responsibility of Contractor.

Temporary Slopes: Temporary construction slopes in excavation or in fill used for temporary drainage channels shall not be steeper than 3 horizontal to 1 vertical, except as indicated on the drawings or as approved.

SARGENT & LUNDY
ENGINEERS
CHICAGO

ASH PIT DIKES
WELSH POWER PLANT - UNIT 1
SOUTHWESTERN ELECTRIC POWER COMPANY

DIVISION 2 - TECHNICAL REQUIREMENTS

SECTION 2-1: EARTHWORK

2-1.1 SECTION SCOPE

2-1.1.1 This section of the Specification includes requirements for the following, as indicated on the drawings, as hereinafter specified (under the Article numbers indicated), or as required to properly complete the WORK:

2-1.2 Services of Testing Laboratory
2-1.3 Soil Data and Topography
2-1.4 Removal of Sod and Topsoil
2-1.5 Excavation
2-1.6 Compacted Fill
2-1.7 Equipment
2-1.8 Fill Placement
2-1.9 Backfill
2-1.10 Excavation & Fill for Corrugated Metal Drainage Piping
2-1.11 Drainage Ditches
2-1.12 Bedding Course for Riprap
2-1.13 Riprap
2-1.14 Grading
2-1.15 Seeding

2-1.2 SERVICES OF TESTING LABORATORY
Will be furnished by Purchaser for use in connection with controlled compacted fill, as specified in Article 6.2 of Form 1714.

2-1.3 SOIL DATA AND TOPOGRAPHY
As specified in Article 2 of Form 1714. Drawings are included, and borings will be available for inspection at SWEPCo or McClelland Engineers at Houston, Texas.

2-1.4 REMOVAL OF SOD AND TOPSOIL
As specified in Article 4.6 of Form 1714. Stockpile topsoil on site, where and as requested by Purchaser's representative, for later reuse. Dispose of sod on site as requested by Purchaser's representative.

2-1.5 EXCAVATION

2-1.5.1 As specified in Article 5 of Form 1714. Dispose of all excavated materials on site, either as fill material or in stockpile are.., as requested by Purchaser's representative. The Contractor's unit price fo[r] excavation shall be based on a free haul distance of 2000 feet. In the event that the Contracto[r is] required to haul dirt in excess of the 2000 foot free haul distance he shall be paid at the unit pr[ice] bid for overhaul per yard - quarter. Item 140 (Overhaul) of the 1972 Texas Highway Standard Spe[c]ification is hereby referenced as the governing specification. The 2000 foot free haul distance is substituted for the 600 foot free haul distance specification in Item 140. Approval and authorizatio[n] in writing from the Engineer must be obtained before payment will be made for overhaul.

2-1.5.2 Area of stockpile shall be cleaned of vegetation and disposed of as specified in Article 4.5 of Form 1714.

2-1.5.3 Dewatering: As specified in Article 5.3 of Form 1714 and as indicated on the design drawings. During course of the WORK, Contractor shall maintain sufficient slope in excavation and on fill area to permit drainage of surface water and maintaining a dry working condition.

2-1.6 COMPACTED FILL

2-1.6.1 Conform to the applicable requirements of Article 6 of Form 1714 and requirements hereinafter specified.

2-1.6.2 Class and Type: One of the following as indicated on the drawings:

a. Class 1, Regular Compacted Fill, Type RCF1, Granular Material.

b. Class 1, Regular Compacted Fill, Type RCF2, Cohesive Material.

c. Class 2, Controlled Compacted Fill, Type CCF1, Granular Material.

d. Class 2, Controlled Compacted Fill, Type CCF2, Cohesive Material.

2-1.6.3 Material: Shall be impervious fill material obtained from excavation and borrow areas on site as indicated on the drawings, or from other approved stockpiles or borrow areas off site. All sources of dike fill shall be designated and approved by the Purchaser's representative. The fill material shall not contain any cobbles or broken rock larger than nine (9) inches maximum dimension at time of placement and compaction.

2-1.6.4 Compaction Densities: Dike fill shall be loosely placed in layers not exceeding ten (10) inches. Each layer of fill shall be thoroughly compacted by means of a sheepsfoot roller or pneumatic tired rollers of adequate capacity and through sufficient coverages to obtain not less than 95 percent of the maximum Modified Proctor density in accordance with ASTM Test D1557, latest edition. Compaction shall be performed within 2-1/2 percent of the optimum moisture content.

2-1.6.5 Disposal of Organic Materials: Vegetation, organic material, and other foreign materials removed in preparation of subgrade, as specified in Articles 6.3.3 and 6.4.3.2 of Form 1714, shall be disposed of on the site as requested by Purchaser's representative.

2-1.6.6 Preparation of Subgrade: Prior to placement of fill material and after stripping, the subgrade shall be compacted (proofrolled) through sufficient passes of an approved sheepsfoot roller capable of densifying the present surface to not less than 90 percent of the maximum Modified Proctor density in accordance with ASTM Test D1557.

2-1.7 EQUIPMENT

2-1.7.1 Compaction Equipment: Equipment to be used for constructing fill may consist of any type normally considered suitable to construct embankments for dams or highways. Main compaction equipment, including heavy pneumatic tired rollers, sheepsfoot rollers, vibratory compactors, shall be subject to approval of Purchaser's representative.

a. In addition to the foregoing equipment, Contractor shall have the following equipment available at the WORK:

a.1 Power tampers to be used for compaction of material in areas where it is impractical to use a roller or tractor.

a.2 A plain cylindrical roller, weighing not less than 1,000 pounds per lineal foot for rolling the surface of fill smooth for drainage in case of heavy precipitation.

a.3 Discs, harrows, and motor graders for drying and maintaining fill.

2-1.8 FILL PLACEMENT

2-1.8.1 As specified in Paragraph 6.4.5 of Form 1714, and as follows:

a. Distribution and gradation of materials throughout rolled fill shall be such that fill will be free from lenses, pockets, streaks or layers of material differing materially in texture or gradation from surrounding material. Combined excavation and placing operations shall be such that materials when compacted in the fill will be blended sufficiently to secure the best practicable degree of compaction, and stability. Travel on the fill shall be satisfactorily controlled to prevent tracking or cutting fill.

b. Successive loads of material shall be dumped so as to produce the best practicable distribution of material, and for this purpose locations in earth fill where individual loads shall be deposited may be designated. If the surface of any layer of material to be placed thereon has formed a hard over-compacted crust from traffic, it shall be moistened or both moistened and scarified as required before the succeeding layer of material is placed.

c. When rain is expected, and at the end of each working day, fill shall be rolled with a plain cylindrical roller to form a smooth surface with sufficient slope to cause rapid runoff of rainwater. Before resuming placement, this surface shall be scarified and moistened, as required. If Purchaser's representative determines that the rolled surface of any layer of earth fill in place is too wet for proper compaction of fill thereon, it shall be removed, allowed to dry, or shall be worked with a harrow, scarifier or other suitable equipment, to reduce water content to the required amount, and then shall be recompacted. Do not place the next succeeding layer of fill until approval to proceed is given by Purchaser's representative and the Consulting Engineers.

d. All openings through embankments required for construction and temporary drainage purposes shall be subject to approval. Approach or construction ramps for dikes and embankments shall be removed and those on the outside face shall be removed and/or trimmed, as requested.

2-1.9 BACKFILL

2-1.9.1 As specified in Article 7 of Form 1714.

2-1.9.2 Material shall be same as indicated in Article 2-1.6.3 for Compacted Fill.

2-1.10 EXCAVATION AND FILL FOR CORRUGATED METAL DRAIN PIPING

As specified in Article 9 of Form 1746.

2-1.11 DRAINAGE DITCHES

Cut and/or fill drainage ditches (if required) to cross sections and profiles indicated on the drawings. All surfaces shall be well compacted.

2-1.12 BEDDING COURSE FOR RIPRAP

2-1.12.1 Material: Bedding shall consist of a clean, well graded mixture of sand and gravel, crushed stone or crushed gravel conforming to the following gradation limits:

Sieve Size	% Passing by Weight
3"	100
1½"	65-85
#4	40-60
#40	20-35
#50	15-25
#100	0-15
#200	0-5

2-1.12.2 Placing: Place by approved means to the minimum thickness indicated on the drawings.

2-1.13 RIPRAP

2-1.13.1 Material:

a. Riprap shall consist of quarried stone, or other stone, free from structural defects and of approved quality. Stone containing shale, unsound sandstone or any other material which will readily disintegrate under handling and placing or weathering, shall not be used. Any stone which is free from incipient fractures and seams and has given evidence of ability to withstand weathering after long exposure to the elements shall be considered suitable for this purpose. Upon presentation of satisfactory evidence of ability to withstand weathering, such stone may be used without laboratory testing.

b. In case newly quarried stone or stone of questionable weathering quality is proposed, it shall be subjected to the sodium sulphate soundness test and shall show a loss, after cycles, of not more than 25 percent. Materials failing this test may be approved if, when subjected to fifty cycles of freezing and thawing, it has a loss not greater than 25 percent. Soundness method AASHO T104 (ASTM C88), "Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate" or T103, "Method of Test for Soundness of Aggregates by Freezing and Thawing" shall be used.

c. The moist unit weight of riprap shall not be less than 164 pounds per cubic foot.

2-1.13.2 Size and Gradation

a. Riprap shall be reasonably well graded and quarried stone shall have a gradation conforming to the following weight limits:

a.1 Maximum size....................................450 lbs.

a.2 At least 25 percent greater than..............200 lbs.

a.3 45 percent - 75 percent from - to.............80-120 lbs.

a.4 Not more than 25 percent less than............50 lbs.

a.5 Sand and rock dust not more than..............5 percent

b. The shortest dimension of any stone shall be not less than 1/3 of the longest dimension for at least 60 percent of the riprap. For the balance, the shortest dimension shall be not less than 1/5 of the longest dimension.

c. Alternate sizes and gradations will be considered for the WORK if they will achieve the desired performance at less cost. If an alternate is proposed, size and gradation of alternate shall be stated in the Bid Proposal, together with the price saving.

2-1.13.3 Placing:

a. Riprap shall be placed by dragline, clamshell or similar equipment which shall be operated so as to place each load of material in approximately its final position without further reworking, and without excessive height of drop.

b. Placement operations, including handling, stockpiling and transporting, shall be accomplished in such manner so as to produce a reasonably well graded mass of rock with minimum percentage of voids, free from objectionable pockets of small stones and clusters of large stones and having a reasonably regular finished surface.

c. Riprap shall be placed on the face of the dikes to the lines and grades and to the minimum thickness indicated on the drawings. The riprap shall be placed to this full minimum thickness in one operation. Thickness shall not be less than the minimum at any point. Hand placing to a limited extent may be required, but only to the extent necessary to secure results specified foregoing.

d. In no case shall a bulldozer be used in shaping the riprap slopes.

2-1.14 GRADING

As specified in Article 8 of Form 1714, and as indicated on the drawings.

2-1.15 SEEDING

2-1.15.1 All slopes and surfaces, as indicated on the drawings, shall be seeded as hereinafter specified.

2-1.15.2 Topsoil:

a. Material: Approved topsoil from topsoil previously excavated and stockpiled on the site or approved topsoil from sources off the property or both.

b. Placing:

b.1 Spread topsoil evenly to a depth which, after settlement and compaction, shall be 4 inches. Do not spread when ground or topsoil is excessively wet or otherwise in any condit on detrimental to the work; if existing surface has become hardened or crusted, rake or otherwise break up to provide bond with layer of topsoil.

b.2 After spreading has been completed, rake up and remove large clods, stones larger than 2 inches in any dimension, roots, stumps, and other litter or deleterious material.

b.3 Completed finish grading shall provide a smooth grade, true to indicated elevations, cross sections and profiles, properly drained and free from pockets or high spots, and as approved for subsequent fertilizing and seeding operations as hereinafter specified.

2-1.15.3 Fertilizing:

a. Material: Ready-mixed material having an analysis of 16-8-8 nitrogen, available phosphoric acid and water soluble potash. Deliver to job in sealed containers with weight, analysis, and name of manufacturer clearly indicated on each container.

b. Storage: Store in such a manner as will not impair fertilizer's effectiveness.

c. Coverage: 300 lbs. per acre.

2-1.15.4 Seeding:

a. Seeding Time: Do fertilizing and seeding as soon as possible after completion of finish topsoil work. However, do no fertilizing or seeding during windy weather or when ground is wet or in an otherwise untillable condition.

b. Seed:

b1. Seed shall be un-Hulled Bermuda and Rye grass with purity and germination of 95 and 90, respectively.

b2. Coverage: Bermuda 5 lbs. per 1000 SY - Rye grass 21 lbs. per 1000SY

b3. All seed shall comply with all applicable laws and regulations of the State of Texas and of U.S. Department of Agriculture.

c. Have seed delivered to job in sealed containers.

d. Furnish to Purchaser duplicate signed copies of statement by seed vendor that each lot of seed has been tested by a recognized laboratory for seed testing within six months of date of delivery, and complies with all requirements for the specified seed.

e. Protection: Immediately after seeding, cover seeded areas with two (2) tons per acre of straw mulch and anchor this by spraying with cutback asphalt (RC-3) at the rate of .10 gallon per sq. yd.

f. Sowing and Maintaining, Etc.: Methods of preparation of seed beds, fertilizing, seeding, sprinkling, maintaining, repair, and reseeding as required will be at option of Contractor. Work shall not be considered complete until after a uniform and dense stand of healthy grass has been produced in accordance with these specifications, free from bare spots and gullies formed by erosion, and when accepted in writing by Purchaser.

Ash Pit Dikes

2-1.15.5

Estimated Quantities:

[illegible],000	cubic yards excavation (common)
97,000	cubic yards excavation (core trench)
100,000	cubic yards excavation (discharge flume)
160,000	cubic yards embankment (density control)
19,000	square yards rip-rap (rock) (Layered rock 12" thick on 6" depth gravel base and 4" thick sand base)
(Alternate:) 19,000	square yards rip-rap (Conc. Cl. B) - Same bas
10,000	square yards topsoil (4" thick layer)
10,000	square yards fertilizing, seeding, mulching, and watering

Basis for Payment:

Price per cubic yard excavation (common)
Price per cubic yard excavation (core trench)
Price per cubic yard excavation (discharge flume)
Price per cubic yard embankment (density control)
Price per yard - quarter - overhaul
Price per square yard rip-rap (rock)
(Alternate:) Price per square yard rip-rap (Conc. Cl. B)
Price per square yard 4" layer of topsoil
Price per square yard fertilizing, seeding, mulching, and watering.

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DIVISION 2 - TECHNICAL REQUIREMENTS

SECTION 2-2: CLEARING AND GRUBBING

2-2.1 SECTION SCOPE

2-2.1.1 This Section of the Specification includes requirements for the following, as indicated on the drawings, as hereinafter specified (under the Article numbers indicated, or as required to properly complete the WORK:

2-2.1.2 Requirements of Division 1, General Requirements, also apply to the WORK under this Section 2-2.

2-2.2 TREE REMOVAL AND CLEARING

2-2.2.1 Conform to applicable requirements of Article 4 of Form 1714, and to requirements hereinafter specified.

2-2.2.2 Tree Removal:

a. Clear and grub all trees in the following areas.
   1. Dike borrow areas.
   2. Within the toes (the entire base) of lake and ash pond dikes.
b. All other trees within the lake and ash pond dikes shall be shear dozed at ground level.
c. Remove and dispose of off the site all partially buried logs, down timber, snags, brush, hedges, bushes and all other vegetation or organic material, all rubbish, debris and other foreign or objectionable material above ground surface.
d. Remove all floating debris in swampy areas and dispose of off site. Cut all trees in swampy areas as directed by Owner's Engineer.

2-2.2.3 CLEARING

a. Contractor shall have full property rights to all timber cut by him, and may sell, off the site only, all merchantable timber which he cuts. Merchantable timber may be processed either on the site or off the site, as agreed to with Purchaser, but shall all be removed from the site before completion of the WORK.

2-2.2.4 ESTIMATED QUANTITY: 32 acres clearing
20 acres clearing and grubbing

2-2.2.5 BASIS FOR PAYMENT: Price per acre clearing
Price per acre clearing and grubbing

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SECTION 2-4: CONCRETE WORK

2-4.1 SECTION SCOPE

2-4.1.1 This Section of the Specification includes requirements for the following, as indicated on the drawings, as hereinafter specified (under the Article numbers indicated), or as required to properly complete the WORK:

- 2-4.2 Services of Testing Laboratory
- 2-4.3 Class of Concrete
- 2-4.4 Cement
- 2-4.5 Fly Ash
- 2-4.6 Water-Reducing Admixtures
- 2-4.7 Reinforcing Steel
- 2-4.8 Formwork
- 2-4.9 Cold Weather Placing of Concrete
- 2-4.10 Hot Weather Placing of Concrete
- 2-4.11 Concrete Finishes

2-4.1.2 Requirements of Division 1, General Requirements, also apply to the WORK under this Section 2-4.

2-4.2 SERVICES OF TESTING LABORATORY

These services will be furnished by Purchaser, as specified in Article 9 of Form 1715.

2-4.3 CLASS OF CONCRETE

Class AA (air-entrained), as specified in Article 8 of Form 1715 for all WORK, unless otherwise indicated.

2-4.4 CEMENT

2-4.4.1 Type: As specified in Item 15-1A, Table 15-1 of Form 1715.

2-4.4.2 Brand and Source: Only one brand and source of cement shall be used for all concrete WORK.

2-4.5 FLY ASH

2-4.5.1 Material: As specified in Item 15-B, Table 15-1 of Form 1715, except that the ASTM Standard Specification Designation shall be revised to ASTM C618, "Fly Ash and Raw or Calcined Natural Pozzolans for Use in Portland Cement Concrete" and the Pozzolan Class shall be Type F.

2-4.5.2 After source of fly ash has been initially approved, changing of source of fly ash will not be permitted without approval of the Consulting Engineers.

2-4.6 <u>WATER-REDUCING ADMIXTURES</u>
Use of <u>any</u> water-reducing admixtures will <u>NOT BE PERMITTED</u>.

2-4.7 <u>REINFORCING STEEL</u>

2-4.7.1 <u>Reinforcing</u>: Domestic steel. Conform to requirements specified in Item 15-1E, Table 15-1 of Form 1715, except steel shall conform to the applicable requirements of ASTM A615, Grade 60.

2-4.2 <u>Splice Requirements</u>: In place of splice requirements specified in Item (2), Table 15-29, Page 15-6 of Form 1715, splice requirements indicated in the "Reinforcement Lap Splice Schedule" on the drawings shall govern. Reinforcing shop drawing setting plans for the work shall also clearly indicate length of lap for each bar.

2-4.7.3 <u>Heating of Reinforcing</u>: Heating of reinforcing for bending or for any other purposes <u>will not be permitted</u>.

2-4.8 <u>FORMWORK</u>
In addition to requirements of Article 5 of Form 1715, also conform to applicable requirements of ACI 347, "Recommended Practice for Concrete Formwork".

2-4.9 <u>COLD WEATHER PLACING OF CONCRETE</u>

2-4.9.1 In place of requirements specified in Paragraph 10.5 Article 10 of Form 1715, the requirements of ACI 306, "Recommended Practice for Cold Weather Concreting" shall govern cold weather placing of concrete, unless otherwise indicated.

2-4.9.2 Attention is especially directed to Table 1.4.1 of ACI 306 for minimum and maximum temperatures of material and of concrete.

2-4.9.3 The use of salts or other chemicals as an accelerating admixture to concrete to prevent freezing and develop strength of concrete in a shorter period of time as specified in Chapter 6 of ACI 306 <u>will not be permitted</u>.

2-4.10 <u>HOT WEATHER PLACING OF CONCRETE</u>
Conform to applicable requirements specified in Article 10.6 of Form 1715 for hot weather placing of concrete.

2-4.11 <u>CONCRETE FINISHES</u>
As specified in Article 11 of Form 1715 and as indicated on the drawings.

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DIVISION 2 - TECHNICAL REQUIREMENTS

SECTION 2-5: GROUT WORK

2-5.1 SECTION SCOPE

2-5.1.1 This Section of the Specification includes requirements for the following, as indicated on the drawings, as hereinafter specified (under the Article numbers indicated), or as required to properly complete the WORK:

2-5.2 General
2-5.3 Antifreeze Solution for Anchor Bolt Sleeves (If Required)
2-5.4 Cold Weather Grouting
2-5.5 Hot Weather Grouting
2-5.6 Curing

2-5.1.2 Requirements of Division 1, General Requirements, also apply to the WORK under this Section 2-5.

2-5.2 GENERAL

2-5.2.1 Provide all grout required for the WORK, including, but not limited to grout for the following:

a. Anchor bolt sleeves.

b. Base plates.

2-5.2.2 Furnish, install and strip all formwork required for grout work.

2-5.3 ANTIFREEZE SOLUTION FOR ANCHOR BOLT SLEEVES (IF REQUIRED)
Place antifreeze solution for anchor bolt sleeves, as specified in Form 1737 and Article 11.1.4 of Form 1742, in all anchor bolt sleeves.

2-5.4 COLD WEATHER GROUTING
Conform to same requirements specified for cold weather placing of concrete in Article 2-4.9 of Section 2-4.

2-5.5 HOT WEATHER GROUTING
Conform to same requirements specified for hot weather placing of concrete in Article 2-4.10 of Section 2-4.

2-5.6 CURING
Use membrane curing, as specified for concrete work in Article 12 of Form 1715, in place of water curing as specified in Form 1741.

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DIVISION 2 - TECHNICAL REQUIREMENTS

SECTION 2-6: MISCELLANEOUS METALWORK AND EMBEDDED WORK

2-6.1 SECTION SCOPE

2-6.1.1 This Section of the Specification includes requirements for the following, as indicated on the drawings, as hereinafter specified (under the Article numbers indicated), or as required to properly complete the WORK:

2-6.2 General
2-6.3 Services of Testing Laboratory
2-6.4 Welding
2-6.5 Materials and Fabrication
2-6.6 Galvanizing
2-6.7 Prime Coat Cleaning and Painting

2-6.1.2 Requirements of Division 1, General Requirements, also apply to the WORK under this Section 2-6.

2-6.2 GENERAL

2-6.2.1 Work Included: Provide all applicable work included under Article 4 of Form 1742 and all similar work herein specified or indicated on the drawings.

2-6.2.2 Extent of Galvanizing: Galvanize all miscellaneous steelwork (except cast iron). For galvanizing requirements see Article 2-6.6.

2-6.3 SERVICES OF TESTING LABORATORY

Will be furnished by Purchaser for inspection of the following:

2-6.3.1 Materials: As specified in Article 7 of Form 1742.

2-6.3.2 Welding: As specified in Article 10 of Form 1701.

2-6.4 WELDING

Conform to applicable requirements of Form 1701.

2-6.5 MATERIALS AND FABRICATION

2-6.5.1 Material: ASTM A36 unless otherwise indicated; however, the use of Bessemer steel not permitted.

2-6.5.2 Anchor Bolts:

a. Contractor shall provide all anchor bolts required for the WORK, as specified in Article 11.1.2 of Form 1742, except that material shall be ASTM A36 for threaded rods and ASTM A307 for headed bolts and for all nuts for ASTM A36 threaded rods and ASTM A307 headed bolts.

b. Plugs: In place of hardwood plugs indicated in Form 1737, or on drawings, provide plastic plugs at top of sleeves with center opening 1/8 in. smaller in diameter than bolt size to insure tight weather-tight fit; shop or field punch or drill openings. Type and make of plastic plugs shall be as specified in Item 3, Table 07-4 of Form 1707.

c. Heating and Welding: Heating of any anchor bolt in the field for bending or other purposes will not be permitted, except that nuts for threaded rods or heads of headed bolts may be tack welded to the plate washers used for embedment in concrete.

2-6.5.3 Expansion Anchors Self-drilling type as specified in Item 8, Table 07-4 of Form 1707.

2-6.5.4 Embedded Steel Plates: Provide 4 nailing holes in each plate to permit ready attachment to formwork.

2-6.5.5 Sluice Gates: As indicated on the drawings.

2-6.5.6 Stop Log Guides: Conform to the applicable requirements of Form 1743..

2-6.5.7 Stop Logs: As specified in Article 8 of Form 1743 and as indicated on the drawings.

2-6.5.8 Guardrails: As specified in Paragraph 20.9 of Form 1742 and as indicated on the drawings.

2-6.6 GALVANIZING
As specified in Article 24 of Form 1742.

2-6.7 PRIME COAT CLEANING AND PAINTING

2-6.7.1 Intent: Clean and paint all ferrous metals, as specified in Article 3 of Form 1790, except the following:

a. Cast iron.

b. Galvanized steel (except for field touch-up).

2-6.7.2 Shop Work: As specified in Article 25 of Form 1742.

2-6.7.3 Field Work for Ferrous Metals: As specified in Articles 11, 12, 13 and 15 of Form 1790, as applicable.

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DIVISION 2 - TECHNICAL REQUIREMENTS

SECTION 2-7: DRAINAGE WORK

2-7.1 SECTION SCOPE

2-7.1.1 This Section of the Specification includes requirements for the following, as indicated on the drawings, as hereinafter specified (under the Article numbers indicated), or as required to properly complete the WORK:

2-7.2 General
2-7.3 Galvanized Corrugated Metal Drainage Piping
2-7.4 Manholes

2-7.1.2 Requirements of Division 1, General Requirements, also apply to the WORK under this Section 2-7.

2-7.2 GENERAL

All drainage work shall conform to applicable requirements of "The American Association of State Highway Officials", as indicated on the drawings and as hereinafter specified.

2-7.3 GALVANIZED CORRUGATED METAL DRAINAGE PIPING

2-7.3.1 Type: Riveted galvanized corrugated metal pipe (CMP), conforming to applicable requirements of AASHO M36, or helically corrugated galvanized metal culvert pipe, conforming to applicable requirements of AASHO M36 and to requirements hereinafter specified.

2-7.3.2 Manufacturers: Provide one of the following types and makes:

a. Standard Armco............ Armco Metal Products Division of Armco Steel Corporation

b. Corrugated................ Republic Steel Corporation

c. Corrugated................ Wheeling Corrugating Company

2-7.3.3 Shape and Material: Round pipe or pipe-arch, sizes and gauges, as indicated on the drawings. Base metal copper bearing steel with copper content 0.20% minimum.

2-7.3.4 Fabrication:

a. Riveted Pipe: As specified in AASHO M36.

b. Helically Corrugated Pipe:

b1. As specified in AASHO M36.

b2. Corrugation pitch 2-3/4 in.; corrugation depth not less than 7/16 in. Seams continuous lock or weld type extending from end to end of pipe. Fabricate seams in such manner as not to affect shape or nominal diameter of pipe nor to create an element of weakness in pipe.

2-7.3.5 Fittings: Provide standard fabricated fittings as indicated or as required.

2-7.3.6 Accessories: Provide standard belted coupling bands, bolts and all other accessories required for a complete installation.

2-7.3.7 Installation: In strict accordance with manufacturer's instructions, as approved, in accordance with applicable requirements of National Corrugated Metal Pipe Association Installation Manual and in accordance with the following requirements:

a. Excavation and Fill:

a1. Normally excavate trenches to match curve of pipe. Flat beds may also be used if as economical as curved beds.

a2. Curved Beds: Bed pipe evenly and firmly for width of 100% of pipe breadth.

a3. Flat Beds:

a3.1 After pipe in place on flat bed, provide well compacted granular fill under haunches. Use clean crushed stone, gravel or coarse sand, or other approved material, with 1½ in. maximum size.

a3.2 Provide same granular fill up to center line of pipe. Place in layers not exceeding 12 in. in depth before compaction.

a4. Fill above center line and up to grade with select, granular material, as approved and thoroughly compact. Place in layers as specified foregoing.

a5. Use fill material free of rocks, hard lumps, or clods larger than 3 in. Do not use sod, cinders or frozen fill.

a6. Use extreme care in placing all compacted fill to maintain fill at approximately the same level (not to exceed one foot differential) on both sides of pipes throughout entire placing of compacted fill.

b. Joints: Securely bolt all joints.

c. Provide beveled end section where indicated.

2-7.4 MANHOLES

2-7.4.1 Construct manholes of precast concrete, complete with cast iron frames and covers, steps, etc., as indicated on the drawings and as hereinafter specified.

2-7.4.2 Precast Concrete Manholes:

a. Type: Precast reinforced concrete ring type with precast reinforced concrete base and with rubber "O-Ring" or flat type rubber compression joints, conforming to applicable requirements of ASTM C478, "Specifications for Precast Reinforced Concrete Manhole Risers and Tops" and to requirements hereinafter specified.

b. Manufacturers: Provide precast elements and joint material as made by one of the following manufacturers:

b1. Continental Concrete Pipe Corporation.

b2. International Pipe & Ceramics Corporation (Lock-Joint Pipe Products).

b3. Concrete Pipe Division of Vulcan Materials Company.

b4. Material Service Division of General Dynamics Corporation.

c. Loading: Design manholes and catch basins for H-20 truck loading.

d. Precast Elements:

d1. Base: Closed-end pipe type with bell end.

d2. Ring Sections for Walls: Provide in multiples of 8 in. in height, with tongue and groove joints as required by depth of each manhole. Wall thickness for rings shall be 4 in. for 36 in. diameter manholes and 5 in. for 48 in. diameter manholes.

d3. Top section shall be eccentric cone type with minimum wall thickness of 4 in. for 36 in. diameter manholes and 5 in. for 48 in. diameter manholes, or shall be flat slab type not less than 8 in. thick, as indicated on drawings or as required by manhole depth. Arrange both types for taking cast iron manhole frame and cover.

d4. Rings and top cone shall have precast openings for field installation of cast iron steps and for all required drain pipes entering manholes.

e. Joints: Rubber "O-Ring" or flat type rubber compression type, with manufacturer's standard rubber ring. Mortar joints may be used if specifically approved.

2-7.4.3 Frames, Covers and Steps:

a. Cast iron, as made by one of the following:

a1. Neenah Foundry Company.

a2. James B. Clow & Sons.

b. Coating: Coat uniformly with coal tar pitch varnish.

c. Type: As indicated on the drawings.

2-7.4.4 Installation of Manholes:

a. Subgrade shall be level and free of projecting stones, rocks, etc.

b. Place a layer of sand, not less than 4 in. thick, over subgrade before installing precast base. Exercise care to install base dead level and with full bearing throughout on sand cushion, to insure that completed catch basins are plumb.

c. Installation of sections, using rubber rings, in strict accordance with manufacturer's instructions, as approved.

JOB SPECIFICATIONS
FOR
EXCAVATION & EMBANKMENT FOR GENERATING PLANT AREA

GENERAL DESCRIPTION

The Generating Plant Area is a part of the plant site. As stated in the Technical Specifications TS-1 covering plant site grading, and shown by the drawings, grubbing, removing and stockpiling of topsoil, and general grading for the plant area under discussion have been performed. These items are included in the pay item quantities outlined under TS-1.

The Contractor shall be required to accomplish the excavation and embankment in the Generating Plant Area to line and grades as shown by drawings, S-148 and S-149, and in accordance with the following specification and Sargent & Lundy's Standard Specification for Earthwork (Form 1714).

Pipe Products),
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EXCAVATION & EMBANKMENT FOR
GENERATING PLANT AREA- CONT'D

I. EARTHWORK

A. The excavation and embankment shall be formed to the sections, slopes and dimensions as shown by Drawings S-148 and S-149.

B. Sections, slopes and dimensions may be changed by the Engineer at his discretion.

C. The Contractor shall be especially careful to slope the excavation in the generating plant area in such a manner to maintain the backslopes with a minimum difficulty. It shall be the responsibility of the Contractor to determine the backslope necessary for the particular soils encountered. However, the slope shall not be steeper than 2:1 (2 horizontal to 1 vertical).

D. The fill material to construct the embankment for the Generating Plant Area shall be excavated from sources designated by the Engineer. A select material as outlined under Form 1714 of these specifications is required. If possible, the select material will be designated in such a manner that it may be obtained in conjunction with the grading of the Plant Site. Prior to starting the embankment for the area under discussion, the Contractor shall consult with the Engineer to determine the source of the fill material. Any fill placed without prior approval of the Engineer shall be removed and replaced as directed by the Engineer at the Contractor's expense.

E. The embankments required under this section shall start from a firm compacted surface from which muck vegetation and other unsuitable material shall have been removed. It shall be compacted to the density required for the embankment.

F. Any unsuitable material excavated in the process of obtaining the select material required shall be placed as directed by the Engineer.

EXCAVATION & EMBANKMENT FOR
GENERATING PLANT AREA - CONT'D

G. The embankment shall be loosely placed in layers not exceeding ten (10) inches. Each layer of fill shall be thoroughly compacted obtaining not less than 95% of the maximum Modified Procter density inaccordance with ASTM test D1557, latest addition. Compaction shall be performed within $2\frac{1}{2}$% of the optimum moisture content.

H. The Contractor shall be required to excavate the area as shown by the referenced drawings in such a manner that will permit drainage of surface water and maintaining a dry area. Article 5.3 of Form 1714 shall apply.

I. When material varies from optimum moisture content, it shall be treated as follows: When wet, it shall be drained or worked until optimum moisture content is attained. When dry it shall be sprinkled with water and mixed until optimum moisture content is attained.

J. The Contractor's unit price for excavation shall be based on a free haul distance of 2000 feet. In the event that the Contractor is required to haul dirt in excess of the 2000 foot free haul distance he shall be paid at the unit price bid for overhaul per yard - quarter. Item 140 (Overhaul) of the 1972 Texas Highway Standard Specification is hereby referenced as the governing specification. The 2000 foot free haul distance is substituted for the 600 foot free haul distance specification in Item 140. Approval and authorization in writing from the Engineer must be obtained before payment will be made for overhaul.

K. Estimated Quantities:

105,000 cubic yards - excavation

86,000 cubic yards - embankment

L. Basis for Payment:

Price per cubic yard excavation
Price per cubic yard embankment
Price per yard-quarter overhaul

QUANTITIES SUMMARY SHEET
(For Contractor's Information)

Item No.	Description	Unit	Plant Site Area	RR Bed Const.	Ash Pit and Dikes	Excav. & Emb. - Gen. Plan	Total Estimated Quantity
1.	Clearing	Acre	---	---	32	---	32
2.	Clearing & Grubbing	Acre	21	10	20	---	51
3.	Re-Grubbing	LS	180 Ac.	---	---	---	180 Ac.
4.	Excav. (Comm. Unclassified)	CY	543,000	126,000	1,000	105,000	775,000
5.	Excavation(Core Trench)	CY	[illegible]	---	97,000	---	97,000
6.	Excavation (Discharge Flume)	CY	---	---	100,000	---	100,000
7.	Stockpile Topsoil	CY	30,000	15,000	2,000	---	47,000
8.	Embankment (Density Control)	CY	335,000	104,000	160,000	86,000	685,000
9.	Overhaul	YQ	40,500	20,500	12,500	43,000	116,500
10.	Placing 96" dia. Steel Conduit	LF	220	---	---	---	220
11.	Structural Excavation (Culverts)	CY	1,550	450	---	---	2,000
12.	Concrete (C. I. A.) (Headwalls)	CY	35	20	---	---	55
13.	CMP (8 gauge)(Bitum. Coated)(72" dia.)	LF	---	270	---	---	270
14.	CMP (8 gauge)(Bitum. Coated)(60" dia)	LF	304	---	---	---	304
15.	CMP (10 gauge)(Bitum. Coated)(48" dia.)	LF	72	---	---	---	72
16.	CMP (12 gauge)(Bitum. Coated)(36" dia.)	LF	328	---	---	---	328
17.	CMP (12 gauge)(Bitum. Coated)(30" dia.)	LF	120	---	---	---	120
18.	CMP (14 gauge)(Bitum. Coated)(24" dia.)	LF	116	---	124	---	240
19.	CMP (Arch)(36"x22")(14 gauge)(Bitum. Coated)	LF	84	36	---	---	120
20.	CMP (Arch)(22"x13")(14 gauge)(Bitum. Coated)	LF	70	---	---	---	70
21.	Rip-Rap (Rock)	SY	---	---	19,000	---	19,000
22.	Placing Topsoil (4" Compact.)	SY	---	130,000	10,000	---	140,000
23.	Erosion Control (Seeding, Fertilizing, mulching, and watering)	SY	---	130,000	10,000	---	140,000
21-Alt.	Rip-Rap (Con. Cl. B)(4")	SY	---	---	19,000	---	19,000

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STANDARD SPECIFICATION FOR EARTHWORK

(Form 1714)

1. GENERAL

1.1 Earthwork shall conform to the requirements of this Standard Specification, the Job Specification, and the design drawings. In the event of variance between this Standard Specification and the Job Specification or design drawings, the Job Specification and the design drawings shall take precedence.

1.2 Where the terms "as indicated" or "indicated" are used in this Standard Specification, they shall mean "as shown, noted, called for or specified".

1.3 All references to the following publications are to the latest issue of each, together with the latest additions and/or amendments thereto, as of the date of Contract, unless otherwise indicated; references to the sponsoring agencies will be made in accordance with the abbreviations indicated:

1.3.1 ASTM .... American Society for Testing and Materials Standard Specifications.

1.3.2 ASA .... American Standards Association Standard Specifications.

1.3.3 AASHO .... American Association of State Highway Officials Standard Specifications.

2. SOIL DATA AND TOPOGRAPHY

2.1 Soil Data: Drawings show borings made at site, and logs given thereon indicate character of soil. This information furnished for Contractor's convenience; in using it Contractor assumes the risk, as Purchaser and the Consulting Engineers assume no responsibility for accuracy of information shown thereon. Contractor will be permitted to make his own soil investigations, but same shall be made at no cost to Purchaser.

2.2 Topography: Drawings indicate elevations, dimensions and/or cross sections, profiles and contour lines of existing ground. This information furnished for Contractor's convenience; in using it Contractor assumes the risk, as Purchaser and the Consulting Engineers assume no responsibility for accuracy of information shown thereon. Contractor will be permitted to make his own investigation of topography during bid period, but same shall be made at no cost to Purchaser.

3. LINES AND GRADES

3.1 Contractor shall lay out lines and grades from existing base lines and bench marks on property and be fully responsible for correctness of such lines and grades and for proper execution of WORK to such lines and grades.

3.2 Purchaser reserves right to verify correctness of lines and grades during progress of WORK. Such verification by Purchaser will not relieve Contractor of responsibility as specified foregoing.

3.3 Contractor shall notify Consulting Engineers of any differences in location of existing work from that indicated, wherever such differences may affect new work.

3.4 Contractor shall preserve and maintain all bench marks and reference points established by Purchaser. Should Contractor, during prosecution of WORK, destroy or remove any bench marks and/or reference points established by Purchaser, the cost to Purchaser of re-establishing these bench marks and/or reference points will be charged to Contractor.

4. <u>CLEARING</u>

4.1 Prior to performing excavation or fill work, areas in which such work is to be done shall be cleared, grubbed and the top soil and sod removed. No clearing, grubbing or removal of top soil and sod shall be done outside designated areas without specific approval.

4.2 If <u>extensive</u> clearing, grubbing and removal of top soil and sod is required, the Job Specification or drawings will specifically so indicate. If such work is <u>incidental</u>, then it will not be specifically indicated and shall be performed prior to, but as part of, excavation work.

4.3 Clearing:

4.3.1 Clearing is defined as removal and disposal of all trees, down timber, snags, brush, hedges, bushes and all other vegetation or organic materials, and also all rubbish, debris or other foreign or objectionable materials above ground surface, except removal of sod and top soil.

4.3.2 Removal of structures, such as buildings, roadways, fences, etc., is classified as demolition and not as clearing, and will be indicated in the Job Specification (under Demolition Work) or on drawings.

4.3.3 Trees shall be filled in such manner as not to damage other trees or other vegetation which are to remain in place nor damage existing structures and facilities nor constitute a hazard to traffic or life.

4.4 Grubbing: Grubbing is defined as removal and disposal of all stumps, large roots, buried logs and all other objectionable material from below ground surface. Explosives may be used only if specifically approved and their use shall conform to all applicable laws and safety regulations.

4.5 Disposal:

4.5.1 All materials from clearing and grubbing operations shall be Contractor's property and shall be promptly disposed of off the site unless otherwise indicated in the Job Specification or on drawings; accumulation of such materials on premises not permitted.

4.5.2 Burning of Debris on Premises: If burning of debris on premises is permitted by the Job Specification, drawings or Purchaser, conform to following requirements:

4.5.2.1 Burn debris only in areas specifically designated by Purchaser.

4.5.2.2 Prior to burning any material, secure approval and permits from, and comply with all regulations of all authorities and all public bodies having jurisdiction in area of WORK.

4.5.2.3 Neatly pile all combustible material and burn when in suitable condition. Do piling in such manner and in such locations as to cause least fire risk.

4.5.2.4 Burn material thoroughly and completely so that materials are reduced to ashes, with no charred pieces, such as charred logs, remaining. Ashes and charcoal residue need not be removed. Combustible materials difficult to burn, such as tree stumps and root clumps, may be buried below grade, with not less than 1'-0" of cover over them and level with surrounding grade, if grubbing is not required for the WORK; if grubbing is required, then all such unburnable materials shall be disposed of off the premises.

4.5.2.5 Fire Protection: Provide fire fighting facilities, satisfactory to authorities having jurisdiction and to Purchaser and maintain such facilities in first class operating condition during course of burning operations.

4.6 Removal of Top Soil and Sod:

4.6.1 Top soil and sod shall be removed as part of excavation work, unless the Job Specification or drawings indicate that top soil and/or sod shall be removed and stored for reuse by Contractor or by others.

4.6.2 If top soil is indicated to be removed for reuse, it shall be carefully stripped off, stored in separate stockpiles and kept clean and free of all foreign material. Sod and other vegetation shall be removed from the top soil before it is stockpiled.

4.6.3 If sod is indicated to be removed for reuse, it shall be carefully removed, rolled up, and stored in a suitable and well protected manner, as approved.

4.6.4 If top soil and/or sod is indicated to be reused by Contractor, any and all excess stockpiles remaining on completion of WORK shall be removed and disposed of off the premises unless otherwise requested.

5. <u>EXCAVATION</u>

5.1 Excavation is defined to include all incidental clearing, all excavation and disposal of excavated materials, all protection, sheeting, shoring, bracing and cofferdams, all dewatering, and preparation of bearing areas as required to properly install and complete the WORK, regardless of portions of WORK for which required, and regardless of nature of materials encountered in excavating. Dredging shall be performed only if specified in the Job Specification or on the drawings.

5.2 Classification: Excavation shall be classified as earth or rock excavation, as follows:

5.2.1 Earth excavation is all material not classified as rock excavation.

5.2.2 Rock Excavation:

5.2.2.1 Rock excavation is defined as any material that requires the continuous use of drilling and blasting, or drilling, channeling, etc., and shall include granite, trap, quartzite, chert, limestone, hard sandstone, hard shale or slate or other similarly hard materials, as well as rocks and boulders measuring 1/2 cubic yard or more.

5.2.2.2 The Job Specification or drawings will indicate whether blasting is permitted. Blasting, if permitted, shall conform to requirements of 5.11, following.

5.3 Dewatering: Contractor shall provide and operate all dewatering equipment required for areas excavated by Contractor, and be responsible for maintaining a dry site satisfactory to Purchaser and Consulting Engineers.

5.4 Protection and Support:

5.4.1 Contractor shall provide all protection and support as required to properly install the WORK, as required for protection and support, of the WORK and of adjacent structures and improvements, and as required for safety of traffic and life.

5.4.2 Protection and support shall include temporary sheeting, bracing, shoring and cofferdams, and also, where indicated, permanent sheeting, bracing and shoring. All temporary sheeting, bracing, shoring and cofferdams shall be as approved, and all such temporary work shall be removed by Contractor when its use is no longer required, unless otherwise requested or approved.

5.4.3 Banks at excavations shall be protected and supported, where necessary or where requested, so that the banks and bottoms will be maintained and adjacent structures or other construction will be protected from damage caused by any earth or rock movement.

5.4.4 Protection and support shall be arranged for minimum interference with pipe laying, electrical ductwork installation and similar work.

5.4.5 Temporary Cofferdams: Contractor shall design temporary cofferdams required by him to perform his work and shall submit drawings thereof for approval. These drawings shall show all data on which the design is based. No such work shall be installed until such approval is received, and the work shall be done only in accordance with these approved drawings.

5.5 Earth excavations shall be of sufficient size to allow for placing of formwork for concrete, for inspection of formwork and surfaces of completed concrete, and for dampproofing, waterproofing, pipework, electrical ductwork, etc. Rock excavations shall be to neat lines unless otherwise indicated; where overbreak of rock occurs behind a vertical face of concrete placed against rock, overbreak shall be filled with the same concrete as required for the vertical face, and no payment will be made for concrete fill.

5.6 Excavations shall be carried to elevations indicated on drawings, and as follows:

5.6.1 Earth Excavation: Foundation excavations carried below the indicated level shall be filled with the same concrete as required for the foundation; other earth excavations carried below the indicated level shall be brought up to the proper level with compacted fill, sand, crushed stone, gravel or concrete, as determined most suitable by the Consulting Engineers.

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5.6.2 Rock Excavation: When designated or approved elevations have been reached, rock surfaces shall be leveled off and all loose rock removed. Where overbreak of rock results in dropping elevations of rock surfaces below designated or approved elevations, overbreak shall be filled with the same concrete as required for the foundations.

5.6.3 No payment will be made for any of the foregoing specified fill required to remedy over-excavation in earth or overbreak in rock.

5.7 Hand excavation shall be used, if requested, for trenching or other excavation adjacent to structures or equipment where use of mechanical excavating equipment is not considered advisable by Purchaser or the Consulting Engineers.

5.8 Bearing Areas:

5.8.1 Bearing areas for all foundations shall be inspected and approved by Purchaser or the Consulting Engineers before any concrete is placed. If bearing areas are not suitable, as determined by the Consulting Engineers, Contractor may be requested to carry the excavations deeper to more suitable bearing material; such additional excavation will be paid for on the unit price basis set forth for the WORK. Contractor may also be requested by the Consulting Engineers to make auger borings or other tests at bearing areas to determine thickness of bearing stratum; these tests will be paid for on a unit price or cost plus basis, whichever is set forth for this item.

5.8.2 All foundations shall be placed on undisturbed soil unless otherwise indicated or approved.

5.8.3 Before placing any concrete for berms or slabs on fill, the soil shall be well tamped.

5.8.4 Before placing any concrete on soil that will absorb water, the surface of the soil shall be thoroughly wet with clean water immediately before the concrete is placed.

5.9 Excavation for Pipework and Electrical Ductwork:

5.9.1 Make excavation for this work true to grade, profile and alignment, and so as to provide full, even and continuous bedding. For pipework, normally excavate trenches to match curve of pipe; however, flat beds may be used if as economical as curved beds, or shall be used if indicated.

5.9.2 Where granular bedding under pipework or ductwork is indicated in the Job Specification or on drawings, excavate the additional amount required to place the indicated depth of bedding material.

5.10 Disposal of Excavated Materials:

5.10.1 Deposit and spread, or stockpile, excavation materials suitable (in opinion of Consulting Engineers) for fill or backfill, in quantities required and approved, on premises where requested.

5.10.2 For excavated materials not suitable for fill or backfill, the Job Specification or drawings will indicate whether such material is to be disposed of on or off premises, and disposal shall accordingly be as follows:

5.10.2.1 For such material to be disposed of on premises, deposit or spread on premises where approved or requested.

5.10.2.2 For such material to be disposed of off premises, promptly remove this material as excavated; stockpiling of such material will not be permitted.

5.10.3 After completion of fill and backfill work, or when approved or requested, dispose of any and all excess stockpiles or excess excavated materials either on or off the premises as specified in 5.10.2 foregoing.

5.11 Requirements for Blasting: If use of blasting is approved by Purchaser or Consulting Engineers, blasting shall conform to following requirements:

5.11.1 Blasting shall be perform-d only when proper precautions are taken for protection of persons, the work, private property, etc. Caps or other exploders or fuses shall in no case be stored or transported in same place in which dynamite or other explosives are transported. Location of storage magazines, methods of transportation and, in general, precautions taken to prevent accidents shall, at all times, be subject to approval of Purchaser or Consulting Engineers, but Contractor shall at all times be liable for any injuries to persons or property caused by explosives.

5.11.2 Every possible precaution shall be taken in blasting operations to preserve rock outside lines of excavation in soundest possible condition. Blasting shall be done only to lines and grades indicated on drawings or as approved by Consulting Engineers.

5.11.3 Explosives shall be of such quantity and power and shall be used in such locations as will not tend to open seals, or to crack or damage rock outside prescribed limits of excavation. If needed, firing of blast shall be controlled by use of delayed explosives. Whenever, in the opinion of Consulting Engineers, continuation of blasting may injure rock on which or against which concrete is to be placed, use of explosives shall be discontinued and excavation shall be completed by wedging, boring, channeling or other suitable means.

5.11.4 Contractor shall submit plans and methods of operation for rock excavation work before work is started. Approval of method of blasting or of strength and amount of explosives used will not relieve Contractor of responsibility for blasting operations.

5.11.5 For blasting, Contractor shall employ a supervisor thoroughly experienced in this type of work and shall at all times maintain rigid inspection to see that intent of these requirements are fully complied with.

5.11.6 Contractor shall maintain a complete and detailed record of blasting operations, in a form approved by Purchaser, and shall submit copies of such records to Purchaser as requested.

5.12 Dredging:

5.12.1 Before submittal of bid, Contractor shall obtain a sweeping map from The U. S. Army Corps of Engineers, and shall also determine from them the full extent of their requirements as it will affect the WORK.

5.12.2 Contractor shall furnish, establish and maintain in good order all range marks, stakes, gauges and buoys required for proper execution of this work, and furnish, on request, the use of such boats, boatmen, laborers and materials forming a part of the ordinary and usual equipment and crew used for this work as may be necessary for Purchaser, Consulting Engineers and Corps of Engineers to inspect work.

5.12.3 Contractor shall provide sounding and sweeping equipment and labor to sound and sweep dredged areas to establish that indicated grade, profile and alignment are met.

5.12.4 As soon as possible after completion of dredging work, Contractor shall thoroughly examine dredged area by sounding and sweeping to determine that completed work meets all requirements indicated on drawings and all requirements specified by Corps of Engineers. Arrange with Purchaser for representatives of Purchaser, Consulting Engineers and Corps of Engineers to be present when sounding and sweeping is performed. However, the presence of these representatives shall in no way relieve Contractor of responsibility for accuracy and proper completion of the work.

5.12.5 Any shoals, lumps or other lack of Contract dimensions disclosed by the foregoing examination shall be remedied by Contractor, and shall again be sounded, and swept if required, until the entire dredged area is satisfactory in every respect to Purchaser, Consulting Engineers and Corps of Engineers.

5.12.6 Contractor shall maintain a complete record of soundings, in a form approved by Consulting Engineers, and shall submit copies of such records to Consulting Engineers as requested.

6. FILL

6.1 Fill includes the following two classes, with two types under each class; the use of each shall be as indicated in the Job Specification or on the drawings:

6.1.1 Class 1: Regular compacted fill, Types RCF1 and RCF2.

6.1.2 Class 2: Controlled compacted fill, Types CCF1 and CCF2.

6.2 Services of Testing Laboratory: Where controlled compacted fill is specified, Purchaser will furnish services of a Testing Laboratory to determine suitability of fill material, to set optimum moisture contents, and to perform field tests to check on compliance with moisture and density requirements. Contractor shall furnish Testing Laboratory with all required quantities of fill material, from the same source as will be used for the WORK, as required for test purposes.

6.3 Class 1, Regular Compacted Fill:

6.3.1 The two types are based on the materials specified for use as fill, as follows:

6.3.1.1 Type RCF1: Granular material (sand, crushed stone, gravel, etc).

6.3.1.2 Type RCF2: Cohesive material (clay, sandy loam, silty loam, etc).

6.3.2 Material: The Job Specification or drawings will indicate the source of materials to be used, such as material previously excavated at the site, or from borrow pits, or from off site sources, etc. All material used shall be as approved by Purchaser and/or the Consulting Engineers.

6.3.3 Preparation of Subgrade: Prior to placing regular compacted fill, strip areas to be covered of all vegetation or other organic material or other foreign or deleterious material.

6.3.4 Compaction Densities: Build up fill to grade elevations indicated or required, with suitable moisture control and compaction throughout placing, as specified in 6.3.5 following, to produce a completed fill capable of supporting trucks and other heavy construction equipment.

6.3.5 Placing of Fill: Place as follows, unless otherwise approved or requested:

6.3.5.1 Place fill, with suitable moisture content, in uniform horizontal layers not over 9" deep before compaction.

6.3.5.2 For Type RCF1 granular fill, compact by successive high speed passage of heavy tractors (with treads covering 100% of area), or with other vibratory type equipment, as approved.

6.3.5.3 For Type RCF2 cohesive fill, compact by use of sheeps foot roller or with other camming type equipment, as approved.

6.3.5.4 In places inaccessible to large equipment, obtain required compaction with mechanical vibrators for Type RCF1 granular fill, and with mechanical rammers for Type RCF2 cohesive fill.

6.4 Class 2, Controlled Compacted Fill:

6.4.1 The two types are based on the materials specified for use as fill, as follows:

6.4.1.1 Type CCF1: Granular material (sand, crushed stone, gravel, etc.)

6.4.1.2 Type CCF2: Cohesive material (clay, sandy loam, silty loam, etc.)

6.4.2 Material: Conform to same requirements specified in 6.3.2 for granular fill.

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6.4.3 Preparation of Subgrade:

6.4.3.1 Subgrade to receive controlled compacted fill shall be inspected by Purchaser or the Consulting Engineers to determine if it is suitable and has sufficient bearing capacity for the fill material and loads to be placed over it. If subgrade is not suitable, as determined by the Consulting Engineers, Contractor may be requested to perform additional excavation as specified in 5.8 for Bearing Areas, with compensation as specified therein.

6.4.3.2 Prior to placing controlled compacted fill, strip areas to be covered of all vegetation, top soil and all organic material or other foreign or deleterious materials.

6.4.3.3 Thoroughly break and turn soil underlying the filled area to depth of 6" before deposition of fill material. Do breaking of ground no more than 200 feet in advance of placing fill.

6.4.4 Compaction Densities: Build up fill to grade elevations indicated or required, with suitable moisture control and compaction throughout placing, as specified in 6.4.5 following, to produce following densities:

6.4.4.1 Decidedly granular fill material: 90% of its maximum density.

6.4.4.2 All other fill material: 95% of its maximum density.

6.4.5 Placing of Fill: Place as follows, unless otherwise approved or requested:

6.4.5.1 Place fill, with optimum moisture content, in uniform horizontal layers not over 6" deep before compaction. Add water, or dry out fill, to maintain optimum moisture content throughout placing and compaction.

6.4.5.2 For Type CCF1 granular fill, compact by successive high speed passage of heavy tractors (with treads covering 100% of area), or with other <u>vibratory type</u> equipment, as approved.

6.4.5.3 For Type CCF2 cohesive fill, compact by use of sheeps foot roller or with other <u>ramming type</u> equipment, as approved.

6.4.5.4 In places inaccessible to large equipment, obtain required compaction with mechanical vibrators for Type CCF1 granular fill, and with mechanical rammers for Type CCF2 cohesive fill.

7. <u>BACKFILL</u>

7.1 Back.:il includes general backfilling around all work excavated for by Contractor, and also all other backfill indicated on drawings as by Contractor.

7.2 Backfill shall be approved materials previously excavated at the site or materials obtained from approved borrow pits and shall be free of sod or other deleterious or foreign matter.

7.3 Backfill shall be built up to the grade elevations indicated or required, with suitable moisture control and compaction throughout placing, in the same manner as specified in 6.3 for Regular Compacted Fill, Types RCF1 and RCF2.

7.4 Backfill against foundation walls shall be placed only when directed.

Form 1714

7.5 Backfill Around Underground Piping: Place backfill around underground piping, drain lines, etc., only after piping, drain lines, etc., have been tested and/or inspected and approved. Use special care in backfilling to see that backfill is free of cinders or other materials which may be injurious, in opinion of Consulting Engineers, to such piping, drain lines, etc. Provide backfill free from rocks, hard lumps or clods larger than 3 inches. Do not use sod. Place backfill below top of piping, drain lines, etc., in alternate layers on each side of piping, drain lines, etc. Backfill around corrugated metal drainage pipe, corrugated structural plate pipe or welded steel plate pipe shall also conform to requirements specified in 7.6, following.

7.6 Backfill For Corrugated and Welded Steel Pipe:

7.6.1 Where flat beds for this piping is indicated in Job Specification or on drawings, provide flat granular bedding fill under pipe, with depth of bedding as indicated on drawings. Provide greater depth bedding fill if required by unsuitable soil conditions, as determined by the Consulting Engineers.

7.6.2 Granular Bedding: Use clean crushed stone or gravel, or other approved material, with 1-1/2" maximum size.

7.6.3 After pipe is in place on flat bed, provide controlled compacted granular fill under haunches. Use clean crushed stone, gravel or coarse sand, or other approved material, with 1-1/2" maximum size.

7.6.4 Also provide same controlled compacted granular fill up to center line of pipe.

7.6.5 Fill above center line of pipe and up to grade with select material, as approved, with controlled compaction.

7.6.6 Controlled compaction shall conform to requirements specified in 6.4 for Controlleo Compacted Fill, Types CCF1 and CCF2. Services of Testing Laboratory will also be furnished for this work as specified in 6.2 foregoing.

7.6.7 Use extreme care in placing all compacted fill to maintain fill at approximately the same level (not to exceed one foot differential) on both sides of pipes throughout entire placing of compacted fill.

7.7 Backfill for Electrical Ductruns:

7.7.1 Requirement of Standard Specification STD-EF-103 that clay or loam backfill shall be used for ductruns shall not apply. Any approved previously excavated material may be used for backfill over ductruns that are cast in place, provided that maximum size of material shall not exceed two inches (2").

7.7.2 For precast concrete ductruns, provide a layer of clean, washed sand not less than 2" thick on SIDES AND TOP, with balance of backfill approved previously excavated material not exceeding 2" maximum size. Provide sand cushion for precast ductruns as specified in Job Specification under Concrete Work, or as indicated on drawings.

7.8 Backfill in Roadways: Where existing roadways are cut to install new work, backfill such areas as quickly as possible after completion (including testing, if required) of new work. Bring backfill to within 10" of road surface ready for installation of new roadway by Contractor or by others as indicated in Job Specification or on drawings.

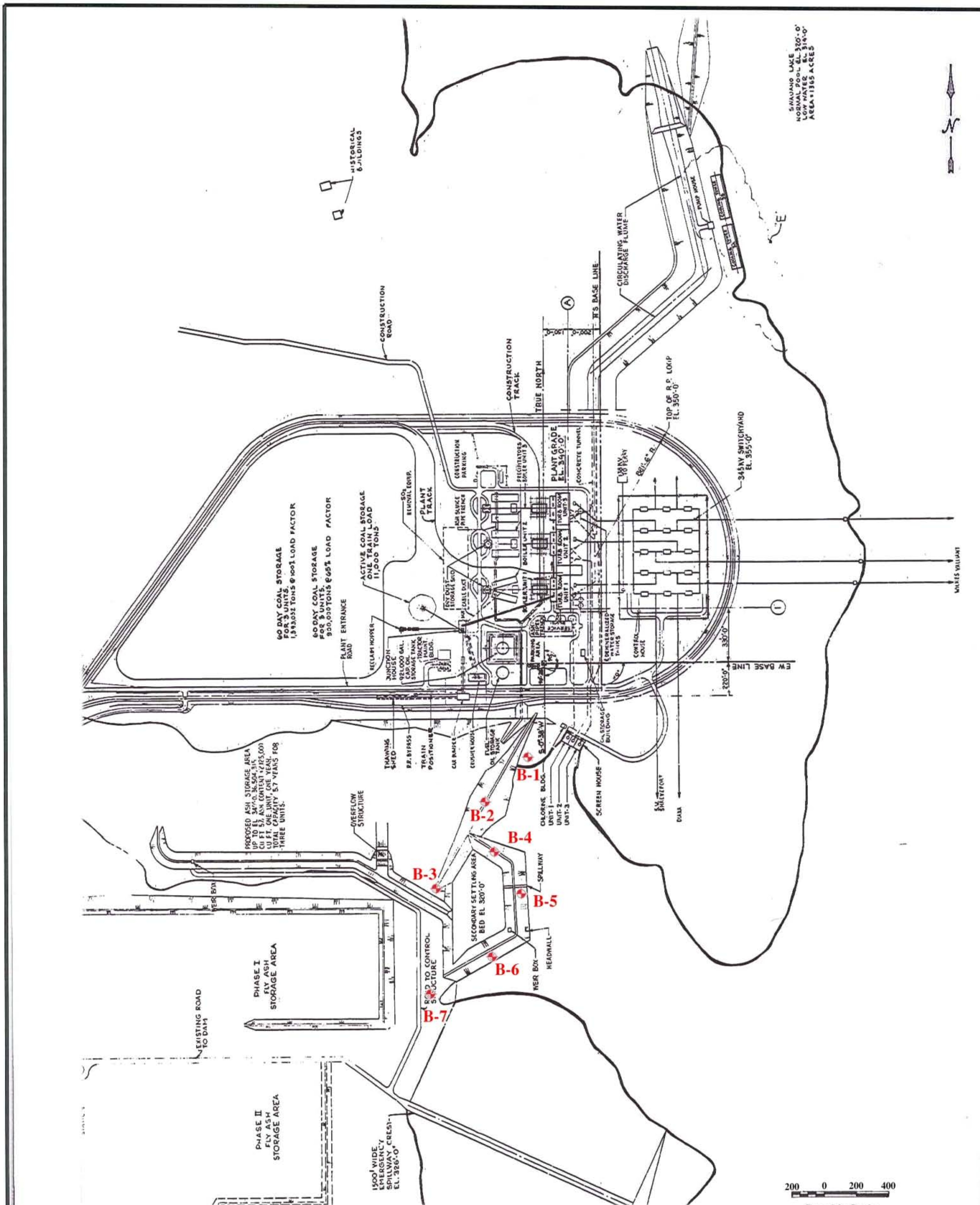
8. GRADING: Consists of rough grading and finish grading, as follows:

8.1 Rough Grading: Cut, fill, spread and level during course of WORK to elevations indicated.

8.2 Finish Grading: Fine grade and level to provide a smooth finish grade free of debris, foreign matter, objectionable stones, slods, lumps, pockets or high spots, properly drained and true to indicated elevations. Do finish grading only near completion of WORK or when requested.

APPENDIX C: EMBANKMENT REPAIR REPORTS AND DOCUMENTS

APPENDIX C-1 – Boring Logs, ETTL Report



ETTL ENGINEERS & CONSULTANTS MAIN OFFICE 1717 East Erwin Tyler, Texas 75702 (903) 595-4421	**WELSH POWER PLANT** **PITTSBURGH, TEXAS**	PLATE 1 - PLAN OF BORINGS JOB NO.: G3242-095 DATE: JAN. 2010 — SCALE: AS SHOWN	APPROVED BY: DRAWN BY: K.C.R.

LEGEND

- OVERHEAD ELECTRIC LINE
- EDGE OF WATER
- EDGE OF GRAVEL
- STORM DRAIN
- WOODLINE
- TOP OF BANK/SLOPE
- TOE OF DITCH/SLOPE
- 1.0' CONTOUR INTERVAL
- 5.0' CONTOUR INTERVAL
- SOIL BORING LOCATION
- MONITOR WELL/PIEZOMETER LOCATION
- POWER POLE
- GUY WIRE
- VALVE
- MISCELLANEOUS (LABELED)

Monitor Well Coordinate Table

Northing	Easting	TOC Elev	TOS Elev	NG Elev	Descriptor
7082649.9588	3088986.5724	333.28	Not Shot	Not Shot	AD-4
7082723.4133	3088944.5928	342.85	340.01	340.19	AD-4A
7082736.7044	3089027.6153	333.23	329.60	329.55	AD-4B
7085241.9050	3087322.4546	346.33	343.42	329.31	AD-6
7085379.0300	3088971.0772	350.82	347.90	347.86	AD-7
7085141.5536	3089572.1473	340.01	337.20	337.53	AD-8
7084426.2753	3089076.0299	343.09	340.51	340.32	AD-9
7084028.9574	3089541.4918	343.01	340.24	340.23	AD-10
7083806.9737	3089153.7064	342.18	339.55	339.61	AD-11
7083999.2913	3086633.7159	369.33	366.58	366.27	AD-12
7084143.6675	3088844.9078	347.00	344.15	344.12	AD-13
7083404.2266	3088923.7792	345.43	342.72	342.32	AD-14
7084922.5293	3089410.4800	339.67	339.95	339.87	B-2
7084518.8188	3089354.9016	340.63	340.89	340.74	B-4
7084252.5216	3089539.8565	339.98	340.29	340.22	B-5
7083922.5883	3089368.3732	340.10	340.42	340.44	B-6

NOTES:

1.) TOC ELEV DENOTES TOP OF CASING ELEVATION
2.) TOS ELEV DENOTES TOP OF CONCRETE SLAB ELEVATION
3.) NG ELEV DENOTES NATURAL GROUND ELEVATION

Soil Boring Coordinate Table

Northing	Easting	Elevation	Descriptor
7084415.3941	3089091.0855	339.63	B-3
7084981.0444	3089557.3777	324.07	B-1
7083836.1327	3089087.7883	330.38	B-7
7082299.4144	3090110.6561	325.90	NEW BORE NO. 1
7081836.9586	3089425.7638	323.63	NEW BORE NO. 2
7081271.2131	3089970.5504	320.85	NEW BORE NO. 3

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
N-7085417.3416
E-3087023.3084

CONTROL MONUMENT NO. 30010
N-7085452.9367
E-3088022.5268

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 NOVEMBER 6, 2009 AND NOVEMBER 17, 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: NOVEMBER 11, 2009
REVISED: NOVEMBER 18, 2009
REVISED: JUNE 22, 2010

MONITOR WELL & PIEZOMETER WELL LOCATIONS

WELSH POWER PLANT
CASON, TEXAS
FOR: AEP

Date		Revision/Description
11/18/09	1	ADDED ADDITIONAL PIPE LOCATION
11/18/09	2	ADDED ADDITIONAL BORING LOCATION
11/18/09	3	CHANGED NEW BORING LOCATION
11/18/09	4	MODIFIED BORING DESCRIPTOR

Drawn By	Checked By	Project No.	Dwg. Date
J.B.D.	M.G.	094026	11/11/09

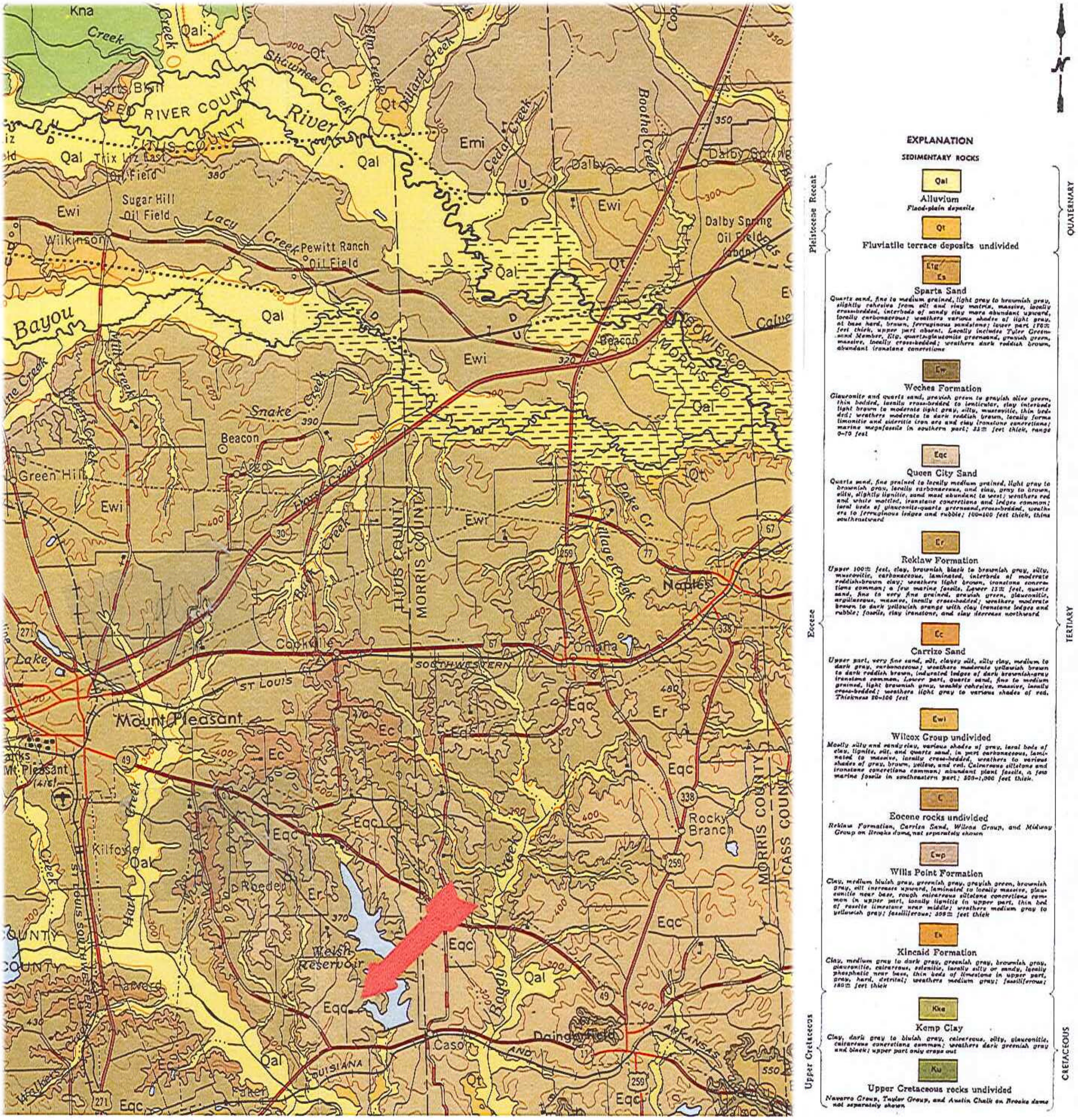
MTG engineers & surveyors
5930 SUMMERHILL RD. | P.O. BOX 3786
TEXARKANA TEXAS 75501
P 903.838.8533 | F 903.832.4700
www.mtgengineers.com

 TBPE NO. 354

File No.

Sheet No. 2 OF 2

X:\2009 Projects\094026 TOPO AT WELSH POWER PLANT - GREG CARTER\094026 Grid_elev REVISED 6-22-10.pro
Tue Jun 22, 2010 11:42AM



Scale 1:250,000

5 0 5 10 15 20 Statute Miles

5 0 5 10 15 20 25 30 Kilometers

5 0 5 10 Nautical Miles

CONTOUR INTERVAL 100 FEET
WITH SUPPLEMENTARY CONTOURS AT 50 FOOT INTERVALS

ETTL ENGINEERS & CONSULTANTS
MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

SITE SURFACE GEOLOGY

JOB No.: G3242-09

DATE: 1975

SCALE: 1:250,000

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Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-1

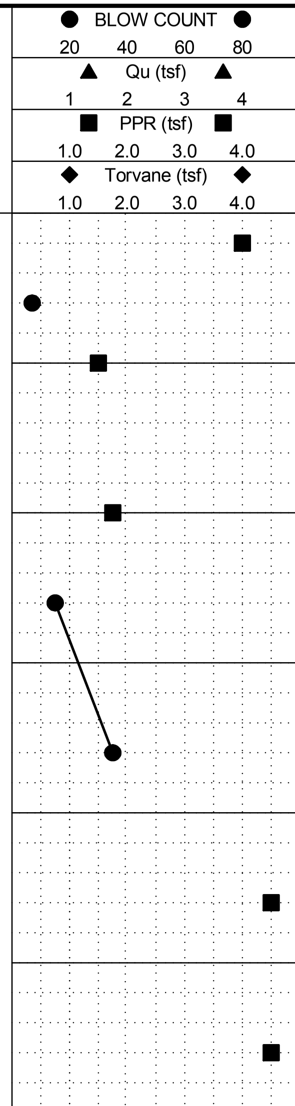
PROJECT: Welsh Power Plant
Pittsburgh, Texas

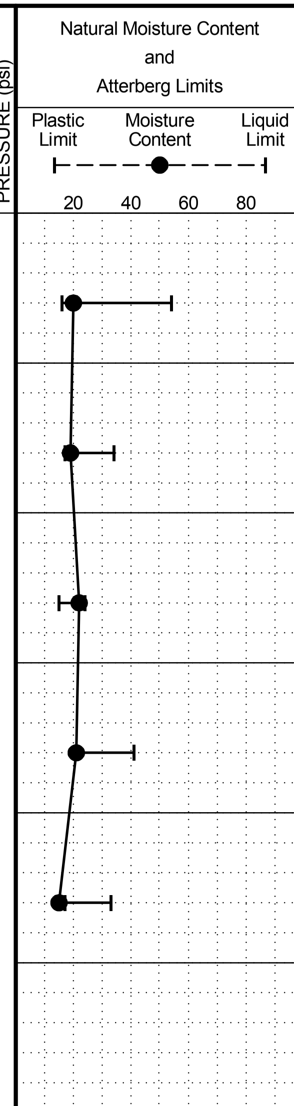
PROJECT NO.: G3242-09 **BORING TYPE:** Flight Auger

DATE 10/27/09

SURFACE ELEVATION 324.1

DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CL		SANDY LEAN CLAY(CL) very stiff; brownish orange	P=4.0 SF										
	SM		SILTY SAND(SM) tannish orange	N=7					20	54	16	38	63	+40Sieve=10%, +4 Sieve=1%
5	CH	▼	SANDY FAT CLAY(CH) medium stiff; tannish orange --stiff	P=1.5										
	SC		CLAYEY SAND(SC) medium dense; tannish orange; with clay seams	P=1.75					19	34	17	17	32	+40 Sieve=7%, +4 Sieve=3%
10	CL		SANDY LEAN CLAY(CL) stiff; orange											
	SC		CLAYEY SAND(SC) medium dense; orange; saturated; with iron oxide cemented sandstone rock	N=15					22	24	15	9	19	+40Sieve=35%, +4 Sieve=22%
15														
	CL		LEAN CLAY WITH SAND(CL) hard; dark gray; with clay seams	N=35					21	41	21	20	75	+40 Sieve=2%, +4 Sieve=0%
20														
	CL		SANDY LEAN CLAY(CL) hard; dark brown	P=4.5+					15	33	17	16	52	+40 Sieve=1%, +4 Sieve=0%
25														
			--grayish brown; laminated with silt	P=4.5+										
30			Bottom of Boring @ 30'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 5' while drilling. Water level @ 4' and open to 30' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.090', W 94°50.417'

LOG OF BORING B-2

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

DATE 10/28/09

SURFACE ELEVATION 339.7

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CL	SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+					13	28	14	14	61	+40 Sieve=3%, +4 Sieve=0%
		--very stiff	P=3.5										
5		--stiff	N=14					14	40	16	24	65	+40 Sieve=0%, +4 Sieve=0%
		--very stiff; reddish brown	P=2.75					13	30	14	16	58	+40 Sieve=0%, +4 Sieve=0%
10													
	CL	SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+										
15													
		--very stiff	P=3.5					14	34	15	19	54	+40 Sieve=0%, +4 Sieve=0%
20													
			P=4.0										
25													
	SC	CLAYEY SAND(SC) medium dense; tan, red, and gray	P=4.5					15	37	16	21	47	+40 Sieve=5%, +4 Sieve=3%
30													

Legend: BLOW COUNT 20 40 60 80; Qu (tsf) 1 2 3 4; PPR (tsf) 1.0 2.0 3.0 4.0; Torvane (tsf) 1.0 2.0 3.0 4.0

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit; 20 40 60 80

Water Level — Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Water level @ 19' and open to 24' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.078', W 94°50.449'

LOG OF BORING B-2

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

PROJECT: Welsh Power Plant, Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

DATE 10/28/09

SURFACE ELEVATION 339.7

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
		--red and tan	P=2.5						
35									
	SM SC	SILTY CLAYEY SAND(SM-SC) red, tan, and gray; saturated	SF	12	22	15	7	48	+40 Sieve=0%, +4 Sieve=0%
40									
	CH	FAT CLAY(CH) hard; brown, tan, and gray; with ferric joints; with lignite and sand seams	P=4.5+						
45									
	SM	SILTY SAND(SM) black and gray	SF						
50		Bottom of Boring @ 50'							

Plot columns: BLOW COUNT 20 40 60 80; Qu (tsf) 1 2 3 4; PPR (tsf) 1.0 2.0 3.0 4.0; Torvane (tsf) 1.0 2.0 3.0 4.0; DRY DENSITY (pcf); COMPRESSIVE STRENGTH (tsf); FAILURE STRAIN (%); CONFINING PRESSURE (psi); Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit, 20 40 60 80

Water Level — Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 19' and open to 24' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes: GPS Coordinates: N 33°03.078', W 94°50.449'

LOG OF BORING B-3

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09 **BORING TYPE:** Flight Auger

DATE 10/27/09

SURFACE ELEVATION 339.6

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	SC	CLAYEY SAND(SC) medium dense; gray and red	N=11										
	CH	FAT CLAY(CH) stiff; red and tan; with sand seams	P=1.0					23	52	18	34	87	+40 Sieve=3%, +4 Sieve=0%
5													
		--very stiff	P=3.5					21	51	19	32	86	+40 Sieve=3%, +4 Sieve=0%
10													
	CH	FAT CLAY WITH SAND(CH) very stiff; brown; with ferric joints	P=3.75					21	54	20	34	85	+40Sieve=10%, +4 Sieve=1%
15													
		--red and tan; layered; with ferric seams	P=2.5					23	61	24	37	81	+40Sieve=11%, +4 Sieve=0%
20													
	CH	FAT CLAY(CH) hard; gray; with sand seams	P=4.5+										
25													
	SC	CLAYEY SAND(SC) very dense; gray; with sand seams	N=56					22	42	22	20	35	+40 Sieve=1%, +4 Sieve=0%
30													

Plot legends: BLOW COUNT 20 40 60 80; Qu (tsf) 1 2 3 4; PPR (tsf) 1.0 2.0 3.0 4.0; Torvane (tsf) 1.0 2.0 3.0 4.0. Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit; 20 40 60 80.

Water Level Est.: Measured: Perched:

Water Observations: Seepage @ 13' while drilling. Water level @ 19' and open to 24' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.998', W 94°50.514'

LOG OF BORING B-3

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09 **BORING TYPE:** Flight Auger

DATE 10/27/09

SURFACE ELEVATION 339.6

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
	CH	FAT CLAY(CH) hard; brown; layered and with sand seams	P=4.5+					21	60	24	36	95	+40 Sieve=1%, +4 Sieve=0%
35													
		--gray and green	P=4.5+										
40													
	CL	SANDY LEAN CLAY(CL) very stiff; gray and dark green; layered; with sand seams	P=3.5										
45													
	CH	FAT CLAY(CH) hard; gray and dark green; layered; with silt seams	P=4.5+										
50		Bottom of Boring @ 50'											

BLOW COUNT 20 40 60 80; Qu (tsf) 1 2 3 4; PPR (tsf) 1.0 2.0 3.0 4.0; Torvane (tsf) 1.0 2.0 3.0 4.0

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit — 20 40 60 80

Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling. Water level @ 19' and open to 24' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.998', W 94°50.514'

LOG OF BORING B-4

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09 **BORING TYPE:** Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.6

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	SM	SILTY SAND(SM) medium dense; tan; with gravel	N=19										
	CL	SANDY LEAN CLAY(CL) dark brown	SF					14	24	15	9	59	+40 Sieve=1%, +4 Sieve=0%
		--tannish orange											
5		--hard; orangish tan	P=4.5										
			P=3.25					22	45	21	24	94	+40 Sieve=2%, +4 Sieve=0%
10		--very stiff; white											
	SC	CLAYEY SAND(SC) medium dense; tan	P=3.25					15	31	15	16	40	+40 Sieve=1%, +4 Sieve=0%
		--orangish gray; with sand seams											
15													
	CL	SANDY LEAN CLAY(CL) stiff; orangish tan	N=9										
20													
	CH	FAT CLAY(CH) very stiff; orangish tan; with ferric seams	P=4.0					25	59	24	35	88	+40 Sieve=4%, +4 Sieve=0%
25													
		--tannish brown; with iron ore seams	P=2.75										
30													

Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Water level @ 18' and open to 48' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.011', W 94°50.462'

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-4

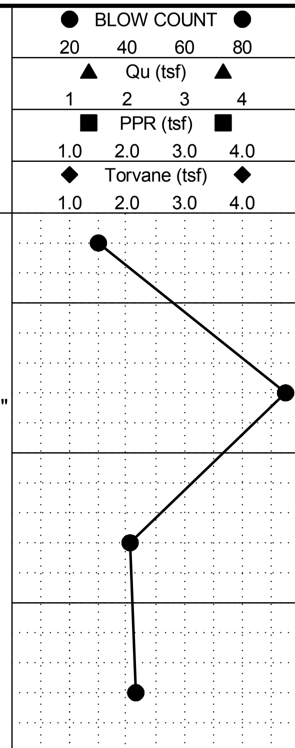
PROJECT: Welsh Power Plant
Pittsburgh, Texas

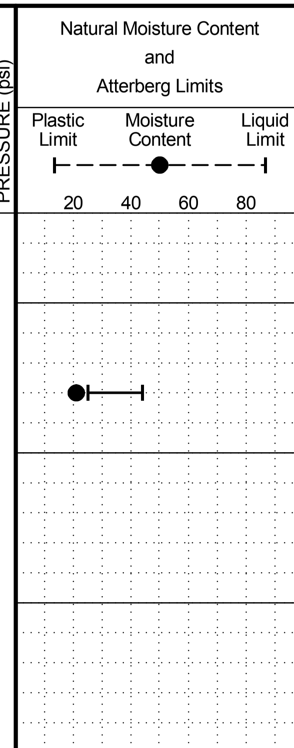
PROJECT NO.: G3242-09 **BORING TYPE:** Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.6

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
		--hard; light gray; layered and with silt seams	N=30										
35													
	CL	LEAN CLAY(CL) hard; light gray; layered and with silt seams	N=50/5.75"					21	44	25	19	93	+40 Sieve=1%, +4 Sieve=0%
40													
		--light gray	N=41										
45													
		--layered and with sand seams; with lignite	N=43										
50		Bottom of Boring @ 50'											





Water Level Est.: Measured: Perched:

Water Observations: Water level @ 18' and open to 48' upon completion.

Key to Abbrevations:
- N - SPT Data (Blows/Ft)
- P - Pocket Penetrometer (tsf)
- T - Torvane (tsf)
- L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°03.011', W 94°50.462'

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-5

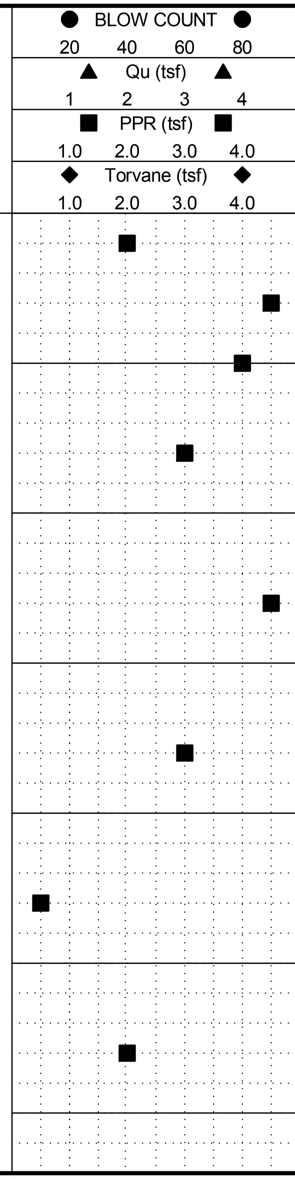
PROJECT: Welsh Power Plant
Pittsburgh, Texas

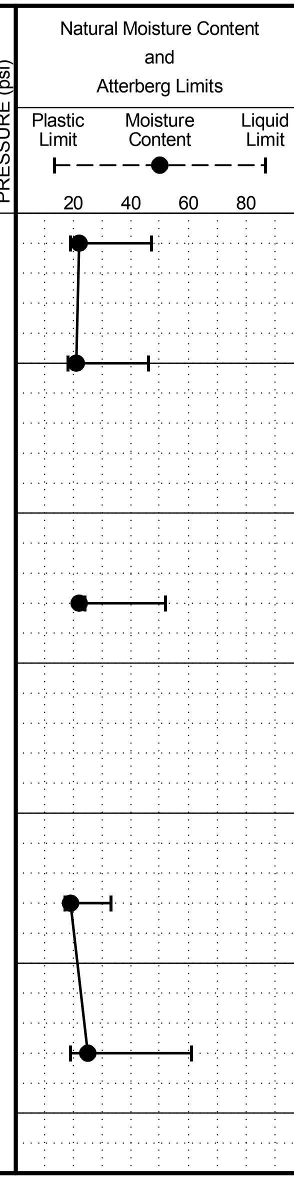
PROJECT NO.: G3242-09 **BORING TYPE:** Flight Auger

DATE 10/27/09
SURFACE ELEVATION 340.0

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LL	PL	PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CL	LEAN CLAY WITH SAND(CL) stiff; red and tan	P=2.0	22	47	19	28	81	+40 Sieve=9%, +4 Sieve=3%
	CL	LEAN CLAY(CL) hard; red and tan	P=4.5+						
5		--very stiff	P=4.0	21	46	18	28	94	+40 Sieve=3%, +4 Sieve=0%
	CH	FAT CLAY(CL) very stiff; brown and tan	P=3.0						
10									
	CH	FAT CLAY WITH SAND(CH) hard; red and tan	P=4.5+	22	52	24	28	88	+40 Sieve=3%, +4 Sieve=0%
15									
	CL	SANDY LEAN CLAY(CL) very stiff; red and gray; with sand seams	P=3.0						
20									
	SC	CLAYEY SAND(SC) very loose; tan, red, and gray	P=0.5	19	33	17	16	44	+40 Sieve=1%, +4 Sieve=0%
25									
	CH	FAT CLAY WITH SAND(CH) stiff; red and gray	P=2.0	25	61	19	42	83	+40 Sieve=5%, +4 Sieve=3%
30									

Other column headings: SAMPLES, GEOLOGIC UNIT, WATER LEVEL, DRY DENSITY (pcf), COMPRESSIVE STRENGTH (tsf), FAILURE STRAIN (%), CONFINING PRESSURE (psi), ATTERBERG LIMITS(%)





Water Level Est.: Measured: Perched:

Water Observations: Seepage @ 35' while drilling. Water level @ 31' and open to 35' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.964', W 94°50.428'

LOG OF BORING B-5

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

PROJECT: Welsh Power Plant, Pittsburgh, Texas

PROJECT NO.: G3242-09 **BORING TYPE:** Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.0

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LL	PL	PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
33–35	SC	SILTY CLAYEY SAND(SC) gray and red; saturated	SF										
38–40	CH	FAT CLAY(CH) hard; red and gray; with sand seams	P=4.5+					25	51	31	20	87	+40 Sieve=6%, +4 Sieve=0%
43–45		--gray, tan, and red; with sand seams	P=4.5+										
48–50	SM SC	SILTY SAND(SM-SC) red and gray	SF										
50		Bottom of Boring @ 50'											

Graph legends: BLOW COUNT (20, 40, 60, 80); Qu (tsf) (1, 2, 3, 4); PPR (tsf) (1.0, 2.0, 3.0, 4.0); Torvane (tsf) (1.0, 2.0, 3.0, 4.0). Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit (20, 40, 60, 80).

Water Level — Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 35' while drilling. Water level @ 31' and open to 35' upon completion and after 30 minutes.

Key to Abbrevations:
- N - SPT Data (Blows/Ft)
- P - Pocket Penetrometer (tsf)
- T - Torvane (tsf)
- L - Lab Vane Shear (tsf)

Notes: GPS Coordinates: N 33°02.964', W 94°50.428'

LOG OF BORING B-6

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09 **BORING TYPE:** Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.1

USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CH	FAT CLAY(CH) very stiff; red and gray; with ferric seams	P=4.0										
CL	SANDY LEAN CLAY(CL) hard; red and tan	P=4.5+					12	32	14	18	60	+40 Sieve=0%, +4 Sieve=0%
							21	49	20	29	93	+40 Sieve=2%, +4 Sieve=0%
		P=3.0										
	--very stiff; red, gray, and brown; with gravel --with sand seams	P=3.0										
		P=4.0					14	49	18	31	65	+40 Sieve=0%, +4 Sieve=0%
SM	SILTY SAND(SM) gray; saturated	P=3.0										
	--very dense; gray and red	N=50/5.25"					20				18	+40 Sieve=0%, +4 Sieve=0%
		SF										

DEPTH (ft): 0, 5, 10, 15, 20, 25, 30

BLOW COUNT: 20 40 60 80 · Qu (tsf): 1 2 3 4 · PPR (tsf): 1.0 2.0 3.0 4.0 · Torvane (tsf): 1.0 2.0 3.0 4.0

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit; 20 40 60 80

Water Level Est.: Measured: Perched:

Water Observations: Seepage @ 17' while drilling. Water level @ 13' and open to 15' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.912', W 94°50.462'

LOG OF BORING B-6

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09 **BORING TYPE:** Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.1

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
35	CH	FAT CLAY(CH) hard; brown; with sand seams	P=4.5+						
40			P=4.5+	22	68	24	44	95	+40 Sieve=0%, +4 Sieve=0%
45		--dark green	P=4.5+						
50	CL	LEAN CLAY(CL) hard; dark green; laminated with lignite	P=4.5+						
		Bottom of Boring @ 50'							

Other columns: SAMPLES, GEOLOGIC UNIT, WATER LEVEL, DRY DENSITY (pcf), COMPRESSIVE STRENGTH (tsf), FAILURE STRAIN (%), CONFINING PRESSURE (psi).

Plot legend: BLOW COUNT 20 40 60 80; Qu (tsf) 1 2 3 4; PPR (tsf) 1.0 2.0 3.0 4.0; Torvane (tsf) 1.0 2.0 3.0 4.0.

Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit; 20 40 60 80

Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 17' while drilling. Water level @ 13' and open to 15' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.912', W 94°50.462'

LOG OF BORING B-7

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

DATE 10/27/09

SURFACE ELEVATION 340.4

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LL	PL	PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	SM	SILTY SAND(SM) dense; tan	N=31	21				21	+40 Sieve=0%, +4 Sieve=0%
			N=36						
5		--gray; saturated	N=38	23				15	+40 Sieve=0%, +4 Sieve=0%
		--very dense	N=59						
13	CH	FAT CLAY(CH) very stiff; dark gray; with silt and ferric seams	N=26	14	58	22	36	98	+40 Sieve=0%, +4 Sieve=0%
		--hard; gray and black; with trace of lignite	P=4.5+						
		--gray							
			P=4.5+						
30		Bottom of Boring @ 30'							

Columns also printed (no data): SAMPLES, GEOLOGIC UNIT, WATER LEVEL, DRY DENSITY (pcf), COMPRESSIVE STRENGTH (tsf), FAILURE STRAIN (%), CONFINING PRESSURE (psi).

Plot legends: BLOW COUNT 20 40 60 80; Qu (tsf) 1 2 3 4; PPR (tsf) 1.0 2.0 3.0 4.0; Torvane (tsf) 1.0 2.0 3.0 4.0. Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit; 20 40 60 80.

Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 4' while drilling. Water level @ 2' and open to 7' upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.898', W 94°50.519'

LOG OF BORING S-1

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

PROJECT: Welsh Power Plant, Pittsburgh, Texas

PROJECT NO.: G3242-09 **BORING TYPE:** Flight Auger

DATE 11/5/09

SURFACE ELEVATION

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LL	PL	PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CL	SANDY LEAN CLAY(CL) very stiff; gray and brown	N=20	12	28	18	10	52	+40 Sieve=3%, +4 Sieve=1%
		--brown and gray; with sand seams	P=2.0						
5	CL	LEAN CLAY(CL) stiff; gray, brown, and red; with sand seams	P=1.5	22	30	20	10	83	+40 Sieve=2%, +4 Sieve=0%
		--tan and white; with sand seams	P=1.5						
10		--gray; with sand seams	P=1.5	24	37	20	17	83	+40 Sieve=3%, +4 Sieve=0%
15	CH	FAT CLAY(CH) very stiff; brown; with sand seams	P=3.0						
20			P=2.0	26	53	20	33	91	+40 Sieve=1%, +4 Sieve=0%
25		--hard	P=4.5						
30		Bottom of Boring @ 30'							

Column headings also printed: SAMPLES, GEOLOGIC UNIT, WATER LEVEL, BLOW COUNT (20 40 60 80), Qu (tsf) (1 2 3 4), PPR (tsf) (1.0 2.0 3.0 4.0), Torvane (tsf) (1.0 2.0 3.0 4.0), DRY DENSITY (pcf), COMPRESSIVE STRENGTH (tsf), FAILURE STRAIN (%), CONFINING PRESSURE (psi), Natural Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit; 20 40 60 80), ATTERBERG LIMITS(%) LIQUID LIMIT, PLASTIC LIMIT, PLASTICITY INDEX.

Water Level Est.: Measured: Perched:

Water Observations: Seepage @ 8' while drilling. Water level @ 5' and open to 25' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.640', W 94°50.329'

LOG OF BORING S-2

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

PROJECT: Welsh Power Plant, Pittsburgh, Texas

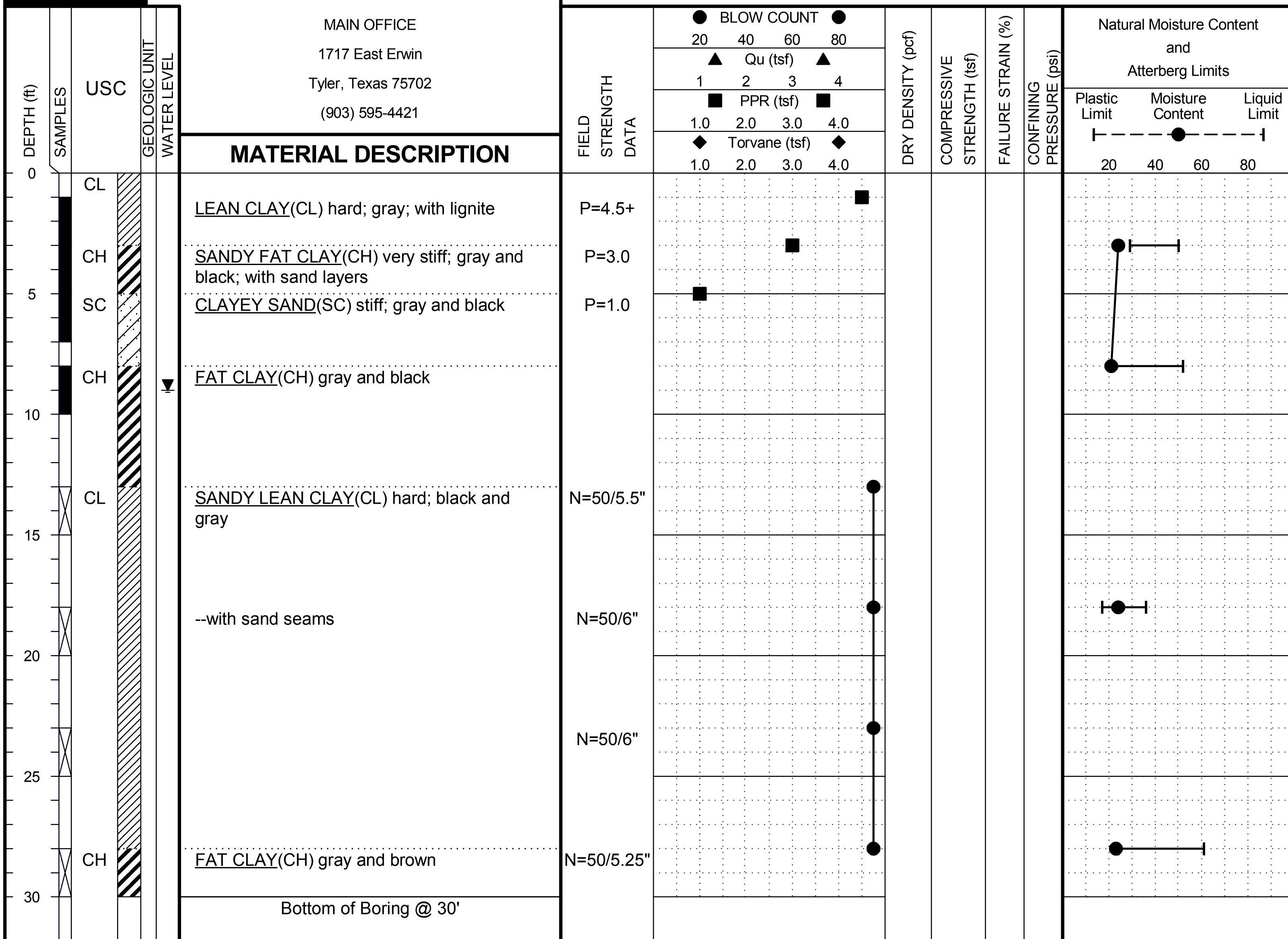
PROJECT NO.: G3242-09

BORING TYPE: Flight Auger

DATE 11/5/09

SURFACE ELEVATION

USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LL	PL	PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	LEAN CLAY(CL) hard; gray; with lignite	P=4.5+						
CH	SANDY FAT CLAY(CH) very stiff; gray and black; with sand layers	P=3.0	24	50	29	21	68	+40 Sieve=2%, +4 Sieve=0%
SC	CLAYEY SAND(SC) stiff; gray and black	P=1.0						
CH	FAT CLAY(CH) gray and black		21	52	21	31	88	+40 Sieve=0%, +4 Sieve=0%
CL	SANDY LEAN CLAY(CL) hard; black and gray	N=50/5.5"						
	--with sand seams	N=50/6"	24	36	17	19	56	+40 Sieve=5%, +4 Sieve=0%
		N=50/6"						
CH	FAT CLAY(CH) gray and brown	N=50/5.25"	23	61	24	37	90	+40 Sieve=2%, +4 Sieve=0%
	Bottom of Boring @ 30'							



Water Level Est.: Measured: Perched:

Water Observations: Seepage @ 8' while drilling. Water level @ 9' and open to 24' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.573', W 94°50.469'

LOG OF BORING S-3

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

PROJECT: Welsh Power Plant
Pittsburgh, Texas

PROJECT NO.: G3242-09 **BORING TYPE:** Flight Auger

DATE 11/5/09

SURFACE ELEVATION

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LL	PL	PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CL	LEAN CLAY WITH SAND(CL) stiff; tan, yellow, and red	N=11					17	30	17	13	73	+40 Sieve=4%, +4 Sieve=1%
		--red and tan; with ferric seams	P=2.0										
5	SC	CLAYEY SAND(SC) medium dense; gray and tan	P=2.75					15	29	15	14	46	+40Sieve=13%, +4 Sieve=8%
	CL ML	SANDY SILTY CLAY(CL-ML) very stiff; gray and tan	P=3.5										
10													
			P=3.5					14	19	14	5	54	+40 Sieve=1%, +4 Sieve=0%
15													
	SM SC	SILTY CLAYEY SAND(SM-SC) medium dense; gray	P=1.75										
20													
		--loose; gray and red; saturated	P=0.75					19	20	14	6	46	+40 Sieve=6%, +4 Sieve=3%
25													
	CL	LEAN CLAY(CL) red and yellow											
30		Bottom of Boring @ 30'											

Graph scales: BLOW COUNT 20 40 60 80; Qu (tsf) 1 2 3 4; PPR (tsf) 1.0 2.0 3.0 4.0; Torvane (tsf) 1.0 2.0 3.0 4.0. Natural Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit; 20 40 60 80.

Water Level Est.: ▽ Measured: ▼ Perched: ▼

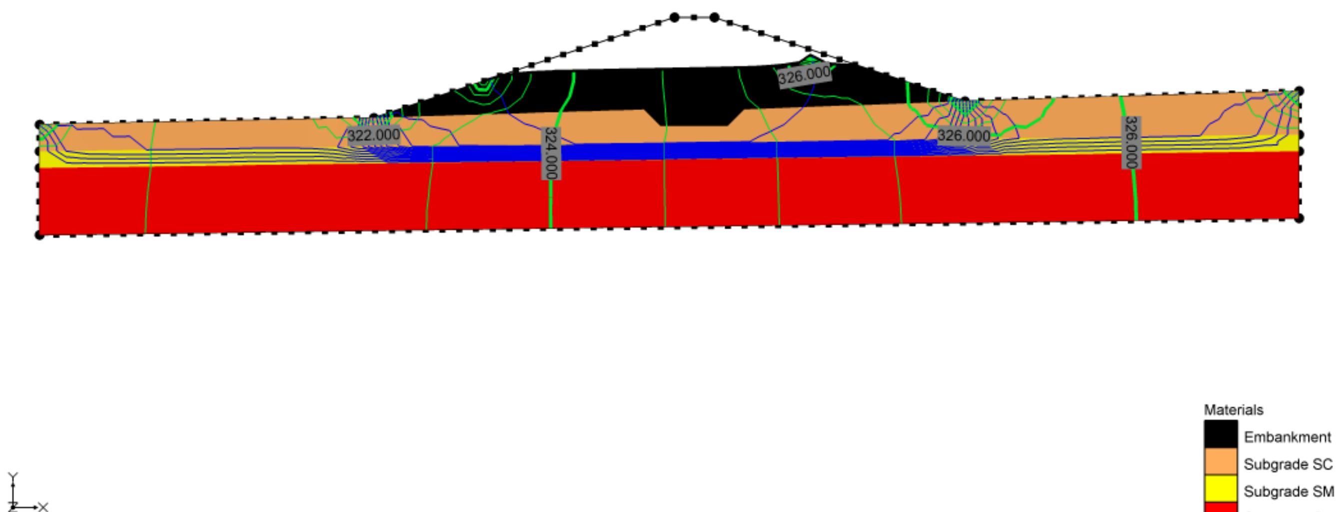
Water Observations: Seepage @ 23' while drilling. Water level @ 18' and open to 18' upon completion and after 30 minutes.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 33°02.471', W 94°50.360'

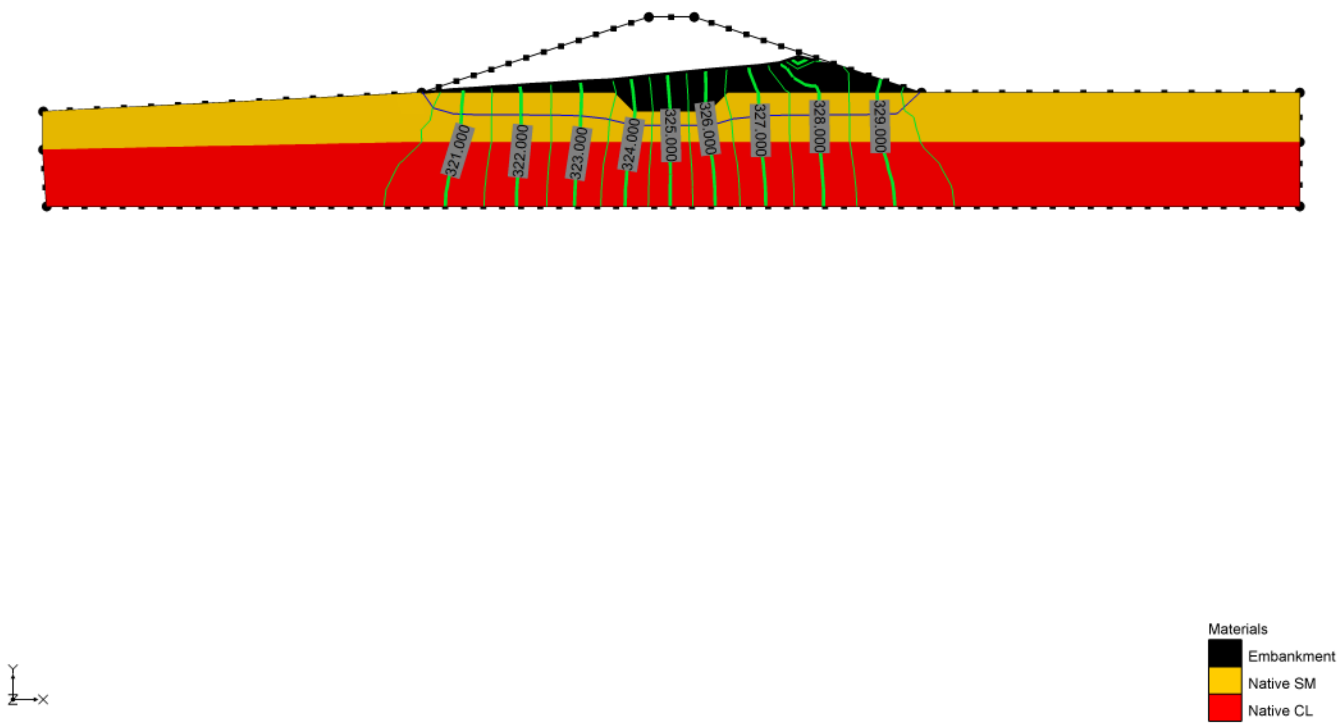
Welsh Power Station Ash Pond #1

Total Flowrate = 0.0076(ft^3/d)/(ft)



Welsh Power Station Ash Pond #2

Total Flowrate = 0.0992(ft^3/d)/(ft)

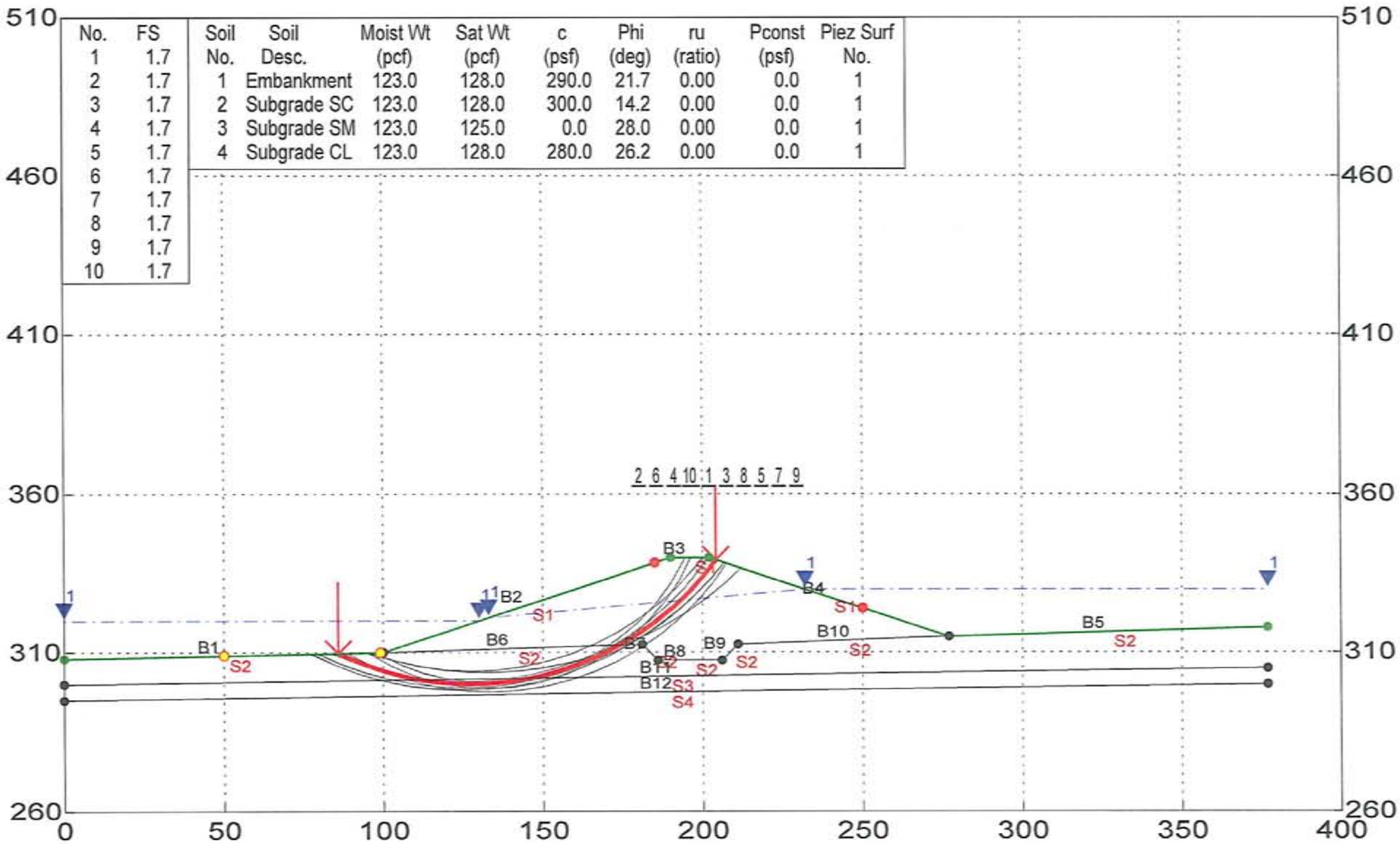


Welsh Power Station Ash Disposal Ponds Embankment Study
Ash Pond #1, Steady State

ETTL Engineers & ConsS:\Geotech\2009 Geotechnical Job Files\3242-095 AEP Welsh Power Plant Embankments\Slope Stability\Pond1 SS.in

No.	FS
1	1.7
2	1.7
3	1.7
4	1.7
5	1.7
6	1.7
7	1.7
8	1.7
9	1.7
10	1.7

Soil No.	Soil Desc.	Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	Pconst (psf)	Piez Surf No.
1	Embankment	123.0	128.0	290.0	21.7	0.00	0.0	1
2	Subgrade SC	123.0	128.0	300.0	14.2	0.00	0.0	1
3	Subgrade SM	123.0	125.0	0.0	28.0	0.00	0.0	1
4	Subgrade CL	123.0	128.0	280.0	26.2	0.00	0.0	1



GEOSTASE FSmin = 1.7

Modified Bishop Method

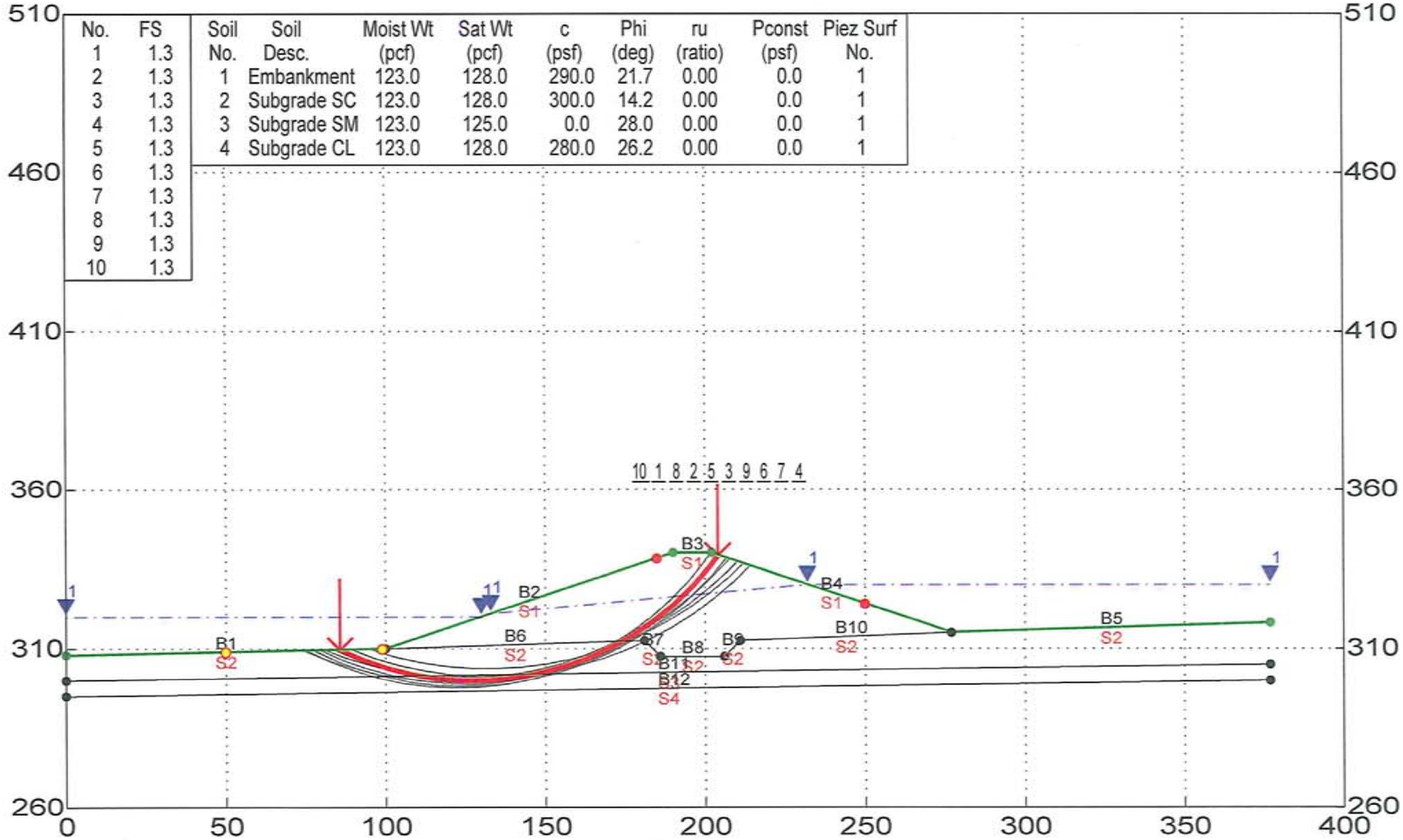
PLATE A1.1

Welsh Power Station Ash Disposal Ponds Embankment Study
Ash Pond #1, Steady State

ETTL Engineers S:\Geotech\2009 Geotechnical Job Files\3242-095 AEP Welsh Power Plant Embankments\Slope Stability\Pond1 SS seismic.in

No.	FS
1	1.3
2	1.3
3	1.3
4	1.3
5	1.3
6	1.3
7	1.3
8	1.3
9	1.3
10	1.3

Soil No.	Soil Desc.	Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	Pconst (psf)	Piez Surf No.
1	Embankment	123.0	128.0	290.0	21.7	0.00	0.0	1
2	Subgrade SC	123.0	128.0	300.0	14.2	0.00	0.0	1
3	Subgrade SM	123.0	125.0	0.0	28.0	0.00	0.0	1
4	Subgrade CL	123.0	128.0	280.0	26.2	0.00	0.0	1



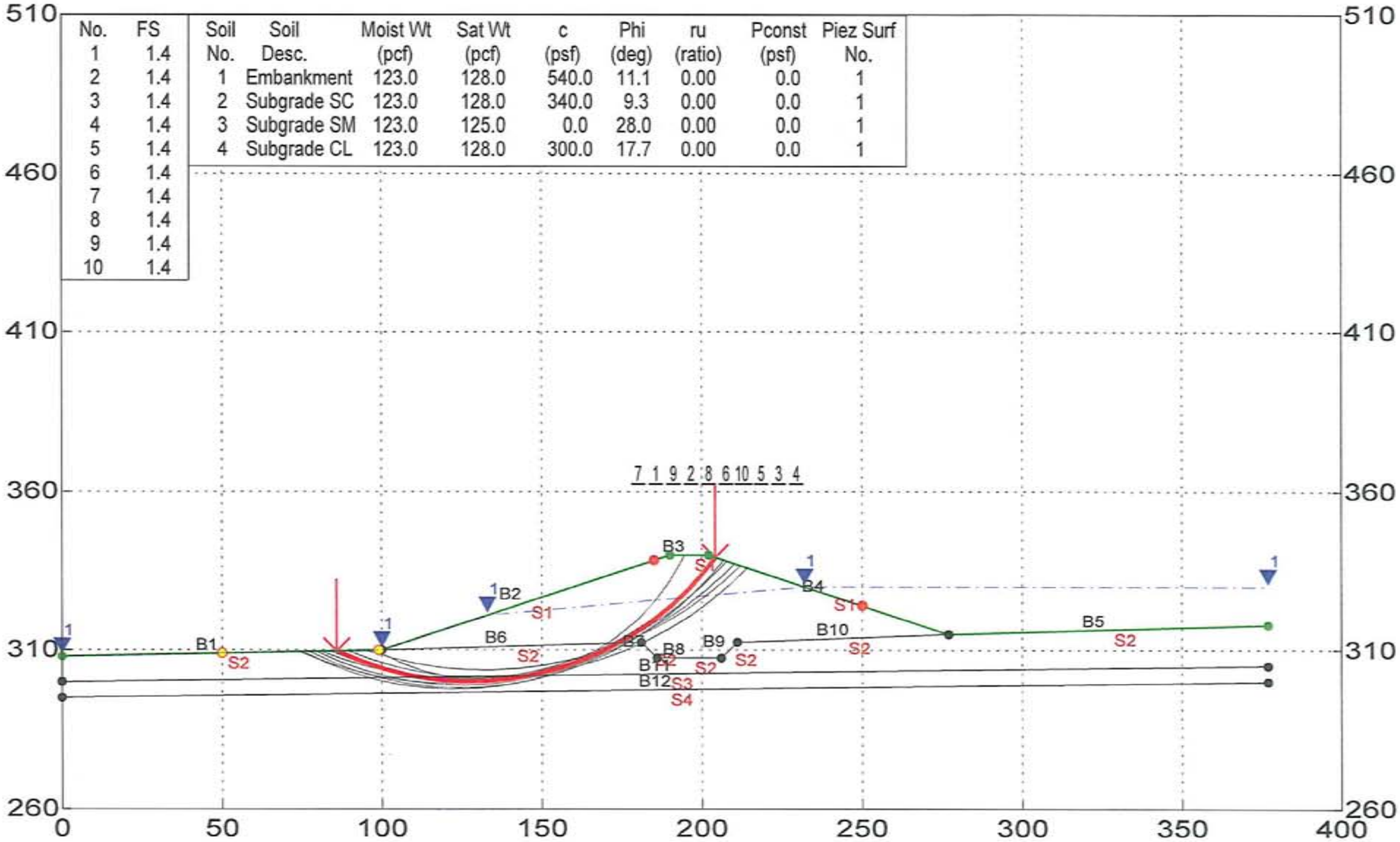
GEOSTASE FSmin = 1.3

Modified Bishop Method

PLATE A1.1

Welsh Power Station Ash Disposal Ponds Embankment Study
Ash Pond #1, Rapid Drawdown

ETTL Engineers & Co6s\Gtantsdh\2009 Geotechnical Job Files\3242-095 AEP Welsh Power Plant Embankments\Slope Stability\Pond1 RD.in



No.	FS
1	1.4
2	1.4
3	1.4
4	1.4
5	1.4
6	1.4
7	1.4
8	1.4
9	1.4
10	1.4

Soil No.	Soil Desc.	Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	Pconst (psf)	Piez Surf No.
1	Embankment	123.0	128.0	540.0	11.1	0.00	0.0	1
2	Subgrade SC	123.0	128.0	340.0	9.3	0.00	0.0	1
3	Subgrade SM	123.0	125.0	0.0	28.0	0.00	0.0	1
4	Subgrade CL	123.0	128.0	300.0	17.7	0.00	0.0	1

GEOSTASE FSmin = 1.4

Modified Bishop Method

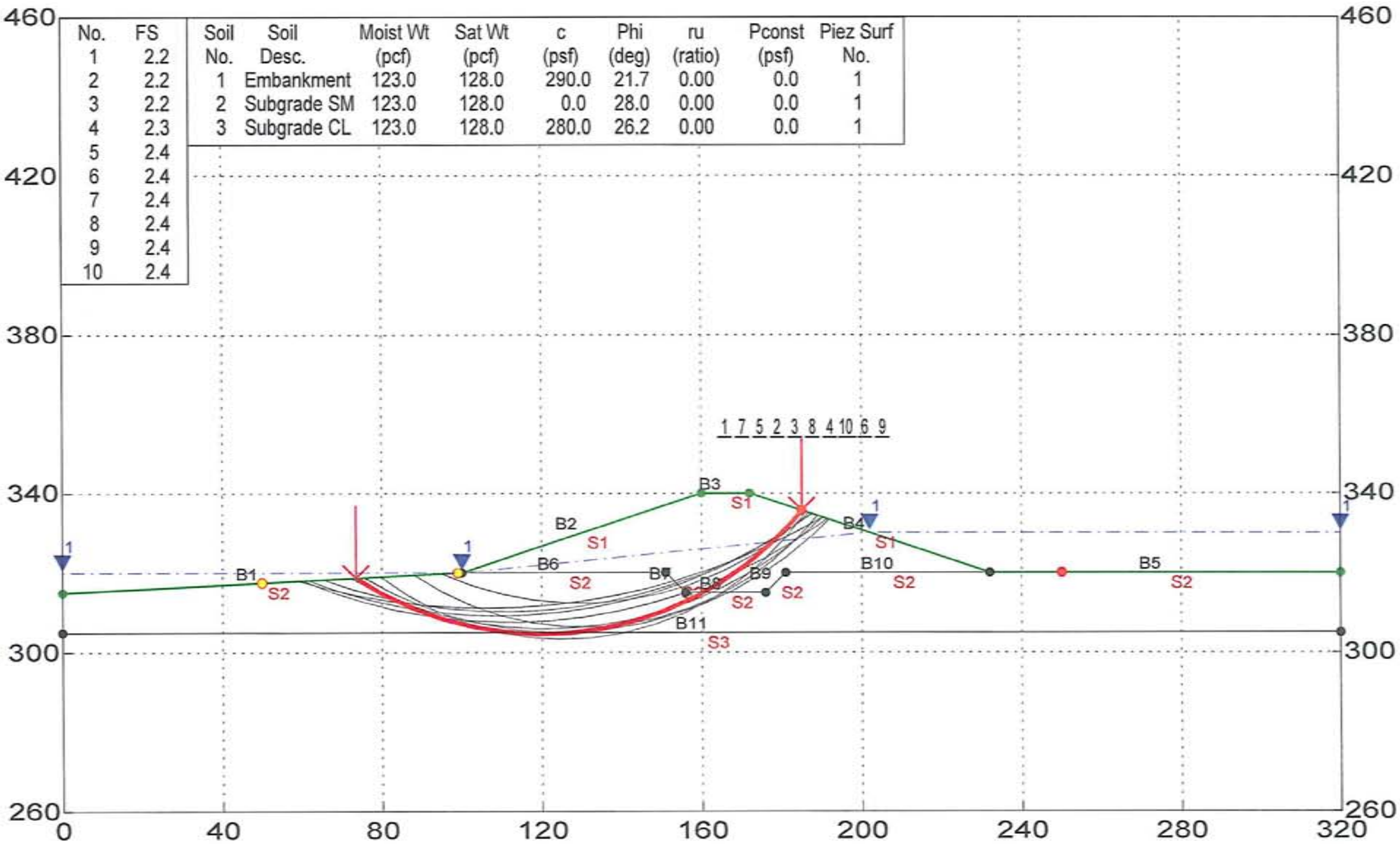
PLATE A1.2

Welsh Power Station Ash Disposal Ponds Embankment Study
Ash Pond #2, Steady State

ETTL Engineers & ConsS:\Geotech\2009 Geotechnical Job Files\3242-095 AEP Welsh Power Plant Embankments\Slope Stability\Pond2 SS.in

No.	FS
1	2.2
2	2.2
3	2.2
4	2.3
5	2.4
6	2.4
7	2.4
8	2.4
9	2.4
10	2.4

Soil No.	Soil Desc.	Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	Pconst (psf)	Piez Surf No.
1	Embankment	123.0	128.0	290.0	21.7	0.00	0.0	1
2	Subgrade SM	123.0	128.0	0.0	28.0	0.00	0.0	1
3	Subgrade CL	123.0	128.0	280.0	26.2	0.00	0.0	1



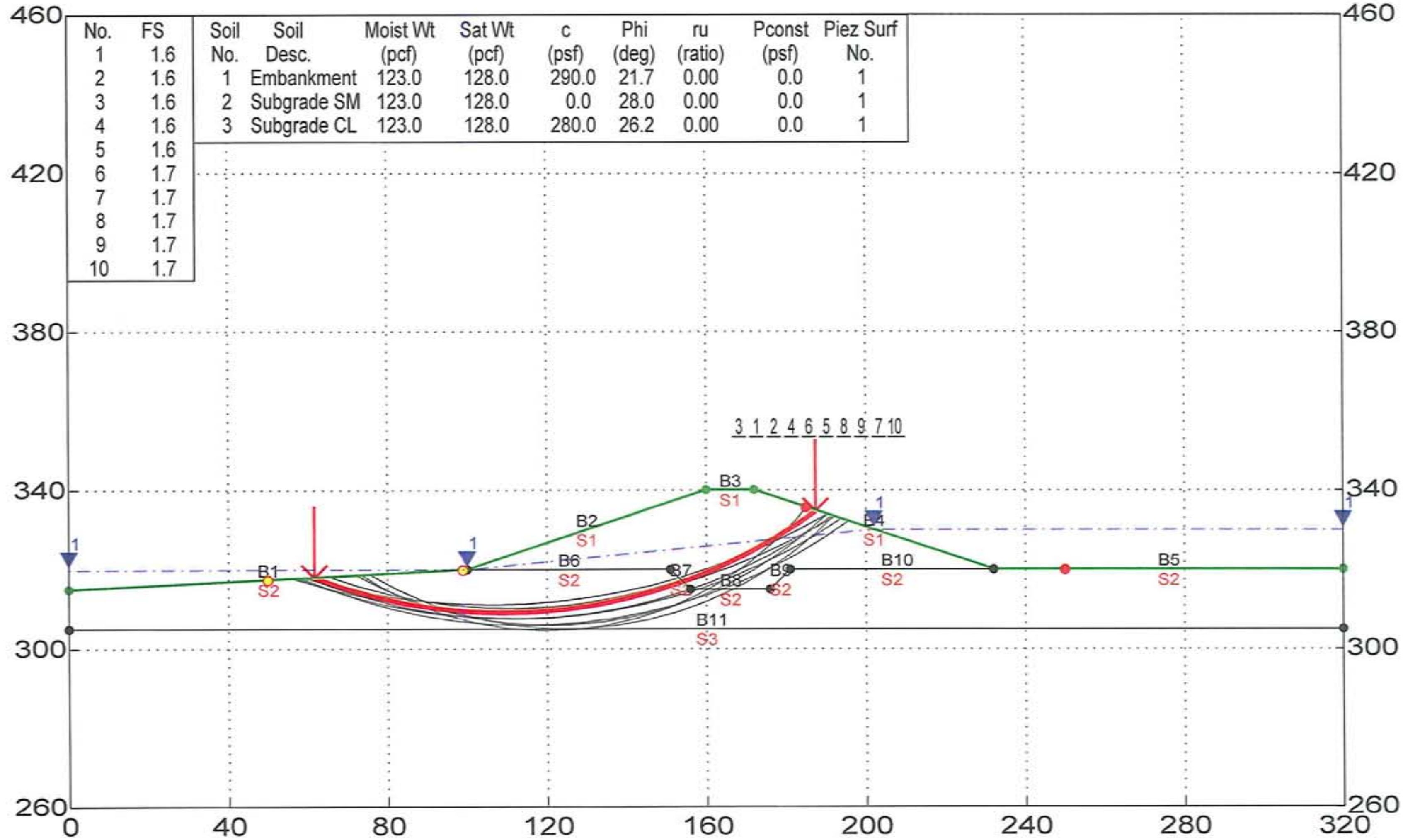
GEOSTASE FSmin = 2.2

Modified Bishop Method

PLATE A2.1

Welsh Power Station Ash Disposal Ponds Embankment Study
Ash Pond #2, Steady State with seismic

ETTL Engineers\Geotech\2009 Geotechnical Job Files\3242-095 AEP Welsh Power Plant Embankments\Slope Stability\Pond2 SS seismic.in



No.	FS
1	1.6
2	1.6
3	1.6
4	1.6
5	1.6
6	1.7
7	1.7
8	1.7
9	1.7
10	1.7

Soil No.	Soil Desc.	Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	Pconst (psf)	Piez Surf No.
1	Embankment	123.0	128.0	290.0	21.7	0.00	0.0	1
2	Subgrade SM	123.0	128.0	0.0	28.0	0.00	0.0	1
3	Subgrade CL	123.0	128.0	280.0	26.2	0.00	0.0	1

GEOSTASE FSmin = 1.6

Modified Bishop Method

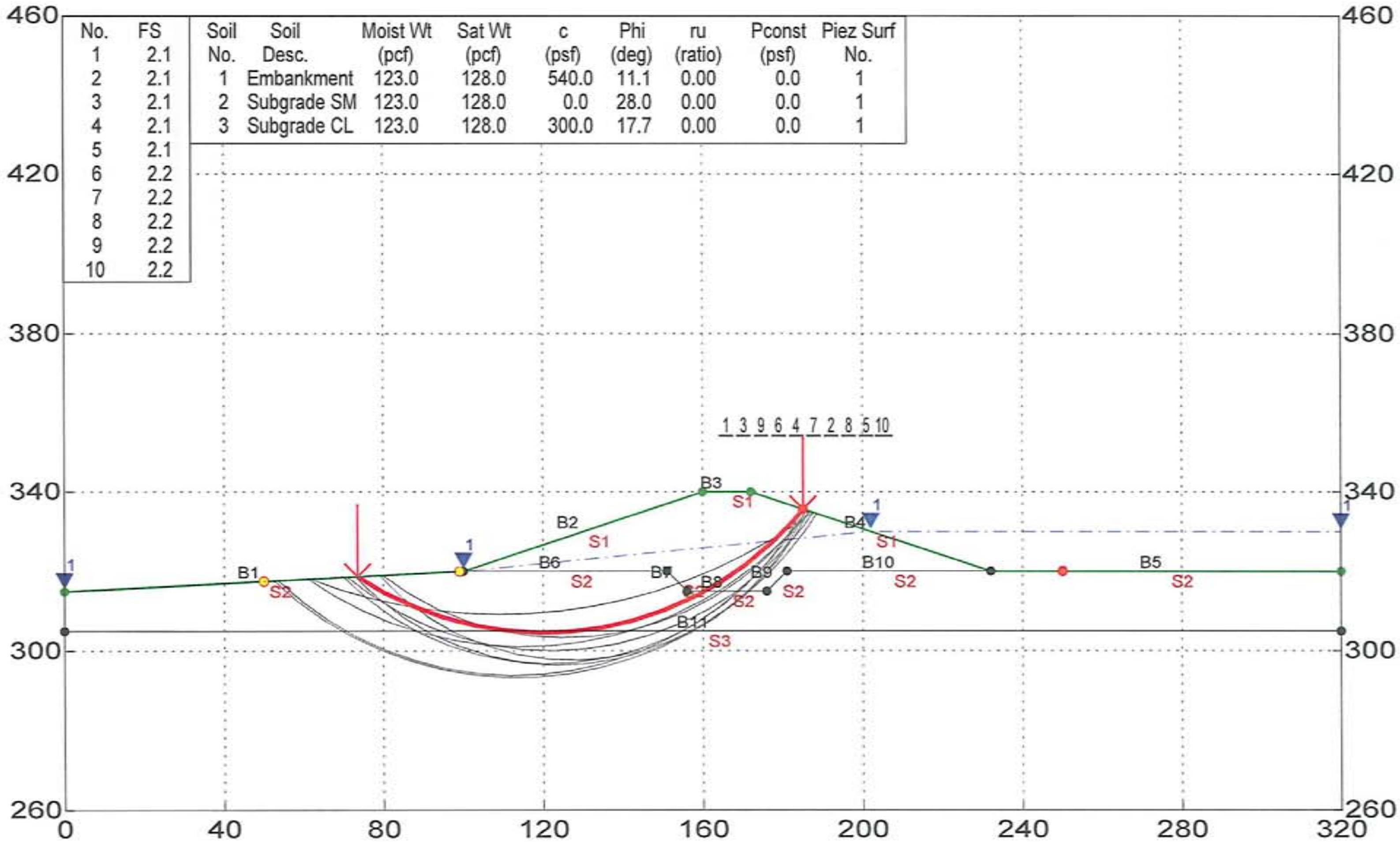
PLATE A2.1

Welsh Power Station Ash Disposal Ponds Embankment Study
Ash Pond #2, Rapid Drawdown

ETTL Engineers & ConsS:\Geotechi\2009 Geotechnical Job Files\3242-095 AEP Welsh Power Plant Embankments\Slope Stability\Pond2 SS.in

No.	FS
1	2.1
2	2.1
3	2.1
4	2.1
5	2.1
6	2.2
7	2.2
8	2.2
9	2.2
10	2.2

Soil No.	Soil Desc.	Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	Pconst (psf)	Piez Surf No.
1	Embankment	123.0	128.0	540.0	11.1	0.00	0.0	1
2	Subgrade SM	123.0	128.0	0.0	28.0	0.00	0.0	1
3	Subgrade CL	123.0	128.0	300.0	17.7	0.00	0.0	1



GEOSTASE FSmin = 2.1

Modified Bishop Method

PLATE A2.2

PROJECT INFORMATION

PROJECT: AEP Welsh Power Plant Bottom Ash Ponds
LOCATION: Pittsburg, Texas
PROJECT NO: G 3242 - 095
CLIENT:
December 2009

TRIAXIAL TEST PROGRAM BY GARRY H. GREGORY, P.E.

VERSION 1.0 - AUGUST 1998 - REVISED MARCH 24, 1999

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Shelby Tube Sample
DESCRIPTION: Tan & Gray Clay & w/ some Ferric Joints
Sampled on Site, B-1 5' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

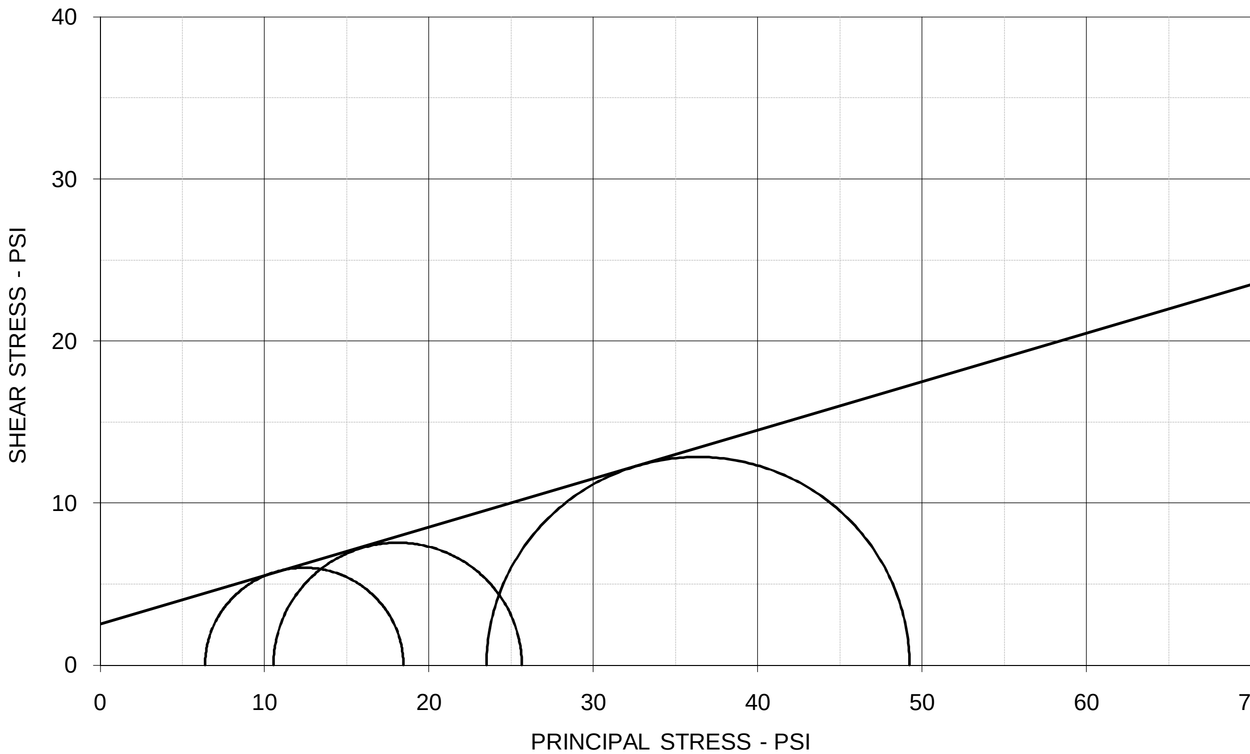
PLATE: B.1

PLATE: B.2

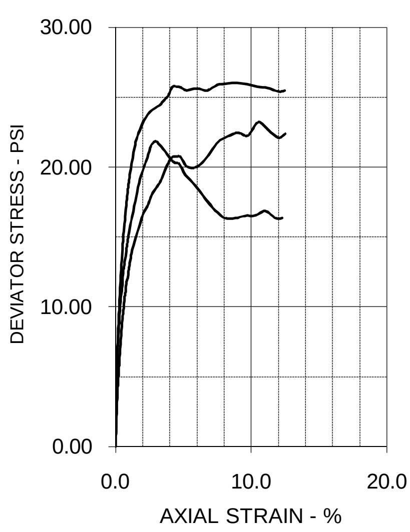
PLATE: B.3

Number of Specimens = 3

TRIAXIAL SHEAR TEST REPORT



EFFECTIVE STRESS PARAMETERS	φ ' = 16.7 deg	c' = 2.5 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	23.9	24.1	26.5	
Dry Density - pcf	102.5	100.6	99.0	
Diameter - inches	2.01	2.00	2.01	
Height - inches	4.00	3.92	3.98	
AT TEST				
Final Moisture - %	25.4	24.3	25.0	
Dry Density - pcf	102.7	102.4	101.9	
Calculated Diameter (in.)	2.01	1.98	1.99	
Height - inches	4.02	3.87	3.92	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	12.03	15.08	25.71	
Total Pore Pressure - psi	53.6	59.4	66.5	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	0.9	0.9	4.8	
σ_1' Failure - psi	18.43	25.64	49.23	
σ_3' Failure - psi	6.40	10.56	23.52	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP

SAMPLE TYPE: Shelby Tube Sample

DESCRIPTION: Tan & Gray Clay & w/ some Ferric Joints

Sampled on Site, B-1 5' to 10' deep

ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve

LL: PL: PI: Percent -200:

REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

G 3242-095, B-1 5'-10' Welsh

PROJECT INFORMATION

PROJECT: AEP Welsh Power Plant Bottom Ash Ponds

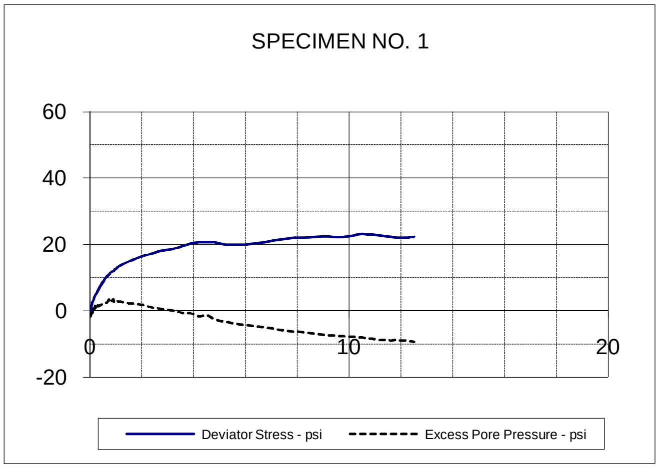
LOCATION: Pittsburg, Texas

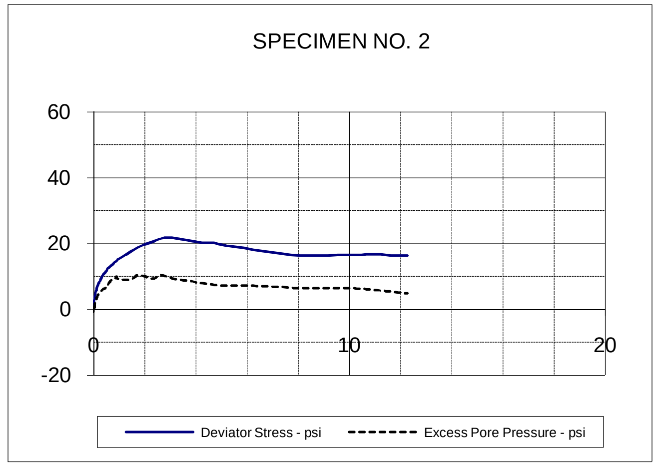
PROJECT NO: G 3242 - 095

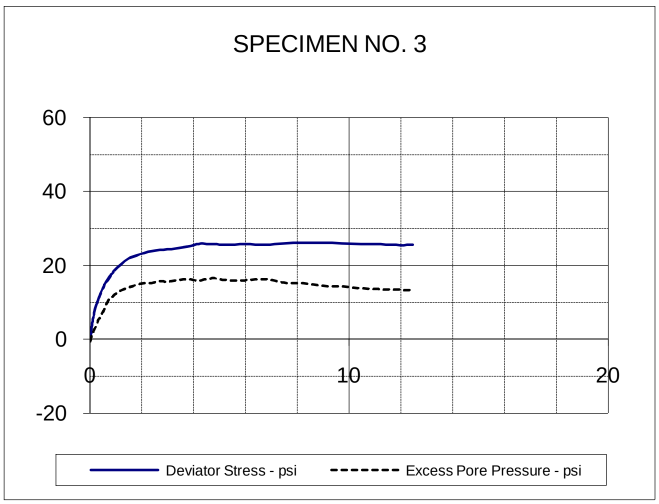
CLIENT:

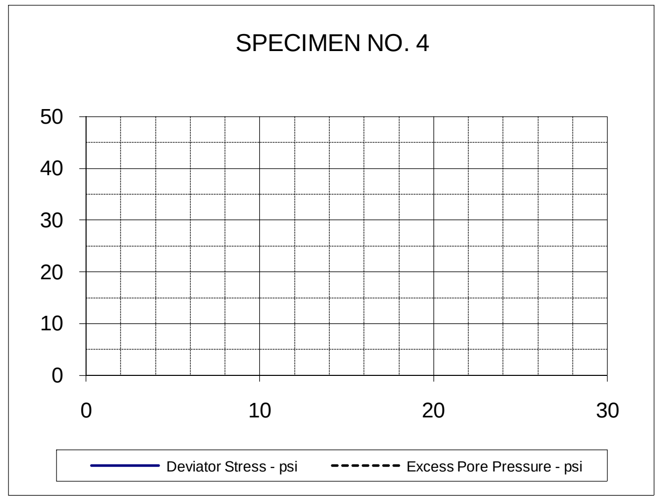
December 2009

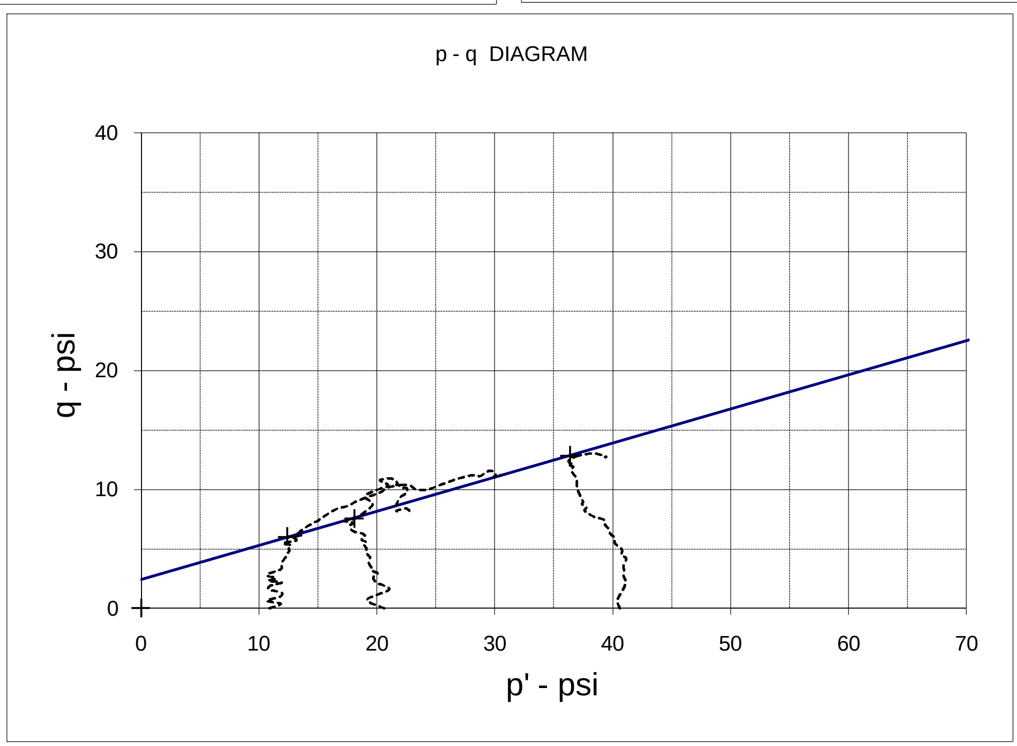
ETTL ENGINEERS & CONSULTANTS PLATE: B.1







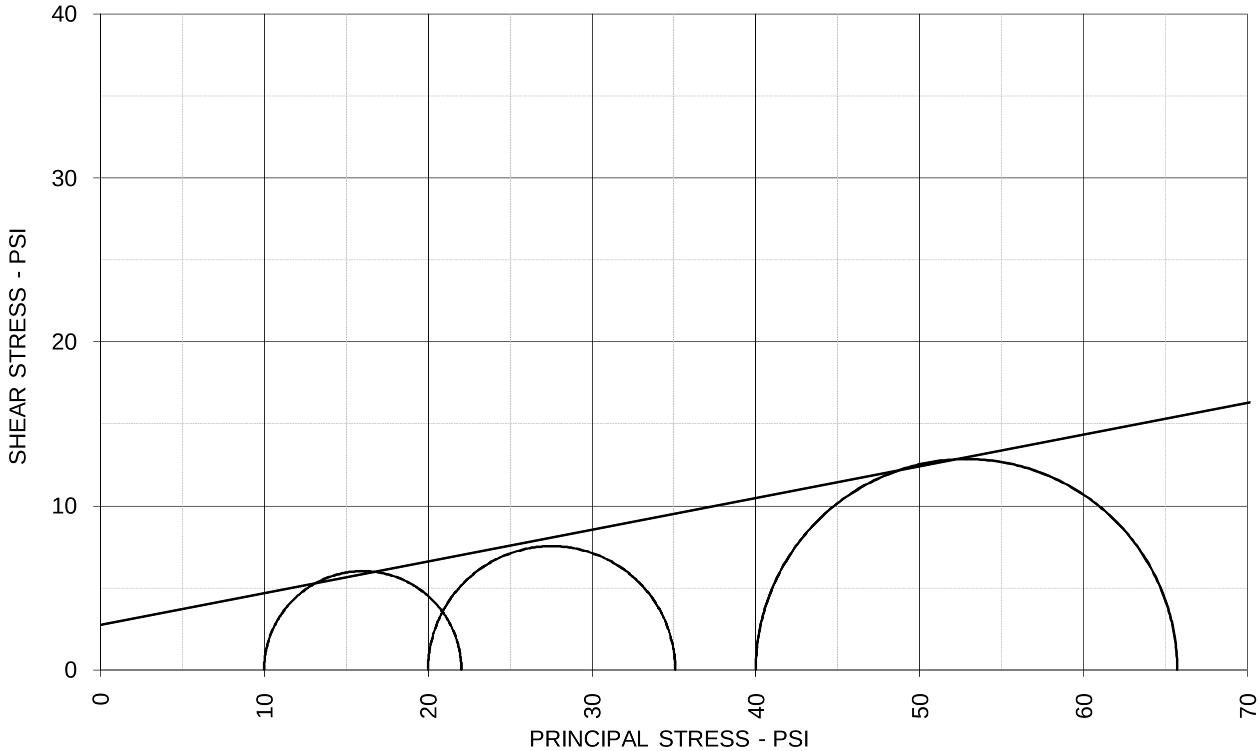




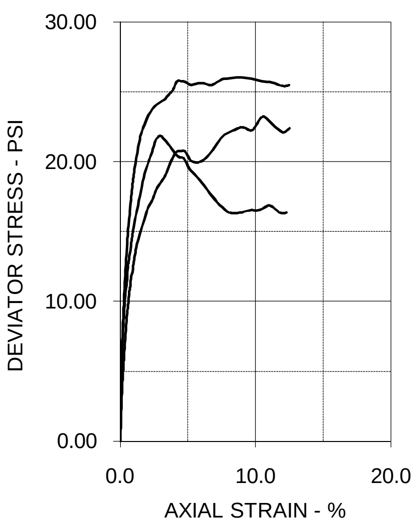
EFFECTIVE STRESS PARAMETERS	R^2 = 1.00	α (deg) = 16.0	a (psi) = 2.4
PROJECT: AEP Welsh Power Plant Bottom Ash Ponds		TYPE OF TEST & NO: CU with PP	
PROJECT NO: G 3242 - 095		**ETTL ENGINEERS & CONSULTANTS**	PLATE: B.2
DESCRIPTION: Tan & Gray Clay & w/ some Ferric Joints			

G 3242-095, B-1 5'-10' Welsh

TRIAXIAL SHEAR TEST REPORT



TOTAL STRESS PARAMETERS	φ = 10.9 deg	c = 2.8 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	23.9	24.1	26.5	
Dry Density - pcf	102.5	100.6	99.0	
Diameter - inches	2.01	2.00	2.01	
Height - inches	4.00	3.92	3.98	
AT TEST				
Final Moisture - %	25.4	24.3	25.0	
Dry Density - pcf	102.7	102.4	101.9	
Calculated Diameter (in.)	2.01	1.98	1.99	
Height - inches	4.02	3.87	3.92	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	12.03	15.08	25.71	
Total Pore Pressure - psi	53.6	59.4	66.5	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	0.9	0.9	4.8	
σ_1 Failure - psi	22.03	35.08	65.71	
σ_3 Failure - psi	10.00	20.00	40.00	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Shelby Tube Sample
DESCRIPTION: Tan & Gray Clay & w/ some Ferric Joints
Sampled on Site, B-1 5' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

PROJECT INFORMATION

PROJECT: AEP Welsh Power Plant Bottom Ash Ponds
LOCATION: Pittsburg, Texas
PROJECT NO: G 3242 - 095
CLIENT:
December 2009

ETTL ENGINEERS & CONSULTANTS PLATE: B.3

PROJECT INFORMATION

PROJECT: AEP Welsh Power Plant Bottom Ash Ponds
LOCATION: Pittsburg, Texas
PROJECT NO: G 3242 - 095
CLIENT:
December 2009

TRIAXIAL TEST PROGRAM BY GARRY H. GREGORY, P.E.

VERSION 1.0 - AUGUST 1998 - REVISED MARCH 24, 1999

THIS COPY LICENSED TO:
ETTL ENGINEERS AND CONSULTANTS, INC.
1717 East Erwin
Tyler, TX 75702

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Shelby Tube Sample
DESCRIPTION: Reddish Brown Sandy Lean Clay
Sampled on Site, B-2 8' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

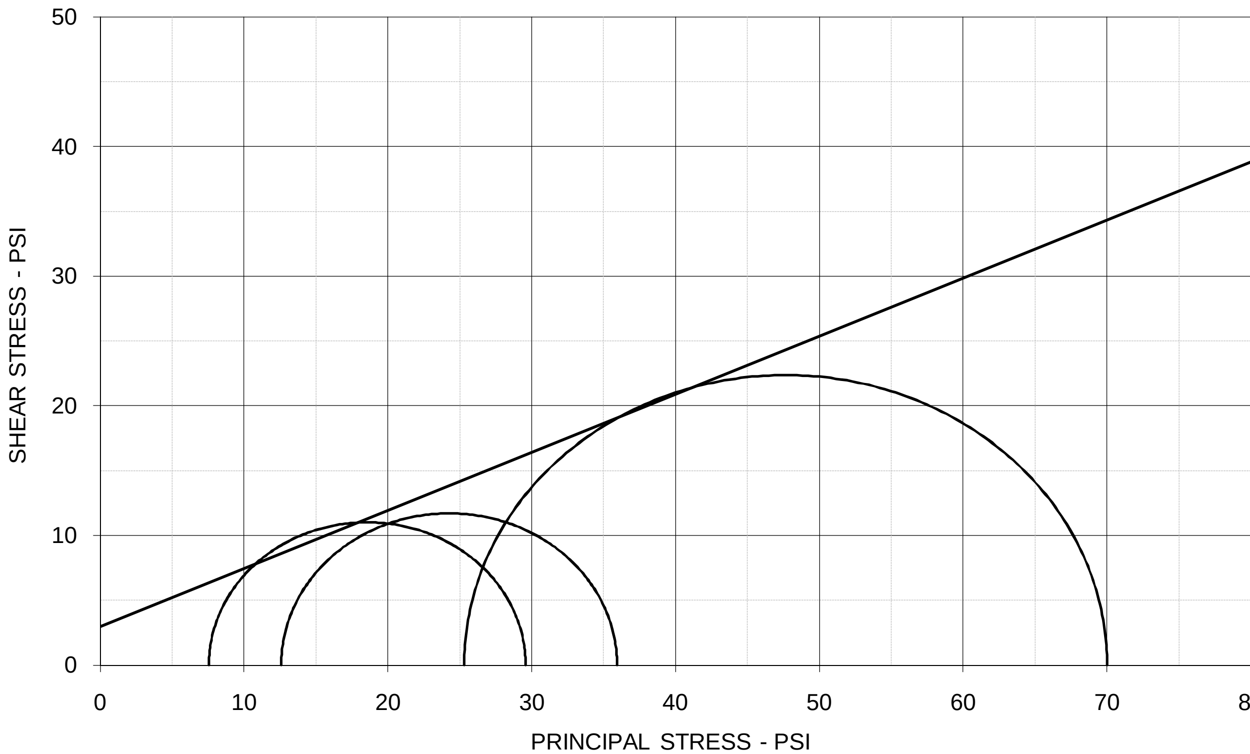
PLATE: B.1

PLATE: B.2

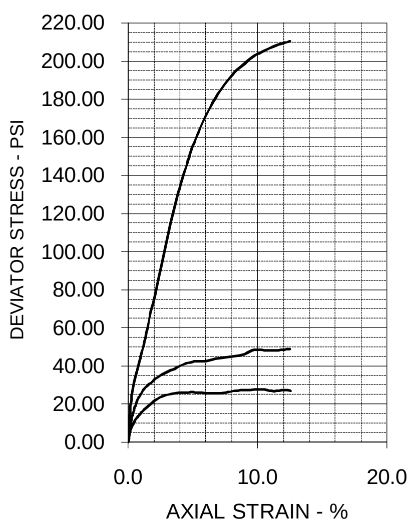
PLATE: B.3

Number of Specimens = 3

TRIAXIAL SHEAR TEST REPORT



EFFECTIVE STRESS PARAMETERS	φ ' = 24.1 deg	c' = 2.9 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	14.4	23.6	13.0	
Dry Density - pcf	114.9	100.1	122.2	
Diameter - inches	2.01	2.02	2.00	
Height - inches	4.00	4.00	4.02	
AT TEST				
Final Moisture - %	18.7	24.4	13.2	
Dry Density - pcf	115.2	101.7	123.3	
Calculated Diameter (in.)	2.00	2.01	1.99	
Height - inches	3.99	3.97	3.98	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	22.03	23.38	44.72	
Total Pore Pressure - psi	52.5	57.4	64.7	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	0.7	2.4	1.0	
σ_1' Failure - psi	29.58	35.95	70.02	
σ_3' Failure - psi	7.55	12.57	25.30	

TEST DESCRIPTION

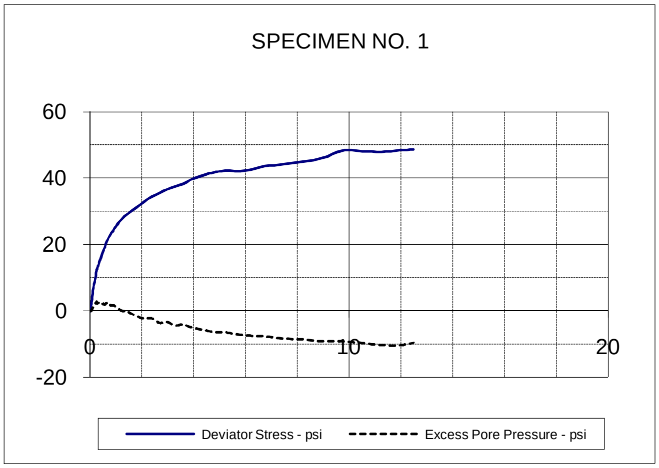
TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Shelby Tube Sample
DESCRIPTION: Reddish Brown Sandy Lean Clay
Sampled on Site, B-2 8' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

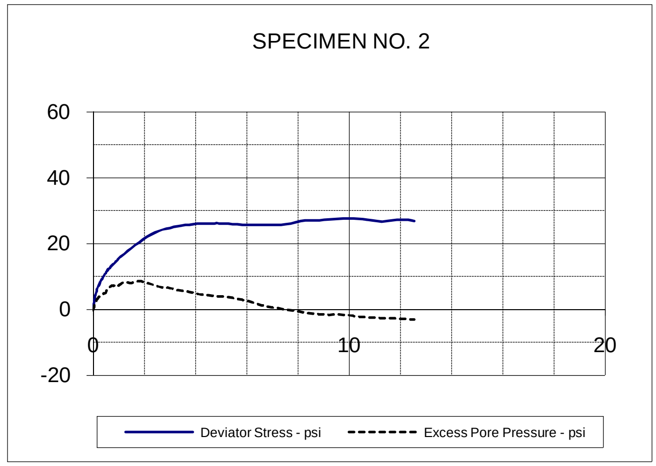
PROJECT INFORMATION

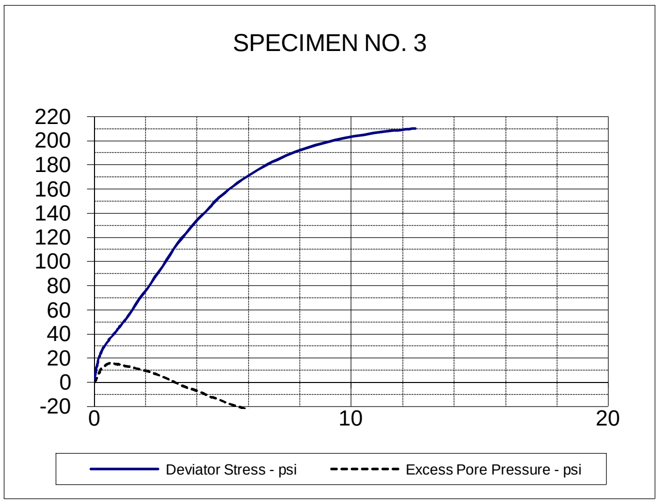
PROJECT: AEP Welsh Power Plant Bottom Ash Ponds
LOCATION: Pittsburg, Texas
PROJECT NO: G 3242 - 095
CLIENT:
December 2009

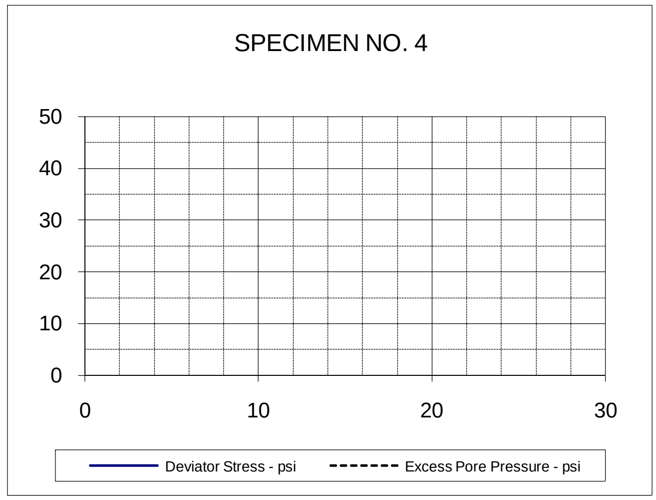
ETTL ENGINEERS & CONSULTANTS PLATE: B.1

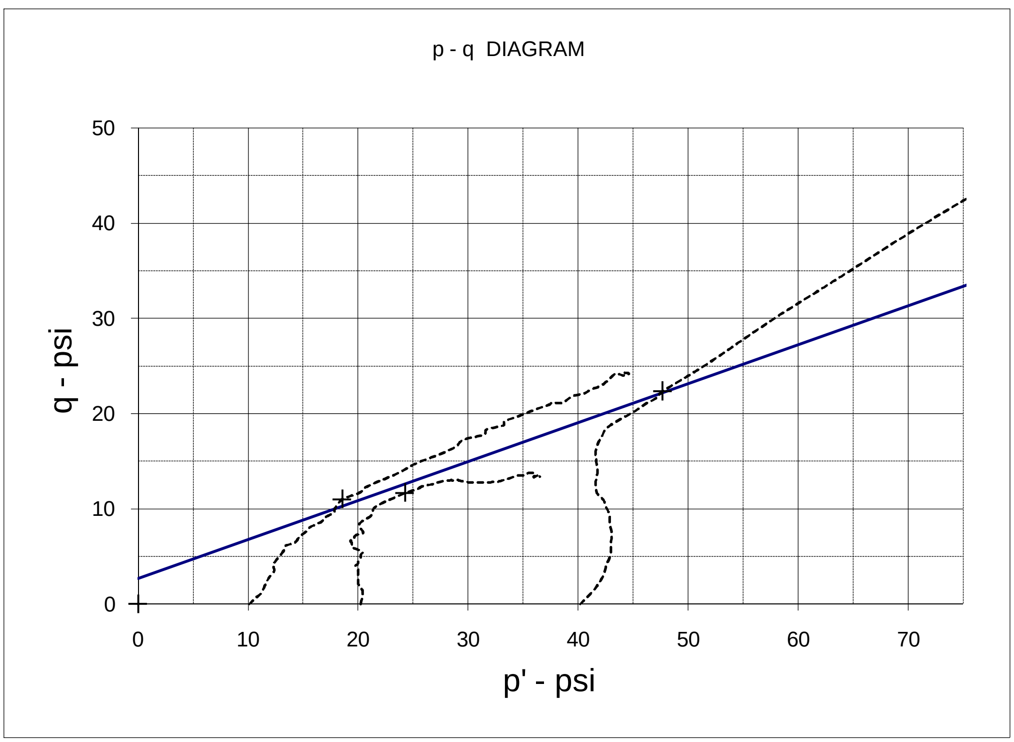
G 3242-095, B-2 8'-10' Welsh







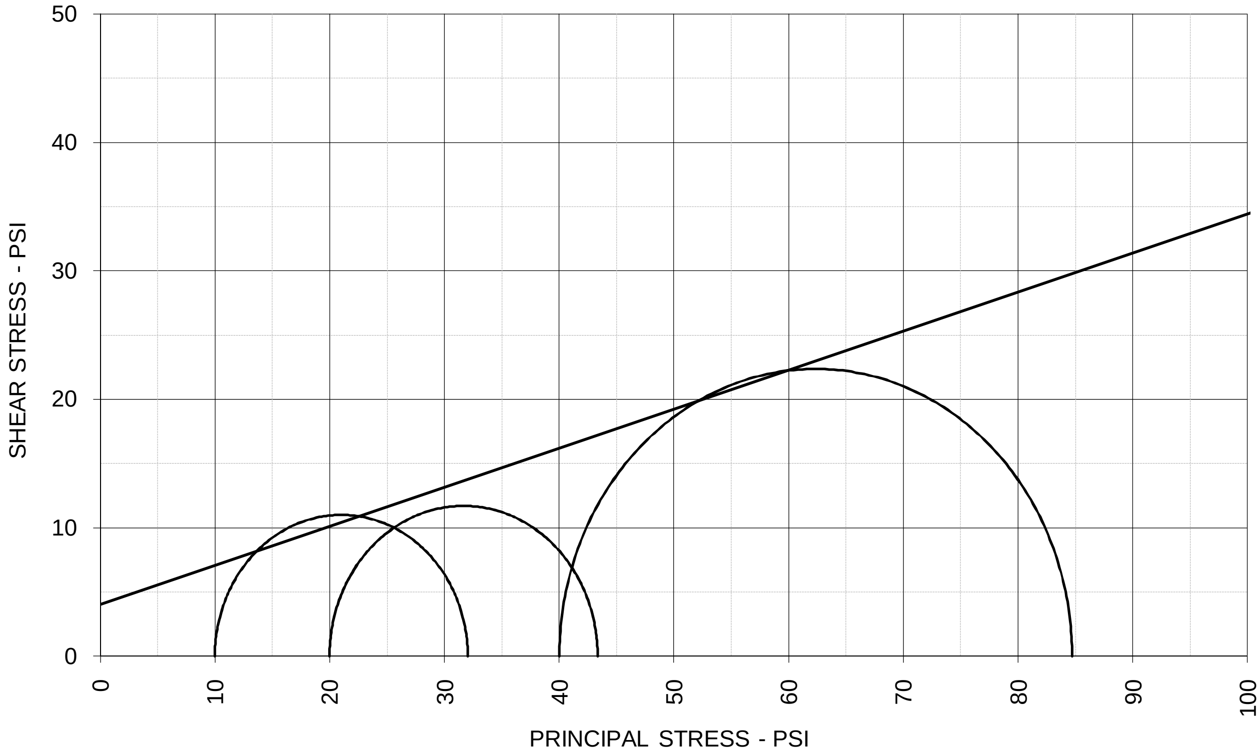




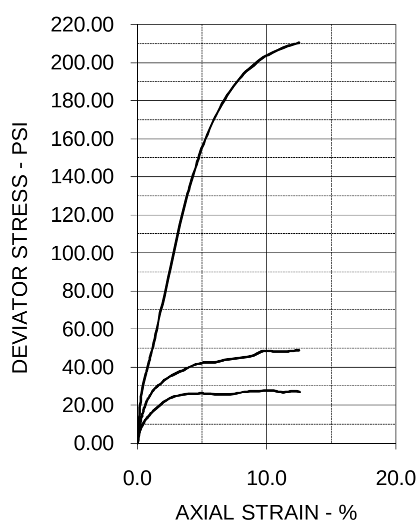
EFFECTIVE STRESS PARAMETERS	R^2 = 0.98	α (deg) = 22.3	a (psi) = 2.7
PROJECT: AEP Welsh Power Plant Bottom Ash Ponds		TYPE OF TEST & NO: CU with PP	
PROJECT NO: G 3242 - 095		ETTL ENGINEERS & CONSULTANTS	PLATE: B.2
DESCRIPTION: Reddish Brown Sandy Lean Clay			

G 3242-095, B-2 8'-10' Welsh

TRIAXIAL SHEAR TEST REPORT



TOTAL STRESS PARAMETERS	ϕ = 16.9 deg	c = 4.0 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	14.4	23.6	13.0	
Dry Density - pcf	114.9	100.1	122.2	
Diameter - inches	2.01	2.02	2.00	
Height - inches	4.00	4.00	4.02	
AT TEST				
Final Moisture - %	18.7	24.4	13.2	
Dry Density - pcf	115.2	101.7	123.3	
Calculated Diameter (in.)	2.00	2.01	1.99	
Height - inches	3.99	3.97	3.98	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	22.03	23.38	44.72	
Total Pore Pressure - psi	52.5	57.4	64.7	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	0.7	2.4	1.0	
σ_1 Failure - psi	32.03	43.38	84.72	
σ_3 Failure - psi	10.00	20.00	40.00	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Shelby Tube Sample
DESCRIPTION: Reddish Brown Sandy Lean Clay
Sampled on Site, B-2 8' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

PROJECT INFORMATION

PROJECT: AEP Welsh Power Plant Bottom Ash Ponds
LOCATION: Pittsburg, Texas
PROJECT NO: G 3242 - 095
CLIENT:
December 2009

ETTL ENGINEERS & CONSULTANTS PLATE: B.3

PROJECT INFORMATION

PROJECT: AEP Welsh Power Plant Bottom Ash Ponds
LOCATION: Pittsburg, Texas
PROJECT NO: G 3242 - 095
CLIENT:
December 2009

TRIAXIAL TEST PROGRAM BY GARRY H. GREGORY, P.E.

VERSION 1.0 - AUGUST 1998 - REVISED MARCH 24, 1999

THIS COPY LICENSED TO:
ETTL ENGINEERS AND CONSULTANTS, INC.
1717 East Erwin
Tyler, TX 75702

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Shelby Tube Sample
DESCRIPTION: Tan, Brown, Gray & Red Clayey Sand
Sampled on Site, B-2 28' to 30' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

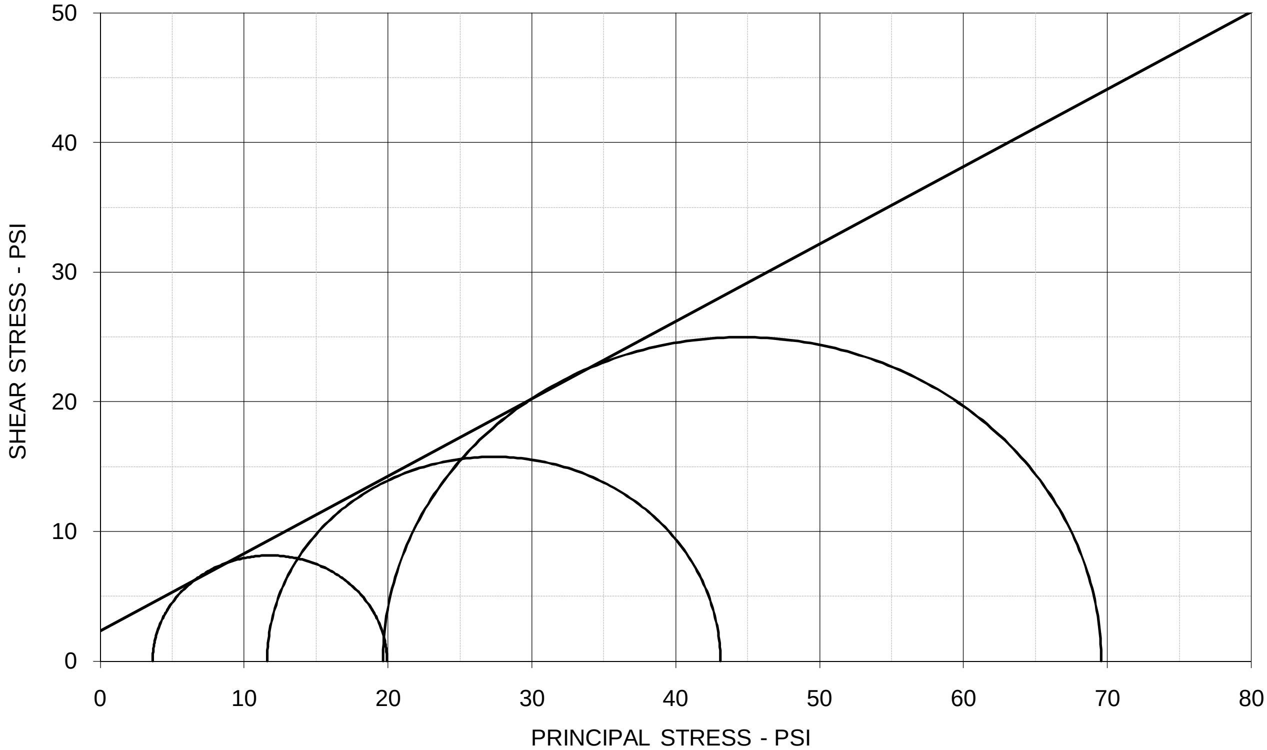
PLATE: B.1

PLATE: B.2

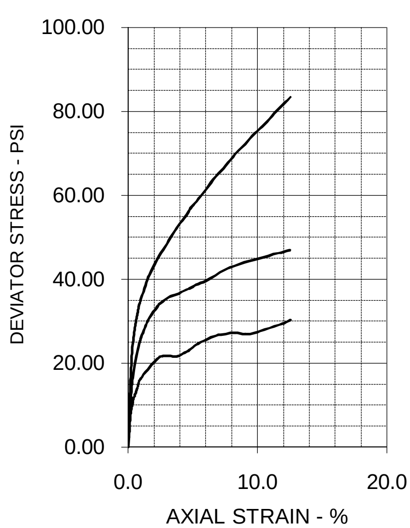
PLATE: B.3

Number of Specimens = 3

TRIAXIAL SHEAR TEST REPORT



EFFECTIVE STRESS PARAMETERS	φ ' = 30.8 deg	c' = 2.3 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	20.5	17.7	16.0	
Dry Density - pcf	106.7	111.3	117.2	
Diameter - inches	2.00	1.99	1.98	
Height - inches	3.99	3.98	4.00	
AT TEST				
Final Moisture - %	27.8	18.6	16.3	
Dry Density - pcf	106.8	112.4	118.7	
Calculated Diameter (in.)	2.00	1.99	1.97	
Height - inches	3.98	3.97	3.96	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	16.30	31.51	49.94	
Total Pore Pressure - psi	56.4	58.4	70.4	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	1.0	1.8	3.3	
σ_1' Failure - psi	19.94	43.12	69.59	
σ_3' Failure - psi	3.64	11.61	19.65	

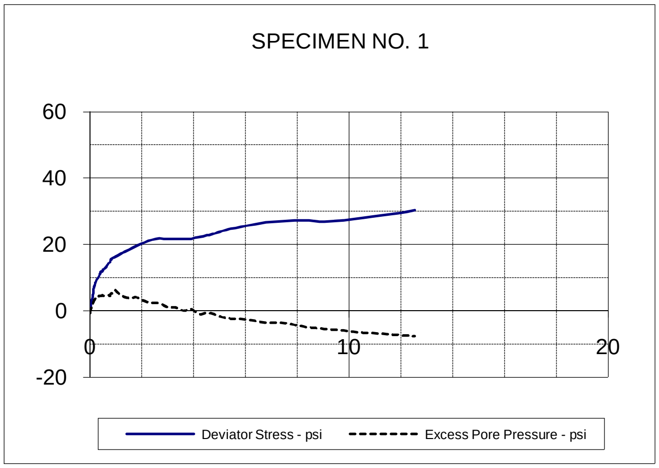
TEST DESCRIPTION

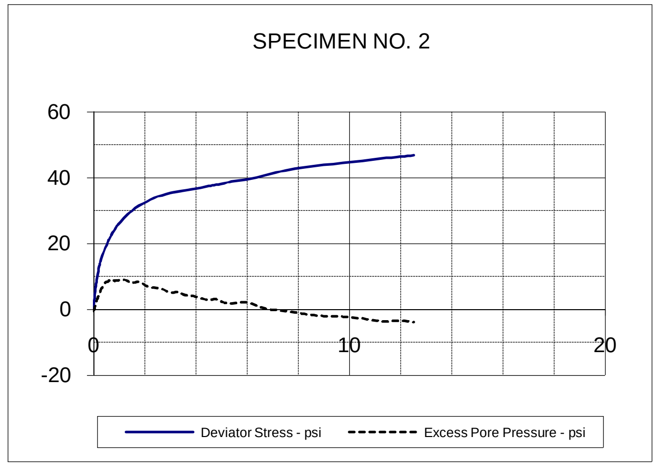
TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Shelby Tube Sample
DESCRIPTION: Tan, Brown, Gray & Red Clayey Sand
Sampled on Site, B-2 28' to 30' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

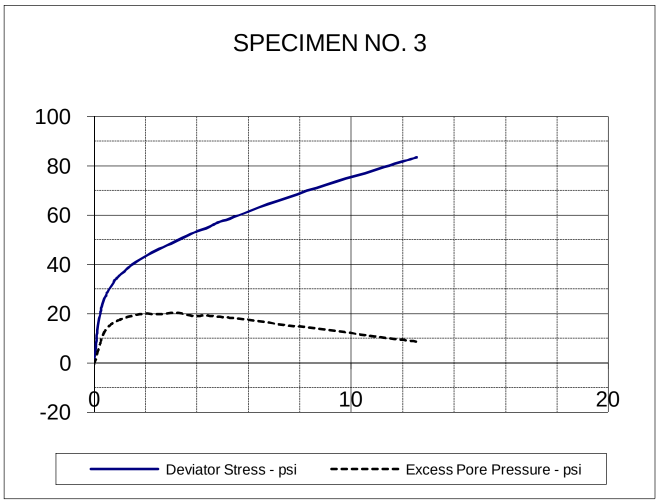
PROJECT INFORMATION

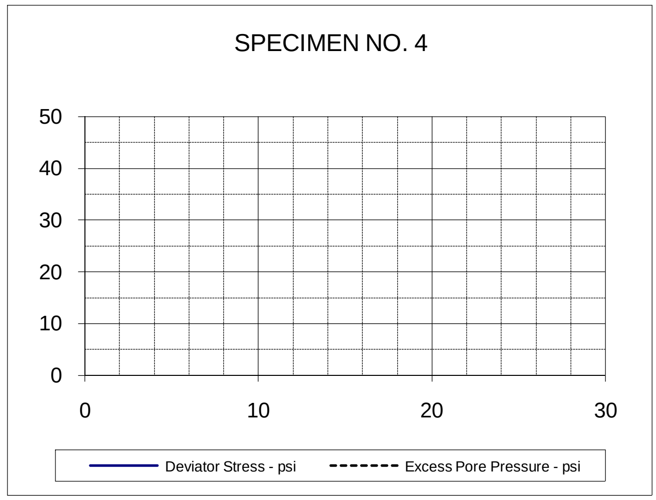
PROJECT: AEP Welsh Power Plant Bottom Ash Ponds
LOCATION: Pittsburg, Texas
PROJECT NO: G 3242 - 095
CLIENT:
December 2009

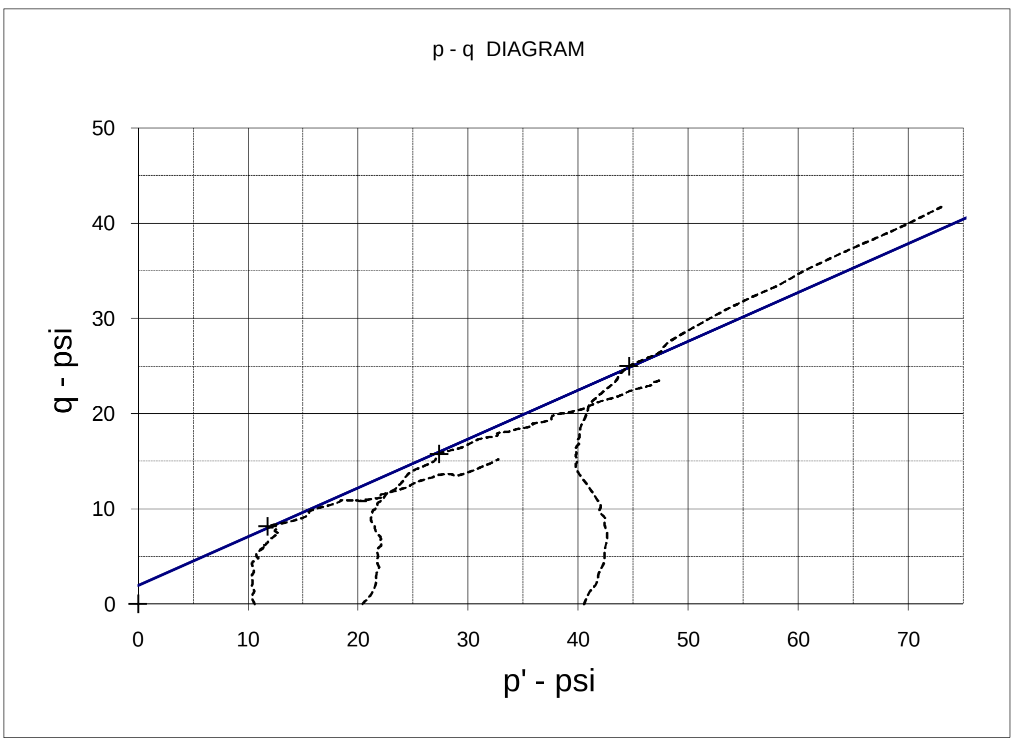
ETTL ENGINEERS & CONSULTANTS PLATE: B.1







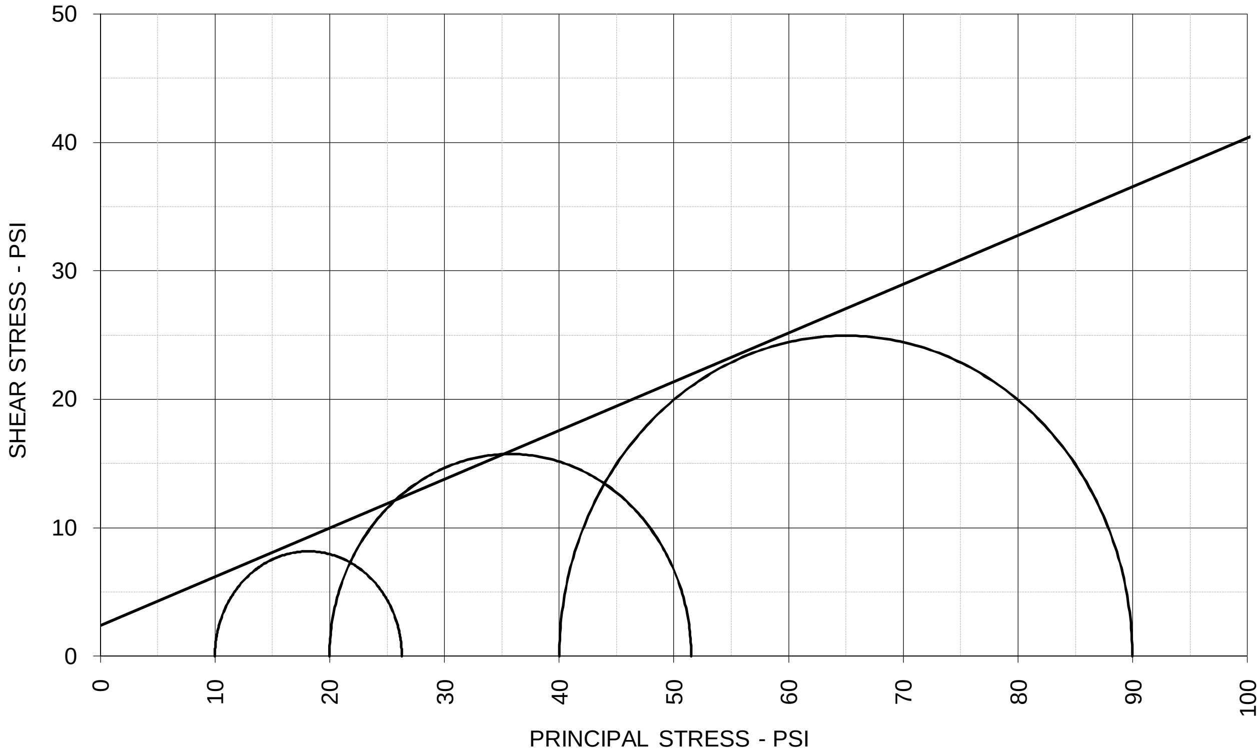




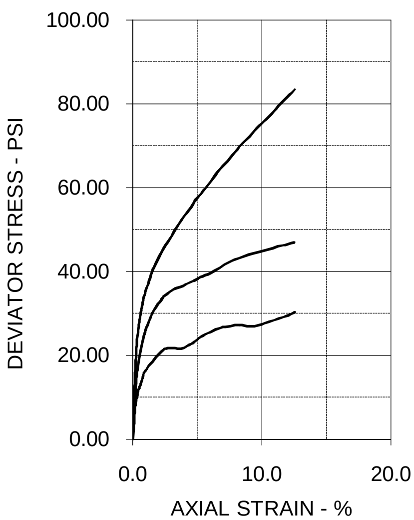
EFFECTIVE STRESS PARAMETERS	R^2 = 1.00	α (deg) = 27.1	a (psi) = 2.0
PROJECT: AEP Welsh Power Plant Bottom Ash Ponds		TYPE OF TEST & NO: CU with PP	
PROJECT NO: G 3242 - 095		ETTL ENGINEERS & CONSULTANTS	PLATE: B.2
DESCRIPTION: Tan, Brown, Gray & Red Clayey Sand			

G 3242-095, B-2 28'-30' Welsh

TRIAXIAL SHEAR TEST REPORT



TOTAL STRESS PARAMETERS	ϕ = 20.8 deg	c = 2.4 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	20.5	17.7	16.0	
Dry Density - pcf	106.7	111.3	117.2	
Diameter - inches	2.00	1.99	1.98	
Height - inches	3.99	3.98	4.00	
AT TEST				
Final Moisture - %	27.8	18.6	16.3	
Dry Density - pcf	106.8	112.4	118.7	
Calculated Diameter (in.)	2.00	1.99	1.97	
Height - inches	3.98	3.97	3.96	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	16.30	31.51	49.94	
Total Pore Pressure - psi	56.4	58.4	70.4	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	1.0	1.8	3.3	
σ_1 Failure - psi	26.30	51.51	89.94	
σ_3 Failure - psi	10.00	20.00	40.00	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Shelby Tube Sample
DESCRIPTION: Tan, Brown, Gray & Red Clayey Sand
Sampled on Site, B-2 28' to 30' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

PROJECT INFORMATION

PROJECT: AEP Welsh Power Plant Bottom Ash Ponds
LOCATION: Pittsburg, Texas
PROJECT NO: G 3242 - 095
CLIENT:
December 2009

ETTL ENGINEERS & CONSULTANTS PLATE: B.3

PROJECT INFORMATION

PROJECT: AEP Welsh Power Plant Bottom Ash Ponds
LOCATION: Pittsburg, Texas
PROJECT NO: G 3242 - 095
CLIENT:
December 2009

TRIAXIAL TEST PROGRAM BY GARRY H. GREGORY, P.E.

VERSION 1.0 - AUGUST 1998 - REVISED MARCH 24, 1999

THIS COPY LICENSED TO:
ETTL ENGINEERS AND CONSULTANTS, INC.
1717 East Erwin
Tyler, TX 75702

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Shelby Tube Sample
DESCRIPTION: Gray, Brown & Tan Fat Clay w/ Ferric Seams
Sampled on Site, B-5 8' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

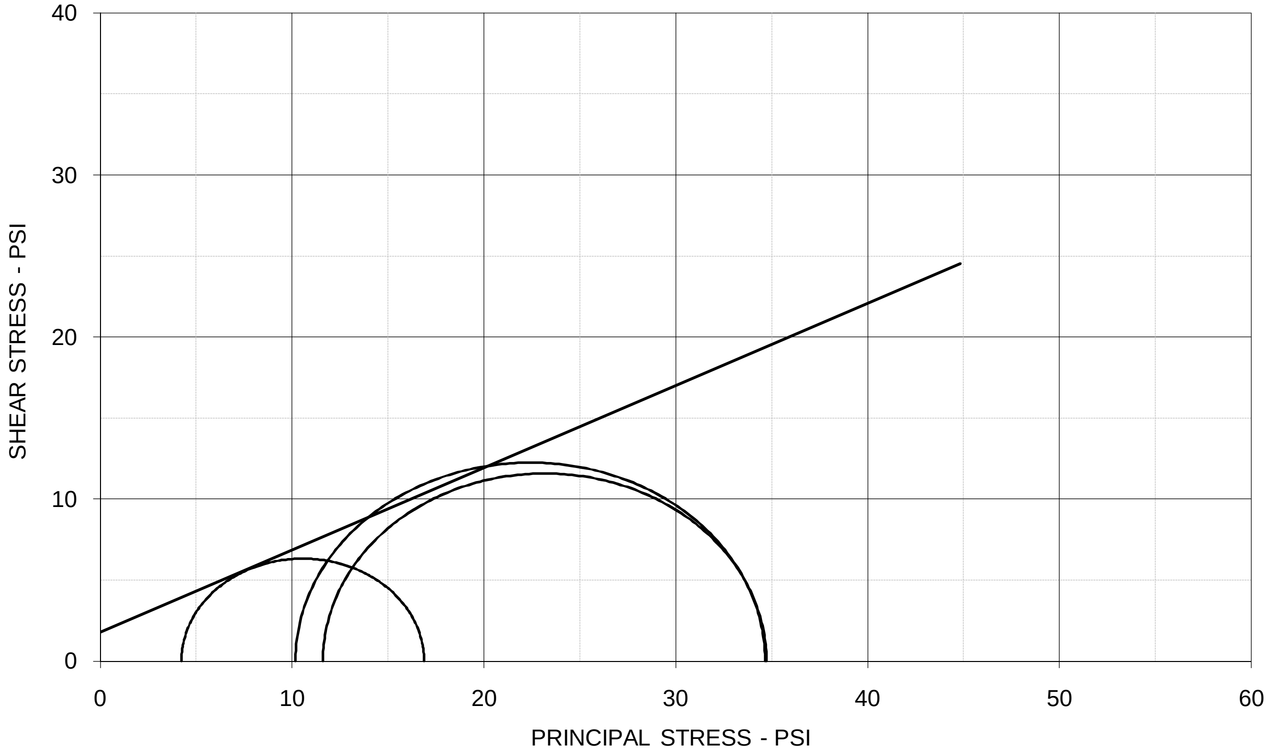
PLATE: B.1

PLATE: B.2

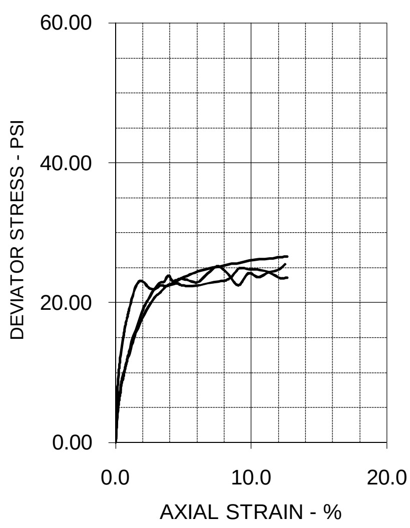
PLATE: B.3

Number of Specimens = 3

TRIAXIAL SHEAR TEST REPORT



EFFECTIVE STRESS PARAMETERS	ϕ ' =	26.9 deg	c' =	1.8 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	24.0	23.2	20.1	
Dry Density - pcf	98.6	102.2	104.5	
Diameter - inches	2.01	2.02	2.00	
Height - inches	3.97	4.01	4.01	
AT TEST				
Final Moisture - %	26.5	24.8	24.2	
Dry Density - pcf	99.5	103.0	105.7	
Calculated Diameter (in.)	2.01	2.02	2.00	
Height - inches	3.99	4.01	4.03	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	12.64	23.13	24.50	
Total Pore Pressure - psi	55.7	58.4	79.8	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	1.0	1.8	6.1	
σ_1' Failure - psi	16.87	34.74	34.66	
σ_3' Failure - psi	4.23	11.61	10.16	

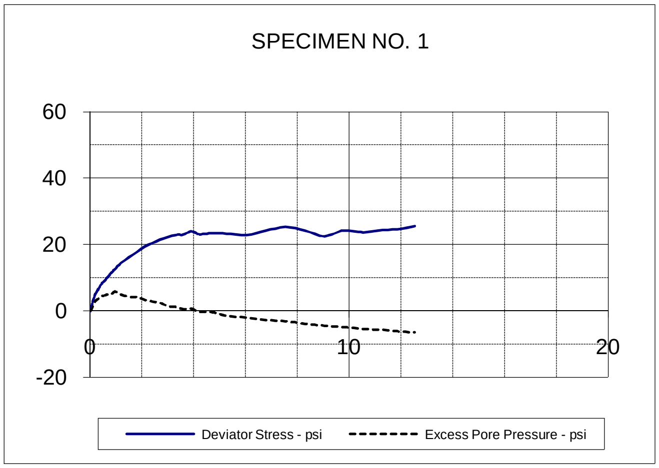
TEST DESCRIPTION

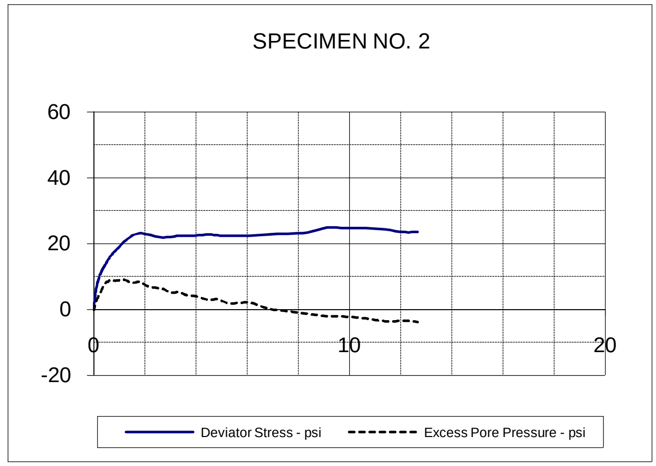
TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Shelby Tube Sample
DESCRIPTION: Gray, Brown & Tan Fat Clay w/ Ferric Seams
Sampled on Site, B-5 8' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

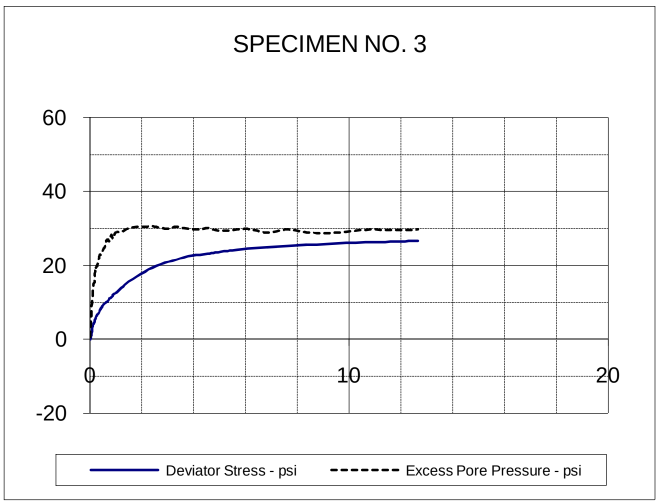
PROJECT INFORMATION

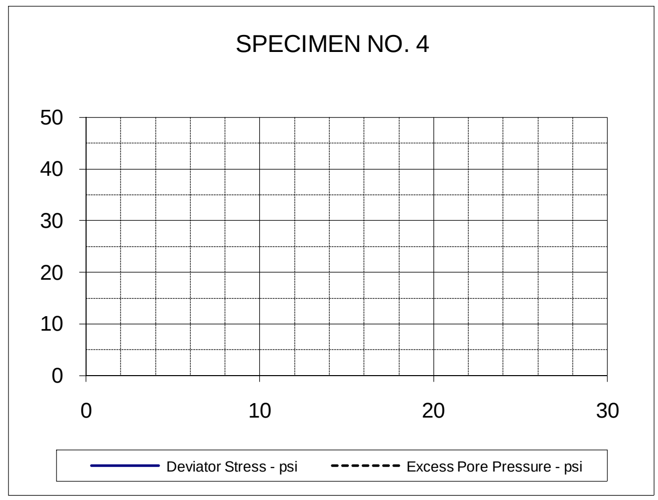
PROJECT: AEP Welsh Power Plant Bottom Ash Ponds
LOCATION: Pittsburg, Texas
PROJECT NO: G 3242 - 095
CLIENT:
December 2009

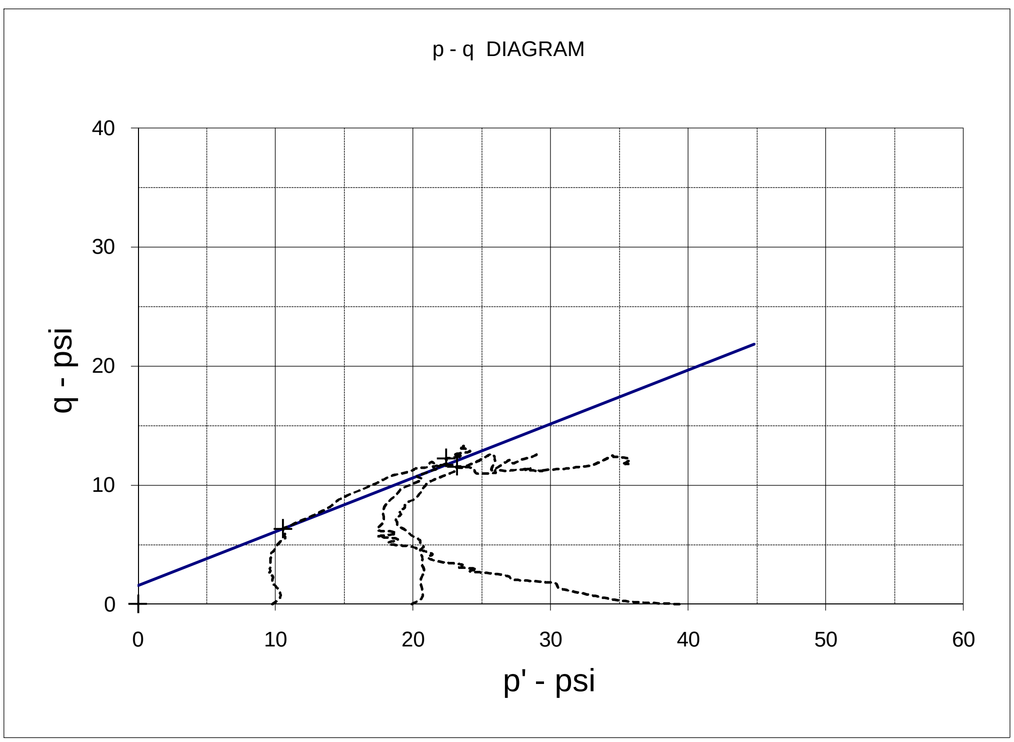
ETTL ENGINEERS & CONSULTANTS PLATE: B.1







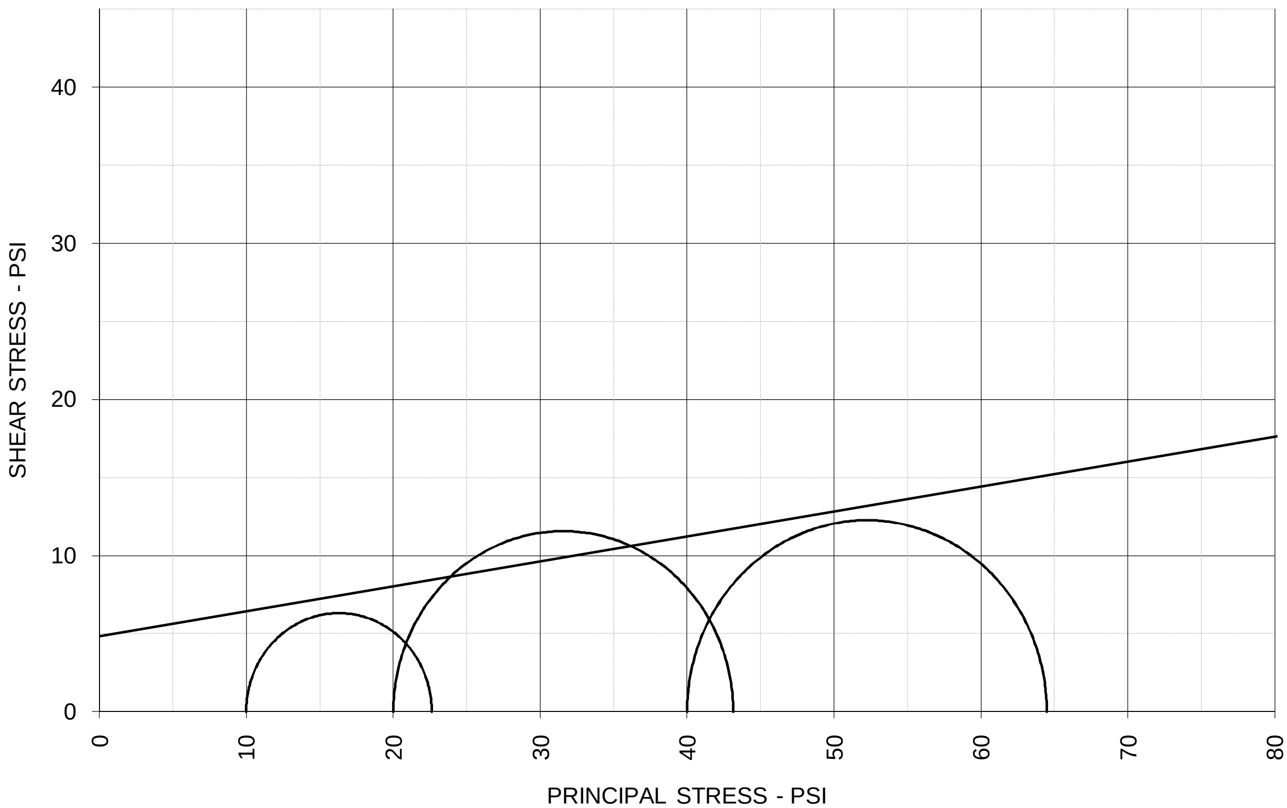




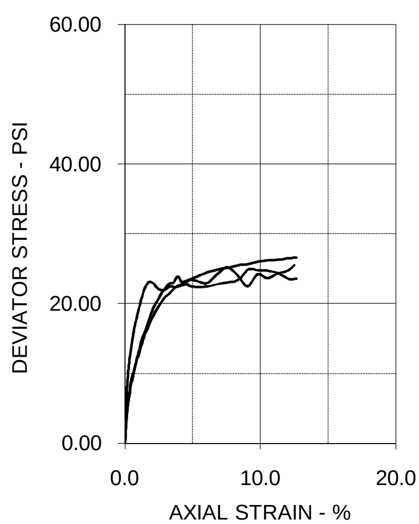
EFFECTIVE STRESS PARAMETERS	R^2 = 0.97	α (deg) = 24.3	a (psi) = 1.6
PROJECT: AEP Welsh Power Plant Bottom Ash Ponds		TYPE OF TEST & NO: CU with PP	
PROJECT NO: G 3242 - 095		ETTL ENGINEERS & CONSULTANTS	PLATE: B.2
DESCRIPTION: Gray, Brown & Tan Fat Clay w/ Ferric Seams			

G 3242-095, B-5 8'-10' Welsh

TRIAXIAL SHEAR TEST REPORT



TOTAL STRESS PARAMETERS	ϕ = 9.1 deg	c = 4.9 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	24.0	23.2	20.1	
Dry Density - pcf	98.6	102.2	104.5	
Diameter - inches	2.01	2.02	2.00	
Height - inches	3.97	4.01	4.01	
AT TEST				
Final Moisture - %	26.5	24.8	24.2	
Dry Density - pcf	99.5	103.0	105.7	
Calculated Diameter (in.)	2.01	2.02	2.00	
Height - inches	3.99	4.01	4.03	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	12.64	23.13	24.50	
Total Pore Pressure - psi	55.7	58.4	79.8	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	1.0	1.8	6.1	
σ_1 Failure - psi	22.64	43.13	64.50	
σ_3 Failure - psi	10.00	20.00	40.00	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Shelby Tube Sample
DESCRIPTION: Gray, Brown & Tan Fat Clay w/ Ferric Seams
Sampled on Site, B-5 8' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

PROJECT INFORMATION

PROJECT: AEP Welsh Power Plant Bottom Ash Ponds
LOCATION: Pittsburg, Texas
PROJECT NO: G 3242 - 095
CLIENT:
December 2009

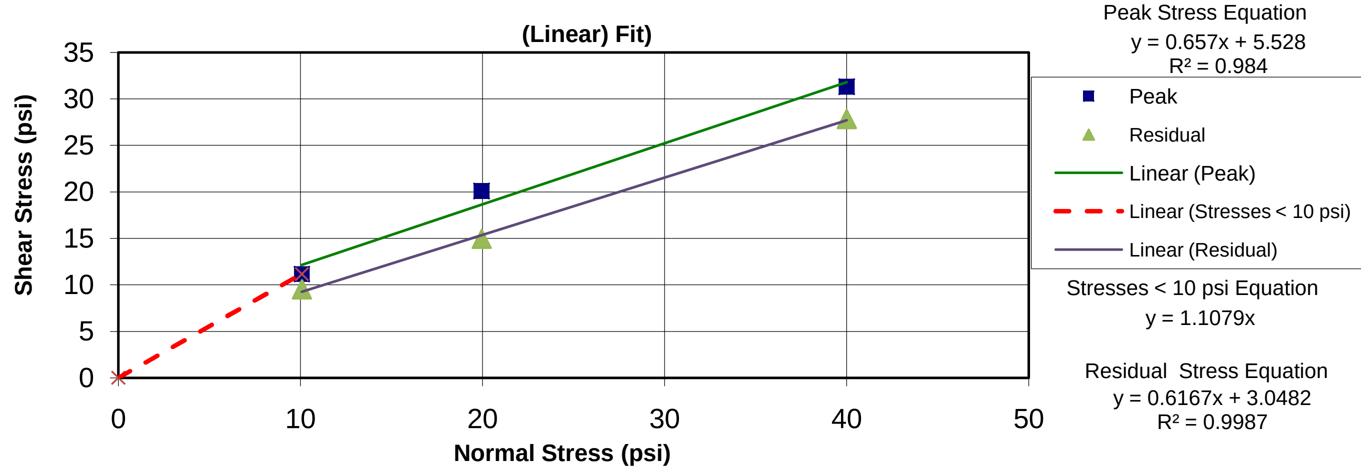
ETTL ENGINEERS & CONSULTANTS

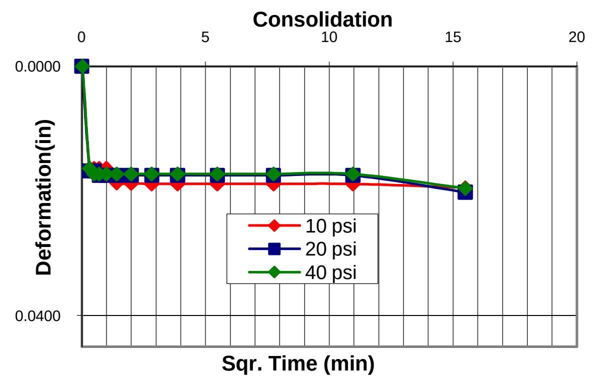
PLATE: B.3

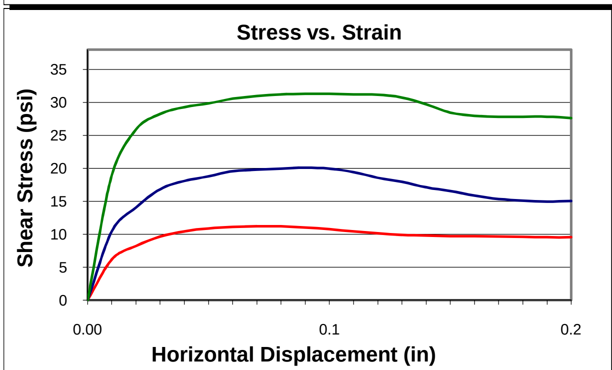
ETTL Engineers & Consultants Inc.

GEOTECHNICAL ✶ MATERIALS ✶ ENVIRONMENTAL ✶ DRILLING ✶ LANDFILLS

ASTM 3080 Direct Shear Test Report







Peak Strength Parameters

	Peak		Residual	
Friction Angle	33.3 (deg)		31.63 (deg)	
Cohesion	5.53 (psi)	796.0 (psf)	3.05 (psi)	438.9 (psf)
Friction Angle Stresses < 10psi			47.91	(deg)
Specimen Number	1		2	3

Specimen Number	1	2	3
Initial			
Moisture Content - %	22.5%	23.5%	23.2%
Dry Density- lb/ft^3	103.8	100.3	101.8
Height-inches	1.008	1.008	1.008
Diameter- inches	2.50	2.50	2.50
Final			
Moisture Content - %	23.1%	25.4%	23.5%
Dry Density- lb/ft^3	103.8	100.9	102.0
Height after shear-(inches)	1.009	1.006	1.006
Height after consolidation (inches)	0.989	0.988	0.988
Normal Stress-(psi)	10	20	40
Peak Failure Stress-(psi)	11.17	20.09	31.31
Residual Failure Stress-(psi)	9.52	14.96	27.84
Strain Rate - (inches/min)	0.0033	0.0033	0.0033

Project Information

		LL	PL	PI
Project :	Welsh power Plant Embankments	-	-	NP
Client:	AEP			
Material Origin:	, TX			
Material Description:	Dark Red Silty Sand	-200%	18	

				Remarks
Job No:	G 3241-095	Technician:	Owen Sanderson	When Calculating stresses < 10 psi: use appropriate Equation above (assuming no Cohesion)
Boring No:	B-6	Sample Type:	Shelby Tube	
Depth:	28'-31'	Sampling method:	Shelby Tube	
Date:	November 24, 2009	Testing Device:	Soiltest B-124BY 2.5 in. round	

C. Brandon Quinn, P.E.

ETTL Engineers & Consultants Inc.

GEOTECHNICAL ✶ MATERIALS ✶ ENVIRONMENTAL ✶ DRILLING ✶ LANDFILLS

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project : AEP Welsh Power Plant Bottom Ash Ponds: Pittsburg, Texas

Date: 12/28/2009 | Panel Number : P-3 ; ASTM D 5084

Project No. : G 3242-095

Permometer Data

Boring No.:	B-2	a_p =	0.031416 cm^2			Set Mercury to Pipet Rp at beginning	Equilibrium	1.7 cm^3
Sample:		a_a =	0.767120 cm^2				**Pipet Rp**	**6.7** cm^3
Depth (ft):	13'-15'	M_1 =	0.030180	C =	0.000444308		Annulus **Ra**	1.5 cm^3
Other Location:		M_2 =	1.040953	T =	0.201660671			

Material Description : Red & Tan Sandy Lean Clay

SAMPLE DATA

Wet Wt. sample + ring or tare :			602.32	g
Tare or ring Wt. :			0.0	g
Wet Wt: of Sample :			602.32	g
Diameter :	2.73	in	6.94	cm^2
Length :	2.76	in	7.02	cm
Area:	5.87	in^2	37.85	cm^2
Volume :	16.21	in^3	265.71	cm^3
Unit Wt.(wet):	**141.45**	pcf	**2.27**	g/cm^3
Unit Wt.(dry):	**125.06**	pcf	**2.00**	g/cm^3

Before Test		After Test	
Tare No.:	T-16	Tare No.:	T-1
Wet Wt.+tare:	292.51	Wet Wt.+tare:	746.56
Dry Wt.+tare:	276.22	Dry Wt.+tare:	683.49
Tare Wt:	151.95	Tare Wt:	217.27
Dry Wt.:	124.27	Dry Wt.:	466.22
Water Wt.:	16.29	Water Wt.:	63.07
% moist.:	**13.1**	% moist.:	**13.5**

Assumed Specific Gravity: **2.65** Max Dry Density(pcf) = 125.1105 OMC = 13.108554

% of max = 100.0 +/- OMC = 0.00

Calculated % saturation: 111.02 Void ratio (e) = **0.32** Porosity (n)= **0.24**

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 5.2 cm Hydraulic Gradient = 9.26

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
12/28/2009	1680	6	0.6588251	23.5	0.920	3.47E-08	9.84E-05	
12/28/2009	2280	5.9	0.7588251	23.5	0.920	2.98E-08	8.44E-05	
12/28/2009	3180	5.7	0.9588251	23.5	0.920	2.76E-08	7.83E-05	
12/28/2009	4140	5.55	1.1088251	23.5	0.920	2.50E-08	7.09E-05	

SUMMARY

ka = 2.93E-08 cm/sec Acceptance criteria = 25 %

ki			Vm	
k1 =	3.47E-08	cm/sec	18.5	%
k2 =	2.98E-08	cm/sec	1.7	%
k3 =	2.76E-08	cm/sec	5.6	%
k4 =	2.50E-08	cm/sec	14.6	%

$$Vm = \frac{|ka-ki|}{ka} \times 100$$

Hydraulic conductivity	k =	**2.93E-08**	cm/sec	**8.30E-05**	ft/day
Void Ratio	e =	**0.32**			
Porosity	n =	**0.24**			
Bulk Density	γ =	**2.27**	g/cm^3	**141.5**	pcf
Water Content	W =	**0.26**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**3.00E-13**	cm^2	(at 20 deg C)	

Robert Duke, P.E.

210 Beech Street
Texarkana, AR 71854
870-772-0013 Phone
870-216-2413 Fax

1717 East Erwin
Tyler, Texas 75702
903-595-4421 Phone
903-595-6113 Fax
www.ettlinc.com

707 West Cotton Street
Longview, Texas 75604-5505
903-758-0915 Phone
903-758-8245 Fax

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HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project : AEP Welsh Power Plant Bottom Ash Ponds: Pittsburg, Texas

Date: 12/28/2009 — Panel Number : P-3 ; ASTM D 5084

Project No. : G 3242-095 — Permometer Data

Boring No.:	B-2	a_p =	0.031416 cm^2			Set Mercury to Pipet Rp at beginning	Equilibrium	1.7 cm^3
Sample:		a_a =	0.767120 cm^2				Pipet **Rp**	**6.7** cm^3
Depth (ft):	33'-35'	M_1 =	0.030180	C =	0.000433922		Annulus **Ra**	1.5 cm^3
Other Location:		M_2 =	1.040953	T =	0.201660671			

Material Description : Red & Tan Clayey Sand

SAMPLE DATA

Wet Wt. sample + ring or tare : 553.04 g

Tare or ring Wt. : 0.0 g

Wet Wt: of Sample : 553.04 g

						Before Test		After Test
					Tare No.:	T-21	Tare No.:	T-13
Diameter :	2.76	in	7.01	cm^2	Wet Wt.+tare:	553.04	Wet Wt.+tare:	784.01
Length :	2.75	in	6.98	cm	Dry Wt.+tare:	464.50	Dry Wt.+tare:	684.19
Area:	5.97	in^2	38.54	cm^2	Tare Wt:	0.00	Tare Wt:	219.69
Volume :	16.42	in^3	269.13	cm^3	Dry Wt.:	464.5	Dry Wt.:	464.5
Unit Wt.(wet):	**128.23**	pcf	**2.05**	g/cm^3	Water Wt.:	88.54	Water Wt.:	99.82
Unit Wt.(dry):	**107.70**	pcf	**1.73**	g/cm^3	% moist.:	**19.1**	% moist.:	**21.5**

Assumed Specific Gravity: **2.73** Max Dry Density(pcf) = 107.7462 OMC = 19.0613563

% of max = 100.0 +/- OMC = 0.00

Calculated % saturation: 100.72 Void ratio (e) = **0.58** Porosity (n)= **0.37**

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 5.2 cm Hydraulic Gradient = 9.31

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
12/28/2009	1580	5.4	1.2588251	23.5	0.920	7.40E-08	2.10E-04	
12/28/2009	2310	5	1.6588251	23.5	0.920	7.04E-08	2.00E-04	
12/28/2009	2535	4.9	1.7588251	23.5	0.920	6.90E-08	1.96E-04	
12/28/2009	2775	4.8	1.8588251	23.5	0.920	6.76E-08	1.92E-04	

SUMMARY

ka = 7.03E-08 cm/sec — Acceptance criteria = 25 %

ki			Vm	
k1 =	7.40E-08	cm/sec	5.3	%
k2 =	7.04E-08	cm/sec	0.2	%
k3 =	6.90E-08	cm/sec	1.8	%
k4 =	6.76E-08	cm/sec	3.8	%

$$Vm = \frac{|ka-ki|}{ka} \times 100$$

Hydraulic conductivity	k =	**7.03E-08**	cm/sec	**1.99E-04**	ft/day
Void Ratio	e =	**0.58**			
Porosity	n =	**0.37**			
Bulk Density	γ =	**2.05**	g/cm^3	**128.2**	pcf
Water Content	W =	**0.33**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**7.20E-13**	cm^2	(at 20 deg C)	

Robert Duke, P.E.

210 Beech Street
Texarkana, AR 71854
870-772-0013 Phone
870-216-2413 Fax

1717 East Erwin
Tyler, Texas 75702
903-595-4421 Phone
903-595-6113 Fax
www.ettlinc.com

707 West Cotton Street
Longview, Texas 75604-5505
903-758-0915 Phone
903-758-8245 Fax

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HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project : AEP Welsh Power Plant Bottom Ash Ponds: Pittsburg, Texas

Date: 12/28/2009 Panel Number : P-3 ; ASTM D 5084

Project No. : G 3242-095 Permometer Data

Boring No.:	B-3	a_p =	0.031416 cm^2	Set Mercury to Pipet Rp at beginning	Equilibrium	1.7	cm^3
Sample:		a_a =	0.767120 cm^2		**Pipet Rp**	**6.7**	cm^3
Depth (ft):	8'-10'	M_1 =	0.030180	C = 0.000431052	Annulus **Ra**	1.5	cm^3
Other Location:		M_2 =	1.040953	T = 0.201660671			

Material Description : Red & Tan Fat Clay

SAMPLE DATA

Wet Wt. sample + ring or tare :		559.11 g					
Tare or ring Wt. :		0.0 g			Before Test		After Test
Wet Wt: of Sample :		559.11 g		Tare No.:	T-23	Tare No.:	T-3
Diameter :	2.75 in	6.99	cm^2	Wet Wt.+tare:	166.09	Wet Wt.+tare:	783.53
Length :	2.72 in	6.90	cm	Dry Wt.+tare:	162.69	Dry Wt.+tare:	700.67
Area:	5.94 in^2	38.32	cm^2	Tare Wt:	140.30	Tare Wt:	220.71
Volume :	16.13 in^3	264.26	cm^3	Dry Wt.:	22.39	Dry Wt.:	479.96
Unit Wt.(wet):	**132.02** pcf	**2.12**	g/cm^3	Water Wt.:	3.4	Water Wt.:	82.86
Unit Wt.(dry):	**114.62** pcf	**1.84**	g/cm^3	% moist.:	**15.2**	% moist.:	**17.3**

Assumed Specific Gravity: **2.68** Max Dry Density(pcf) = 114.6685 OMC = 15.1853506

% of max = 100.0 +/- OMC = 0.00

Calculated % saturation: 100.64 Void ratio (e) = **0.46** Porosity (n)= **0.31**

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 5.2 cm Hydraulic Gradient = 9.43

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
12/28/2009	1476	5.4	1.258825	23.5	0.920	7.87E-08	2.23E-04	
12/28/2009	2205	5	1.658825	23.5	0.920	7.33E-08	2.08E-04	
12/28/2009	2370	4.9	1.758825	23.5	0.920	7.33E-08	2.08E-04	
12/28/2009	2580	4.8	1.858825	23.5	0.920	7.22E-08	2.05E-04	

SUMMARY

ka = 7.44E-08 cm/sec Acceptance criteria = 25 %

ki		Vm	
k1 =	7.87E-08 cm/sec	5.8	%
k2 =	7.33E-08 cm/sec	1.5	%
k3 =	7.33E-08 cm/sec	1.4	%
k4 =	7.22E-08 cm/sec	2.9	%

$$Vm = \frac{|ka-ki|}{ka} \times 100$$

Hydraulic conductivity	k =	**7.44E-08**	cm/sec	**2.11E-04**	ft/day
Void Ratio	e =	**0.46**			
Porosity	n =	**0.31**			
Bulk Density	γ =	**2.12**	g/cm^3	**132.0**	pcf
Water Content	W =	**0.28**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**7.62E-13**	cm^2	(at 20 deg C)	

Robert Duke, P.E.

210 Beech Street
Texarkana, AR 71854
870-772-0013 Phone
870-216-2413 Fax

1717 East Erwin
Tyler, Texas 75702
903-595-4421 Phone
903-595-6113 Fax
www.ettlinc.com

707 West Cotton Street
Longview, Texas 75604-5505
903-758-0915 Phone
903-758-8245 Fax

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HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project : AEP Welsh Power Plant Bottom Ash Ponds: Pittsburg, Texas

Date: 12/28/2009 — Panel Number : P-3 ; ASTM D 5084

Project No. : G 3242-095 — Permometer Data

Boring No.: B-4	a_p = 0.031416 cm^2		Set Mercury to Pipet Rp at beginning	Equilibrium	1.7	cm^3
Sample:	a_a = 0.767120 cm^2			**Pipet Rp**	**6.7**	cm^3
Depth (ft): 8'-10'	M_1 = 0.030180	C =	0.000429664	Annulus **Ra**	1.5	cm^3
Other Location:	M_2 = 1.040953	T =	0.201660671			

Material Description : Dark Brown Sandy Lean Clay

SAMPLE DATA

Wet Wt. sample + ring or tare : 531.96 g

Tare or ring Wt. : 0.0 g

Wet Wt: of Sample : 531.96 g

						Before Test		After Test	
					Tare No.:	T-24	Tare No.:	T-6	
Diameter :	2.76	in	7.01	cm^2	Wet Wt.+tare:	230.01	Wet Wt.+tare:	759.40	
Length :	2.72	in	6.92	cm	Dry Wt.+tare:	207.52	Dry Wt.+tare:	648.84	
Area:	5.98	in^2	38.57	cm^2	Tare Wt:	112.35	Tare Wt:	217.34	
Volume :	16.29	in^3	266.87	cm^3	Dry Wt.:	95.17	Dry Wt.:	431.5	
Unit Wt.(wet):	**124.38**	pcf	**1.99**	g/cm^3	Water Wt.:	22.49	Water Wt.:	110.56	
Unit Wt.(dry):	**100.61**	pcf	**1.61**	g/cm^3	% moist.:	**23.6**	% moist.:	**25.6**	

Assumed Specific Gravity: **2.72** — Max Dry Density(pcf) = 100.6512 — OMC = 23.6313964

% of max = 100.0 — +/- OMC = 0.00

Calculated % saturation: 101.32 — Void ratio (e) = **0.69** — Porosity (n)= **0.41**

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 5.2 cm — Hydraulic Gradient = 9.40

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
12/28/2009	2280	6.1	0.558825	23.5	0.920	2.07E-08	5.88E-05	
12/28/2009	2940	6	0.658825	23.5	0.920	1.92E-08	5.44E-05	
12/28/2009	3660	5.9	0.758825	23.5	0.920	1.79E-08	5.09E-05	
12/28/2009	4200	5.84	0.818825	23.5	0.920	1.70E-08	4.82E-05	

SUMMARY

k_a = 1.87E-08 cm/sec — Acceptance criteria = 25 %

ki			Vm	
k1 =	2.07E-08	cm/sec	10.8	%
k2 =	1.92E-08	cm/sec	2.5	%
k3 =	1.79E-08	cm/sec	4.1	%
k4 =	1.70E-08	cm/sec	9.2	%

$$Vm = \frac{|ka-ki|}{ka} \times 100$$

Hydraulic conductivity	k =	**1.87E-08**	cm/sec	**5.30E-05**	ft/day
Void Ratio	e =	**0.69**			
Porosity	n =	**0.41**			
Bulk Density	γ =	**1.99**	g/cm^3	**124.4**	pcf
Water Content	W =	**0.38**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**1.92E-13**	cm^2	(at 20 deg C)	

Robert Duke, P.E.

210 Beech Street
Texarkana, AR 71854
870-772-0013 Phone
870-216-2413 Fax

1717 East Erwin
Tyler, Texas 75702
903-595-4421 Phone
903-595-6113 Fax
www.ettlinc.com

707 West Cotton Street
Longview, Texas 75604-5505
903-758-0915 Phone
903-758-8245 Fax

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HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project : AEP Welsh Power Plant Bottom Ash Ponds: Pittsburg, Texas

Date: 12/28/2009 Panel Number : P-3 ; ASTM D 5084

Project No. : G 3242-095 Permometer Data

Boring No.:	B-5	a_p =	0.031416 cm^2		Set Mercury to Pipet Rp at beginning	Equilibrium	1.7	cm^3
Sample:		a_a =	0.767120 cm^2			Pipet **Rp**	**6.7**	cm^3
Depth (ft):	23'-25'	M_1 =	0.030180	C =	0.00043565	Annulus **Ra**	1.5	cm^3
Other Location:		M_2 =	1.040953	T =	0.201660671			

Material Description : Orangish Tan Fat Clay

SAMPLE DATA

Wet Wt. sample + ring or tare : 532.37 g

Tare or ring Wt. : 0.0 g

Wet Wt: of Sample : 532.37 g

						Before Test		After Test
					Tare No.:	T-25	Tare No.:	T-9
Diameter :	2.74	in	6.97	cm^2	Wet Wt.+tare:	532.37	Wet Wt.+tare:	765.78
Length :	2.73	in	6.94	cm	Dry Wt.+tare:	441.00	Dry Wt.+tare:	661.51
Area:	5.91	in^2	38.15	cm^2	Tare Wt:	0.00	Tare Wt:	220.51
Volume :	16.16	in^3	264.75	cm^3	Dry Wt.:	441	Dry Wt.:	441
Unit Wt.(wet):	**125.48**	pcf	**2.01**	g/cm^3	Water Wt.:	91.37	Water Wt.:	104.27
Unit Wt.(dry):	**103.94**	pcf	**1.67**	g/cm^3	% moist.:	**20.7**	% moist.:	**23.6**

Assumed Specific Gravity: **2.72** Max Dry Density(pcf) = 103.9846 OMC = 20.7188209

% of max = 100.0 +/- OMC = 0.00

Calculated % saturation: 101.48 Void ratio (e) = **0.63** Porosity (n)= **0.39**

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 5.2 cm Hydraulic Gradient = 9.37

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
12/28/2009	212	5.5	1.158825	23.5	0.920	5.03E-07	1.43E-03	
12/28/2009	237	5.4	1.258825	23.5	0.920	4.95E-07	1.40E-03	
12/28/2009	259	5.3	1.358825	23.5	0.920	4.96E-07	1.41E-03	
12/28/2009	289	5.2	1.458825	23.5	0.920	4.83E-07	1.37E-03	

SUMMARY

ka = 4.95E-07 cm/sec Acceptance criteria = 25 %

ki			Vm	
k1 =	5.03E-07	cm/sec	1.8	%
k2 =	4.95E-07	cm/sec	0.2	%
k3 =	4.96E-07	cm/sec	0.3	%
k4 =	4.83E-07	cm/sec	2.2	%

$$Vm = \frac{|ka-ki|}{ka} \times 100$$

Hydraulic conductivity	k =	**4.95E-07**	cm/sec	**1.40E-03**	ft/day
Void Ratio	e =	**0.63**			
Porosity	n =	**0.39**			
Bulk Density	γ =	**2.01**	g/cm^3	**125.5**	pcf
Water Content	W =	**0.35**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**5.07E-12**	cm^2	(at 20 deg C)	

Robert Duke, P.E.

210 Beech Street
Texarkana, AR 71854
870-772-0013 Phone
870-216-2413 Fax

1717 East Erwin
Tyler, Texas 75702
903-595-4421 Phone
903-595-6113 Fax
www.ettlinc.com

707 West Cotton Street
Longview, Texas 75604-5505
903-758-0915 Phone
903-758-8245 Fax

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HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project : AEP Welsh Power Plant Bottom Ash Ponds: Pittsburg, Texas

Date: 12/28/2009 Panel Number : P-3 ; ASTM D 5084

Project No. : G 3242-095 Permometer Data

Boring No.:	B-6	a_p =	0.031416 cm^2		Set Mercury to Pipet Rp at beginning	Equilibrium	1.7	cm^3
Sample:		a_a =	0.767120 cm^2			Pipet **Rp**	**6.7**	cm^3
Depth (ft):	28'-30'	M_1 =	0.030180	C =	0.000408156	Annulus **Ra**	1.5	cm^3
Other Location:		M_2 =	1.040953	T =	0.201660671			

Material Description : Gray Silty Sand

SAMPLE DATA

Wet Wt. sample + ring or tare : 457.40 g

Tare or ring Wt. : 0.0 g

Wet Wt: of Sample : 457.40 g

						Before Test		After Test
					Tare No.:	T-5	Tare No.:	T-10
Diameter :	2.69	in	6.83	cm^2	Wet Wt.+tare:	355.86	Wet Wt.+tare:	661.49
Length :	2.46	in	6.24	cm	Dry Wt.+tare:	328.36	Dry Wt.+tare:	581.76
Area:	5.68	in^2	36.64	cm^2	Tare Wt:	218.80	Tare Wt:	221.13
Volume :	13.96	in^3	228.75	cm^3	Dry Wt.:	109.56	Dry Wt.:	360.63
Unit Wt.(wet):	**124.77**	pcf	**2.00**	g/cm^3	Water Wt.:	27.5	Water Wt.:	79.73
Unit Wt.(dry):	**99.74**	pcf	**1.60**	g/cm^3	% moist.:	**25.1**	% moist.:	**22.1**

Assumed Specific Gravity: **2.55** Max Dry Density(pcf) = 99.78226 OMC = 25.1004016

% of max = 100.0 +/- OMC = 0.00

Calculated % saturation: 94.57 Void ratio (e) = **0.60** Porosity (n)= **0.37**

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 5.2 cm Hydraulic Gradient = 10.42

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
12/28/2009	7	4	2.658825	23.5	0.920	4.12E-05	1.17E-01	
12/28/2009	9	3.5	3.158825	23.5	0.920	4.23E-05	1.20E-01	
12/28/2009	11	3	3.658825	23.5	0.920	4.57E-05	1.30E-01	
12/28/2009	16	2.5	4.158825	23.5	0.920	4.28E-05	1.21E-01	

SUMMARY

k_a = 4.30E-05 cm/sec Acceptance criteria = 25 %

ki			Vm	
k1 =	4.12E-05	cm/sec	4.2	%
k2 =	4.23E-05	cm/sec	1.7	%
k3 =	4.57E-05	cm/sec	6.3	%
k4 =	4.28E-05	cm/sec	0.4	%

$$Vm = \frac{|ka-ki|}{ka} \times 100$$

Hydraulic conductivity	k =	**4.30E-05**	cm/sec	**1.22E-01**	ft/day
Void Ratio	e =	**0.60**			
Porosity	n =	**0.37**			
Bulk Density	γ =	**2.00**	g/cm^3	**124.8**	pcf
Water Content	W =	**0.40**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**4.41E-10**	cm^2	(at 20 deg C)	

Robert Duke, P.E.

210 Beech Street
Texarkana, AR 71854
870-772-0013 Phone
870-216-2413 Fax

1717 East Erwin
Tyler, Texas 75702
903-595-4421 Phone
903-595-6113 Fax
www.ettlinc.com

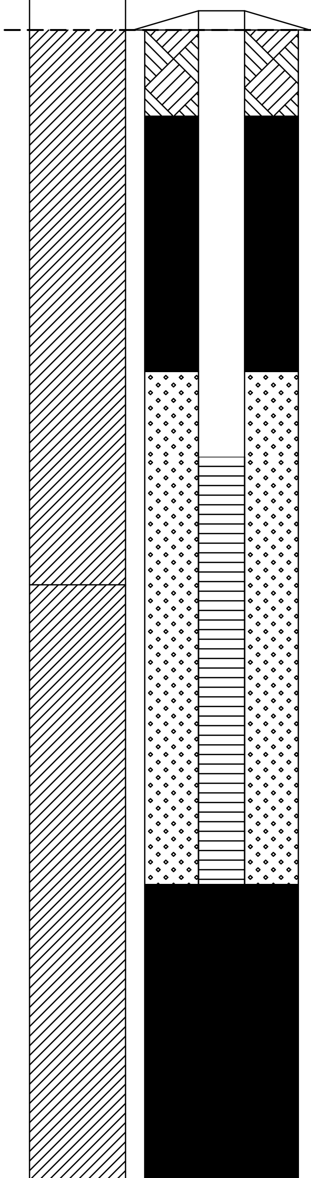
707 West Cotton Street
Longview, Texas 75604-5505
903-758-0915 Phone
903-758-8245 Fax

ENVIRONMENTAL LOG

Client: Welsh Power Plant
Project No: G3242-095 **Phase** **Task**

Well No. B-2
Location Pittsburg, Texas
Surface Elev.

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
							T.O.C. Elev.
0		**Ground Surface**				0	
		SANDY LEAN CLAY(CL) hard; red and tan					
		--very stiff					
5		--stiff				5	
		--very stiff; reddish brown					
10						10	
		SANDY LEAN CLAY(CL) hard; red and tan					
15						15	
		--very stiff					
20						20	
25						25	



Continued Next Page

Driller Doug Hinds
Logged By James Griffith
Drilling Started 10/28/09
Drilling Completed 10/28/09
Construction Completed
Development Completed
Type of Well

Drilling Method Soild Stem Auger
Borehole Diameter 6.5"
Well Casing 2.0" **Dia.** 0.0' **to** 10.0'
Casing Type PVC
Well Screen 2.0" **Dia.** 10.0' **to** 20.0'
Screen Type Slotted
Slot Size 0.010"
Grout Type Bentonite

Bentonite Seal 2-8' & 20-50'
Filter Pack Qty. 8-20'
Filter Pack Type 20/40 Sand
Static Water Level

Notes:

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

Well No. B-2

Location Pittsburg, Texas

Surface Elev.

Depth Feet	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
	Continued from previous page					
	CLAYEY SAND(SC) medium dense; tan, red, and gray					
30					30	
	--red and tan					
35					35	
	SILTY CLAYEY SAND(SM-SC) red, tan, and gray; saturated					
40					40	
	FAT CLAY(CH) hard; brown, tan, and gray; with ferric joints; with lignite and sand seams					
45					45	
	SILTY SAND(SM) black and gray					
50	Bottom of Boring @ 50'				50	
55						
60						

ENVIRONMENTAL LOG

Client: Welsh Power Plant

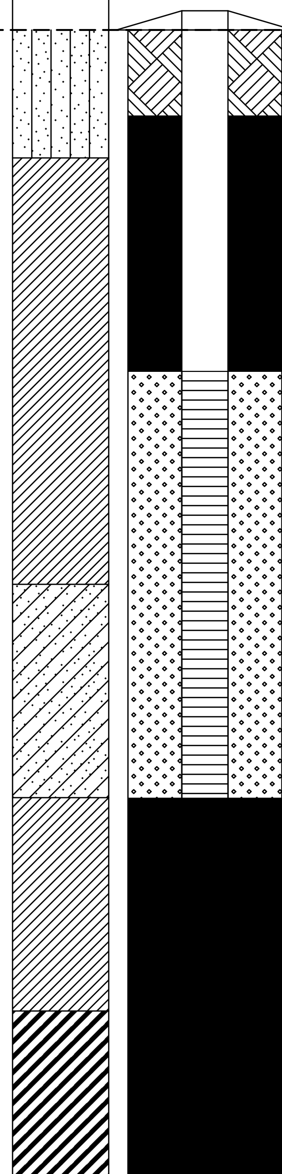
Project No: G3242-095 **Phase** **Task**

Well No. B-4

Location Pittsburg, Texas

Surface Elev.

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
							T.O.C. Elev.
0		Ground Surface				0	
		SILTY SAND(SM) medium dense; tan; with gravel					
		SANDY LEAN CLAY(CL) dark brown					
		--tannish orange					
5		--hard; orangish tan				5	
10		--very stiff; white				10	
		CLAYEY SAND(SC) medium dense; tan					
15		--orangish gray; with sand seams				15	
		SANDY LEAN CLAY(CL) stiff; orangish tan					
20						20	
		FAT CLAY(CH) very stiff; orangish tan; with ferric seams					
25						25	



Continued Next Page

Driller Doug Hinds	**Drilling Method** Soild Stem Auger	**Bentonite Seal** 2-8' & 18-50'
Logged By James Griffith	**Borehole Diameter** 6.5"	**Filter Pack Qty.** 6-18'
Drilling Started 10/27/09	**Well Casing** 2.0" **Dia.** 0.0' **to** 8.0'	**Filter Pack Type** 20/40 Sand
Drilling Completed 10/27/09	**Casing Type** PVC	**Static Water Level**
Construction Completed	**Well Screen** 2.0" **Dia.** 8.0' **to** 18.0'	
Development Completed	**Screen Type** Slotted	**Notes:**
Type of Well	**Slot Size** 0.010"	
	Grout Type Bentonite	

ETTL Engineers & Consultants Inc.

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

Well No. B-4

Location Pittsburg, Texas

Surface Elev.

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
		Continued from previous page					
		--tannish brown; with iron ore seams					
30						30	
		--hard; light gray; layered and with silt seams					
35						35	
		LEAN CLAY(CL) hard; light gray; layered and with silt seams					
40						40	
		--light gray					
45						45	
		--layered and with sand seams; with lignite					
50						50	
		Bottom of Boring @ 50'					
55							
60							

ENVIRONMENTAL LOG

Client: Welsh Power Plant

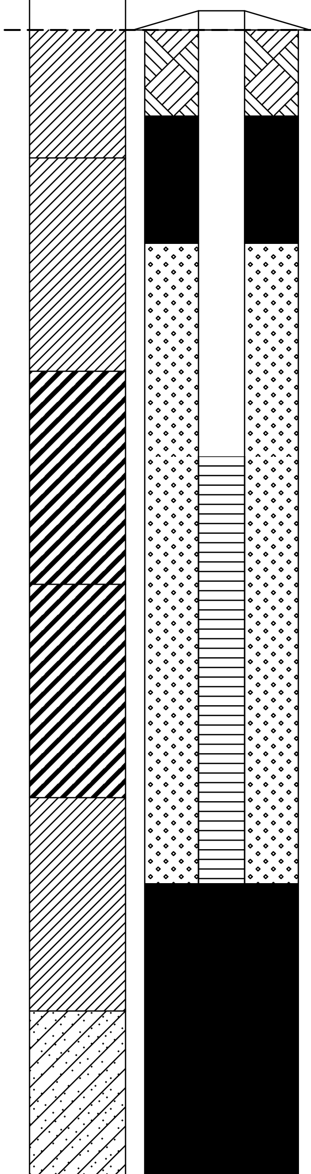
Project No: G3242-095 **Phase** **Task**

Well No. B-5

Location Pittsburg, Texas

Surface Elev.

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
							T.O.C. Elev.
0		**Ground Surface**				0	
		LEAN CLAY WITH SAND(CL) stiff; red and tan					
		LEAN CLAY(CL) hard; red and tan					
5		--very stiff				5	
		FAT CLAY(CL) very stiff; brown and tan					
10						10	
		FAT CLAY WITH SAND(CH) hard; red and tan					
15						15	
		SANDY LEAN CLAY(CL) very stiff; red and gray; with sand seams					
20						20	
		CLAYEY SAND(SC) very loose; tan, red, and gray					
25						25	



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Driller Doug Hinds

Logged By James Griffith

Drilling Started 10/27/09

Drilling Completed 10/27/09

Construction Completed

Development Completed

Type of Well

Drilling Method Soild Stem Auger

Borehole Diameter 6.5"

Well Casing 2.0" **Dia.** 0.0' **to** 10.0'

Casing Type PVC

Well Screen 2.0" **Dia.** 10.0' **to** 20.0'

Screen Type Slotted

Slot Size 0.010"

Grout Type Bentonite

Bentonite Seal 2-5' & 20-50'

Filter Pack Qty. 5-20'

Filter Pack Type 20/40 Sand

Static Water Level

Notes:

ETTL Engineers & Consultants Inc.

ENVIRONMENTAL LOG

Client: Welsh Power Plant

Project No: G3242-095 **Phase** **Task**

Well No. B-5

Location Pittsburg, Texas

Surface Elev.

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
		Continued from previous page					
		FAT CLAY WITH SAND(CH) stiff; red and gray					
30						30	
		SILTY CLAYEY SAND(SC) gray and red; saturated					
35						35	
		FAT CLAY(CH) hard; red and gray; with sand seams					
40						40	
		--gray, tan, and red; with sand seams					
45						45	
		SILTY SAND(SM-SC) red and gray					
50						50	
		Bottom of Boring @ 50'					
55							
60							

ENVIRONMENTAL LOG

Client: Welsh Power Plant

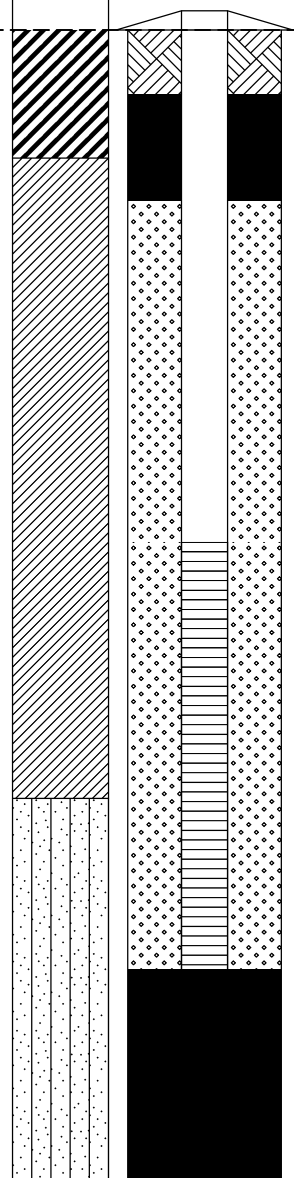
Project No: G3242-095 **Phase** **Task**

Well No. B-6

Location Pittsburg, Texas

Surface Elev.

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
							T.O.C. Elev.
0		Ground Surface				0	
		FAT CLAY(CH) very stiff; red and gray; with ferric seams					
		SANDY LEAN CLAY(CL) hard; red and tan					
5						5	
		--very stiff; red, gray, and brown; with gravel					
		--with sand seams					
10						10	
15						15	
		SILTY SAND(SM) gray; saturated					
20						20	
		--very dense; gray and red					
25						25	



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Driller Doug Hinds	**Drilling Method** Soild Stem Auger	**Bentonite Seal** 1.5-4' & 22-50'
Logged By James Griffith	**Borehole Diameter** 6.5"	**Filter Pack Qty.** 4-22'
Drilling Started 10/28/09	**Well Casing** 2.0" **Dia.** 0.0' **to** 12.0'	**Filter Pack Type** 20/40 Sand
Drilling Completed 10/28/09	**Casing Type** PVC	**Static Water Level**
Construction Completed	**Well Screen** 2.0" **Dia.** 12.0' **to** 22.0'	
Development Completed	**Screen Type** Slotted	**Notes:**
Type of Well	**Slot Size** 0.010"	
	Grout Type Bentonite	

ETTL Engineers & Consultants Inc.

ENVIRONMENTAL LOG			Well No. B-6	
Client: Welsh Power Plant			Location Pittsburg, Texas	
Project No: G3242-095	Phase	Task	Surface Elev.	Page 2 of 2

Depth Feet	Sampler	Overburden/Lithologic Description	Field Strength Data	Graphic Log	Well Construction Graphics	Depth Feet	Well Construction Details
		Continued from previous page					
30						30	
		FAT CLAY(CH) hard; brown; with sand seams					
35						35	
40						40	
		--dark green					
45						45	
		LEAN CLAY(CL) hard; dark green; laminated with lignite					
50						50	
		Bottom of Boring @ 50'					
55							
60							

STATE OF TEXAS WELL REPORT for Tracking #206942

Owner:	AEP	Owner Well #:	B-2
Address:	1187 CR 4865 Pittsburg , TX 75686	Grid #:	16-58-4
Well Location:	1187 CR 4865 Pittsburg , TX 75686	Latitude:	33° 03' 05" N
Well County:	Camp	Longitude:	094° 50' 27" W
Elevation:	No Data	GPS Brand Used:	Garmin 12 GPS
Type of Work:	New Well	Proposed Use:	Monitor

Drilling Date:	Started: 10/28/2009 Completed: 10/28/2009
Diameter of Hole:	Diameter: 6.5 in From Surface To 20 ft
Drilling Method:	Other: solid stem auger
Borehole Completion:	Gravel Packed From: 8 ft to 20 ft Gravel Pack Size: 20/40
Annular Seal Data:	1st Interval: From 2 ft to 8 ft with 3 bentonite (#sacks and material) 2nd interval: From 0 ft to 2 ft with 0.5 cement (#sacks and material) 3rd Interval: No Data Method Used: Gravity Cemented By: Driller Distance to Septic Field or other Concentrated Contamination: No Data Distance to Property Line: No Data Method of Verification: No Data Approved by Variance: No Data
Surface Completion:	Alternative Procedure Used
Water Level:	Static level: No Data Artesian flow: No Data
Packers:	No Data
Plugging Info:	Casing or Cement/Bentonite left in well: No Data
Type Of Pump:	No Data
Well Tests:	No Data
Water Quality:	Type of Water: No Data Depth of Strata: No Data Chemical Analysis Made: No Did the driller knowingly penetrate any strata which contained undesirable constituents: No
Certification Data:	The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company Information:	ETTL Engineers & Consultants Inc. 1717 E. Erwin

	Tyler , TX 75702
Driller License Number:	**2126**
Licensed Well Driller Signature:	**H. Douglas Hinds**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking **#206942**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0-20 Sandy lean clay - tan & red

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
2 New PVC Sch. 40 0 - 10
2 New PVC Sch. 40 10 - 20 0.010"

STATE OF TEXAS WELL REPORT for Tracking #206948

Owner:	AEP	Owner Well #:	B-4
Address:	1187 CR 4865 Pittsburg , TX 75686	Grid #:	16-58-4
Well Location:	1187 CR 4865 Pittsburg , TX 75686	Latitude:	33° 03' 01" N
Well County:	Camp	Longitude:	094° 50' 28" W
Elevation:	No Data	GPS Brand Used:	Garmin 12 GPS
Type of Work:	New Well	Proposed Use:	Monitor

Drilling Date:	Started: 10/27/2009 Completed: 10/27/2009
Diameter of Hole:	Diameter: 6.5 in From Surface To 50 ft
Drilling Method:	Other: solid stem auger
Borehole Completion:	Gravel Packed From: 6 ft to 18 ft Gravel Pack Size: 20/40
Annular Seal Data:	1st Interval: From 18 ft to 50 ft with 5 bentonite (#sacks and material) 2nd Interval: From 2 ft to 8 ft with 3 bentonite (#sacks and material) 3rd Interval: From 0 ft to 2 ft with 0.5 cement (#sacks and material) Method Used: Gravity Cemented By: Driller Distance to Septic Field or other Concentrated Contamination: No Data Distance to Property Line: No Data Method of Verification: No Data Approved by Variance: No Data
Surface Completion:	Alternative Procedure Used
Water Level:	Static level: No Data Artesian flow: No Data
Packers:	No Data
Plugging Info:	Casing or Cement/Bentonite left in well: No Data
Type Of Pump:	No Data
Well Tests:	No Data
Water Quality:	Type of Water: No Data Depth of Strata: No Data Chemical Analysis Made: No Did the driller knowingly penetrate any strata which contained undesirable constituents: No
Certification Data:	The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company Information:	ETTL Engineers & Consultants Inc. 1717 E. Erwin

	Tyler , TX 75702
Driller License Number:	2126
Licensed Well Driller Signature:	H. Douglas Hinds
Registered Driller Apprentice Signature:	No Data
Apprentice Registration Number:	No Data
Comments:	No Data

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0-4 Silty sand - ran & brown
4-13 Sandy lean clay - tan, orang, & white
13-18 Clayey sand - tan, orange, & gray
18-23 Sandy lean clay - orange & tan
23-38 Fat clay - orange, tan, brown, & gray
38-50 Lean clay - gray

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
2 New PVC Sch. 40 0 - 8
2 New PVC Sch. 40 8 - 18 0.010"

STATE OF TEXAS WELL REPORT for Tracking #200989

Owner:	**AEP**	Owner Well #:	**B-5**
Address:	**1187 CR 4865** **Pittsburg , TX 75686**	Grid #:	**16-58-4**
Well Location:	**1187 CR4865** **Pittsburg , TX 75686**	Latitude:	**33° 02' 58" N**
Well County:	**Camp**	Longitude:	**094° 50' 26" W**
Elevation:	**No Data**	GPS Brand Used:	**Garmin 12 GPS**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date:	Started: **10/27/2009** Completed: **10/27/2009**
Diameter of Hole:	Diameter: **6.5 in From Surface To 20 ft**
Drilling Method:	Other: **solid stem auger**
Borehole Completion:	Gravel Packed From: **5 ft to 20 ft** Gravel Pack Size: **20/40**
Annular Seal Data:	1st Interval: **From 2 ft to 5 ft with 2 bentonite (#sacks and material)** 2nd Interval: **From 0 ft to 2 ft with 0.5 cement (#sacks and material)** 3rd Interval: **No Data** Method Used: **Gravity** Cemented By: **Driller** Distance to Septic Field or other Concentrated Contamination: **No Data** Distance to Property Line: **No Data** Method of Verification: **No Data** Approved by Variance: **No Data**
Surface Completion:	**Alternative Procedure Used**

Water Level:	Static level: **No Data** Artesian flow: **No Data**
Packers:	**No Data**
Plugging Info:	Casing or Cement/Bentonite left in well: **No Data**
Type Of Pump:	**No Data**
Well Tests:	**No Data**

Water Quality:	Type of Water: **No Data** Depth of Strata: **No Data** Chemical Analysis Made: **No** Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**
Certification Data:	The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company Information:	**ETTL Engineers & Consultants Inc.** **1717 E. Erwin**

	Tyler , TX
Driller License Number:	**2126**
Licensed Well Driller Signature:	**H. Douglas Hinds**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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Please include the report's Tracking number (Tracking **#200989**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0-20 Clayey sand - red & tan

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
2 New PVC Sch. 40 0 - 10
2 New PVC Sch. 40 - slotted 10 - 20 0.010"

STATE OF TEXAS WELL REPORT for Tracking #200991

Owner:	**AEP**	Owner Well #:	**B-6**
Address:	**1187 CR 4865** **Pittsburg , TX 75686**	Grid #:	**16-58-4**
Well Location:	**1187 CR4865** **Pittsburg , TX 75686**	Latitude:	**33° 02' 55" N**
Well County:	**Camp**	Longitude:	**094° 50' 28" W**
Elevation:	**No Data**	GPS Brand Used:	**Garmin 12 GPS**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Date:	Started: **10/28/2009** Completed: **10/28/2009**
Diameter of Hole:	Diameter: **6.5 in From Surface To 22 ft**
Drilling Method:	Other: **solid stem auger**
Borehole Completion:	Gravel Packed From: **4 ft to 22 ft** Gravel Pack Size: **20/40**
Annular Seal Data:	1st Interval: **From 1.5 ft to 4 ft with 2 bentonite (#sacks and material)** 2nd Interval: **From 0 ft to 1.5 ft with 0.5 cement (#sacks and material)** 3rd Interval: **No Data** Method Used: **Gravity** Cemented By: **Driller** Distance to Septic Field or other Concentrated Contamination: **No Data** Distance to Property Line: **No Data** Method of Verification: **No Data** Approved by Variance: **No Data**
Surface Completion:	**Alternative Procedure Used**
Water Level:	Static level: **No Data** Artesian flow: **No Data**
Packers:	**No Data**
Plugging Info:	Casing or Cement/Bentonite left in well: **No Data**
Type Of Pump:	**No Data**
Well Tests:	**No Data**
Water Quality:	Type of Water: **No Data** Depth of Strata: **No Data** Chemical Analysis Made: **No** Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**
Certification Data:	The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company Information:	**ETTL Engineers & Consultants Inc.** **1717 E. Erwin**

	Tyler , TX
Driller License Number:	**2126**
Licensed Well Driller Signature:	**H. Douglas Hinds**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**No Data**

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Please include the report's Tracking number (Tracking **#200991**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0-22 Clayey sand - red & tan

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
2 New PVC Sch. 40 0 - 12
2 New PVC Sch. 40 - slotted 12 - 22 0.010"

ETTL Engineers & Consultants Inc.

GEOTECHNICAL ✶ MATERIALS ✶ ENVIRONMENTAL ✶ DRILLING ✶ LANDFILLS

June 21, 2010

W. Greg Carter, P.E.
American Electric Power
1187 CR 4865
Pittsburg, TX 75686

SUBJECT: Welsh Power Station, Existing Ash Storage Ponds Embankment Investigation, Pittsburg, Texas
Geotechnical Investigation
ETTL Job No. G3242-09

Dear Mr. Carter:

Submitted herein is the report summarizing the results of a geotechnical investigation conducted at the site of the above referenced project.

If you have any questions concerning this report, please contact us. We are available to perform any construction materials testing and inspection services that you may require.

Thank you for the opportunity to be of service.

Sincerely,
ETTL Engineers & Consultants Inc.

Robert M. Duke, P.E.
Senior Project Manager

STATE OF TEXAS
ROBERT M. DUKE
91757
LICENSED
PROFESSIONAL ENGINEER

ETTL
ENGINEERS & CONSULTANTS
F-3208

6/21/2010

C. Brandon Quinn, P.E., P.G.
Manager of Engineering Services
Vice President

STATE OF TEXAS
C. BRANDON QUINN
72441
REGISTERED
PROFESSIONAL ENGINEER

ETTL
ENGINEERS & CONSULTANTS
F-3208

June 21, 2010

Distribution: (2) AEP

210 Beech Street
Texarkana, Texas 71854
870-772-0013 Phone
870-216-2413 Fax

1717 East Erwin
Tyler, Texas 75702
903-595-4421 Phone
903-595-6113 Fax

707 West Cotton Street
Longview, Texas 75604-5505
903-758-0915 Phone
903-758-8245 Fax

w w w . e t t l i n c . c o m

APPENDIX C-2 – Geotechnical Investigation, Welsh Power Station, Existing Primary and Secondary Ash Storage Ponds Embankment Study, ETTL, June 21, 2010

Geotechnical Investigation
Welsh Power Station
Existing Ash Storage Ponds Embankment Investigation
Pittsburg, Texas

Submitted to

American Electric Power
Pittsburg, Texas

Prepared by

ETTL Engineers & Consultants Inc.
Tyler, Texas

June 2010

EXECUTIVE SUMMARY

This Executive Summary is provided as a brief synopsis of the specific recommendations and design criteria provided in the attached report. It is not intended as a substitute for a thorough reading of the report in its entirety.

Project Description

Evaluation of the existing earthen embankments for the ash ponds at the Welsh Power Station. Slope stability and seepage analyses for the embankments were performed using information obtained from soil borings located on the crest and outside toe of the embankments. The embankments for the Primary and Secondary Ash Ponds were investigated.

Site Description

This investigation was conducted on the Welsh Power Station embankments that are located throughout the plant which is located at 1187 CR 4865. The power plant is located on the west side of Welsh Reservoir, north of the reservoir dam.

Depth & Number of Borings

Two borings were drilled to 30 feet deep at the native soil level and five borings were drilled to 50 feet deep in the crests of the embankments.

Pond	Boring Numbers And Depth	Piezometer Numbers and Depth
Primary Ash Pond (Pond 1)	B-1 - 30 Feet Deep B-2 - 50 Feet Deep B-3 - 50 Feet Deep	B-2 - 50 Feet Deep B-3 - 50 Feet Deep
Secondary Ash Pond (Pond 2)	B-4 - 50 Feet Deep B-5 - 50 Feet Deep B-6 - 50 Feet Deep B-7 - 30 Feet Deep	B-4 - 50 Feet Deep B-5 - 50 Feet Deep B-6 - 50 Feet Deep

Soils Encountered

The fill material in the containment berm consists primarily of stiff to hard lean clay (CL), fat clay (CH) and medium dense clayey sand (SC) overlying the native soils which consist primarily of stiff to hard lean clay (CL) and fat clay (CH) with intermittent layers of medium dense to very dense clayey sand (SC) and silty sand (SM). The western borings (B-6 and B-7) have a thick layer of very dense silty sand (SM) which is apparently the native surficial soil near the previous creek bed. Atterberg Plasticity Indices of the tested soils ranged from 9 to 44.

Groundwater Depth

Found to range from elevation 309 to 327 msl.

Embankment Stability

The existing berm slopes are acceptable ***if conditions are maintained*** and the existing surface failure is repaired. A minimum factor of safety of 1.7 in the long term was found on the Primary Ash Pond. Rapid drawdown of the level of water in the lake lowers the predicted overall stability factors of safety to a minimum of 1.4.

Embankment Rehabilitation

The easternmost downstream side (lake side) of the Secondary Ash Pond has a shallow surficial slope failure most likely due to the removal of the larger vegetation and the subsequent loss of strength in the zone desiccated by the roots and saturated by a large rain. This should be repaired as soon as possible. Proctors were conducted on fill for this repair which was to proceed soon after ETTL's field investigation, weather permitting. During the repair, additional slippage was observed and additional investigations were conducted (repair recommendations and analysis will be issued as a supplement to this report).

TABLE OF CONTENTS

1.0 INTRODUCTION
This study was performed at the request and authorization to proceed granted by Greg Carter, P.E. with AEP, Hallsville, Texas in accordance with our proposal dated October 13, 2009. Field operations were conducted on October 27th though November 5th, 2009.

The purpose of this investigation was to define and evaluate the general subsurface conditions for the primary and secondary ash ponds in Cason, Texas. Specifically, the study was planned to determine the following:

- Subsurface stratigraphy within the limits of exploratory borings;
- Classification, strength, and compressibility characteristics of the embankment and foundation soils; and
- Slope stability and seepage of the existing embankments.

To determine this information a variety of tests were performed on the soil and ash samples. The scope of testing for this report comprised Standard Penetration, Atterberg liquid and plastic limits, Percentage of Fines Passing the No. 200 sieve and Natural Moisture Content, Unconsolidated Undrained Triaxial tests, Hydrometer, Permeability, and Direct Shear. These tests were conducted to classify the soil strata according to a widely used engineering classification system; identify, and provide quantitative data for soils; define shear strength characteristics; predict total settlement; and determine the slope stability of the existing embankments.

The conclusions and recommendations that follow are based on limited information regarding site grading provided to ETTL by others. Borings were drilled at locations based on a site plan provided by the client. *Should any portion of it prove incorrect, this firm should be notified in order to assess the need for revisions to this report.*

2.0 PROJECT DESCRIPTION
This project will consist of the evaluation of the existing earthen embankments at the Welsh Power Station. Slope stability and seepage analyses for the embankments will be performed using information obtained from soil borings located on the crest and outside toe of the embankments. The embankments for the Primary and Secondary ash ponds were evaluated:

One seepage and one stability analyses was conducted for each pond. Table 2.0 below, lists the number of borings and depths for each pond as well as the piezometers installed.

Table 2.0 Boring and Piezometer Depths and Locations

Pond	Boring Numbers And Depth	Piezometer Numbers and Depth
Primary Ash Pond (Pond 1)	B-1 - 30 Feet Deep B-2 - 50 Feet Deep B-3 - 50 Feet Deep	B-2 - 50 Feet Deep B-3 - 50 Feet Deep
Secondary Ash Pond (Pond 2)	B-4 - 50 Feet Deep B-5 - 50 Feet Deep B-6 - 50 Feet Deep B-7 - 30 Feet Deep	B-4 - 50 Feet Deep B-5 - 50 Feet Deep B-6 - 50 Feet Deep

3.0 SITE DESCRIPTION

This investigation was conducted on the Welsh Power Station embankments that are located throughout the plant which is located at 1187 CR 4835, Pittsburg, Texas. See the Plans of Borings for the locations of the embankments investigated.

4.0 FOUNDATION STRATIGRAPHY & PROPERTIES

The subject property is at the AEP Welsh Power Plant which is located on the east side of FM 1735 east of Pittsburg, Texas. Regional, local, and site-specific environmental characteristics have been identified by review of the surface, subsurface, and groundwater data gathered during the course of this study.

4.1 Surface Water Characteristics

The site is situated on a topographically level feature, with a slight slope from west to east from an elevation of 350 feet to 300 feet. The normal pool elevation of Welsh Reservoir is at 320 (msl). The surface elevation of the study site is 325 feet above mean sea level (msl). An unnamed intermittently flowing tributary of Swauano Creek enters the subject site along the western portion of the property and flows into Swauano Creek. Flow within the tributary is generally to the south. Surface water runoff from the site is expected to move to the south along a tributary of Swauano Creek.

4.2 Regional Geology and Hydrogeology

4.2.1 Geologic History

The stratigraphy of Titus County, as it relates to the occurrence of fresh groundwater, consists of alternating sequences of continental, deltaic, and marine sediments that are predominantly of Eocene age. Continental and deltaic units that are composed predominantly of quartz sand with varying quantities of silt and clay contain the fresh ground water in the area and form the major conduits for its movement. Marine portions of the section, consisting largely of clay or shale with lesser quantities of silt and glauconitic sandstone, form the intervening aquitards.

4.2.2 Stratigraphy and Structure

Titus County lies in the northeastern portion of the East Texas Basin, a negative structural feature that developed by faulting during the Triassic Period. The Luling-Mexia-Talco fault zone bounds the depression on the north and west and by the Sabine Uplift on the east. The referenced site is situated on the northern portion of the East Texas Basin.

4.3 Geologic Processes

4.3.1 Fault Systems

The project site was examined for the presence of faulting by reviewing available literature, maps, and site reconnaissance, in addition to the examination of the subsurface boring data for the site.

The referenced site is situated on the northern portion of the East Texas Basin. The closest fault system is located approximately 30 miles north of the subject site. This fault system is referred to as the Luling-Mexia-Talco Fault Zone. The fault system trends northwest from Luling, through Mexia, and ending east of Talco, Texas. Surface expression can be seen in a series of scattered low-lying hills that resulted from differential erosion of sediments.

No unusual scarps or topographic breaks were observed. A site walkover was conducted to delineate the surface features, including observation of excavation sidewalls and bottom as well as formation outcrops. No evidence of faulting was found associated with the roadways; no structural influence of seam courses was observed; and no unusual relief or topographic features, such as sag ponds, truncated alluvial spurs, or offset tributary alignments, were observed during the site reconnaissance. Also no vertical offsets of subsurface material were interpreted from the site borings.

4.3.1.1 Seismic Design Parameters

Data regarding soil type and density to a depth of 100 feet is needed to designate a design class for the profile where liquefaction potential is not considered. However, we predict that the site could be classified **Class D** based on the limited data available.

A seismic impact zone is an area with a 10 percent or greater probability that the maximum horizontal acceleration in rock, expressed as a percentage of the earth's gravitational pull, will exceed 0.10g in 50 years.

Based on the maps and the site coefficients determined for **site class D** contained in the IBC, parameters as listed below are recommended by the Code:

Site Coefficients:	$F_a = 1.60$ $F_v = 2.40$
Maximum Earthquake Spectral Response Acceleration Parameters:	$S_{MS} = 0.238$* $S_{M1} = 0.158$
Design Spectral Response Acceleration Parameters:	$S_{DS} = 0.159$ $S_{D1} = 0.105$

*Note: Acceleration used for seismic evaluation.

4.3.1.2 Liquefaction

Liquefaction is a phenomenon where soil pore pressure builds up rapidly during cyclic loading causing a loss of shear strength and consequent significant ground movement both laterally and vertically. In layman's terms the soil turns into quick sand, losing ability to support load, and can spread laterally out from under foundations. Foundations sitting on sand that liquefies during an earthquake can sink into the soil.

Recent research[1, 2] has shown that liquefaction potential exists not only in relatively clean sands, but also, under certain circumstances, in sands, silts and clayey soils of low plasticity (PI<12 or up to 20 if MC>0.85*Liquid Limit) with significant fines content. In order for liquefaction to be triggered, the water content of finer soils needs to be high (generally > 80-85% of the Liquid Limit) and the density relatively low (assessed in terms of the SPT blow count generally where N1 (SPT Value normalized for overburden pressure) is low). In addition, the frequency and magnitude of ground shaking has to reach a certain threshold, which is related to the soil properties and local geology.

The native soils are predominantly medium stiff to hard lean and fat clays (CL & CH), medium dense clayey sand (SC) and very dense silty sands (SM). These characteristics taken together with the fact that the site is in a zone of relatively low maximum ground acceleration (<0.2g) indicate a negligible

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1 Idriss, I.M. and Boulanger, R.W., Semi Empirical Procedures for Evaluating Liquefaction Potential During Earthquakes, Invited Paper, 11th International Conference on Soil Dynamics and Earthquake Engineering, Berkley, CA, January 2004.

2 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.

risk of liquefaction.

4.3.2 Erosional Processes

Erosional processes in the area of study are limited to those produced by the drainage systems of Swauano Creek. As previously discussed, some tributaries flow intermittently. Due to this and the gentle relief of the site topography, erosion is minimal.

4.4 Regional Aquifers and Geology

The deepest fresh water aquifer in Titus County is the Carrizo-Wilcox. The Carrizo-Wilcox is composed of the Wilcox Group and the immediately overlying Carrizo Sand. Excellent aquifer characteristics have made the Carrizo-Wilcox the most productive aquifer in East Texas. The Reklaw Formation and Queen City Sand overlie the Carrizo-Wilcox successively. The Reklaw normally has poor water-bearing characteristics, but it may produce small amounts of water in those areas where sandy intervals are found in the lower portion of the formation. Although water from the Queen City generally has low total dissolved solids content (less than 660 ppm), high iron concentrations and low pH have restricted its use as an industrial or municipal water supply. Because of undesirable water quality, the current availability of water in the Queen City Sand far exceeds its usage.

4.4.1 Reklaw Formation

The Reklaw Formation outcrops at the referenced site. The Reklaw is typically composed of thin beds of gray to brown silty clay. The upper portion of the formation commonly contains brownish black to brownish gray silty clay. The lower portion of the formation commonly contains interbeds of silt and very fine to fine-grained, grayish green, glauconitic, quartz sand and may be transitional with the underlying Carrizo Sand.

In the area of Reklaw outcrop, the basal sandy interval offers only limited potential for groundwater production. Where the Reklaw occurs at depth, drilling usually targets the more favorable Carrizo-Wilcox, which closely underlies the sandy zone. The Carrizo-Wilcox and the sandy portion of the Reklaw are considered to be hydraulically interconnected. Protection of the important Carrizo-Wilcox aquifer should emphasize similar protection of any interconnected strata.

4.4.2 Queen City

The Queen City Sand outcrops at the referenced site. Characteristic lithologies are light gray to brownish gray, fine- to medium-grained quartz sand and gray to brown clay, occasionally silty and slightly lignitic. Ironstone concretions, sometimes occurring as ledges, are common within the formation. In outcrop, the Queen City weathers to a mottled red and white color. Thickness of the formation in Titus County ranges from 100 to 400 feet, generally thinning southeastward.
Shallow, or near-surface, ground water at the site persists in the unconfined portion of the Queen City Sand (reference the Site Surface Geology Map at the end of this section). In unconfined aquifers, ground-water flow is controlled primarily by gravity, by lithology, and by the structure of the formation. Excluding anomalous conditions, ground water is expected to move in approximately the same direction as the surface water flow at this location.

4.5 Soil Stratigraphy

Detailed on the attached boring logs are the specific types and depths of the various soil strata encountered. The logs show defined boundaries between various soil types, but in reality the transition between types is generally gradual.

The fill material in the containment berm consists primarily of stiff to hard lean clay (CL), fat clay (CH) and medium dense clayey sand (SC) overlying the native soils which consist primarily of stiff to hard lean clay (CL) and fat clay (CH) with intermittent layers of medium dense to very dense clayey sand (SC) and silty sand (SM). The western borings (B-6 and B-7) have a thick layer of very dense silty sand (SM) which is apparently the native surficial soil near the previous creek bed. Atterberg Plasticity Indices of the tested soils ranged from 9 to 44.

The embankments appear to have been constructed with layers of cohesive soils consisting primarily of lean clay (CL) and/or fat clay (CH). No obvious seams of soft or loose soils were encountered in the constructed embankments.

5.0 GROUNDWATER OBSERVATIONS

Groundwater was measured at each location and at least one monitor well was installed at each pond location. During drilling, water was found to range from elevation 309 to 327 msl although final water level is anticipated to be above the lake pool elevation of 320. The ash level in the primary pond is near the water elevation. Water was measured in the piezometers at elevations ranging from 323 to 327.

It should be noted, however, that seasonal groundwater conditions might vary throughout the year depending upon prevailing climatic conditions. This magnitude of variance will be largely dependent upon the duration and intensity of precipitation, surface drainage characteristics of the surrounding area, and significant changes in site topography.

5.1 Piezometers

Four piezometers were installed for the various embankments at the site. These piezometers will be used to monitor the water level in the embankments. Piezometers were installed in the boring locations selected by AEP prior to the site work. The piezometers are numbered based on the boring number where it was installed (i.e. B-5 was installed at boring location B-5). Copies of the Well Logs and State of Texas Well Reports may be found in the Appendix.

Upon completion of drilling activities for the geotechnical borings, the monitor wells were installed in the open borehole to the depth approximating the natural ground level. If the boring was deeper than the depth of proposed screening, the boring was backfilled with bentonite to the appropriate depth. The monitoring well was installed within the open borehole along with a 1-inch PVC pipe. Fresh water was pumped within the 1-inch PVC pipe until the water flowing back from the bottom of the borehole to the surface had thinned. The monitoring wells were constructed of schedule 40, 2-inch diameter, PVC pipe consisting of new, box-wrapped, flush-joint threaded screen (0.010-inch mill slot) and casing. This installation depth should measure the final groundwater elevation after the water through the embankment has stabilized. This is the depth predicted by the seepage analyses below.

The filter pack material placed around the well screen consisted of 20/40 silica sand. The filter pack sand was gravity placed into the annular space around the screen between the well and the borehole wall. Filter pack material was poured until the top of the filter pack extended two (2) feet above the top of the screen. Material thickness in the annular space was verified using a weighted fiberglass measuring tape or through the use of a 1-inch PVC pipe. The top of the filter pack was then sealed with bentonite pellets, which were allowed to gravity flow into the annular space to a minimum thickness of two (2) feet. The bentonite seal was hydrated with water. An additional bentonite seal was placed within the remaining portion of the annular seal to the surface. The wells were protected with flush mount surface completions.

5.2 Embankment Seepage Studies

5.2.1 Seepage Losses and Pressures

The anticipated water level due to seepage through the embankments was investigated based on the high water level anticipated in each individual pond using the computer program SEEP 2D by Environmental Modeling Systems, Incorporated. The seepage both through the embankment and through the foundation soils at each embankment location was estimated based on the permeability tests of soils encountered at the site. The soil permeabilities ranged from 4.3 x 10^{-5} cm/sec to 2.9 x 10^{-8} cm/sec at the ash ponds (test results included in the Appendix).

Seepage losses for the highest permeability embankments are predicted at 0.1 gallon per day (gpd) per foot of dam length.

Table 5.2.1.1 – Permeability Test Results

Boring	Depth	Unit Weight (pcf)	Permeability (cm/sec)
B-2	13' - 15'	141.5	2.9 x 10^{-8}
B-2	33' - 35'	128.2	7.0 x 10^{-8}
B-3	8' - 10'	132.0	7.4 x 10^{-8}
B-4	8' - 10'	124.4	1.9 x 10^{-8}
B-5	23' – 25'	125.5	5.0 x 10^{-7}
B-6	28' – 30'	124.8	4.3 x 10^{-5}

Table 5.2.1.2 – Embankment Seepage Rates

Embankment	Seepage Rate (Cubic Feet per Day per Foot)
Primary Ash Pond	7.6 x 10^{-3}
Secondary Ash Pond	9.9 x 10^{-2}

The water levels at the piezometers are predicted to reach slightly above the average of the upstream (pond) and downstream (lake) normal pool elevations. Water levels approaching the pond level could indicate a seepage pressure not anticipated in this design. Levels found to be within 1 foot of the pond levels should be brought to the attention of ETTL for additional study.

6.0 POND EMBANKMENT SECTIONS

The berm heights ranged from 20 feet on the Secondary Ash Pond to a maximum of around 30 feet on the Primary Ash Pond.

6.1 Slope Stability Analysis

All embankment slopes must be stable with respect to shear failure through the embankment and the foundation strata. The existing slopes are standing with no obvious slope failures with the exception of the surface sloughing in the east side of the secondary ash pond. Therefore, all slopes must have a Factor of Safety above 1. However, the Factor of Safety for long term stability should be a minimum of 1.5 for all new construction. This study was conducted to assure that the embankments meet the minimum Safety Factors.

Slope stability was evaluated using the computer program Geostase developed by Gregory Geotechnical Software. The program calculates the factor of safety for potential failure circles using several different methods. These analyses were conducted using the modified Bishop method. The program has an automatic search routine for determining the minimum factor of safety. The resulting analyses, which also show the cross section, are included in the Appendix.

The borings were surveyed for an embankment top elevation and the original topographical maps along with the construction plans (S&L Drawing S-12) for the embankments were used in order to determine cross sections for the stability analyses. The toes of slope were predicted based on the constructed slope angles and known pool elevations in the lake and ash ponds.

The "worst case" embankment was modeled at each embankment based on visual observations during the initial site visit and from soil types found in the borings. The highest section was chosen in both ponds. The soil strengths were modeled using 85 percent of the strength values determined from testing where a test was conducted due to the possibility of variations in the soil masses. Where no triaxial tests were conducted, average values of the fill and native soils were used based on the soil types. These results were also reduced by 15 percent. These reductions were used to accommodate potential variations in the soil due to the minimal number of tests performed. Results of Triaxial and Direct Shear tests are summarized in **Table 6.1.1** below. The test results are included in the Appendix.

Table 6.1.1 - Summary of Soil Test Results

Boring	Depth	Fill or Native	Soil Classification	Effective Stress Parameters		Total Stress Parameters	
				Friction Angle	Cohesion (psf)	Friction Angle	Cohesion (psf)
B-1	5'-10'	Native	CL/SC	16.7	360	10.9	400
B-2	8'-10'	Fill	CL	24.1	420	16.9	575
B-2	28'-30'	Native	SC	30.8	330	20.8	350
B-5	8'-10'	Fill	CH	26.9	260	9.1	700
B-6	28'-30'	Native	SM	33.3	796		

The native clayey sands (SC) and sandy clay clays (CL), and the two fill clays (CL/CH) in the table were averaged and used in the analyses.

Three cases were analyzed for each slope: steady-state (long term), steady state with seismic loads and rapid drawdown of the water in the ash ponds. For the evaluation of steady-state conditions, the soils were evaluated using *effective* stress parameters. For the rapid drawdown case the slopes were evaluated using *total* stress parameters. ETTL used a minimum of Factor of Safety of 1.5 for long term, 1.2 for seismic and 1.3 for rapid drawdown. Graphical representations of the slope stability results are included in the **Appendix**. Results of the analysis are summarized in **Table 6.1.2**, below.

Table 6.1.2 Slope Stability Analyses Results			
Pond	**Steady State Factor of Safety**	**Steady State with Seismic Factor of Safety**	**Rapid Drawdown Factor of Safety**
Primary Ash Pond (Pond 1)	1.7	1.3	1.4
Secondary Ash Pond (Pond 2)	2.2	1.6	2.1

6.2 Slope Protection

Earthen embankment slopes require some form of protection from excessive erosion. A good cover of approved grasses should provide adequate slope protection. The embankments appeared to have adequate vegetation, but some of the locations had been recently cleared of trees. The east embankment of the Secondary Ash Pond, which had the surficial slope slide, had been cleared recently. Bushes and trees of two feet or more in height are not considered satisfactory slope protection because of the harmful effect on grass and the hazards of tree roots.

The failure on the east bank of the Secondary Ash Pond was likely due to the removal of large vegetation and the subsequent saturation of the zone where the roots had desiccated the surficial soils.

A routine and periodic maintenance program should be implemented to prevent excessive growth. Animal control should also be considered an integral part of routine embankment maintenance.

6.2.1 Secondary Pond Slope Repair

The downstream side of the east embankment of the Secondary Ash Pond had a surficial slip recently, approximately 100 feet long or longer. This failure was observed during the initial site visit. This was also a location where the trees had been removed. As the tree roots decomposed, the section lost the reinforcement of the roots. A large rain saturated the soil and further reduced the soil strength (and added weight) which probably caused the failure (surficial only). This section should be repaired as soon as possible. Testing for the proposed fill material was conducted and repairs were underway during the writing of this report. During the repair, additional sloughing occurred and an additional investigation was conducted. This investigation and repair recommendations will be given in a supplement to this report.

6.2.1.2 Riprap

The downstream toe at the lake level has rock riprap as a slope cover. This should provide adequate slope protection for the area.

7.0 EMBANKMENT MONITORING

Visual drive-by inspections and cursory on-foot inspections should be performed in accordance with AEP requirements. As a minimum, dam safety inspections should be conducted biannually.

Should any unusual occurrences be noted in connection with the operation of the dams, either as a result of the cursory drive-by inspections or as the result of the detailed dam safety inspections, AEP Geotechnical Engineering, and ETTL Engineers & Consultants Inc. should be immediately notified for evaluation and development, if necessary, of a Remedial Action Plan.

8.0 LIMITATIONS

Geotechnical design work is characterized by the presence of a calculated risk that soil and groundwater conditions may not have been fully revealed by the exploratory borings. This risk derives from the practical necessity of basing interpretations and design conclusions on a limited sampling of the subsoil stratigraphy at the project site. The number of borings and spacing is chosen in such a manner as to decrease the possibility of undiscovered anomalies, while considering the nature of loading, size and cost of the project. The recommendations given in this report are based upon the conditions that existed at the boring locations at the time they were drilled. The term "existing groundline" or "existing subgrade" refers to the ground elevations and soil conditions at the time of our field operations.

It is conceivable that soil conditions throughout the site may vary from those observed in the exploratory borings. If such discontinuities do exist, they may not become evident until construction begins or possibly much later. Consequently, careful observations by the geotechnical engineer must be made of the construction as it progresses to help detect significant and obvious deviations of actual conditions throughout the project area from those inferred from the exploratory borings. Should any conditions at variance with those noted in this report be encountered during construction, this office should be notified immediately so that further investigations and supplemental recommendations can be made.

This company is not responsible for the conclusions, opinions, or recommendations made by others based on the contents of this report. The purpose of this study is only as stated elsewhere herein and is not intended to comply with the requirements of 30 TAC 330 Subchapter T regarding testing to determine the presence of a landfill. Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. No warranties are either expressed or implied.

APPENDIX

I.0 FIELD OPERATIONS

Subsurface conditions were defined by 7 sample core borings drilled to depths ranging from 30 to 50 feet. ETTL personnel drilled the borings at locations selected based on a site visit in conjunction with the client. Field boring logs were prepared as drilling and sampling progressed. The final boring logs are also included in the Appendix. Descriptive terms and symbols used on the logs are in accordance with the Unified Soil Classification System (ASTM D 2487). A reference key is provided on the final page of this report.

Truck and track-mounted drill rigs utilizing dry auger drilling procedures were used to advance the borings. Samples were continuous in the upper 10 feet and at 5 feet intervals below 10 feet (or at major strata changes). Soils were sampled by means of a 1 3/8-inch I.D. by 24-inch long split-spoon sampler driven into the bottom of the borehole in accordance with ASTM D 1586 procedures. In conjunction with this sampling technique, the Standard Penetration Test was conducted by recording the N-value, which is the number of blows required by a 140-pound weight falling 30 inches to drive a split-spoon sampler 1 foot into the ground. For very dense strata, the number of blows is limited to a maximum of 50 blows within a 6-inch increment. Where possible, the sampler is "seated" six inches before the N-value is determined. The N-value obtained from the Standard Penetration Test provides an approximate measure of the relative density, which correlates with the shear strength of soil. The disturbed samples were removed from the sampler, logged, packaged, and transported to the laboratory for further identification and classification.

Soils were sampled by means of a 3-inch O.D. by 24-inch long thick-walled Shelby Tube sampler. Using the drilling rig's hydraulic pressure, the sampler was pushed smoothly into the bottom of the borehole. The consistency of these samples was measured in the field by a calibrated pocket penetrometer. These values, recorded in tons per square foot, are shown on the boring logs. Such samples were extruded in the field, logged, sealed to maintain *in situ* conditions, and packaged for transport to the laboratory.

All boreholes were backfilled with grout after collecting final groundwater readings. Samples obtained during our field studies and not consumed by laboratory testing procedures will be retained in our Tyler office free of charge for a period of 60 days. To arrange storage beyond this point in time, please contact the Tyler office.

II.0 LABORATORY TESTING

Upon return to the laboratory, a geotechnical engineer visually examined all samples and several specimens were selected for representative identification of the substrata. By determining the Atterberg liquid and plastic limits (ASTM D 4318) and percentage of fines passing the No. 200 sieve (ASTM D 1140), field classification of the various strata was verified. Also conducted were natural moisture content tests (ASTM D 2216). Permeabilities (ASTM D 5084) were also performed on representative samples.

Strength characteristics of the cohesive substrata were evaluated by conducting unconsolidated, undrained triaxial compression tests (ASTM D 2850) on selected undisturbed field samples obtained with the Shelby tube sampler. Direct Shear tests (ASTM D 3080) were performed on undisturbed samples retrieved during drilling operations and also from remolded bulk ash samples. The results of these tests are either presented in the individual log of boring provided in this Appendix or as a separate result behind the logs in the Appendix.

June 22, 2010

W. Greg Carter, P.E.
American Electric Power
1187 CR 4865
Pittsburg, TX 75686

RE: Welsh Power Station, Existing Ash Storage Ponds Embankment Investigation, Pittsburg, Texas
Supplemental Geotechnical Investigation
Embankment Repair Supplement
ETTL Job No. G3242-09

Dear Mr. Carter:

At your request and direction, ETTL Engineers and Consultants Inc. inspected a slope failure on the northern slope of the Secondary Ash Pond (ash Pond #2) on May 7, 2010 in order to give additional recommendations for the repair of the slope. You have requested an investigation to determine the appropriate repairs based on a much deeper failure surface than originally anticipated.

1.0 HISTORY

A surface slough was observed during the October 2009 field investigation and preliminary recommendations were given at that time for repair. The slough reportedly occurred sometime during the week of September 13, 2009 and a 4.1 inch rainfall was recorded on September 14, 2009. In October of 2009, over 17 inches of rain was recorded, which delayed the repairs.

During the repair of this original slough, the slope moved again. The embankment is thought to have moved approximately 10 feet out into the lake, based on the observed shoreline (see Photo 2). The original shoreline picture, Photo 1, appears that the embankment edge was straight after initial construction. The failure necessary to produce the anticipated movement would need to be deeper than a simple shallow surface failure that was originally assumed. Due to the observed movement, ETTL recommended that the slope below the water table be measured in order to provide a more accurate back-calculation of the failure. The data retrieved is given in the table below. Five lines were measured perpendicular to the water's edge with reading at three distances from the shore. The first and last lines (1 and 5) are just outside the bulged area to the west and east, respectively, and the other three lines (2 though 4) are spaced evenly across the bulge.

Table 1 – Water Depth Based on Soundings

Line #	6' from Shore	14' from Shore	22' from Shore
1	6'	11'	7.5'
2	12'	15.5'	16.5'
3	10'	16.5'	17.5'
4	7'	15'	18'
5	6.5'	13'	18.5'

These readings indicate that the lake floor is significantly lower than the predictions used in the original slope stability report (from Drawing S-12) and the slope below the waterline is also significantly steeper (typically 1H:1V). A TWDB Survey from November 2001 also indicates the water depth is approximately 8 feet deeper than used in the original report.

Several test pits were conducted during two additional site visits and soil samples were taken from both failure surfaces seen (see Photos 4 and 5) for additional testing (see attached triaxial and direct shear results). Both tests were above the strength predicted from the analysis, so the back-calculated strengths were used in the analyses below.

2.0 REVISED STABILITY ANALYSIS

Based on the revised slopes, the slope analysis was re-run to predict the soil properties necessary to cause the failure. A Factor of Safety of 1 was achieved using a friction angle of 23.5 in the sands below the water table. Based on the test pits, the actual subgrade soils are more varied with higher strength clays and lower strength sands comprising the actual failure surface. The actual failure surface is believed to be above that found in the analysis since the failure is what caused the very steep surface below the water table in the model (bulge at water's edge is buildup of sloughed soils). However, for the repair, the lower surface presented in the analysis will be more conservative.

3.0 EMBANKMENT REPAIR

Sheet piles are anticipated to be used to provide the insurance against future failure. Based on available piles, a PZ-27 (grade 50) pile is anticipated. A PZC-13 was also investigated. Both piles may be used for an acceptable repair as given below.

3.1 Stability of Slope During Repair

The slope must be stable for the equipment used for the repair. In order to provide a more stable slope, the "bulge" should be removed which will decrease the driving force causing slope movement and weight should be added to the toe below the water table to increase the resisting force. Providing a 2H:1V slope below the water table by excavation of the bulged soils and adding rip-rap at the toe, the factor of safety is increase to approximately 1.5 for the repair area (see attached analysis). Seismic loads caused by installation have a possibility of causing liquefaction is some soils. Based on the information in the two sections below, this will not be an issue at this site.

3.1.1 Seismic Design Parameters

Data regarding soil type and density to a depth of 100 feet is needed to designate a design class for the profile where liquefaction potential is not considered. However, we predict that the site could be classified **Class D** based on the limited data available.

A seismic impact zone is an area with a 10 percent or greater probability that the maximum horizontal acceleration in rock, expressed as a percentage of the earth's gravitational pull, will exceed 0.10g in 50 years.

Based on the maps and the site coefficients determined for **site class D** contained in the IBC, parameters as listed below are recommended by the Code:

Site Coefficients: $F_a = 1.60$
$F_v = 2.40$

Maximum Earthquake Spectral Response Acceleration Parameters: S_{MS} = 0.238*
S_{M1} = 0.158

Design Spectral Response Acceleration Parameters: S_{DS} = 0.159
S_{D1} = 0.105

*Note: Acceleration used for seismic evaluation.

3.1.2 Liquefaction

Liquefaction is a phenomenon where soil pore pressure builds up rapidly during cyclic loading causing a loss of shear strength and consequent significant ground movement both laterally and vertically. In layman's terms the soil turns into quick sand, losing ability to support load, and can spread laterally out from under foundations. Foundations sitting on sand that liquefies during an earthquake can sink into the soil.

Recent research[1, 2] has shown that liquefaction potential exists not only in relatively clean sands, but also, under certain circumstances, in sands, silts and clayey soils of low plasticity (PI<12 or up to 20 if MC>0.85*Liquid Limit) with significant fines content. In order for liquefaction to be triggered, the water content of finer soils needs to be high (generally > 80-85% of the Liquid Limit) and the density relatively low (assessed in terms of the SPT blow count generally where N1 (SPT Value normalized for overburden pressure) is low). In addition, the frequency and magnitude of ground shaking has to reach a certain threshold, which is related to the soil properties and local geology.

The native soils are predominantly medium stiff to hard lean and fat clays (CL & CH), medium dense clayey sand (SC) and very dense silty sands (SM). These characteristics taken together with the fact that the site is in a zone of relatively low maximum ground acceleration (<0.2g) indicate a negligible risk of liquefaction.

3.2 Stability of Slope After Repair

The stability of the slope after the repair of the below water portion was checked to determine if the sheet piles were necessary. A Factor of Safety of 1.3 was found for the embankment without the use of the sheet piles (See attached). The installation of the sheet piles approximately 5' back from the water's edge to a depth of over 37 feet will increase the Factor of Safety to 1.5 if the section can supply a resisting force of 6,000 pounds per foot of wall. The resistance required to provide a Factor of Safety of 1.5 was back-calculated and this value was checked to determine if the wall would hold the required load (see section below). The Factor of Safety was also checked using the Spencer (Limit Equilibrium) Method for a more detailed analysis (also attached).

3.2.1 Sheet Piles

Laterally loaded piles can be analyzed by a finite-element computer program that utilizes a modulus of horizontal subgrade reaction or by a simplified method developed by Broms. A computer program such as PY Wall (by Ensoft) has the capability to analyze the pile wall as a partially supported cantilever beam. The sheet piles should extend beyond the failure surface on both ends by a minimum of 10 feet.

The resisting load from the stability analysis above was used on a cantilever wall section using the properties for the PZ-27 and PZC-13. Based on the analysis, the maximum shear on the section is

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1 Idriss, I.M. and Boulanger, R.W., Semi Empirical Procedures for Evaluating Liquefaction Potential During Earthquakes, Invited Paper, 11th International Conference on Soil Dynamics and Earthquake Engineering, Berkley, CA, January 2004.
2 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.

10 kips; the maximum moment is 1,100 in-kips; and the deflection is approximately 6.5 inches at the surface. These values are conservative since the cantilever section is estimated at the maximum depth possible, no passive resistance was given for soils above the failure plane on the downhill side, and the full load will not be applied since the Factor of Safety is 1.5.

After the sheet piles are installed, the following recommendations are given for the slope repair:

1. Cut the slope back behind the failure surface above the pile wall. The entire failure surface must be removed.

2. Scarify the subgrade, adjust the moisture content to optimum ±3 % and recompact to a minimum of 95% of standard proctor (ASTM D698).

3. Place Select Fill as required (see section below).

3.2.2 Select Fill

Select fill shall consist of homogeneous soils (i.e. not sand with clay lumps) free of organic matter and rocks larger than 6 inches in diameter. The soil should possess an Atterberg PI >15, with a liquid limit >30 and a percent passing the #200 sieve >35%. Atterberg limits testing of the fill at a rate of 1 test per 500 cubic yards of fill (minimum 1 test per lift and as visual change occurs) placed is recommended to verify that fill specifications are met. The material should be placed in the following manner

- Prepare the subgrade in accordance with the recommendations discussed above. Sites that slope more than about 15% should be benched with 5-foot wide benches prior to placing fill.

- Place subsequent lifts of select fill in thin, loose layers not exceeding nine inches in thickness to the desired rough grade and compact to a minimum of 95% of standard proctor density (ASTM D698) at a moisture content within a range of optimum to optimum +3%.

- Conduct in-place field density tests at a rate of one test per 3,000 square feet for every lift with a minimum of 2 tests per lift. *Density testing is essential to assure that the soil is properly placed.*

- Prevent excessive loss of moisture during construction.

3.2.3 Riprap

The downstream toe at the lake level has rock riprap as a slope cover. This should provide adequate slope protection for the area.

We appreciate the opportunity to be of service to you in this matter. Should you have any questions regarding this matter, please do not hesitate to contact the undersigned.

Sincerely,
ETTL Engineers and Consultants Inc.

Robert M. Duke, P.E.
Senior Project Manager

C. Brandon Quinn, P.E.
Vice President
Manager of Engineering Services

STATE OF TEXAS
ROBERT M. DUKE
91757
LICENSED
PROFESSIONAL ENGINEER
ETTL
ENGINEERS & CONSULTANTS
F-3208
6/22/10

STATE OF TEXAS
C. BRANDON QUINN
72441
REGISTERED
PROFESSIONAL ENGINEER
ETTL
ENGINEERS & CONSULTANTS
F-3208
6/22/10

Photos

Photo 1 Original Embankment Before Slough

Photo 2 Shoreline after movement

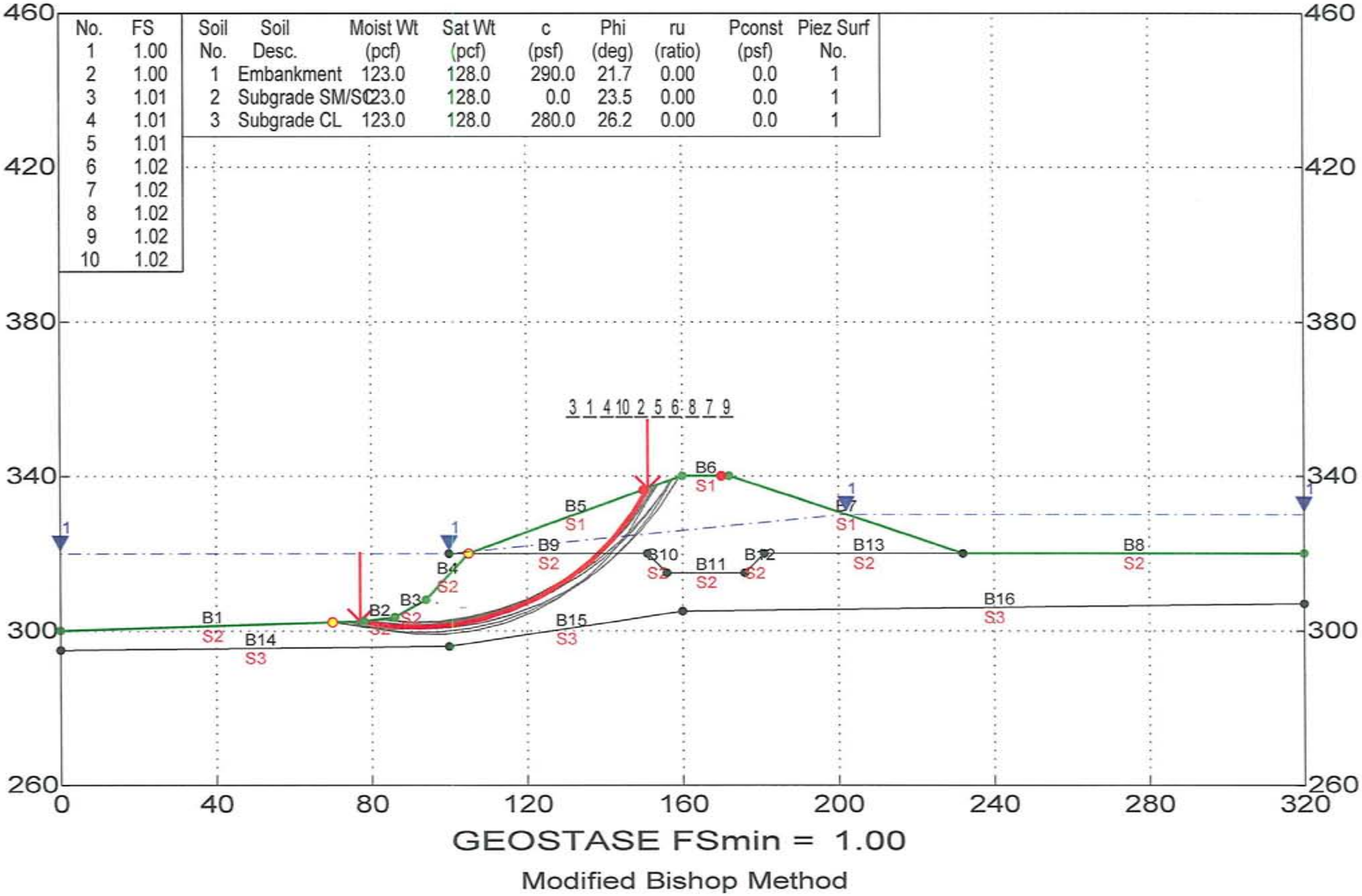
Photo 3 Slipping of Repair Surface

Photo 4 - Top of Failure Plane

Photo 5 – Second Slip Seen at the Toe

Welsh Power Station Ash Disposal Ponds Embankment Study
Ash Pond #2 Failure Surface, Steady State

ETTL Engineers & Consultants Inc. S:\Geotech\2009 Geotechnical Job Files\3242-095 AEP Welsh Power Plant Embankments\Slope Stability\Pond2 fail.in



No.	FS
1	1.00
2	1.00
3	1.01
4	1.01
5	1.01
6	1.02
7	1.02
8	1.02
9	1.02
10	1.02

Soil No.	Soil Desc.	Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	Pconst (psf)	Piez Surf No.
1	Embankment	123.0	128.0	290.0	21.7	0.00	0.0	1
2	Subgrade SM/SC	123.0	128.0	0.0	23.5	0.00	0.0	1
3	Subgrade CL	123.0	128.0	280.0	26.2	0.00	0.0	1

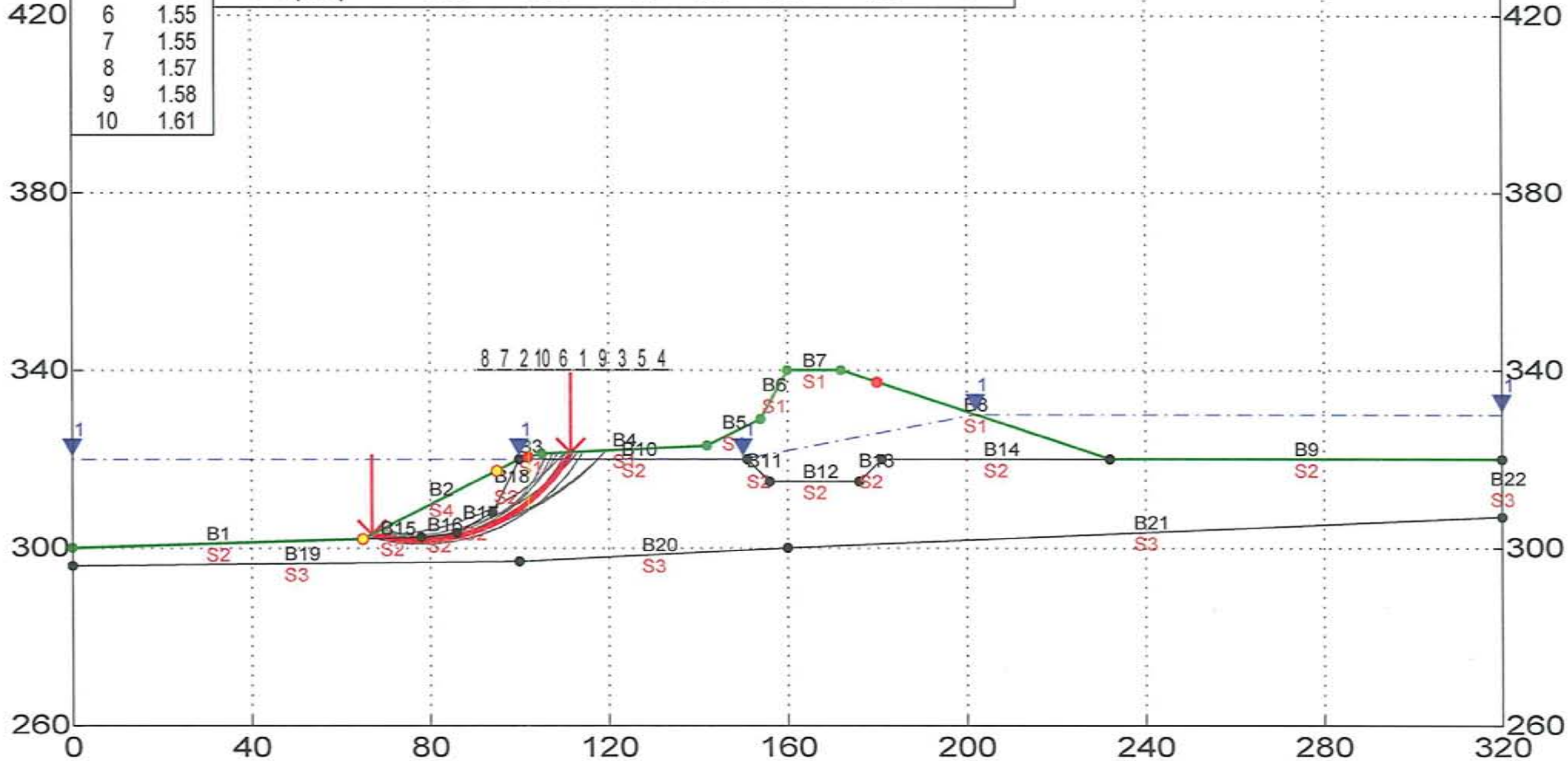
PLATE A2.1

Welsh Power Station Ash Disposal Ponds Embankment Study
Ash Pond #2 Failure Surface, Steady State

ETTL Engineers & Consultants Inc. S:\Clients\2009 Geotechnical Job Files\3242-095 AEP Welsh Power Plant Embankments\Slope Stability\Pond2 fail2.in

No.	FS
1	1.49
2	1.51
3	1.52
4	1.54
5	1.54
6	1.55
7	1.55
8	1.57
9	1.58
10	1.61

Soil No.	Soil Desc.	Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	Pconst (psf)	Piez Surf No.
1	Embankment	123.0	128.0	290.0	21.7	0.00	0.0	1
2	Subgrade SM/SC	123.0	128.0	50.0	23.5	0.00	0.0	1
3	Subgrade CL	123.0	128.0	280.0	26.2	0.00	0.0	1
4	Rip Rap	120.0	120.0	0.0	35.0	0.00	0.0	1



GEOSTASE FSmin = 1.49

Modified Bishop Method

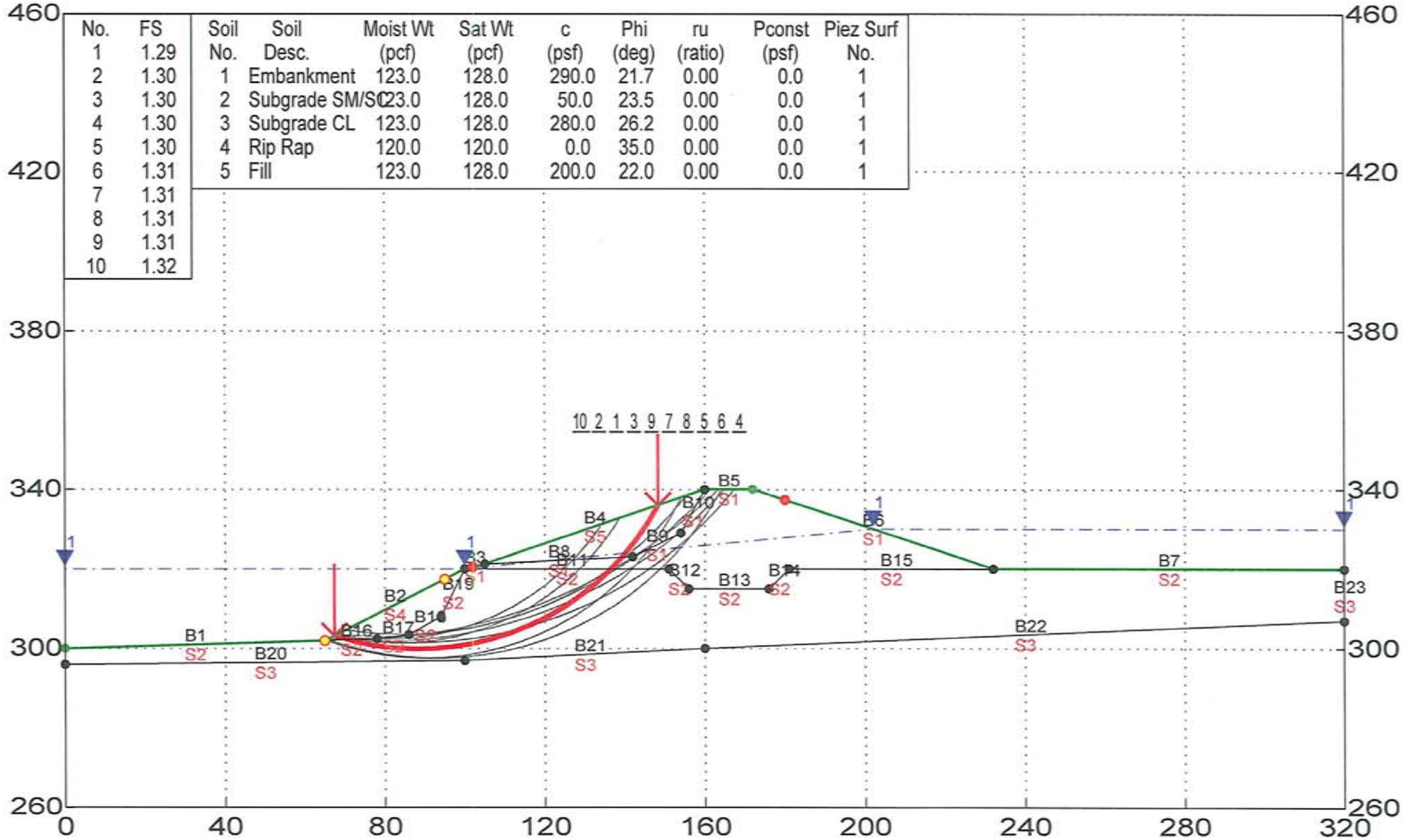
PLATE A2.1

Welsh Power Station Ash Disposal Ponds Embankment Study
Ash Pond #2 Failure Surface, Steady State

ETTL Engineers & Consultants 2009 Geotechnical Job Files\3242-095 AEP Welsh Power Plant Embankments\Slope Stability\Pond2 slope fix1

No.	FS
1	1.29
2	1.30
3	1.30
4	1.30
5	1.30
6	1.31
7	1.31
8	1.31
9	1.31
10	1.32

Soil No.	Soil Desc.	Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	Pconst (psf)	Piez Surf No.
1	Embankment	123.0	128.0	290.0	21.7	0.00	0.0	1
2	Subgrade SM/SC	123.0	128.0	50.0	23.5	0.00	0.0	1
3	Subgrade CL	123.0	128.0	280.0	26.2	0.00	0.0	1
4	Rip Rap	120.0	120.0	0.0	35.0	0.00	0.0	1
5	Fill	123.0	128.0	200.0	22.0	0.00	0.0	1



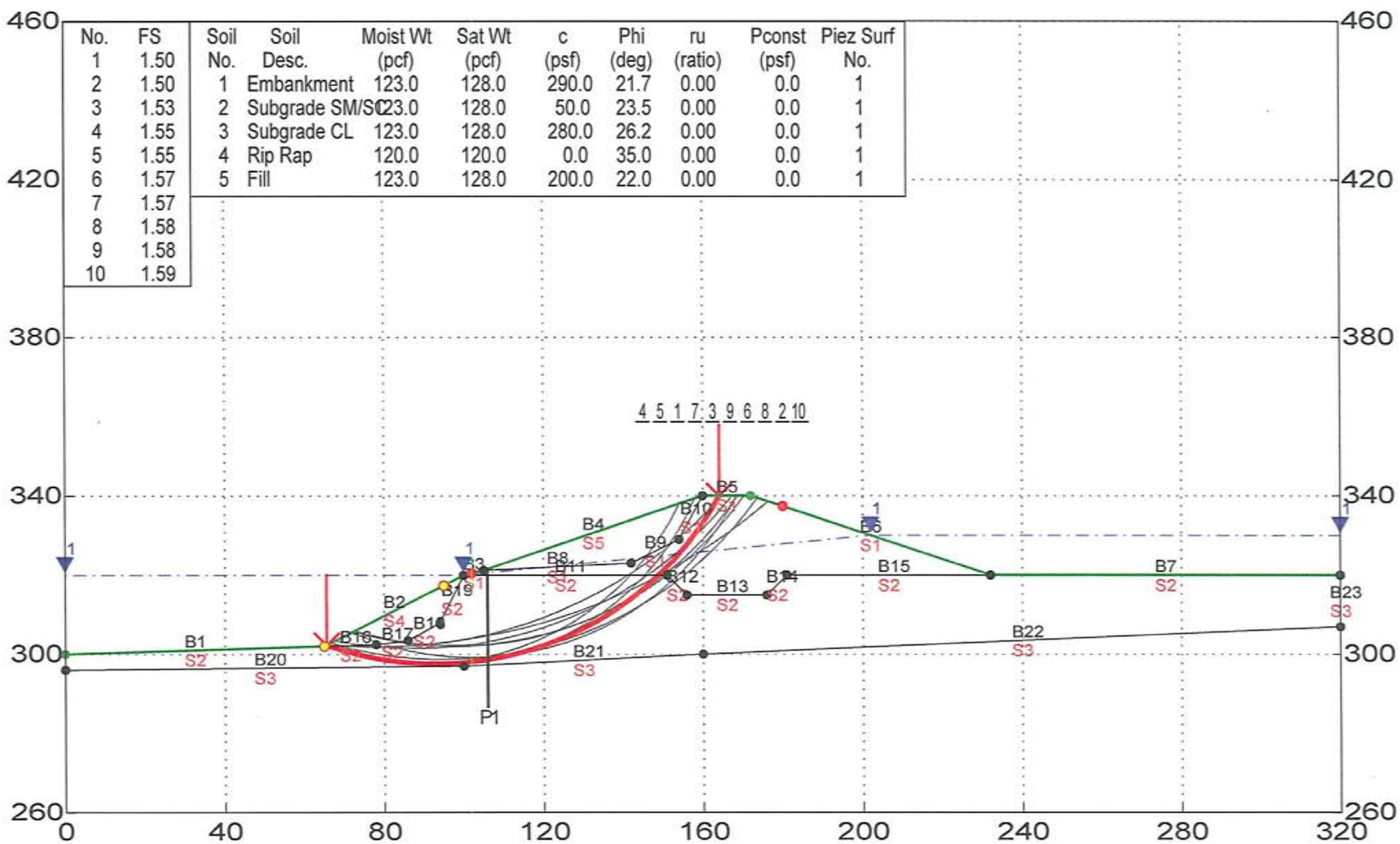
GEOSTASE FSmin = 1.29

Modified Bishop Method

PLATE A2.1

Welsh Power Station Ash Disposal Ponds Embankment Study
Ash Pond #2 Failure Surface, Steady State

ETTL Engineers & Consultants C:\Geotech\2009 Geotechnical Job Files\3242-095 AEP Welsh Power Plant Embankments\Slope Stability\Pond2 slope fix1



No.	FS
1	1.50
2	1.50
3	1.53
4	1.55
5	1.55
6	1.57
7	1.57
8	1.58
9	1.58
10	1.59

Soil No.	Soil Desc.	Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	Pconst (psf)	Piez Surf No.
1	Embankment	123.0	128.0	290.0	21.7	0.00	0.0	1
2	Subgrade SM/SC	123.0	128.0	50.0	23.5	0.00	0.0	1
3	Subgrade CL	123.0	128.0	280.0	26.2	0.00	0.0	1
4	Rip Rap	120.0	120.0	0.0	35.0	0.00	0.0	1
5	Fill	123.0	128.0	200.0	22.0	0.00	0.0	1

GEOSTASE FSmin = 1.50

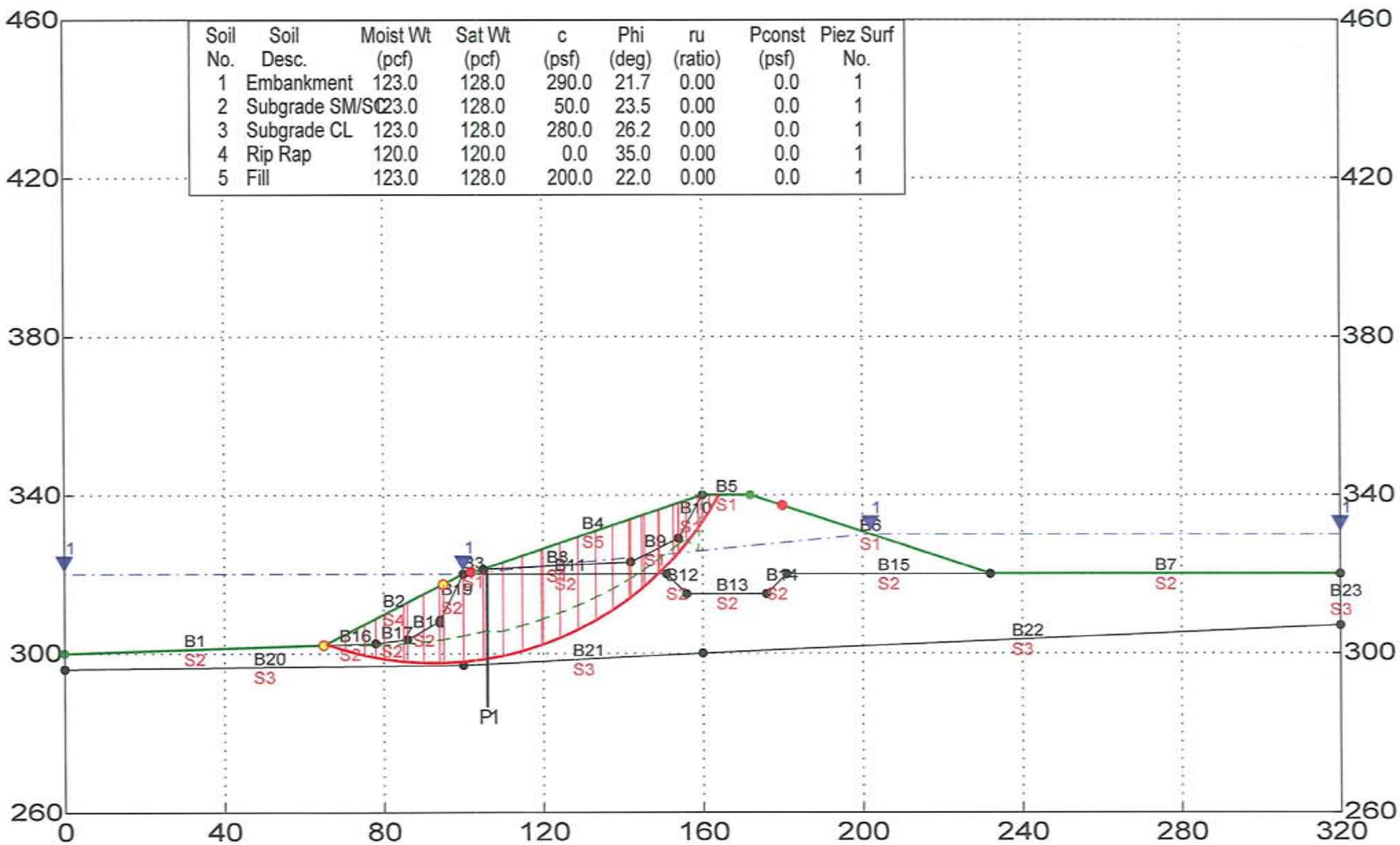
Modified Bishop Method

PLATE A2.1

Welsh Power Station Ash Disposal Ponds Embankment Study
Ash Pond #2 Failure Surface, Steady State

ETTL Engineers & Consultants Inc. S:\Geotech\2009 Geotechnical Job Files\3242-095 AEP Welsh Power Plant Embankments\Slope Stability\Pond2 slope fix1

Soil No.	Soil Desc.	Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	Pconst (psf)	Piez Surf No.
1	Embankment	123.0	128.0	290.0	21.7	0.00	0.0	1
2	Subgrade SM/SC	123.0	128.0	50.0	23.5	0.00	0.0	1
3	Subgrade CL	123.0	128.0	280.0	26.2	0.00	0.0	1
4	Rip Rap	120.0	120.0	0.0	35.0	0.00	0.0	1
5	Fill	123.0	128.0	200.0	22.0	0.00	0.0	1

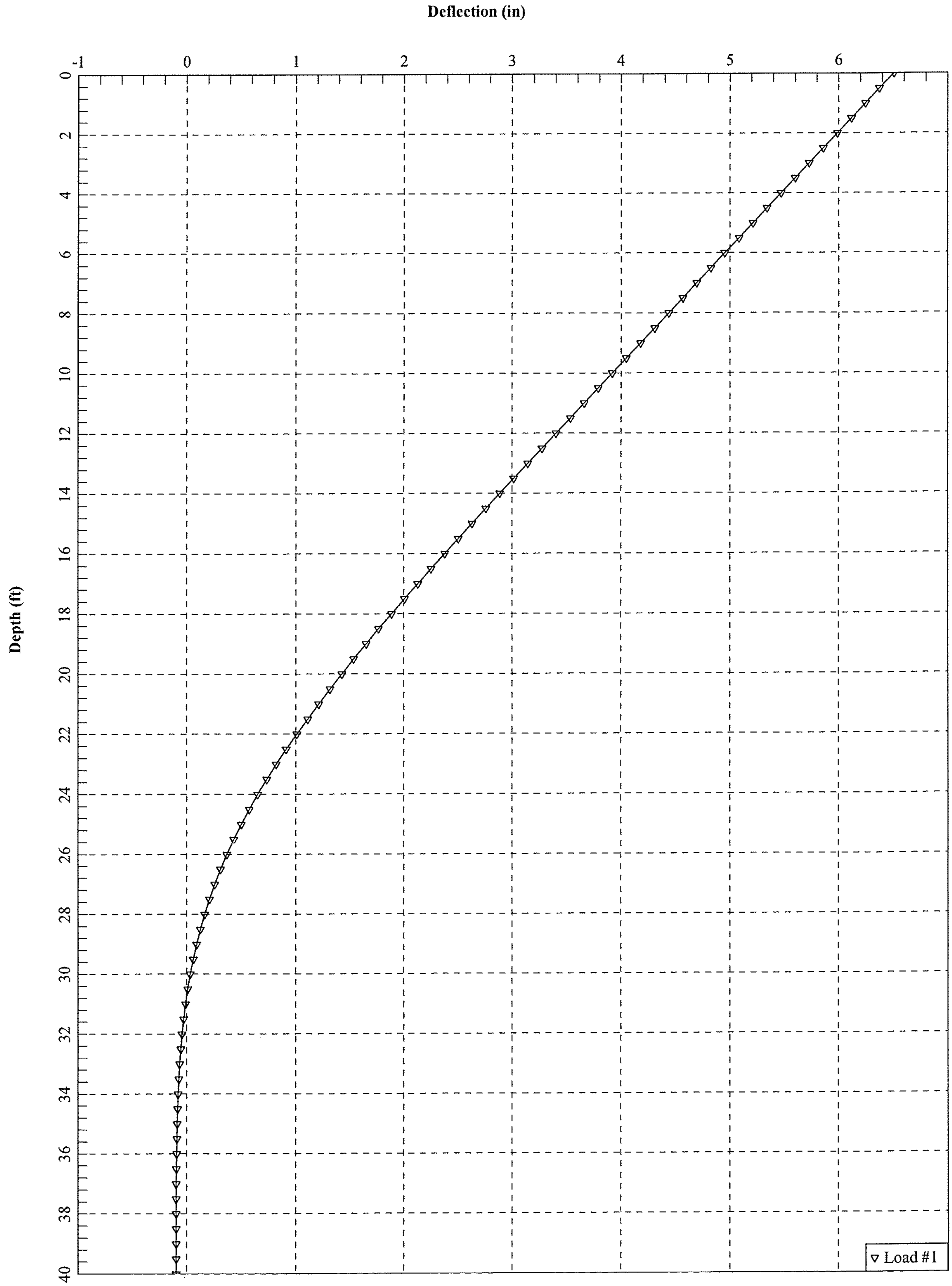


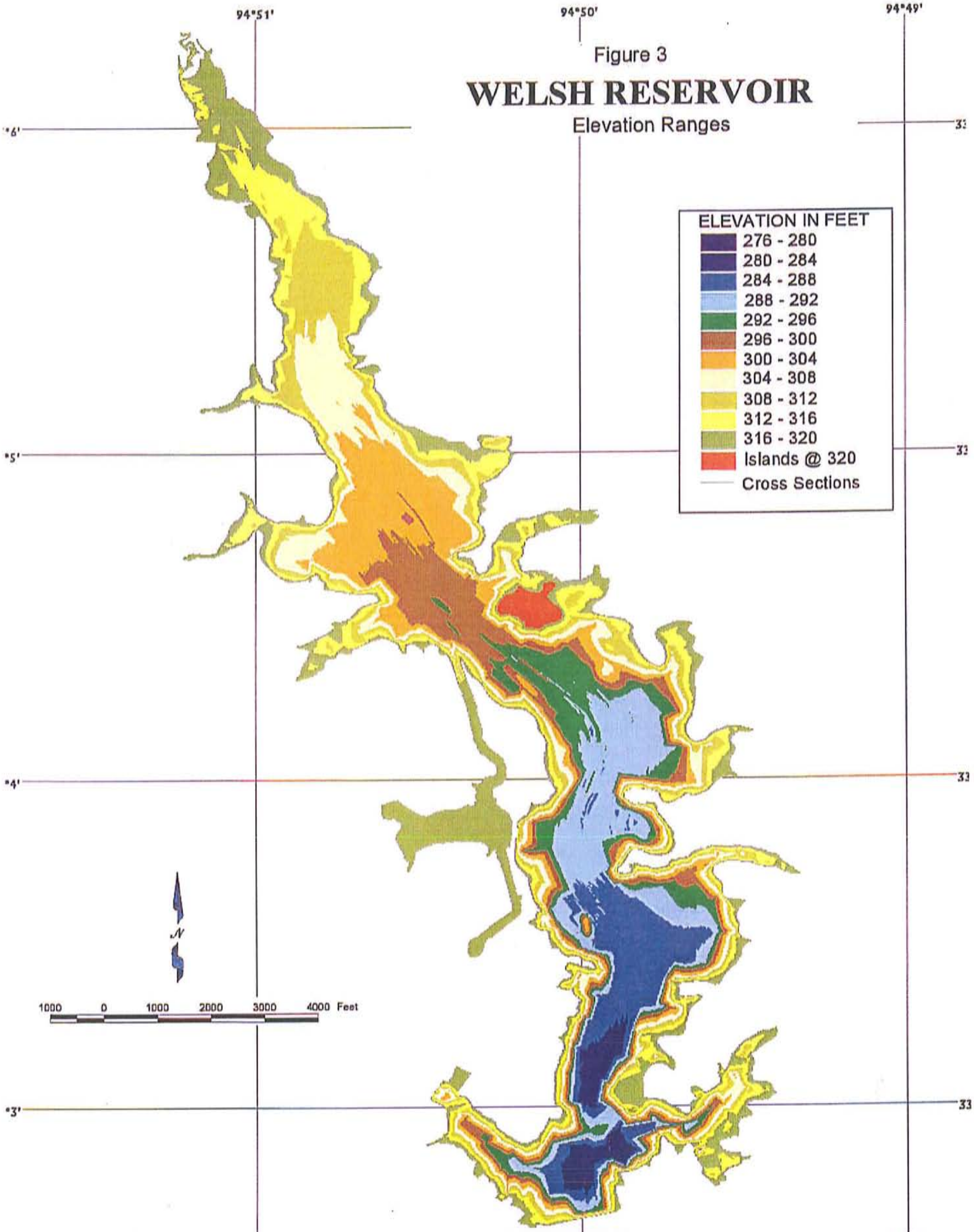
GEOSTASE FS = 1.54

GLE (Spencer) Method

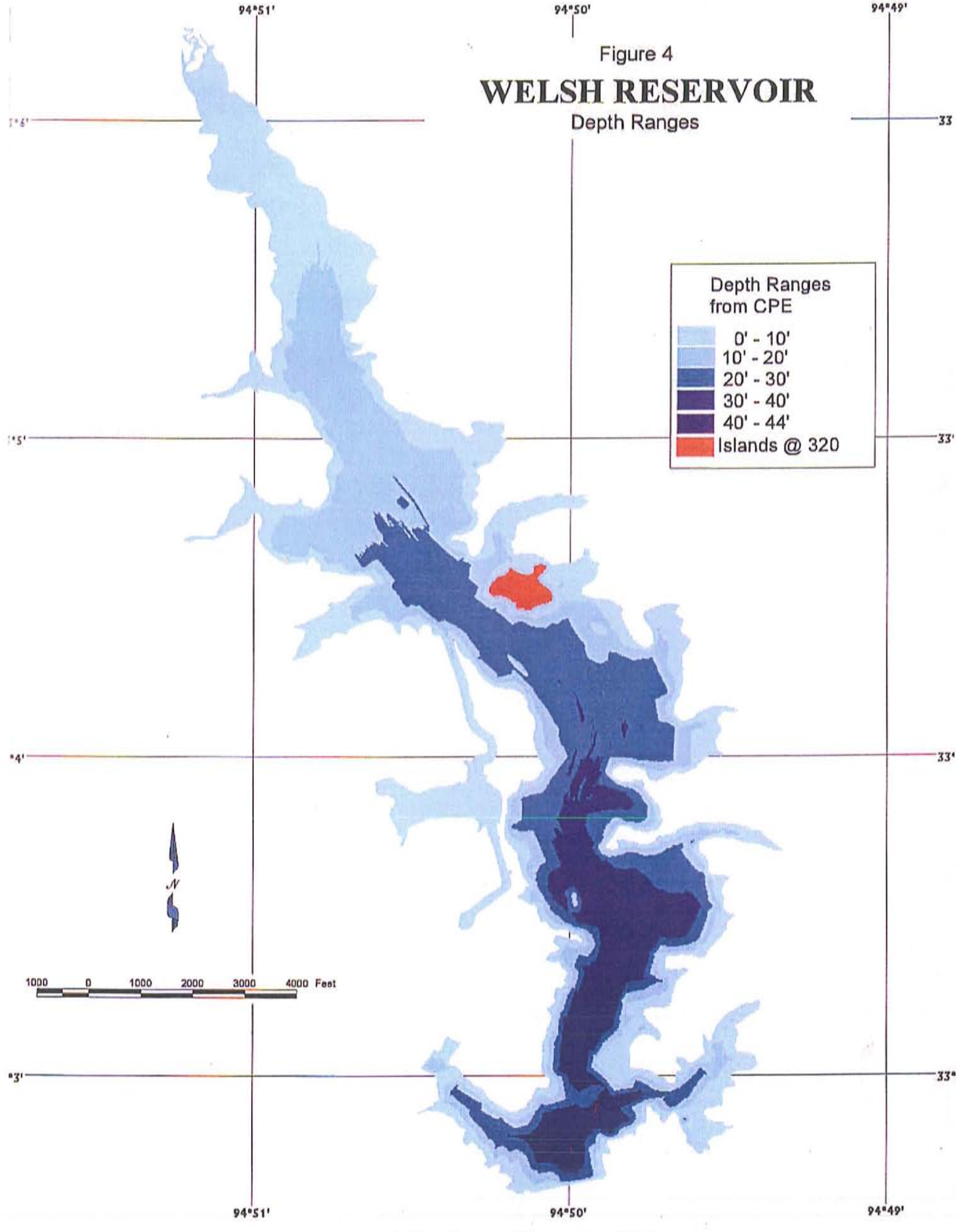
PLATE A2.1

Welsh Power Plant Slope Repair with PZ-27 Sheet Piles





TWDB Survey November 2001

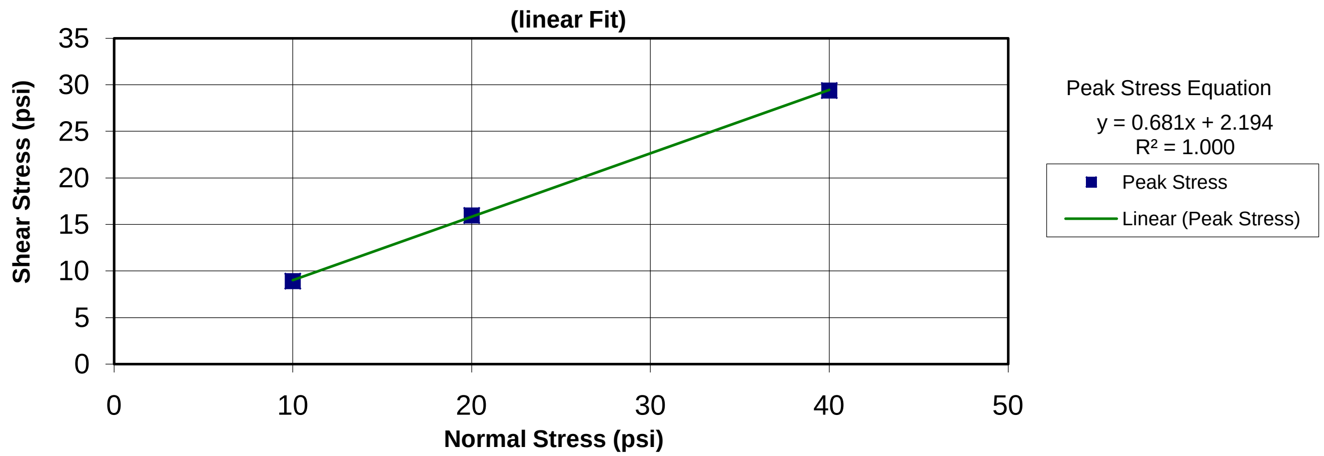


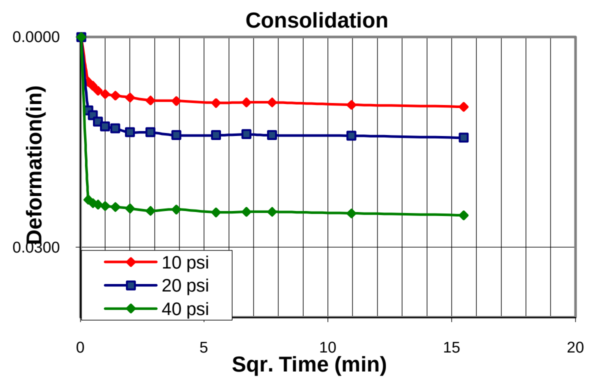
TWDB Survey November 2001

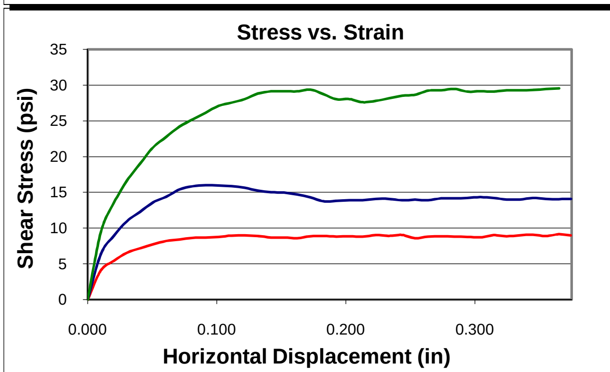
ETTL Engineers & Consultants Inc.

GEOTECHNICAL ✶ MATERIALS ✶ ENVIRONMENTAL ✶ DRILLING ✶ LANDFILLS

ASTM 3080 Direct Shear Test Report







Peak Strength Parameters

	Peak		Residual	
Friction Angle	34.25		-	
	(deg)		(deg)	
Cohesion	2.19	315.9	-	-
	(psi)	(psf)	(psi)	(psf)

Specimen Number	1	2	3
Initial			
Moisture Content - %	18.2%	17.0%	16.2%
Dry Density- lb/ft^3	109.0	111.5	109.6
Height-inches	1.006	1.006	1.007
Diameter- inches	2.50	2.50	2.50
Final			
Moisture Content - %	19.8%	19.5%	18.5%
Dry Density- lb/ft^3	110.5	112.7	113.5
Height after shear-(inches)	0.781	0.872	0.869
Height after consolidation (inches)	0.783	0.865	0.876
Normal Stress-(psi)	10	20	40
Peak Failure Stress-(psi)	8.91	15.96	29.40
Residual Failure Stress-(psi)	-	-	-
Strain Rate - (inches/min)	0.0005	0.0005	0.0005

Project Information

		LL	PL	PI
Project :	Welch Power Plant	25	18	7
Client:	American Electric Power			
Material Origin:	On Site Existing Ash Storage Pond			
Material Description:	Tan, Red & Gray Clayey Sand	-200%	34	

Job No:	G 3317-10	Technician:	Owen Sanderson	Remarks
Boring No:	Mid Slope Sand	Sample Type:	Undistrubed	
Depth:	1'-2'	Sampling method:	Shelby Tube	
Date:	May 18, 2010	Testing Device:	Humboldt	

Respectfully Submitted,

Robert M. Duke, P.E.

210 Beech Street
Texarkana, Arkansas
71854
870-772-0013 Phone

1717 East Erwin
Tyler, Texas 75702
903-595-4421 Phone
903-595-6113 Fax
www.ettlinc.com

707 West Cotton Street
Longview, Texas 75604-5505
903-758-0915 Phone
903-758-8245 Fax

PROJECT INFORMATION

PROJECT: AEP Welsh Power Plant Bottom Ash Ponds
LOCATION: Pittsburg, Texas
PROJECT NO: G 3242 - 095
CLIENT: AEP
May 2010

TRIAXIAL TEST PROGRAM BY GARRY H. GREGORY, P.E.

VERSION 1.0 - AUGUST 1998 - REVISED MARCH 24, 1999

TEST DESCRIPTION

TYPE OF TEST : CU with PP, 1 Sample, 3 stages (10, 20 & 40psi)
SAMPLE TYPE: Shelby Tube Sample
DESCRIPTION: Brownish Gray, Yellow & Red Lean Clay w/ Sand
Sampled on Site, Mid Slope
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve 7%
LL: 47 PL: 21 PI: 26 Percent -200: 85%
REMARKS: Both Ends Trimmed + # 4 Sieve 4%

Number of Specimens = 3

PLATE: B.1

PLATE: B.2

PLATE: B.3

SPECIMEN DATA

SPECIMEN NO. 1

	initial		final		Diameter			Height		
Moist soil & Tare :	1142.50	g	1406.27	g	top	2.85	in	Ht 1	6.17	in
Dry soil and Tare :	973.16	g	1192.47	g	mid	2.87	in	Ht 2	6.17	in
Tare :	0.00	g	219.31	g	bot	2.84	in	Ht 3	6.19	in
Moisture content :	17.40	%	21.97	%	Avg	2.85	in	Ht4	6.74	in
Weight:	1142.5	g						Avg Ht	6.32	in

Change in Ht due to saturation :	-0.03	in	Initial specimen vol :	660.94	cc
Change in Ht due to consolidation :	-0.047	in	At test specimen vol :	646.64	cc
Change in pipet vol due to consolidation :	14.3	cc	Initial dry density :	91.92	pcf
Saturation Parameter " B " = 99.00			At test dry density:	93.95	pcf

Strain Rate (in/min) =	0.0005	Failure Strain % =	3.4	Effective Cell Pressure (psi) =	10.0
σ_1' Failure (psi) =	10.96	σ_1 Failure (psi) =	18.26	Estimated ν =	0.35
σ_3' Failure (psi) =	2.70	σ_3 Failure (psi) =	10.00	Back Pressure (psi) =	40.0
ΔU =	7.3	Total Pore Pressure =	47.3	Cell Pressure (psi) =	50.0

SPECIMEN NO. 2

	initial		final		Diameter			Height		
Moist soil & Tare :	1142.50	g	1406.27	g	top	2.85	in	Ht 1	6.17	in
Dry soil and Tare :	973.16	g	1192.47	g	mid	2.87	in	Ht 2	6.17	in
Tare :	0.00	g	219.31	g	bot	2.84	in	Ht 3	6.19	in
Moisture content :	17.40	%	21.97	%	Avg	2.85	in	Ht4	6.74	in
Weight:	1142.5	g						Avg Ht	6.32	in

Change in Ht due to saturation :	-0.03	in	Initial specimen vol :	660.94	cc
Change in Ht due to consolidation :	-0.283	in	At test specimen vol :	629.54	cc
Change in pipet vol due to consolidation :	31.4	cc	Initial dry density :	91.92	pcf
Saturation Parameter " B " = 0.99			At test dry density:	96.50	pcf

Strain Rate (in/min) =	0.0005	Failure Strain % =	2.0	Effective Cell Pressure (psi) =	20.0
σ_1' Failure (psi) =	23.54	σ_1 Failure (psi) =	35.55	Estimated ν =	0.35
σ_3' Failure (psi) =	7.99	σ_3 Failure (psi) =	20.00	Back Pressure (psi) =	40.0
ΔU =	12.0	Total Pore Pressure =	52.0	Cell Pressure (psi) =	60.0

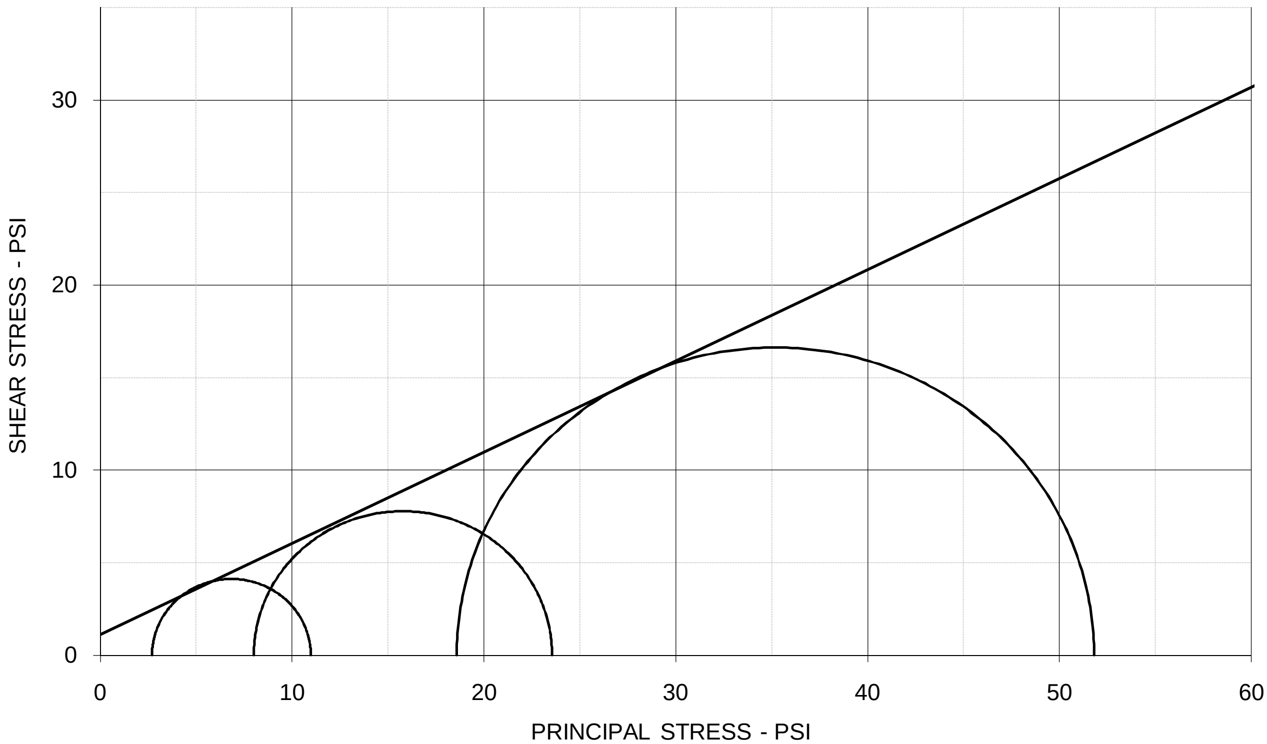
SPECIMEN NO. 3

	initial		final		Diameter			Height		
Moist soil & Tare :	1142.50	g	1406.27	g	top	2.85	in	Ht 1	6.17	in
Dry soil and Tare :	973.16	g	1192.47	g	mid	2.87	in	Ht 2	6.17	in
Tare :	0.00	g	219.31	g	bot	2.84	in	Ht 3	6.19	in
Moisture content :	17.40	%	21.97	%	Avg	2.85	in	Ht4	6.74	in
Weight:	1142.5	g						Avg Ht	6.32	in

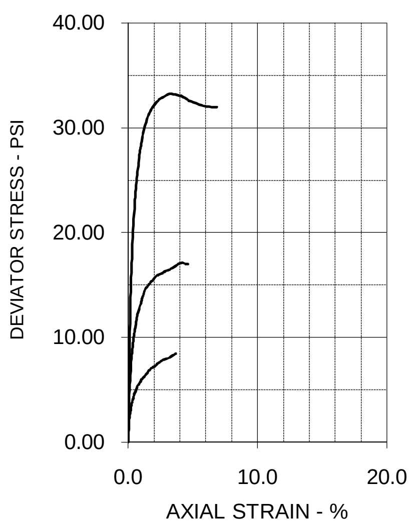
Change in Ht due to saturation :	-0.03	in	Initial specimen vol :	660.94	cc
Change in Ht due to consolidation :	-0.579	in	At test specimen vol :	612.34	cc
Change in pipet vol due to consolidation :	48.6	cc	Initial dry density :	91.92	pcf
Saturation Parameter " B " = 0.99			At test dry density:	99.21	pcf

Strain Rate (in/min) =	0.0005	Failure Strain % =	3.5	Effective Cell Pressure (psi) =	40.0
σ_1' Failure (psi) =	51.81	σ_1 Failure (psi) =	73.22	Estimated ν =	0.35
σ_3' Failure (psi) =	18.59	σ_3 Failure (psi) =	40.00	Back Pressure (psi) =	40.0
ΔU =	21.4	Total Pore Pressure =	61.4	Cell Pressure (psi) =	80.0

TRIAXIAL SHEAR TEST REPORT



EFFECTIVE STRESS PARAMETERS	ϕ ' = 26.2 deg	c' = 1.1 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	17.4	17.4	17.4	
Dry Density - pcf	91.9	91.9	91.9	
Diameter - inches	2.85	2.85	2.85	
Height - inches	6.32	6.32	6.32	
AT TEST				
Final Moisture - %	22.0	22.0	22.0	
Dry Density - pcf	94.0	96.5	99.2	
Calculated Diameter (in.)	2.82	2.74	2.64	
Height - inches	6.24	6.00	5.71	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	8.26	15.55	33.22	
Total Pore Pressure - psi	47.3	52.0	61.4	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	3.4	2.0	3.5	
σ_1' Failure - psi	10.96	23.54	51.81	
σ_3' Failure - psi	2.70	7.99	18.59	

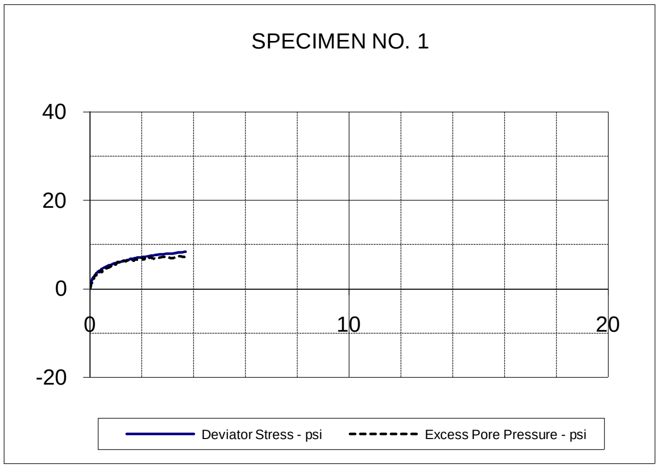
TEST DESCRIPTION

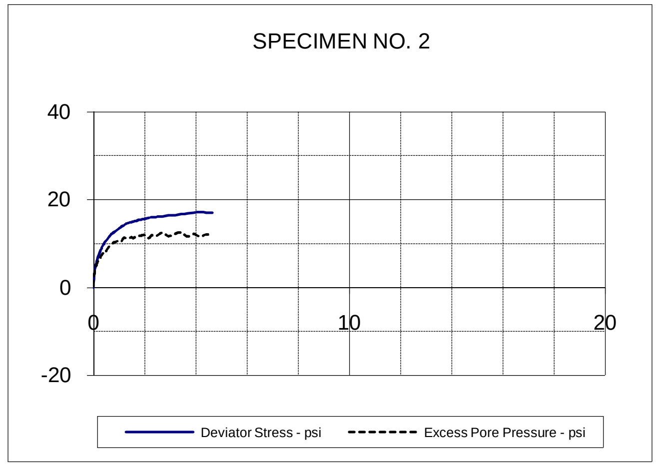
TYPE OF TEST : CU with PP, 1 Sample, 3 stages (10, 20 & 40psi)
SAMPLE TYPE: Shelby Tube Sample
DESCRIPTION: Brownish Gray, Yellow & Red Lean Clay w/ Sand
Sampled on Site, Mid Slope
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve 7%
LL: 47 PL: 21 PI: 26 Percent -200: 85%
REMARKS: Both Ends Trimmed + # 4 Sieve 4%

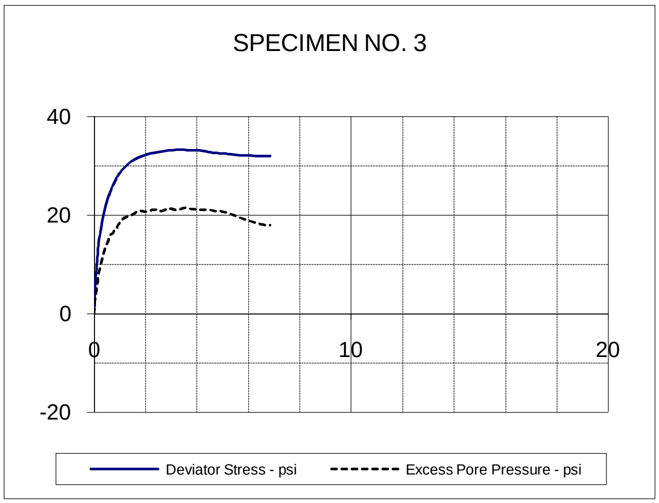
PROJECT INFORMATION

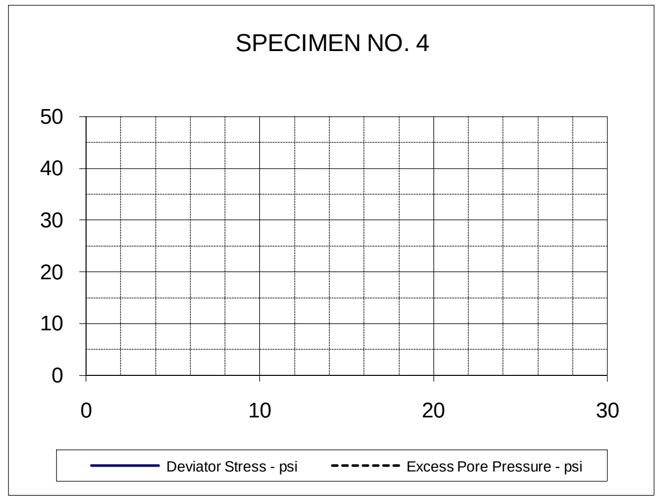
PROJECT: AEP Welsh Power Plant Bottom Ash Ponds
LOCATION: Pittsburg, Texas
PROJECT NO: G 3242 - 095
CLIENT: AEP
May 2010

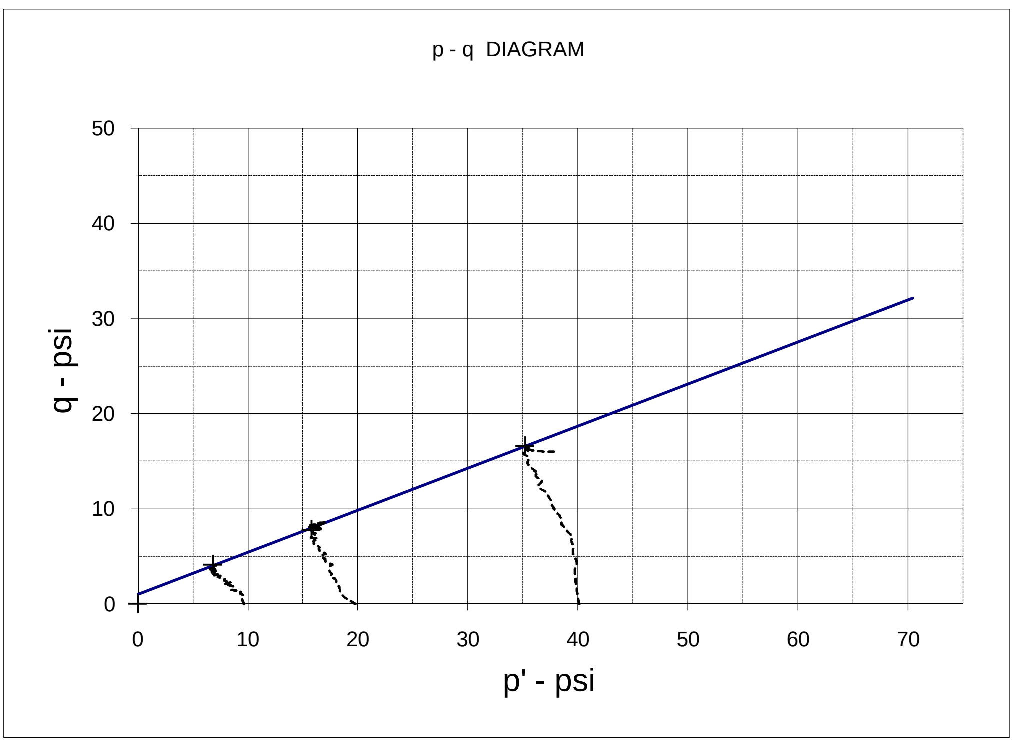
ETTL ENGINEERS & CONSULTANTS PLATE: B.1







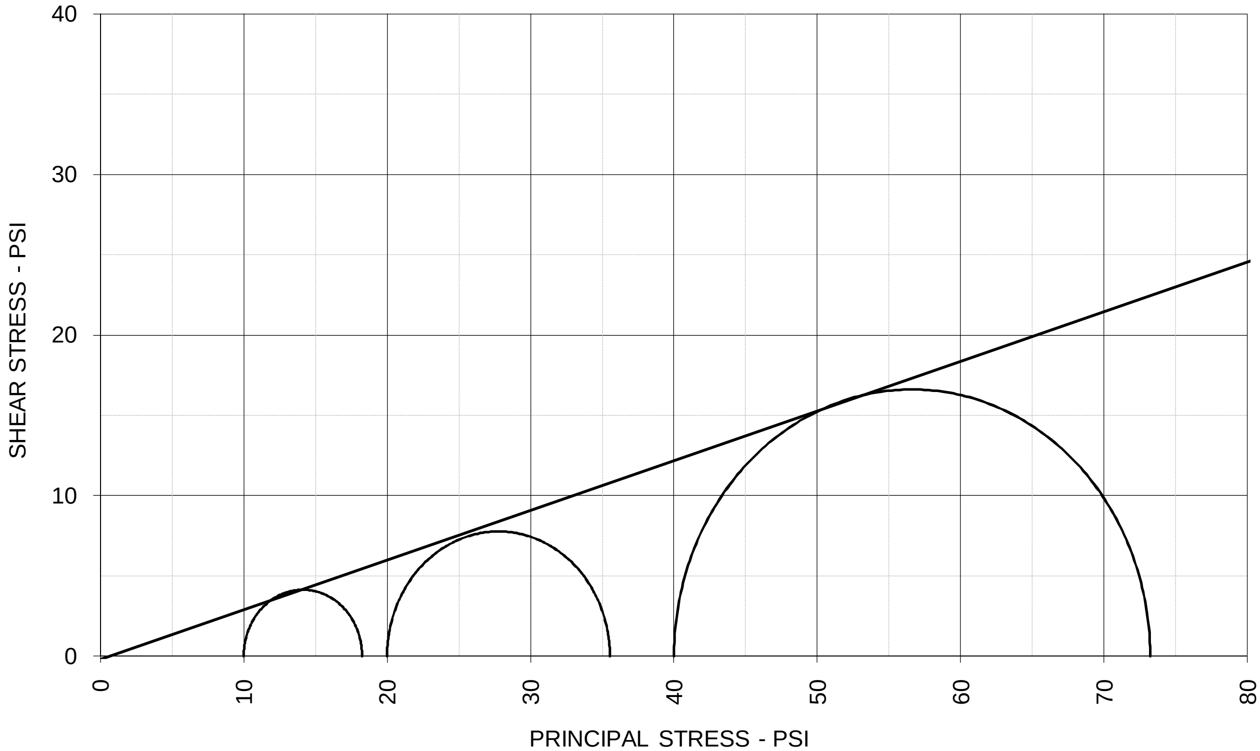




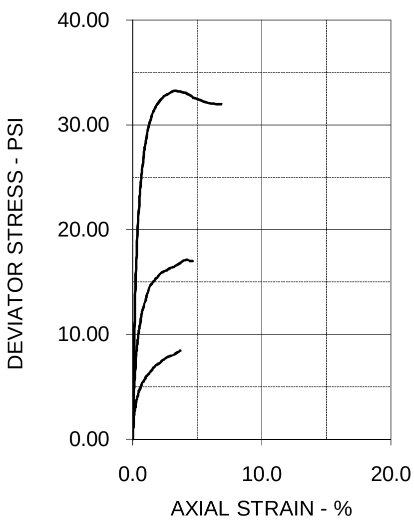
EFFECTIVE STRESS PARAMETERS	R^2 = 1.00	α (deg) = 23.9	a (psi) = 1.0
PROJECT: AEP Welsh Power Plant Bottom Ash Ponds		TYPE OF TEST : CU with PP, 1 Sample, 3 stages (10, 20 & 40psi)	
PROJECT NO: G 3242 - 095		**ETTL ENGINEERS & CONSULTANTS**	PLATE: B.2
DESCRIPTION: Brownish Gray, Yellow & Red Lean Clay w/ Sand			

G 3242-095, Mid Slope Welsh 2010

TRIAXIAL SHEAR TEST REPORT



TOTAL STRESS PARAMETERS	ϕ = 17.2 deg	c = -0.2 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	17.4	17.4	17.4	
Dry Density - pcf	91.9	91.9	91.9	
Diameter - inches	2.85	2.85	2.85	
Height - inches	6.32	6.32	6.32	
AT TEST				
Final Moisture - %	22.0	22.0	22.0	
Dry Density - pcf	94.0	96.5	99.2	
Calculated Diameter (in.)	2.82	2.74	2.64	
Height - inches	6.24	6.00	5.71	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	8.26	15.55	33.22	
Total Pore Pressure - psi	47.3	52.0	61.4	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	3.4	2.0	3.5	
σ_1 Failure - psi	18.26	35.55	73.22	
σ_3 Failure - psi	10.00	20.00	40.00	

TEST DESCRIPTION

TYPE OF TEST : CU with PP, 1 Sample, 3 stages (10, 20 & 40psi)
SAMPLE TYPE: Shelby Tube Sample
DESCRIPTION: Brownish Gray, Yellow & Red Lean Clay w/ Sand
Sampled on Site, Mid Slope
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve 7%
LL: 47 PL: 21 PI: 26 Percent -200: 85%
REMARKS: Both Ends Trimmed + # 4 Sieve 4%

PROJECT INFORMATION

PROJECT: AEP Welsh Power Plant Bottom Ash Ponds
LOCATION: Pittsburg, Texas
PROJECT NO: G 3242 - 095
CLIENT: AEP
May 2010

ETTL ENGINEERS & CONSULTANTS PLATE: B.3

APPENDIX D: TECQ DOCUMENTS

SUBCHAPTER B: DESIGN AND EVALUATION OF DAMS
§§299.11 - 299.17
Effective January 1, 2009

§299.11. General.

The executive director shall evaluate the hydrologic, hydraulic, and structural adequacy of the dam in determining whether a proposed or existing dam is considered a deficient dam.

(1) The executive director shall evaluate the hydrologic and hydraulic adequacy of the dam and spillways using the criteria in the most current version, at the time of the evaluation, of the agency's *Hydrologic and Hydraulic Guidelines for Dams in Texas*.

(2) The executive director may also take into consideration the condition of the dam, including the possibility that the dam might be endangered by:

(A) overtopping;

(B) seepage;

(C) piping;

(D) settlement;

(E) erosion;

(F) cracking;

(G) sinkholes;

(H) earth movement;

(I) uplift;

(J) overturning;

(K) failure of gates or operation of gates;

(L) failure of spillways;

(M) failure of conduits; or

(N) other conditions, as appropriate.

§299.12. Classification of Dams.

(a) The executive director shall classify all proposed and existing dams based on size (small, intermediate, or large) and downstream hazard (low, significant, or high) and not on the physical condition of the dam.

(b) The executive director may reclassify the hazard classification of a dam at any time based on:

(1) an inspection and downstream hazard evaluation by the executive director;

(2) a report of an inspection and downstream hazard evaluation by the owner's professional engineer;

(3) a breach analysis performed by either the executive director or the owner's professional engineer as described in §299.15(a)(4)(A)(i) of this title (relating to Hydrologic and Hydraulic Criteria for Dams); or

(4) a review of current aerial photography and topographic maps, along with information obtained in the field.

Adopted December 10, 2008 Effective January 1, 2009

§299.13. Size Classification Criteria.

The executive director shall classify dams for size based on the larger of the height of the dam or the maximum storage capacity.

Figure: 30 TAC §299.13

SIZE CLASSIFICATION		
Category	Impoundment Maximum Storage (Acre-Foot)	Height (Ft.)
Small	Equal to or Greater than 15 & Less than 1,000 Equal to or Greater than 50 & Less than 1,000	Equal to or Greater than 25 & Less than 40 Greater than 6 & Less than 40
Intermediate	Equal to or Greater than 1,000 & Less than 50,000	Equal to or Greater than 40 & Less than 100
Large	Equal to or Greater than 50,000	Equal to or Greater than 100

Adopted December 10, 2008 Effective January 1, 2009

§299.14. Hazard Classification Criteria.

The executive director shall classify dams for hazard based on either potential loss of human life or property damage, in the event of failure or malfunction of the dam or appurtenant structures, within affected developments, that are existing at the time of the classification. The hazard classification may include use of a breach analysis that addresses the incremental impact of the potential breach over and above the impact of the flood that may have caused the breach, as defined in §299.15(a)(4)(A)(i) of this title (relating to Hydrologic and Hydraulic Criteria for Dams). The classification must be according to the following.

(1) Low. A dam in the low-hazard potential category has:

(A) no loss of human life expected (no permanent habitable structures in the breach inundation area downstream of the dam); and

(B) minimal economic loss (located primarily in rural areas where failure may damage occasional farm buildings, limited agricultural improvements, and minor highways as defined in §299.2(38) of this title (relating to Definitions)).

(2) Significant. A dam in the significant-hazard potential category has:

(A) loss of human life possible (one to six lives or one or two habitable structures in the breach inundation area downstream of the dam); or

(B) appreciable economic loss, located primarily in rural areas where failure may cause:

(i) damage to isolated homes;

(ii) damage to secondary highways as defined in §299.2(58);

(iii) damage to minor railroads; or

(iv) interruption of service or use of public utilities, including the design purpose of the utility.

(3) High. A dam in the high-hazard potential category has:

(A) loss of life expected (seven or more lives or three or more habitable structures in the breach inundation area downstream of the dam); or

(B) excessive economic loss, located primarily in or near urban areas where failure would be expected to cause extensive damage to:

(i) public facilities;

(ii) agricultural, industrial, or commercial facilities;

(iii) public utilities, including the design purpose of the utility;

(iv) main highways as defined in §299.2(33); or

(v) railroads used as a major transportation system.

Adopted December 10, 2008 Effective January 1, 2009

§299.15. Hydrologic and Hydraulic Criteria for Dams.

(a) Hydrologic criteria.

(1) Minimum hydrologic criteria for proposed dams. The following minimum hydrologic criteria includes those proposed dams to be constructed according to Texas Water Code, §11.142.

(A) A proposed dam design must meet the minimum design flood hydrograph criteria.

Figure: 30 TAC §299.15(a)(1)(A)

HYDROLOGIC CRITERIA FOR DAMS		
Classification		
Hazard, as defined in §299.14 of this title (relating to Hazard Classification Criteria)	Size, as defined in §299.13 of this title (relating to Size Classification Criteria)	Minimum Design Flood Hydrograph (expressed as a percentage of the probable maximum flood (PMF)).
Low	Small	25% PMF
	Intermediate	25% PMF to 50% PMF
	Large	50% to 75% PMF
Significant	Small	50% PMF
	Intermediate	50% PMF to 75% PMF
	Large	75% to PMF
High	Small	75% PMF
	Intermediate	75% to PMF

<table>
<tr><td></td><td>Large</td><td>PMF</td></tr>
<tr><td colspan="3">When a range is given, the minimum flood hydrograph must be determined by straight-line interpolation within the given range. Interpolation must be based on either height of dam or maximum storage capacity, whichever results in the highest percentage of PMF. The interpolation for large, low-hazard dams for height must be between end points of 100 feet and 50% PMF and 200 feet and 75% PMF. The interpolation for large, low-hazard dams for maximum storage capacity must be between the end points of 50,000 acre-feet and 50% PMF and 300,000 acre-feet and 75% PMF. The interpolation for large, significant-hazard dams for height must be between end points of 100 feet and 75% PMF and 200 feet and PMF. The interpolation for large, significant-hazard for maximum storage capacity must be between the end points of 50,000 acre-feet and 75% PMF and 300,000 acre-feet and PMF.</td></tr>
</table>

(B) The minimum design flood hydrograph must be based on the size and hazard classification of a proposed dam at the time of the design and calculated using the criteria in the most current version, at the time of the analysis, of the agency's *Hydrologic and Hydraulic Guidelines of Dams in Texas*.

(C) Proposed dams and spillways or dams and spillway to be reconstructed, modified, enlarged, rehabilitated, or altered using hydrologic procedures of the Natural Resources Conservation Service will be acceptable, provided that the procedures are shown to be equal to or more conservative than the procedures provided in the most current version, at the time of the analysis, of the agency's *Hydrologic and Hydraulic Guidelines for Dams in Texas.*

(2) Exemptions to minimum hydrologic criteria for proposed dams. Any dam designed to withstand overtopping without failure of the dam, including the foundation and abutments, as demonstrated by studies prepared by the owner's professional engineer will be exempt from the minimum hydrologic criteria.

(3) Minimum hydrologic criteria for existing dams. The following criteria applies to dams that existed before the effective date of this subchapter.

(A) An owner of a large- or high-hazard existing dam that was required to meet 100% of the probable maximum flood (PMF) before the effective date of these rules and that is shown by an evaluation by a professional engineer to meet 75% or more of the PMF will not be required to upgrade the dam to meet minimum hydrologic criteria in paragraph (1)(A) of this subsection. The dam will be considered adequate to meet the minimum hydrologic criteria, provided the owner:

(i) has an emergency action plan that meets the requirements in §299.61 of this title (relating to Emergency Action Plans);

(ii) has an operation and maintenance plan for the dam as described in §299.43 of this title (relating to Operation and Maintenance);

(iii) has an inspection program that has been implemented as described in §299.42 of this title (relating to Inspections); and

(iv) submits an annual report to the executive director documenting compliance with the requirements in clauses (ii) and (iii) of this subparagraph, beginning 12 months after the effective date of this section.

(B) An owner of a dam not specified in paragraph (3)(A) of this subsection that was required to meet the minimum hydrologic criteria before the effective date of these rules, but is shown by an evaluation by a professional engineer to meet the minimum hydrologic criteria in paragraph (1)(A) of this subsection, will not be required to be upgraded and the dam will be considered adequate to meet the minimum hydrologic criteria.

(C) An owner of an existing dam that does not meet the minimum hydrologic criteria in paragraph (1)(A) of this subsection or the size or hazard classification has been raised and the dam does not meet the minimum hydrologic criteria in paragraph (1)(A) of this subsection for the new size or hazard classification may be required to submit to the executive director any of the following, prepared by a professional engineer:

(i) final construction plans and specifications as described in §299.22 of this title (relating to Review and Approval of Construction Plans and Specifications) for modifying, enlarging, or altering the dam or spillways to meet the minimum hydrologic criteria as described in paragraph (1)(A) of this subsection, provided the minimum hydrologic criteria at least meets 75% of the PMF and the owner addresses the requirements in paragraph (3)(A) of this subsection;

(ii) an analysis or other option to request a reduction in the minimum hydrologic criteria as described in paragraph (4) of this subsection; or

(iii) a plan for alternatives to upgrading as described in §299.17 of this title (relating to Alternatives to Upgrading Dams).

(D) An owner of an existing dam that meets the requirements of subparagraph (A) of this paragraph and that is required to be modified due to structural deficiencies shall be required to submit to the executive director final construction plans and specifications for the structural modifications as described in §299.22 of this title. The dam will not be required to be upgraded to meet the minimum design criteria in paragraph (1)(A) of this subsection.

(E) An owner of a dam that has been evaluated under this paragraph shall be advised of the requirements for the owner's dam by letter. The owner shall be required to submit a written plan of action to address the requirements and a time frame to complete the requirements.

(4) Reduction of minimum hydrologic criteria. The minimum hydrologic criteria may be reduced as follows.

(A) The owner may request that the executive director reduce the minimum hydrologic criteria if the owner submits:

(i) dam breach analysis, prepared by a professional engineer and using the normal storage capacity non-flood event, the barely overtopping flood event, and the design flood event, if applicable, that demonstrate existing downstream improvements would not be adversely affected, which is defined as the downstream flooding differentials being less than or equal to one foot between breach and non-breach simulations in the affected area;

(ii) one or more technical options included in the most current version, at the time of the analysis, of the agency's *Hydrologic and Hydraulic Guidelines of Dams in Texas*, demonstrating that existing downstream improvements would not be adversely affected;

(iii) documentation of the purchase, or an easement for, the property downstream of the dam that would be impacted by a dam failure and showing that it has been dedicated to non-residential and non-commercial use; or

(iv) documentation that the property downstream has been dedicated by the property owner to non-residential and non-commercial use.

(B) The executive director shall evaluate the owner's request for reduction in the minimum hydrologic criteria to determine if the request is appropriate. If the executive director agrees with the analysis, the executive director shall approve the request in writing.

(C) If the executive director does not agree with the owner's request for reduction in the minimum hydrologic criteria, the executive director shall deny the request in writing.

(b) Hydraulic criteria for proposed dams or dams proposed to be reconstructed, modified, enlarged, rehabilitated, or altered.

(1) The owner shall have a professional engineer evaluate the hydraulic adequacy of the dam and spillways using the guidelines in the most current version, at the time of the analysis, of the agency's *Hydrologic and Hydraulic Guidelines of Dams in Texas*.

(2) The owner shall have a professional engineer address the stability of the spillways to determine if the spillways will adequately meet the minimum design storm without being significantly damaged.

(3) The owner shall have a professional engineer determine a minimum freeboard for a proposed large size dam as defined in §299.13 of this title (relating to Size Classification Criteria) as outlined in the most current version, at the time of the analysis, of the agency's *Hydrologic and Hydraulic Guidelines for Dams in Texas*.

(c) Hydraulic criteria for existing dams. If it becomes necessary for an owner of an existing dam to reevaluate the hydraulic adequacy of the dam and spillways, the owner shall have a professional engineer evaluate the hydraulic adequacy of the dam and spillways using the guidelines in the most current version, at the time of the analysis, of the agency's *Hydrologic and Hydraulic Guidelines of Dams in Texas*.

§299.16. Structural Evaluation of Dams.

(a) The owner shall have a professional engineer submit a geotechnical, geological, and structural evaluation in a report to the executive director with the final construction plans and specifications as described in §299.22 of this title (relating to Review and Approval of Construction Plans and Specifications) to support the design of a proposed dam or a dam that is proposed to be reconstructed, or structurally modified, enlarged, rehabilitated, or altered. The report must include, as applicable:

(1) details of the geology of the project site and vicinity;

(2) location and logs of test borings, pits, and shafts;

(3) results of field and laboratory tests on structural and foundation materials;

(4) seepage studies;

(5) stability analyses of embankments, spillways, retaining walls, and inlet structures, as described in subsection (b) of this section; and

(6) recommendations concerning:

(A) embankment slopes, crest width, and berms;

(B) core trench size and depths;

(C) moisture-density and strength requirements;

(D) soil dispersion requirements;

(E) minimum compressive strength for concrete;

(F) construction sequence procedures and techniques for excavations and embankments;

(G) types of compaction equipment; and

(H) seepage control requirements.

(b) The owner shall have a professional engineer develop a stability analysis as outlined in the most current version, at the time of the analysis, of the agency's *Design and Construction Guidelines for Dams in Texas* to support the design of proposed large- and intermediate-size dams, as defined in §299.13 of this title (relating to Size Classification Criteria), and large- and intermediate-size dams that are proposed to be reconstructed or structurally modified, enlarged, rehabilitated, or altered. The analysis must be submitted to the executive director with the final construction plans and specifications as described in §299.22 of this title.

(c) The executive director may require the owner of an existing dam to have a professional engineer perform a geotechnical and structural evaluation or a stability analysis and submit a report, as described in subsections (a) and (b) of this section, following an inspection, as described in §299.42 of this title (relating to Inspections), if the executive director determines that the dam was found to be deficient and the integrity of the dam was threatened. If the owner has a professional engineer prepare a report, the owner shall submit the professional engineer's report to the executive director for review upon completion of the report.

(d) When a person proposes one of the following activities near the owner's dam, the owner or the executive director may request that the person have a professional engineer perform an evaluation to determine if the integrity of the dam would be compromised. If the person has a report prepared by a professional engineer, the person shall submit the evaluation report to the executive director and the owner for review and approval before any work is performed for a proposal to:

(1) dredge the reservoir within 200 feet of the dam;

(2) install a utility line or pipeline in the dam or in the spillways that requires significant excavation in the dam or spillways;

(3) construct a road across the dam or spillways or within 200 feet of the dam;

(4) drill oil or gas wells, perform horizontal drilling or fracturing, or perform oil or gas exploration within 500 feet of the dam and spillways; or

(5) blast within 1/2 mile of the dam.

Adopted December 10, 2008 Effective January 1, 2009

§299.17. Alternatives to Upgrading Dams.

(a) An owner may elect to implement alternative methods, instead of upgrading the dam using structural methods, to meet minimum hydrologic criteria by submitting to the executive director:

(1) a plan for meeting the requirements in §299.15(a)(3) of this title (relating to Hydrologic and Hydraulic Criteria for Dams);

(2) a plan for meeting the requirements in §299.15(a)(4) of this title;

(3) a plan for removing the dam, as described in §299.51 of this title (relating to Removal or Breach of Dams);

(4) a plan for lowering the reservoir level to a level that will allow it to meet the appropriate minimum hydrologic criteria; or

(5) a plan using a combination of structural and non-structural methods as proposed by the owner's professional engineer.

(b) The executive director shall review the owner's proposal and respond as described in §299.22(e) of this title (relating to Review and Approval of Construction Plans and Specifications).

Adopted December 10, 2008 Effective January 1, 2009

IHW-31086-IN

Texas Commission on Environmental Quality
Investigation Report
AEP SOUTHWESTERN ELECTRIC POWER CO
CN602843245

AEP - WELSH POWER PLANT
RN100213370

Investigation # 748124

Incident #

Investigator: DALE RICE

Site Classification
CONDITIONALLY EXEMPT SMALL QUANTITY GENERATOR
INDUSTRIAL MAJOR

Conducted: 04/16/2009 -- 04/16/2009

SIC Code: 4911
NAIC Code: 221112

Program(s): WASTEWATER
INDUSTRIAL AND HAZARDOUS WASTE GENERATION
MUNICIPAL SOLID WASTE NON PERMITTED

Investigation Type : Compliance Investigation

Location : OLD: FM 1735 Rd, Pittsburg, TX NEW 911 ADDRESS IS 1187 COUNTY RD 4865 PITTSBURG TX

Additional ID(s) : TX0063215
TPDES0063215
WQ0001811000

Address: 1187 COUNTY ROAD 4865; PITTSBURG, TX 75686

Activity Type : REGION 05 - TYLER
WWRECONMIN - WW Recon Minor
IHWOTH61 - Investigation involving non-hazardous wast only

Principal(s) :

Role	Name
RESPONDENT	AEP SOUTHWESTERN ELECTRIC POWER CO
RESPONDENT	SOUTHWESTERN ELECTRIC POWER COMPANY

Contact(s) :

Role	Title	Name	Phone	
Participated in Investigation	REGIONAL ENVIRONMENTAL CONSULTANT	MR KELLY SPENCER	Work	(903) 927-5830
Participated in Investigation		MS NIKKI COULTER	Work	(903) 855-5444
Regulated Entity Contact	PLANT ENVIRONMENTAL COORDINATOR-WELSH	MR MAX DIAZ	Work	(903) 855-5444

Other Staff Member(s) :

Role	Name
QA Reviewer	CRAIG CONNOR
Supervisor	MICHAEL BRASHEAR
Investigator	CRAIG CONNOR

Associated Check List

Checklist Name	Unit Name

WQ COMPLIANCE CHECK/RECONNAISSANCE INVESTIGATION | Welsh

Investigation Comments :

INTRODUCTION

On April 16, 2009, Mr. Dale Rice and Mr. Craig Connor, Environmental Investigators with the TCEQ Tyler Region Office, conducted an on-site investigation at the AEP Welsh Power Plant. The facility is located off of SH11 at 1187 CR 4865, near Cason, Texas in an attainment area in Titus County. The investigation was announced by telephone on April 8, 2009. The investigators held a preliminary meeting with Mr. Max Diaz, Plant Environmental Coordinator, Mr. Kelly Spencer, Lead Plant Environmental & IH Coordinator, and Ms. Nikki Coulter, Lab Manager. Mr. Rice explained that the reason for the visit was to conduct a wastewater reconnaissance investigation and an inspection of all surface impoundments. The investigators were accompanied on the investigation by the personnel listed above. The investigation included a tour of the facility to evaluate the surface impoundments and on-site landfill areas, and a review of various related records. The investigators conducted an exit interview on April 16, 2009, at the conclusion of the investigation. It was attended by the facility personnel listed above. The investigators discussed the results of the investigation and reported that no alleged violations were observed during the investigation.

GENERAL FACILITY AND PROCESS INFORMATION

The AEP Welsh Power Plant is a coal fired facility. Low sulphur, sub-bituminous coal is brought to the facility by rail from the Powder River Basin in Wyoming. It is composed of three generating units (1, 2, and 3) that are 528 MW Westinghouse turbine generators and Babcock & Wilcox coal-fired boilers. Unit 1 of the Welsh Plant Boiler # 1 (W -1) began operation in 1977, Boiler # 2 (W-2) began operation in 1980 and Boiler # 3 (W-3) began operation in 1982. The facility has not changed from its core operations, but it has been modified to reduce emissions, through equipment and/or operational changes. At this facility, electrostatic precipitators and baghouse filter systems remove particulate matter, and a scrubber removes sulfur dioxide (SO_2). Special burners are used in the boiler system to hold down the formation of nitrogen oxide (NO_x).

Two wastes are generated by the combustion of coal, bottom ash and fly ash, both of which are Class 2 Industrial Waste. Fly ash is the light non-combustible particulate matter that rises in the combustion gasses. The fly ash is collected from the baghouse and contained in silos. The ash is then either sold by LaFarge as a cement manufacturing product, or managed in Unit 001 (Old Ash Storage Area). Currently about half of all fly ash is bought and marketed by LaFarge. Bottom ash is the larger and heavier non-combustible particles that stays on the bottom of the furnaces. The bottom ash slurry is collected in the Primary and Secondary Ash Settling Ponds (Unit 004). These settling ponds are currently dredged about once per year. This dredged ash is managed in Unit 014 (New Ash Storage Area).

Welsh Power Plant has wastewater facility coverage under the Texas Pollutant Discharge Elimination System (TPDES) permit WQ0001811000. The facility is currently permitted to discharge metal cleaning wastes from Outfall 101 subject to the following effluent limitations: report the daily average flow, daily average total iron 1 mg/l, and daily average total copper 0.5 mg/l. The flow from this outfall is estimated by how many gallons in the pond or frac tank that are discharged. There is typically no discharge from this outfall. Outfall 103 is permitted to discharge treated domestic wastewater subject to the following effluent limitations: daily average flow 0.006 MGD, daily average BOD 20 mg/l, daily average total suspended solids 20 mg/l, and pH between 6 - 9 standard units. The effluent shall contain a minimum chlorine residual of 1.0 mg/l and maximum chlorine residual of 4.0 mg/l after a detention time of at least 20 minutes. The primary flow measuring device is a 22° v-notch weir. No industrial wastes are treated at the domestic wastewater plant. The treatment units of the package plant are: aeration basin, clarifier, and chlorine contact basin. Outfall 103 discharges to the secondary ash settling area before entering into Welsh Reservoir. There is no collection system and no significant plant modifications have been made since the last comprehensive compliance investigation. Outfall 001 is permitted to discharge low volume wastes.

ash transport water, coal pile runoff, storm water, and metal cleaning wastes subject to the following effluent limitations: daily average flow 20 MGD, daily average total suspended solids 30 mg/l, daily average oil and grease 15 mg/l, daily average total selenium 0.013 mg/l, and pH between 6-9 standard units. This outfall discharges into the secondary ash pond before entering into Welsh Reservoir. Outfall 003 is permitted to discharge once through cooling water, storm water, and previously monitored effluents subject to the following effluent limitations: daily average flow 1,425 MGD, daily free available chlorine 0.2 mg/l. The flow is calculated from how many circulating pumps are running. Once all outfalls enter Welsh Reservoir, they flow to Swauano Creek, then to Big Cypress Creek below Lake Bob Sandlin in Segment No. 0404 of the Cypress Creek Basin.

BACKGROUND

On January 13, 2009, Dale Rice performed a brief investigation of the facility's surface impoundments and ash landfills. Also, a query was conducted into TCEQ databases and it was determined that the current compliance history for this customer was classified as high. This review process indicated the facility has no outstanding violations from the comprehensive compliance investigation conducted on August 18, 2008 for wastewater.

ADDITIONAL INFORMATION

The investigation consisted of a tour of the facility to evaluate the condition of all regulated impoundments and the ash storage areas, or landfills. During the investigation the surface impoundments and ash landfills were thoroughly reviewed. Following the tour, a conference was conducted to discuss the TCEQ checklists. This meeting also included an evaluation of documents such as groundwater monitoring data, and AEP's letter to the EPA (both attached to this report). The Primary Ash Settling Pond (NOR unit 004) functions as a settling basin for wastewater containing bottom and economizer ash slurry. The impoundment encompasses an area of 98.1 surface acres and has a total storage capacity of 307.4 acre feet. The maximum height of the impoundment is 20 feet. The impoundment was designed by a professional engineer (P.E.) and was constructed under the supervision of a P.E. The unit went into service in 1973 at plant start-up. The impoundment has a compacted clay liner. Effluent from the impoundment is regulated under the facility's TPDES permit. Effluent flows through outfall 001 and into a small secondary pond. There have not been any known spills or un-permitted releases from the unit within the last ten years. Mr. Carter, the facility's senior engineer, performed a safety assessment of the impoundment on March 18, 2009, and determined the unit was a low hazard. Another safety assessment is scheduled to be performed in 2012. At the time of the current investigation, the impoundment had approximately six feet of freeboard. There were no signs of seepage below the dikes. The dike is covered in grassy vegetation with no significant trees on the structure. An estimated 30,000 cubic yards are currently stored in the impoundment. The impoundment is dredged approximately once per year.

The Secondary Ash Settling Pond (NOR unit 004) functions as a settling basin for wastewater containing a bottom and economizer ash slurry. The impoundment encompasses an area of 4.5 surface acres and has a total storage capacity of 36.9 acre feet. The maximum height of the impoundment is 20 feet. The impoundment was designed by a P.E. and was constructed under the supervision of a P.E. The unit went into service in 1973 at plant start-up. The impoundment has a compacted clay liner. Effluent from the impoundment is regulated under the facility's TPDES permit. Effluent flows through outfall 003 into the onsite discharge canal before entering into Welsh Reservoir. There have not been any known spills or un-permitted releases from the unit within the last ten years. Mr. Carter, the facility's senior engineer, performed a safety assessment of the impoundment on March 18, 2009, and determined the unit was a low hazard. Another safety assessment is scheduled to be performed in 2012. This impoundment shares the dike with the Primary Ash Settling Pond and is covered in grassy vegetation with no significant trees on the structure. At the time of the current investigation, the impoundment had approximately 12 feet of freeboard. There were no signs of seepage from the unit. An estimated 7,200 cubic yards are currently stored in the impoundment. AEP notes that minimal sediment reaches and is stored in this pond, and that the majority of volume is water.
The Boiler Pond (NOR unit 005) functions as a collecting basin for stormwater, and wastewater

Signed _Dale E Rice_ Date _6-9-09_
Environmental Investigator

Signed _Mike Bankhead_ Date _6-10-09_
Supervisor

Attachments: (in order of final report submittal)

___Enforcement Action Request (EAR)
___Letter to Facility (specify type) : ___________
Investigation Report
___Sample Analysis Results
___Manifests
___NOR

___Maps, Plans, Sketches
___Photographs
___Correspondence from the facility
___Other (specify) :
____
____

containing metal cleaning waste and other non-hazardous aqueous waste. The impoundment encompasses an area of approximately .5 surface acres and has a total storage capacity of 5 acre feet. The maximum height of the impoundment is 10 feet. The impoundment was designed by a P.E. and was constructed under the supervision of a P.E. The unit went into service in 1973 at plant start-up. The impoundment has a compacted clay liner. Effluent from the impoundment is regulated under the facility's TPDES permit. Effluent flows through outfall 101. There have not been any known spills or un-permitted releases from the unit within the last ten years. The dike is covered in grassy vegetation with no trees on the structure, although the pond is below ground level. At the time of the current investigation, the impoundment had approximately five feet of freeboard. There were no signs of seepage from the unit. An estimated 4,000 cubic yards are currently stored in the impoundment. AEP notes that the pond currently only contains stormwater, and is preparing for closure.

The New Ash Storage Area (NOR unit 014) is predominately used for the disposal of bottom ash and economizer ash. The landfill encompasses an area of 20 surface acres, with a total storage capacity of 270 acre feet. The landfill is currently at approximately 60% capacity. The current life of the landfill before future expansion is predicted to be approximately 3 years. The maximum height is 34.6 feet. The landfill was designed by a P.E. and was constructed under the supervision of a P.E. The unit went into service in 2000. The landfill is lined with a compacted clay and a synthetic liner. There have not been any known spills or un-permitted releases from the unit within the last ten years. Liquid wastes, containers holding liquid wastes, and empty containers are not placed in the landfill. At the time of the investigation, the investigators did not observe any wind dispersal issues. Ground water monitoring data did not indicate the landfill poses a current threat to groundwater.

The Old Ash Storage Area (NOR unit 001) is predominately used for the disposal of fly ash. Currently, LaFarge is excavating ash and sifting and sorting particles by size to sell. The landfill encompasses an area of 16 surface acres. The landfill is currently at approximately 20% capacity. The current life of the landfill before future expansion is dependent on the sale rate of the fly ash. AEP estimates another four feet of ash can be added. The landfill was designed by a P.E. and was constructed under the supervision of a P.E. The unit went into service in 1973. The landfill is lined with compacted clay. There have not been any known spills or un-permitted releases from the unit within the last ten years. Liquid wastes, containers holding liquid wastes, and empty containers are not placed in the landfill. At the time of the investigation, the investigators did not observe any wind dispersal issues.

CONCLUSION

No violations are currently being alleged as a result of this investigation conducted on April 16, 2009.

No Violations Associated to this Investigation

TPDES PERMIT NO. WQ0001811000
*[For TCEQ office use only -
EPA I.D. No. TX0063215]*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
P. O. Box 13087
Austin, Texas 78711-3087

This permit supercedes and replaces TPDES Permit No. WQ0001811000, issued on February 5, 2004.

PERMIT TO DISCHARGE WASTES
under provisions of
Section 402 of the Clean Water Act
and Chapter 26 of the Texas Water Code

THIS PERMIT IS SUPERSEDED CANCELLED OR EXPIRED

Southwestern Electric Power Company

whose mailing address is

1187 County Road 4865
Pittsburg, Texas 75686-8561

is authorized to treat and discharge wastes from the Welsh Power Plant, a steam electric power generating station (SIC 4911)

located approximately two miles northwest of the Town of Cason and approximately one and one half miles north of State Highway 11, Titus County, Texas

to Welsh Reservoir; thence to Swauano Creek; thence to Big Cypress Creek Below Lake Bob Sandlin in Segment No. 0404 of the Cypress Creek Basin

only according to effluent limitations, monitoring requirements and other conditions set forth in this permit, as well as the rules of the Texas Commission on Environmental Quality (TCEQ), the laws of the State of Texas, and other orders of the TCEQ. The issuance of this permit does not grant to the permittee the right to use private or public property for conveyance of wastewater along the discharge route described in this permit. This includes, but is not limited to, property belonging to any individual, partnership, corporation or other entity. Neither does this permit authorize any invasion of personal rights nor any violation of federal, state, or local laws or regulations. It is the responsibility of the permittee to acquire property rights as may be necessary to use the discharge route.

This permit shall expire at midnight on February 1, 2011.

ISSUED DATE: **JAN 30 2007**

For the Commission

1. During the period beginning upon date of issuance and lasting through date of expiration, the permittee is authorized to discharge low volume wastes (*1), ash transport water (*1), coal pile runoff (*1), storm water, and previously monitored effluents (metal cleaning wastes) subject to the following effluent limitations:

   The daily average flow of effluent shall not exceed 20 million gallons per day (MGD). The daily maximum flow shall not exceed 60 MGD.

Effluent Characteristics	Discharge Limitations					Minimum Self-Monitoring Requirements	
	Daily Average		Daily Maximum		Single Grab	Report Daily Average and Daily Maximum	
	lbs/day	mg/L	lbs/day	mg/L	mg/L	Measurement Frequency	Sample Type
Flow (MGD)	(Report)		(Report)		N/A	Continuous	Record
Total Suspended Solids	5,007	30	16,690	100	100	1/month	Grab
Oil and Grease	2,504	15	3,338	20	20	1/month	Grab
Selenium, Total	2.17	0.013	4.51	0.027	0.03	1/week	Grab

   (*1) See Other Requirement No. 2.

2. The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/week by grab sample.

3. There shall be no discharge of floating solids or visible foam in other than trace amounts and no discharge of visible oil.

4. Effluent monitoring samples shall be taken at the following location: At Outfall 001, at the discharge from the secondary bottom ash pond settling basin prior to discharge to Welsh Reservoir.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

Outfall Number 003

1. During the period beginning upon date of issuance and lasting through date of expiration, the permittee is authorized to discharge once through cooling water (*1), storm water, and previously monitored effluents subject to the following effluent limitations:

The daily average flow of effluent shall not exceed 1,425 million gallons per day (MGD). The daily maximum flow shall not exceed 1,425 MGD.

Effluent Characteristics	Discharge Limitations					Minimum Self-Monitoring Requirements	
	Daily Average		Daily Maximum		Single Grab	Report Daily Average and Daily Maximum	
	lbs/day	mg/L	lbs/day	mg/L	mg/L	Measurement Frequency	Sample Type
Flow (MGD)	(Report)		(Report)		N/A	1/ 2 hours	Calculated
Temperature (degrees F)	Report (*1)		Report (*1)		N/A	1/ 2 hours	In-Situ
Free Available Chlorine (*1)	198	0.2	495	0.5	N/A	1/week (*3)	Grab
Total Residual Chlorine (*1)	N/A	N/A	198	0.2	N/A	1/week (*3)	Grab

(*1) See Other Requirement No. 2.

(*2) Samples shall be representative of periods of chlorination. Sampling is required only if there is chlorination during a calendar week.

2. There shall be no discharge of floating solids or visible foam in other than trace amounts and no discharge of visible oil.

3. Effluent monitoring samples shall be taken at the following location: At Outfall 003, where once through cooling water is discharged from the onsite discharge canal into Welsh Reservoir. If the cooling towers are in use, a grab sample shall be taken at the discharge from the cooling towers prior to discharge into Welsh Reservoir and from the onsite discharge canal into Welsh Reservoir. The samples shall be combined either physically or arithmetically into a single flow weighted sample for analysis and reporting.

1. During the period beginning upon date of issuance and lasting through date of expiration, the permittee is authorized to discharge treated domestic wastewater subject to the following effluent limitations:

The daily average flow of effluent shall not exceed 0.006 million gallons per day (MGD). The daily maximum flow shall not exceed 0.010 MGD.

Effluent Characteristics	Discharge Limitations					Minimum Self-Monitoring Requirements	
	Daily Average		Daily Maximum		Single Grab	Report Daily Average and Daily Maximum	
	lbs/day	mg/L	lbs/day	mg/L	mg/L	Measurement Frequency	Sample Type
Flow (MGD)	(Report)		(Report)		N/A	1/day	Estimate
Biochemical Oxygen Demand (5-day)	1.0	20	2.3	45	45	1/week	Grab
Total Suspended Solids	1.0	20	2.3	45	45	1/week	Grab

2. The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/week, by grab sample.

3. The effluent shall contain a minimum chlorine residual of 1.0 mg/L and maximum chlorine residual of 4.0 mg/L after a detention time of at least 20 minutes (based on peak flow), and shall be monitored 1/week by grab sample. The sample shall be taken at the chlorine contact chamber, prior to final filtration and discharge via Outfall 103. An equivalent method of disinfection may be substituted only with prior approval of the Executive Director.

4. There shall be no discharge of floating solids or visible foam in other than trace amounts and no discharge of visible oil.

5. Effluent monitoring samples shall be taken at the following location: At Outfall 103, at the discharge from the sewage treatment system prior to discharge to Welsh Reservoir.

1. During the period beginning upon date of issuance and lasting through date of expiration, the permittee is authorized to discharge metal cleaning wastes (*1) subject to the following effluent limitations:

Volume: Intermittent and flow variable

Effluent Characteristics	Discharge Limitations			Minimum Self-Monitoring Requirements	
	Daily Average mg/L	Daily Maximum mg/L	Single Grab mg/L	Report Daily Average and Daily Maximum Measurement Frequency	Sample Type
Flow (MGD)	(Report)	(Report)	N/A	1/day (*2)	Estimate
Iron, Total	1.0	1.0	1.0	1/week (*2)	Grab (*3)
Copper, Total	0.5	1.0	1.0	1/week (*2)	Grab (*3)

(*1) See Other Requirement No. 2.
(*2) When discharge occurs.
(*3) Since more than one source is associated with this particular waste category, grab samples from each source shall be either physically or arithmetically composited into a single flow weighted sample for analysis and/or reporting.

2. There shall be no discharge of floating solids or visible foam in other than trace amounts and no discharge of visible oil.

3. Effluent monitoring samples shall be taken at the following location: At Outfall 101, where metal cleaning wastes are discharged and prior to mixing with any other wastewaters.

DEFINITIONS AND STANDARD PERMIT CONDITIONS

As required by Title 30 Texas Administrative Code (TAC) Chapter 305, certain regulations appear as standard conditions in waste discharge permits. 30 TAC §§ 305.121 - 305.129 (relating to Permit Characteristics and Conditions) as promulgated under the Texas Water Code §§ 5.103 and 5.105, and the Texas Health and Safety Code §§ 361.017 and 361.024(a), establish the characteristics and standards for waste discharge permits, including sewage sludge, and those sections of 40 Code of Federal Regulations (CFR) Part 122 adopted by reference by the Commission. The following text includes these conditions and incorporates them into this permit. All definitions in Section 26.001 of the Texas Water Code and 30 TAC Chapter 305 shall apply to this permit and are incorporated by reference. Some specific definitions of words or phrases used in this permit are as follows:

1. Flow Measurements

   a. Annual average flow - the arithmetic average of all daily flow determinations taken within the preceding 12 consecutive calendar months. The annual average flow determination shall consist of daily flow volume determinations made by a totalizing meter, charted on a chart recorder and limited to major domestic wastewater discharge facilities with a 1 million gallons per day or greater permitted flow.

   b. Daily average flow - the arithmetic average of all determinations of the daily flow within a period of one calendar month. The daily average flow determination shall consist of determinations made on at least four separate days. If instantaneous measurements are used to determine the daily flow, the determination shall be the arithmetic average of all instantaneous measurements taken during that month. Daily average flow determination for intermittent discharges shall consist of a minimum of three flow determinations on days of discharge.

   c. Daily maximum flow - the highest total flow for any 24-hour period in a calendar month.

   d. Instantaneous flow - the measured flow during the minimum time required to interpret the flow measuring device.

   e. 2-hour peak flow (domestic wastewater treatment plants) - the maximum flow sustained for a two-hour period during the period of daily discharge. The average of multiple measurements of instantaneous maximum flow within a two-hour period may be used to calculate the 2-hour peak flow.

   f. Maximum 2-hour peak flow (domestic wastewater treatment plants) - the highest 2-hour peak flow for any 24-hour period in a calender month.

2. Concentration Measurements

   a. Daily average concentration - the arithmetic average of all effluent samples, composite or grab as required by this permit, within a period of one calendar month, consisting of at least four separate representative measurements.

      i. For domestic wastewater treatment plants - When four samples are not available in a calendar month, the arithmetic average (weighted by flow) of all values in the previous four consecutive month period consisting of at least four measurements shall be utilized as the daily average concentration.

      ii. For all other wastewater treatment plants - When four samples are not available in a calender month, the arithmetic average (weighted by flow) of all values taken during the month shall be utilized as the daily average concentration.

   b. 7-day average concentration - the arithmetic average of all effluent samples, composite or grab as required by this permit, within a period of one calendar week, Sunday through Saturday.

   c. Daily maximum concentration - the maximum concentration measured on a single day, by the sample type specified in the permit, within a period of one calender month.

   d. Daily discharge - the discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in terms of mass, the "daily discharge" is calculated as the total mass of the pollutant discharged over the sampling day. For pollutants with limitations expressed in other units of measurement, the "daily discharge" is calculated as the average measurement of the pollutant over the sampling day.

      The "daily discharge" determination of concentration made using a composite sample shall be the concentration of the composite sample. When grab samples are used, the "daily discharge" determination of concentration shall be the arithmetic average (weighted by flow value) of all samples collected during that day.

e. Fecal coliform bacteria concentration - the number of colonies of fecal coliform bacteria per 100 milliliters effluent. The daily average fecal coliform bacteria concentration is a geometric mean of the values for the effluent samples collected in a calendar month. The geometric mean shall be determined by calculating the nth root of the product of all measurements made in a calender month, where n equals the number of measurements made; or, computed as the antilogarithm of the arithmetic mean of the logarithms of all measurements made in a calender month. For any measurement of fecal coliform bacteria equaling zero, a substituted value of one shall be made for input into either computation method. The 7-day average for fecal coliform bacteria is the geometric mean of the values for all effluent samples collected during a calender week.

f. Daily average loading (lbs/day) - the arithmetic average of all daily discharge loading calculations during a period of one calender month. These calculations must be made for each day of the month that a parameter is analyzed. The daily discharge, in terms of mass (lbs/day), is calculated as (Flow, MGD x Concentration, mg/l x 8.34).

g. Daily maximum loading (lbs/day) - the highest daily discharge, in terms of mass (lbs/day), within a period of one calender month.

3. Sample Type

a. Composite sample - For domestic wastewater, a composite sample is a sample made up of a minimum of three effluent portions collected in a continuous 24-hour period or during the period of daily discharge if less than 24 hours, and combined in volumes proportional to flow, and collected at the intervals required by 30 TAC § 319.9 (a). For industrial wastewater, a composite sample is a sample made up of a minimum of three effluent portions collected in a continuous 24-hour period or during the period of daily discharge if less than 24 hours, and combined in volumes proportional to flow, and collected at the intervals required by 30 TAC § 319.9 (b).

b. Grab sample - an individual sample collected in less than 15 minutes.

4. Treatment Facility (facility) - wastewater facilities used in the conveyance, storage, treatment, recycling, reclamation and/or disposal of domestic sewage, industrial wastes, agricultural wastes, recreational wastes, or other wastes including sludge handling or disposal facilities under the jurisdiction of the Commission.

5. The term "sewage sludge" is defined as solid, semi-solid, or liquid residue generated during the treatment of domestic sewage in 30 TAC Chapter 312. This includes the solids which have not been classified as hazardous waste separated from wastewater by unit processes .

6. Bypass - the intentional diversion of a waste stream from any portion of a treatment facility.

MONITORING AND REPORTING REQUIREMENTS

1. Self-Reporting

Monitoring results shall be provided at the intervals specified in the permit. Unless otherwise specified in this permit or otherwise ordered by the Commission, the permittee shall conduct effluent sampling and reporting in accordance with 30 TAC §§ 319.4 - 319.12. Unless otherwise specified, a monthly effluent report shall be submitted each month, to the Enforcement Division (MC 224), by the 20th day of the following month for each discharge which is described by this permit whether or not a discharge is made for that month. Monitoring results must be reported on an approved self-report form, that is signed and certified as required by Monitoring and Reporting Requirements No. 10.

As provided by state law, the permittee is subject to administrative, civil and criminal penalties, as applicable, for negligently or knowingly violating the Clean Water Act, the Texas Water Code, Chapters 26, 27, and 28, and Texas Health and Safety Code, Chapter 361, including but not limited to knowingly making any false statement, representation, or certification on any report, record, or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance, or falsifying, tampering with or knowingly rendering inaccurate any monitoring device or method required by this permit or violating any other requirement imposed by state or federal regulations.

2. Test Procedures

Unless otherwise specified in this permit, test procedures for the analysis of pollutants shall comply with procedures specified in 30 TAC §§319.11 - 319.12. Measurements, tests and calculations shall be accurately accomplished in a representative manner.

3. Records of Results

   a. Monitoring samples and measurements shall be taken at times and in a manner so as to be representative of the monitored activity.

   b. Except for records of monitoring information required by this permit related to the permittee's sewage sludge use and disposal activities, which shall be retained for a period of at least five years (or longer as required by 40 CFR Part 503), monitoring and reporting records, including strip charts and records of calibration and maintenance, copies of all records required by this permit, records of all data used to complete the application for this permit, and the certification required by 40 CFR § 264.73(b)(9) shall be retained at the facility site, or shall be readily available for review by a TCEQ representative for a period of three years from the date of the record or sample, measurement, report, application or certification. This period shall be extended at the request of the Executive Director.

   c. Records of monitoring activities shall include the following:

      i. date, time and place of sample or measurement;
      ii. identity of individual who collected the sample or made the measurement.
      iii. date and time of analysis;
      iv. identity of the individual and laboratory who performed the analysis;
      v. the technique or method of analysis; and
      vi. the results of the analysis or measurement and quality assurance/quality control records.

   The period during which records are required to be kept shall be automatically extended to the date of the final disposition of any administrative or judicial enforcement action that may be instituted against the permittee.

4. Additional Monitoring by Permittee

   If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit using approved analytical methods as specified above, all results of such monitoring shall be included in the calculation and reporting of the values submitted on the approved self-report form. Increased frequency of sampling shall be indicated on the self-report form.

5. Calibration of Instruments

   All automatic flow measuring or recording devices and all totalizing meters for measuring flows shall be accurately calibrated by a trained person at plant start-up and as often thereafter as necessary to ensure accuracy, but not less often than annually unless authorized by the Executive Director for a longer period. Such person shall verify in writing that the device is operating properly and giving accurate results. Copies of the verification shall be retained at the facility site and/or shall be readily available for review by a TCEQ representative for a period of three years.

6. Compliance Schedule Reports

   Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of the permit shall be submitted no later than 14 days following each schedule date to the Regional Office and the Enforcement Division (MC 224).

7. Noncompliance Notification

   a. In accordance with 30 TAC § 305.125(9) any noncompliance which may endanger human health or safety, or the environment shall be reported by the permittee to the TCEQ. Report of such information shall be provided orally or by facsimile transmission (FAX) to the Regional Office within 24 hours of becoming aware of the noncompliance. A written submission of such information shall also be provided by the permittee to the Regional Office and the Enforcement Division (MC 224) within five working days of becoming aware of the noncompliance. The written submission shall contain a description of the noncompliance and its cause; the potential danger to human health or safety, or the environment; the period of noncompliance, including exact dates and times; if the noncompliance has not been corrected, the time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance, and to mitigate its adverse effects.

   b. The following violations shall be reported under Monitoring and Reporting Requirement 7.a.:

      i. Unauthorized discharges as defined in Permit Condition 2(g).
      ii. Any unanticipated bypass which exceeds any effluent limitation in the permit.
      iii. Violation of a permitted maximum daily discharge limitation for pollutants listed specifically in the Other

Requirements section of an Industrial TPDES permit.

c. In addition to the above, any effluent violation which deviates from the permitted effluent limitation by more than 40% shall be reported by the permittee in writing to the Regional Office and the Enforcement Division (MC 224) within 5 working days of becoming aware of the noncompliance.

d. Any noncompliance other than that specified in this section, or any required information not submitted or submitted incorrectly, shall be reported to the Enforcement Division (MC 224) as promptly as possible. For effluent limitation violations, noncompliances shall be reported on the approved self-report form.

8. In accordance with the procedures described in 30 TAC §§ 35.301 - 35.303 (relating to Water Quality Emergency and Temporary Orders) if the permittee knows in advance of the need for a bypass, it shall submit prior notice by applying for such authorization.

9. Changes in Discharges of Toxic Substances

All existing manufacturing, commercial, mining, and silvicultural permittees shall notify the Regional Office, orally or by facsimile transmission within 24 hours, and both the Regional Office and the Enforcement Division (MC 224) in writing within five (5) working days, after becoming aware of or having reason to believe:

a. That any activity has occurred or will occur which would result in the discharge, on a routine or frequent basis, of any toxic pollutant listed at 40 CFR Part 122, Appendix D, Tables II and III (excluding Total Phenols) which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

i. One hundred micrograms per liter (100 μg/L);
ii. Two hundred micrograms per liter (200 μg/L) for acrolein and acrylonitrile; five hundred micrograms per liter (500 μg/L) for 2,4-dinitrophenol and for 2-methyl-4,6-dinitrophenol; and one milligram per liter (1 mg/L) for antimony;
iii. Five (5) times the maximum concentration value reported for that pollutant in the permit application; or
iv. The level established by the TCEQ.

b. That any activity has occurred or will occur which would result in any discharge, on a nonroutine or infrequent basis, of a toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

i. Five hundred micrograms per liter (500 μg/L);
ii. One milligram per liter (1 mg/L) for antimony;
iii. Ten (10) times the maximum concentration value reported for that pollutant in the permit application; or
iv. The level established by the TCEQ.

10. Signatories to Reports

All reports and other information requested by the Executive Director shall be signed by the person and in the manner required by 30 TAC § 305.128 (relating to Signatories to Reports).

11. All Publicly Owned Treatment Works (POTWs) must provide adequate notice to the Executive Director of the following:

a. Any new introduction of pollutants into the POTW from an indirect discharger which would be subject to section 301 or 306 of the CWA if it were directly discharging those pollutants;

b. Any substantial change in the volume or character of pollutants being introduced into that POTW by a source introducing pollutants into the POTW at the time of issuance of the permit; and

c. For the purpose of this paragraph, adequate notice shall include information on:

i. The quality and quantity of effluent introduced into the POTW; and
ii. Any anticipated impact of the change on the quantity or quality of effluent to be discharged from the POTW.

PERMIT CONDITIONS

1. General

a. When the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in an application or in any report to the Executive Director, it shall promptly submit such facts or information.

b. This permit is granted on the basis of the information supplied and representations made by the permittee during action on an application, and relying upon the accuracy and completeness of that information and those representations. After notice and opportunity for a hearing, this permit may be modified, suspended, or revoked, in whole or in part, in accordance with 30 TAC Chapter 305, Subchapter D, during its term for good cause including, but not limited to, the following:

   i. Violation of any terms or conditions of this permit;
   ii. Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts; or
   iii. A change in any condition that requires either a temporary or permanent reduction or elimination of the authorized discharge.

c. The permittee shall furnish to the Executive Director, upon request and within a reasonable time, any information to determine whether cause exists for amending, revoking, suspending or terminating the permit. The permittee shall also furnish to the Executive Director, upon request, copies of records required to be kept by the permit.

2. Compliance

a. Acceptance of the permit by the person to whom it is issued constitutes acknowledgment and agreement that such person will comply with all the terms and conditions embodied in the permit, and the rules and other orders of the Commission.

b. The permittee has a duty to comply with all conditions of the permit. Failure to comply with any permit condition constitutes a violation of the permit and the Texas Water Code or the Texas Health and Safety Code, and is grounds for enforcement action, for permit amendment, revocation or suspension, or for denial of a permit renewal application or an application for a permit for another facility.

c. It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of the permit.

d. The permittee shall take all reasonable steps to minimize or prevent any discharge or sludge use or disposal or other permit violation which has a reasonable likelihood of adversely affecting human health or the environment.

e. Authorization from the Commission is required before beginning any change in the permitted facility or activity that may result in noncompliance with any permit requirements.

f. A permit may be amended, suspended and reissued, or revoked for cause in accordance with 30 TAC §§ 305.62 and 305.66 and Texas Water Code Section 7.302. The filing of a request by the permittee for a permit amendment, suspension and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

g. There shall be no unauthorized discharge of wastewater or any other waste. For the purpose of this permit, an unauthorized discharge is considered to be any discharge of wastewater into or adjacent to water in the state at any location not permitted as an outfall or otherwise defined in the Other Requirements section of this permit.

h. In accordance with 30 TAC § 305.535(a), the permittee may allow any bypass to occur from a TPDES permitted facility which does not cause permitted effluent limitations to be exceeded or an unauthorized discharge to occur, but only if the bypass is also for essential maintenance to assure efficient operation.

i. The permittee is subject to administrative, civil, and criminal penalties, as applicable, under Texas Water Code §§7.051 - 7.075 (relating to Administrative Penalties), 7.101 - 7.111 (relating to Civil Penalties), and 7.141 - 7.202 (relating to Criminal Offenses and Penalties) for violations including, but not limited to, negligently or knowingly violating the federal Clean Water Act, §§ 301, 302, 306, 307, 308, 318, or 405, or any condition or limitation implementing any sections in a permit issued under the CWA § 402, or any requirement imposed in a pretreatment program approved under the CWA §§ 402 (a)(3) or 402 (b)(8).

3. Inspections and Entry

a. Inspection and entry shall be allowed as prescribed in the Texas Water Code Chapters 26, 27, and 28, and Texas Health and Safety Code Chapter 361.

b. The members of the Commission and employees and agents of the Commission are entitled to enter any public or private property at any reasonable time for the purpose of inspecting and investigating conditions relating to the quality of water in the state or the compliance with any rule, regulation, permit or other order of the Commission. Members, employees, or agents of the Commission and Commission contractors are entitled to enter public or private property at any reasonable time to investigate or monitor or, if the responsible party is not responsive or there is an immediate danger to public health or the environment, to remove or remediate a condition related to the quality of water in the state. Members, employees, Commission contractors, or agents acting under this authority who enter private property shall observe the establishment's rules and regulations concerning safety, internal security, and fire protection, and if the property has management in residence, shall notify management or the person then in charge of his presence and shall exhibit proper credentials. If any member, employee, Commission contractor, or agent is refused the right to enter in or on public or private property under this authority, the Executive Director may invoke the remedies authorized in Texas Water Code Section 7.002. The statement above, that Commission entry shall occur in accordance with an establishment's rules and regulations concerning safety, internal security, and fire protection, is not grounds for denial or restriction of entry to any part of the facility, but merely describes the Commission's duty to observe appropriate rules and regulations during an inspection.

4. Permit Amendment and/or Renewal

a. The permittee shall give notice to the Executive Director as soon as possible of any planned physical alterations or additions to the permitted facility if such alterations or additions would require a permit amendment or result in a violation of permit requirements. Notice shall also be required under this paragraph when:

i. The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source in accordance with 30 TAC § 305.534 (relating to New Sources and New Dischargers); or

ii. The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject neither to effluent limitations in the permit, nor to notification requirements in Monitoring and Reporting Requirements No. 9;

iii. The alteration or addition results in a significant change in the permittee's sludge use or disposal practices, and such alteration, addition, or change may justify the application of permit conditions that are different from or absent in the existing permit, including notification of additional use or disposal sites not reported during the permit application process or not reported pursuant to an approved land application plan.

b. Prior to any facility modifications, additions, or expansions that will increase the plant capacity beyond the permitted flow, the permittee must apply for and obtain proper authorization from the Commission before commencing construction.

c. The permittee must apply for an amendment or renewal at least 180 days prior to expiration of the existing permit in order to continue a permitted activity after the expiration date of the permit. If an application is submitted prior to the expiration date of the permit, the existing permit shall remain in effect until the application is approved, denied, or returned. If the application is returned or denied, authorization to continue such activity shall terminate upon the effective date of the action. If an application is not submitted prior to the expiration date of the permit, the permit shall expire and authorization to continue such activity shall terminate.

d. Prior to accepting or generating wastes which are not described in the permit application or which would result in a significant change in the quantity or quality of the existing discharge, the permittee must report the proposed changes to the Commission. The permittee must apply for a permit amendment reflecting any necessary changes in permit conditions, including effluent limitations for pollutants not identified and limited by this permit.

e. In accordance with the Texas Water Code § 26.029(b), after a public hearing, notice of which shall be given to the permittee, the Commission may require the permittee, from time to time, for good cause, in accordance with applicable laws, to conform to new or additional conditions.

f. If any toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is promulgated under Section 307(a) of the Clean Water Act for a toxic pollutant which is present in the discharge and that standard or prohibition is more stringent than any limitation on the pollutant in this permit, this permit shall be modified or revoked and reissued to conform to the toxic effluent standard or prohibition. The permittee shall comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that established those standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

5. Permit Transfer

   a. Prior to any transfer of this permit, Commission approval must be obtained. The Commission shall be notified in writing of any change in control or ownership of facilities authorized by this permit. Such notification should be sent to the Applications Review and Processing Team (MC 148) of the Water Quality Division.

   b. A permit may be transferred only according to the provisions of 30 TAC § 305.64 (relating to Transfer of Permits) and 30 TAC § 50.133 (relating to Executive Director Action on Application or WQMP update).

6. Relationship to Hazardous Waste Activities

   This permit does not authorize any activity of hazardous waste storage, processing, or disposal which requires a permit or other authorization pursuant to the Texas Health and Safety Code.

7. Relationship to Water Rights

   Disposal of treated effluent by any means other than discharge directly to water in the state must be specifically authorized in this permit and may require a permit pursuant to Chapter 11 of the Texas Water Code.

8. Property Rights

   A permit does not convey any property rights of any sort, or any exclusive privilege.

9. Permit Enforceability

   The conditions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstances, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

10. Relationship to Permit Application

    The application pursuant to which the permit has been issued is incorporated herein; provided, however, that in the event of a conflict between the provisions of this permit and the application, the provisions of the permit shall control.

11. Notice of Bankruptcy.

    a. Each permittee shall notify the executive director, in writing, immediately following the filing of a voluntary or involuntary petition for bankruptcy under any chapter of Title 11 (Bankruptcy) of the United States Code (11 USC) by or against:

       i. the permittee;
       ii. an entity (as that term is defined in 11 USC, §101(15)) controlling the permittee or listing the permit or permittee as property of the estate; or
       iii. an affiliate (as that term is defined in 11 USC, §101(2)) of the permittee.

    b. This notification must indicate:

       i. the name of the permittee;
       ii. the permit number(s);
       iii. the bankruptcy court in which the petition for bankruptcy was filed; and
       iv. the date of filing of the petition.

OPERATIONAL REQUIREMENTS

1. The permittee shall at all times ensure that the facility and all of its systems of collection, treatment, and disposal are properly operated and maintained. This includes, but is not limited to, the regular, periodic examination of wastewater solids within the treatment plant by the operator in order to maintain an appropriate quantity and quality of solids inventory as described in the various operator training manuals and according to accepted industry standards for process control. Process control, maintenance, and operations records shall be retained at the facility site, or shall be readily available for review by a TCEQ representative, for a period of three years.

2. Upon request by the Executive Director, the permittee shall take appropriate samples and provide proper analysis in order to demonstrate compliance with Commission rules. Unless otherwise specified in this permit or otherwise ordered by the

Commission, the permittee shall comply with all applicable provisions of 30 TAC Chapter 312 concerning sewage sludge use and disposal and 30 TAC §§ 319.21 - 319.29 concerning the discharge of certain hazardous metals.

3. Domestic wastewater treatment facilities shall comply with the following provisions:

   a. The permittee shall notify the Municipal Permits Team, Wastewater Permitting Section (MC 148) of the Water Quality Division, in writing, of any facility expansion at least 90 days prior to conducting such activity.

   b. The permittee shall submit a closure plan for review and approval to the Land Application Team, Wastewater Permitting Section (MC 148) of the Water Quality Division, for any closure activity at least 90 days prior to conducting such activity. Closure is the act of permanently taking a waste management unit or treatment facility out of service and includes the permanent removal from service of any pit, tank, pond, lagoon, surface impoundment and/or other treatment unit regulated by this permit.

4. The permittee is responsible for installing prior to plant start-up, and subsequently maintaining, adequate safeguards to prevent the discharge of untreated or inadequately treated wastes during electrical power failures by means of alternate power sources, standby generators, and/or retention of inadequately treated wastewater.

5. Unless otherwise specified, the permittee shall provide a readily accessible sampling point and, where applicable, an effluent flow measuring device or other acceptable means by which effluent flow may be determined.

6. The permittee shall remit an annual water quality fee to the Commission as required by 30 TAC Chapter 21. Failure to pay the fee may result in revocation of this permit under Texas Water Code § 7.302(b)(6).

7. Documentation

   For all written notifications to the Commission required of the permittee by this permit, the permittee shall keep and make available a copy of each such notification under the same conditions as self-monitoring data are required to be kept and made available. Except for information required for TPDES permit applications, effluent data, including effluent data in permits, draft permits and permit applications, and other information specified as not confidential in 30 TAC § 1.5(d), any information submitted pursuant to this permit may be claimed as confidential by the submitter. Any such claim must be asserted in the manner prescribed in the application form or by stamping the words "confidential business information" on each page containing such information. If no claim is made at the time of submission, information may be made available to the public without further notice. If the Commission or Executive Director agrees with the designation of confidentiality, the TCEQ will not provide the information for public inspection unless required by the Texas Attorney General or a court pursuant to an open records request. If the Executive Director does not agree with the designation of confidentiality, the person submitting the information will be notified.

8. Facilities which generate domestic wastewater shall comply with the following provisions; domestic wastewater treatment facilities at permitted industrial sites are excluded.

   a. Whenever flow measurements for any domestic sewage treatment facility reach 75 percent of the permitted daily average or annual average flow for three consecutive months, the permittee must initiate engineering and financial planning for expansion and/or upgrading of the domestic wastewater treatment and/or collection facilities. Whenever the flow reaches 90 percent of the permitted daily average or annual average flow for three consecutive months, the permittee shall obtain necessary authorization from the Commission to commence construction of the necessary additional treatment and/or collection facilities. In the case of a domestic wastewater treatment facility which reaches 75 percent of the permitted daily average or annual average flow for three consecutive months, and the planned population to be served or the quantity of waste produced is not expected to exceed the design limitations of the treatment facility, the permittee shall submit an engineering report supporting this claim to the Executive Director of the Commission.

      If in the judgement of the Executive Director the population to be served will not cause permit noncompliance, then the requirement of this section may be waived. To be effective, any waiver must be in writing and signed by the Director of the Enforcement Division (MC 149) of the Commission, and such waiver of these requirements will be reviewed upon expiration of the existing permit; however, any such waiver shall not be interpreted as condoning or excusing any violation of any permit parameter.

   b. The plans and specifications for domestic sewage collection and treatment works associated with any domestic permit must be approved by the Commission, and failure to secure approval before commencing construction of such works or making a discharge is a violation of this permit and each day is an additional violation until approval has been secured.

c. Permits for domestic wastewater treatment plants are granted subject to the policy of the Commission to encourage the development of area-wide waste collection, treatment and disposal systems. The Commission reserves the right to amend any domestic wastewater permit in accordance with applicable procedural requirements to require the system covered by this permit to be integrated into an area-wide system, should such be developed; to require the delivery of the wastes authorized to be collected in, treated by or discharged from said system, to such area-wide system; or to amend this permit in any other particular to effectuate the Commission's policy. Such amendments may be made when the changes required are advisable for water quality control purposes and are feasible on the basis of waste treatment technology, engineering, financial, and related considerations existing at the time the changes are required, exclusive of the loss of investment in or revenues from any then existing or proposed waste collection, treatment or disposal system.

9. Domestic wastewater treatment plants shall be operated and maintained by sewage plant operators holding a valid certificate of competency at the required level as defined in 30 TAC Chapter 30.

10. For Publicly Owned Treatment Works (POTWs), the 30-day average (or monthly average) percent removal for BOD and TSS shall not be less than 85 percent, unless otherwise authorized by this permit.

11. Facilities which generate industrial solid waste as defined in 30 TAC § 335.1 shall comply with these provisions:

    a. Any solid waste, as defined in 30 TAC § 335.1 (including but not limited to such wastes as garbage, refuse, sludge from a waste treatment, water supply treatment plant or air pollution control facility, discarded materials, discarded materials to be recycled, whether the waste is solid, liquid, or semisolid), generated by the permittee during the management and treatment of wastewater, must be managed in accordance with all applicable provisions of 30 TAC Chapter 335, relating to Industrial Solid Waste Management.

    b. Industrial wastewater that is being collected, accumulated, stored, or processed before discharge through any final discharge outfall, specified by this permit, is considered to be industrial solid waste until the wastewater passes through the actual point source discharge and must be managed in accordance with all applicable provisions of 30 TAC Chapter 335.

    c. The permittee shall provide written notification, pursuant to the requirements of 30 TAC § 335.8(b)(1), to the Environmental Cleanup Section (MC 127) of the Remediation Division informing the Commission of any closure activity involving an Industrial Solid Waste Management Unit, at least 90 days prior to conducting such an activity.

    d. Construction of any industrial solid waste management unit requires the prior written notification of the proposed activity to the Registration and Reporting Section (MC 129) of the Permitting and Remediation Support Division. No person shall dispose of industrial solid waste, including sludge or other solids from wastewater treatment processes, prior to fulfilling the deed recordation requirements of 30 TAC § 335.5.

    e. The term "industrial solid waste management unit" means a landfill, surface impoundment, waste-pile, industrial furnace, incinerator, cement kiln, injection well, container, drum, salt dome waste containment cavern, or any other structure vessel, appurtenance, or other improvement on land used to manage industrial solid waste.

    f. The permittee shall keep management records for all sludge (or other waste) removed from any wastewater treatment process. These records shall fulfill all applicable requirements of 30 TAC Chapter 335 and must include the following, as it pertains to wastewater treatment and discharge:

        i. Volume of waste and date(s) generated from treatment process;
        ii. Volume of waste disposed of on-site or shipped off-site;
        iii. Date(s) of disposal;
        iv. Identity of hauler or transporter;
        v. Location of disposal site; and
        vi. Method of final disposal.

    The above records shall be maintained on a monthly basis. The records shall be retained at the facility site, or shall be readily available for review by authorized representatives of the TCEQ for at least five years.

12. For industrial facilities to which the requirements of 30 TAC Chapter 335 do not apply, sludge and solid wastes, including tank cleaning and contaminated solids for disposal, shall be disposed of in accordance with Chapter 361 of the Texas Health and Safety Code.

OTHER REQUIREMENTS

1. Violations of daily maximum limitations for the following pollutants shall be reported orally or by facsimile to TCEQ Region 5, within 24 hours from the time the permittee becomes aware of the violation followed by a written report within five working days to TCEQ Region 5 and the Enforcement Division (MC 224):

POLLUTANT	MAL (mg/L)
Copper (Total)	0.030
Selenium (Total)	0.010

Test methods utilized shall be sensitive enough to demonstrate compliance with the permit effluent limitations. Permit compliance/noncompliance determinations will be based on the effluent limitations contained in this permit with consideration given to the minimum analytical level (MAL) for the parameters specified above.

When an analysis of an effluent sample for any of the parameters listed above indicates no detectable levels above the MAL and the test method detection level is as sensitive as the specified MAL, a value of zero (0) shall be used for that measurement when determining calculations and reporting requirements for the self-reporting form. This applies to determinations of daily maximum concentration, calculations of loading and daily averages, and other reportable results.

When a reported value is zero (0) based on this MAL provision, the permittee shall submit the following statement with the self-reporting form either as a separate attachment to the form or as a statement in the comments section of the form.

"The reported value(s) of zero (0) for ______ [list parameter(s)] ______ on the self-reporting form for___ [monitoring period date range]___ is based on the following conditions: 1) the analytical method used had a method detection level as sensitive as the MAL specified in the permit, and 2) the analytical results contained no detectable levels above the specified MAL."

When an analysis of an effluent sample for a parameter indicates no detectable levels and the test method detection level is not as sensitive as the MAL specified in the permit, or an MAL is not specified in the permit for that parameter, the level of detection achieved shall be used for that measurement when determining calculations and reporting requirements for the self-reporting form. A zero (0) may not be used.

2. DEFINITIONS

A. The term "10-year, 24-hour rainfall event" shall mean a rainfall event with the probable recurrence interval of once in ten years as defined by the National Weather Service in Technical Paper No. 40, "Rainfall Frequency Atlas of the United States," May 1961, and subsequent amendments, or equivalent regional or state rainfall event and facility design, construction, and operation resides with the permittee.

B. Daily average temperature is defined as the flow weighted average temperature (FWAT) shall be computed and recorded on a daily basis. FWAT shall be computed at equal time intervals not greater than two hours. The method of calculating FWAT is as follows:

$$\text{FWAT} = \frac{\text{SUMMATION (INSTANTANEOUS FLOW X INSTANTANEOUS TEMPERATURE)}}{\text{SUMMATION (INSTANTANEOUS FLOW)}}$$

The "daily average temperature" shall be the arithmetic average of all FWAT's calculated during the calendar month.

The "daily maximum temperature" shall be the highest FWAT calculated during the calendar month.

C. The term "total residual chlorine" (or total residual oxidants for intake water with bromides) means the value obtained using the amperometric method for total residual chlorine described in 40 CFR Part 136. The permittee may use the DPD spectrophotometric method (EPA Method 330.5) upon written notification of the Executive Director, provided that EPA has modified the existing effluent limitation guidelines (40 CFR Part 423) or has provided the permittee with documentation that this new test method is appropriate for use by steam electric power generating facilities.

The term "free available chlorine" shall mean the value obtained using the amperometric titration method for free available chlorine described in "Standard Methods for the Examination of Water and Wastewater".

Total residual chlorine may not be discharged from any single generating unit for more than two hours per day unless the discharger demonstrates to the permitting authority that discharge for more than two hours is required for macroinvertebrate control.

Simultaneous multi-unit chlorination is not permitted.

D. The term "metal cleaning waste" means any wastewater resulting from cleaning (with or without chemical compounds) any metal process equipment including, but not limited to, boiler tube cleaning, boiler fireside cleaning, and air preheater cleaning.

The term "chemical metal cleaning waste" means any wastewater resulting from the cleaning of any metal process equipment with chemical compounds, including, but not limited to, boiler tube cleaning.

E. The term "low volume waste sources" includes "utility waste waters" and "water treatment wastes". "Utility waste waters" include, but are not limited to: wet scrubber air pollution control systems, evaporator blowdown, boiler blowdown, laboratory and sampling streams, floor drainage, cooling tower basin cleaning wastes, and blowdown from recirculating house service water systems. "Water treatment wastes" include, but are not limited to: ion exchange water treatment system wastes, demineralizer backwash, cold lime water treatment wastes, reverse osmosis waste, and water treatment system filter backwash. Sanitary and air conditioning wastes are not included.

F. The term "once through cooling water" means water passed through the main cooling condensers in one or two passes for the purpose of removing waste heat.

G. The term "ash transport water" shall mean water used in the transport of either fly ash or bottom ash.

H. The term "coal pile runoff" means the rainfall runoff from or through any coal, ash, or other material storage pile.

Any untreated overflow from facilities designed, constructed, and operated to treat the volume of "coal pile runoff" which is associated with a 10-year, 24-hour rainfall event shall not be subject to the limitations specified on page 2 of this permit. The burden of proof regarding the rainfall event and facility design, construction, and operation resides with the permittee.

3. There shall be no discharge of polychlorinated biphenyl compounds, such as those commonly used for transformer fluid.

4. This provision supersedes and replaces Provision 1, Paragraph 1 of <u>Monitoring and Reporting Requirements</u> found on Page 4 of this permit.

Monitoring results shall be provided at the intervals specified in the permit. Unless otherwise specified in this permit or otherwise ordered by the Commission, the permittee shall conduct effluent sampling and reporting in accordance with 30 TAC §§ 319.4 - 319.12. Unless otherwise specified, a monthly effluent report shall be submitted each month, to the location(s) specified on the reporting form or the instruction sheet, by the 25th day of the following month for each discharge which is described by this permit whether or not a discharge is made for that month. Monitoring results must be reported on the approved TPDES self-report form, Discharge Monitoring Report (DMR) Form EPA No. 3320-1, signed and certified as required by Monitoring and Reporting Requirements No. 10.

5. The following table describes the ponds authorized by this permit:

Pond No.	Wastewater Type	Surface Area (Acres)	Capacity (Acre-feet)	Liner Type
1 - Primary Ash Pond	Ash transport water, low volume waste, coal pile runoff	20	200	Native clay
2 - Secondary Ash Pond	Ash transport water, low volume waste, coal pile runoff	4.5	45	Native clay
3 - Acid Wash Pond	Metal cleaning wastes	0.5	1.6	Native clay
4 - Ash Pond	Ash transport water, low volume waste, coal pile runoff	17.5	111	Synthetic

6. All newly constructed process wastewater ponds shall be lined in compliance with one of the following requirements:

   a. Soil Liner: The soil liner shall contain at least 3 feet of clay-rich (liquid limit greater than or equal to 30 and plasticity index greater than or equal to 15) soil material along the sides and bottom of the pond compacted in lifts of no more than 9 inches, to 95% standard proctor density at the optimum moisture content to achieve a permeability equal to or less than 1 x 10^{-7} cm/sec.

   b. Plastic/Rubber Liner: The liner shall be either a plastic or rubber membrane liner at least 30 mils in thickness which completely covers the sides and the bottom of the pond and which is not subject to degradation due to reaction with wastewater with which it will come into contact. If this lining material is vulnerable to ozone or ultraviolet deterioration it should be covered with a protective layer of soil of at least 6 inches. A leak detection system is also required.

   c. Alternate Liner: The permittee shall submit plans for any other pond lining method. Pond liner plans must be approved in writing by the Executive Director of the Texas Commission on Environmental Quality prior to pond construction.

   The permittee shall notify the Texas Commission on Environmental Quality Regional Office upon completion of construction of the pond and at least a week prior to its use. Certification of the lining specifications shall be provided by a Texas licensed professional engineer and shall be available for inspection by TCEQ personnel upon request. For new construction, the certification and the test results of soils forming the bottom and sides of the pond shall be submitted to the TCEQ, Wastewater Permitting Section (MC-148) and Regional Office for review prior to discharging any wastewaters into the ponds. Permeability tests shall be made with material typical of the expected use.

7. All wastewater retention ponds shall be operated in such a manner as to maintain a minimum freeboard of two feet.

8. All coal shall be stored in such a manner that storm water runoff is diverted to the ash ponds.

9. This requirement is applicable to the treatment and disposal of domestic wastewater at Outfall 103 only.

   On-site disposal of sewage sludge is not authorized. The permittee shall ensure that all sewage sludge which is not a hazardous waste (as defined in 30 TAC Chapter 335) is handled, transported, and disposed of in compliance with the applicable provisions of 30 TAC Chapter 312. The permittee shall ensure that all sewage sludge which is a hazardous waste (as defined in 30 TAC Chapter 335) is handled, transported, and disposed of in compliance with the applicable provisions of 30 TAC Chapter 335. The permittee shall keep records of all sludges removed from the wastewater treatment plant site. Such records will include the following information:

a. Volume (dry weight basis) of sludge disposed
b. Date of disposal
c. Identity and registration number of hauler
d. Location and registration or permit number of disposal site
e. Method of final disposal

The above records shall be maintained on a monthly basis and be available at the plant site for inspection by authorized representatives of the Texas Commission on Environmental Quality for at least five years.

10. For Outfalls 001 and 003, toxic criteria apply at the edge of the mixing zone. The mixing zone is defined as a volume of water within a radius of 100 feet extending over the receiving water from the pont where the discharges reach Welsh Reservoir.

11. Welsh Reservoir is permitted as an industrial cooling impoundment under Certification of Adjudication No. 04-4576, and is exempt from numeric temperature criteria or a maximum temperature differential as provided in 30 TAC §307.4(f). Welsh Reservoir shall be maintained as to not interfere with the reasonable use of such waters.

12. The permittee shall comply with all necessary sampling requirements in the Selenium Monitoring Program, Welsh Reservoir, as approved by the Executive Director. Revisions to the Selenium Monitoring Program must be approved by the Water Quality Assessment Team (MC-150), Water Quality Division, TCEQ prior to initiating any modifications.

13. This facility is subject to Title 40 Code of Federal Regulations Part 125, Subpart J. The permittee shall submit Worksheet 11.0 of the Industrial Technical Report (and all required information therein) and the completed Comprehensive Demonstration Study (where required by 40 CFR Part 125, Subpart J) to the Industrial Team (MC-148) of the Water Quality Division no later than January 7, 2008.

CHRONIC BIOMONITORING REQUIREMENTS: FRESHWATER

The provisions of this Section apply to Outfalls 001 and 003 for whole effluent toxicity testing (biomonitoring).

1. Scope, Frequency and Methodology

a. The permittee shall test the effluent for toxicity in accordance with the provisions below. Such testing will determine if an appropriately dilute effluent sample adversely affects the survival, reproduction, or growth of the test organisms.

b. The permittee shall conduct the following toxicity tests utilizing the test organisms, procedures and quality assurance requirements specified in this Part of the permit and in accordance with "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, Fourth Edition" (EPA-821-R-02-013), or the most recent update thereof:

1) Chronic static renewal survival and reproduction test using the water flea (*Ceriodaphnia dubia*) (Method 1002.0 or the most recent update thereof). This test should be terminated when 60% of the surviving adults in the control produce three broods. This test shall be conducted once per quarter.

2) Chronic static renewal 7-day larval survival and growth test using the fathead minnow (*Pimephales promelas*) (Method 1000.0 or the most recent update thereof). A minimum of five replicates with eight organisms per replicate shall be used in the control and in each dilution. This test shall be conducted once per quarter.

The permittee must perform and report a valid test for each test species during the prescribed reporting period. An invalid test must be repeated during the same reporting period. An invalid test is herein defined as any test failing to satisfy the test acceptability criteria, procedures, and quality assurance requirements specified in the test methods and permit. All test results, valid or invalid, must be submitted as described below.

c. The permittee shall use five effluent dilution concentrations and a control in each toxicity test. These additional effluent concentrations are 8%, 10%, 14%, 18%, and 24% effluent for Outfall 001, and 32%, 42%, 56% , 75%, and 100% for Outfall 003. The critical dilution, defined as 18% effluent for Outfall 001 and 100% for Outfall 003, is the effluent concentration representative of the proportion of effluent in the receiving water during critical low flow or critical mixing conditions.

d. This permit may be amended to require a Whole Effluent Toxicity (WET) limit, Chemical-Specific (CS) limits, a Best Management Practice (BMP), additional toxicity testing, and/or other appropriate actions to address toxicity. The permittee may be required to conduct additional biomonitoring tests and/or a Toxicity Reduction Evaluation (TRE) if biomonitoring data indicate multiple numbers of unconfirmed toxicity events.

e. Testing Frequency Reduction

1) If none of the first four consecutive quarterly tests demonstrates significant lethal or sub-lethal effects, the permittee may submit this information in writing and, upon approval from the Water Quality Standards Team, reduce the testing frequency to once per six months for the invertebrate test species and once per year for the vertebrate test species.

2) If one or more of the first four consecutive quarterly tests demonstrates significant sub-lethal effects, the permittee shall continue quarterly testing for that species until four consecutive quarterly tests demonstrate no significant sub-lethal effects. At that time, the permittee may apply for the appropriate testing frequency reduction for that species.

3) If one or more of the first four consecutive quarterly tests demonstrates significant lethal effects, the permittee shall continue quarterly testing for that species until the permit is reissued. If a

testing frequency reduction had been previously granted and a subsequent test demonstrates significant lethal effects, the permittee will resume a quarterly testing frequency for that species until the permit is reissued.

2. Required Toxicity Testing Conditions

a. Test Acceptance - The permittee shall repeat any toxicity test, including the control and all effluent dilutions, which fails to meet any of the following criteria:

1) a control mean survival of 80% or greater;

2) a control mean number of water flea neonates per surviving adult of 15 or greater;

3) a control mean dry weight of surviving fathead minnow larvae of 0.25 mg or greater;

4) a control Coefficient of Variation percent (CV%) of 40 or less between replicates for the young of surviving females in the water flea reproduction and survival test; and the growth and survival endpoints in the fathead minnow growth and survival test.

5) a critical dilution CV% of 40 or less for young of surviving females in the water flea reproduction and survival test; and the growth and survival endpoints for the fathead minnow growth and survival test. However, if statistically significant lethal or nonlethal effects are exhibited at the critical dilution, a CV% greater than 40 shall not invalidate the test.

6) a Percent Minimum Significant Difference of 47 or less for water flea reproduction;

7) a Percent Minimum Significant Difference of 30 or less for fathead minnow growth.

b. Statistical Interpretation

1) For the water flea survival test, the statistical analyses used to determine if there is a significant difference between the control and an effluent dilution shall be Fisher's Exact Test as described in the "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, Fourth Edition" (EPA-821-R-02-013), or the most recent update thereof.

2) For the water flea reproduction test and the fathead minnow larval survival and growth tests, the statistical analyses used to determine if there is a significant difference between the control and an effluent dilution shall be in accordance with the methods described in the "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, Fourth Edition" (EPA-821-R-02-013), or the most recent update thereof.

3) The permittee is responsible for reviewing test concentration-response relationships to ensure that calculated test-results are interpreted and reported correctly. The EPA manual, "Method Guidance and Recommendation for Whole Effluent Toxicity (WET) Testing (40 CFR Part 136)" (EPA 821-B-00-004) provides guidance on determining the validity of test results.

4) If significant lethality is demonstrated (that is, there is a statistically significant difference in survival at the critical dilution when compared to the control), the conditions of test acceptability are met, and the survival of the test organisms are equal to or greater than 80% in the critical dilution and all dilutions below that, then the permittee shall report a survival No Observed Effect Concentration (NOEC) of not less than the critical dilution for the reporting requirements.

5) The NOEC is defined as the greatest effluent dilution at which no significant effect is demonstrated. The Lowest Observed Effect Concentration (LOEC) is defined as the lowest effluent dilution at which a significant effect is demonstrated. A significant effect is herein defined as a statistically significant difference at the 95% confidence level between the survival,

reproduction, or growth of the test organism(s) in a specified effluent dilution compared to the survival, reproduction, or growth of the test organism(s) in the control (0% effluent).

6) The use of NOECs and LOECs assumes either a monotonic (continuous) concentration-response relationship or a threshold model of the concentration-response relationship. For any test result that demonstrates a non-monotonic (non-continuous) response, the NOEC should be determined based on the guidance manual referenced in Item 3 above and a full report will be submitted to the Water Quality Standards Team

7) Pursuant to the responsibility assigned to the permittee in Part 2.b.3), test results that demonstrate a non-monotonic (non-continuous) concentration-response relationship may be submitted, prior to the due date, for technical review. The above-referenced guidance manual will be used when making a determination of test acceptability

8) The Water Quality Standards Team will review test results (i.e., Table 1 and Table 2 forms) for consistency with established TCEQ rules, procedures, and permit requirements.

c. Dilution Water

1) Dilution water used in the toxicity tests shall be the receiving water collected as close as possible to the discharge point, but unaffected by the discharge.

2) Where the receiving water proves unsatisfactory as a result of preexisting instream toxicity (i.e. fails to fulfill the test acceptance criteria of item 2.a.), the permittee may substitute synthetic dilution water for the receiving water in all subsequent tests provided the unacceptable receiving water test met the following stipulations:

a) a synthetic lab water control was performed (in addition to the receiving water control) which fulfilled the test acceptance requirements of item 2.a;

b) the test indicating receiving water toxicity was carried out to completion (i.e., 7 days);

c) the permittee submitted all test results indicating receiving water toxicity with the reports and information required in Part 3 of this Section.

The synthetic dilution water shall have a pH, hardness, and alkalinity similar to that of the receiving water or a natural water in the drainage basin that is unaffected by the discharge, provided the magnitude of these parameters will not cause toxicity in a synthetic dilution water control that has been formulated to match the pH, hardness, and alkalinity naturally found in the receiving water. Upon approval, the permittee may substitute other appropriate dilution water with chemical and physical characteristics similar to that of the receiving water.

d. Samples and Composites

1) The permittee shall collect a minimum of three flow-weighted 24-hour composite samples from Outfall 001 and 003. The second and third 24-hour composite samples will be used for the renewal of the dilution concentrations for each toxicity test. A 24-hour composite sample consists of a minimum of 12 effluent portions collected at equal time intervals representative of a 24-hour operating day and combined proportionally to flow, or a sample continuously collected proportionally to flow over a 24-hour operating day.

The permittee shall combine the effluent composite samples in proportion to the average flow from each outfall defined in item 1.a for the day the sample was collected. The permittee shall perform the toxicity test on the flow-weighted composite of the combined outfall samples.

2) The permittee shall collect the 24-hour composite samples such that the samples are representative of any periodic episode of chlorination, biocide usage, or other potentially toxic

substance discharged on an intermittent basis.

3) The permittee shall initiate the toxicity tests within 36 hours after collection of the last portion of the first 24-hour composite sample. The holding time for any subsequent 24-hour composite sample shall not exceed 72 hours. Samples shall be maintained at a temperature of 0-6 degrees Centigrade during collection, shipping, and storage.

4) If flow from the outfall being tested ceases during the collection of effluent samples, the requirements for the minimum number of effluent samples, the minimum number of effluent portions, and the sample holding time, are waived during that sampling period. However, the permittee must have collected an effluent composite sample volume sufficient to complete the required toxicity tests with daily renewal of the effluent. When possible, the effluent samples used for the toxicity tests shall be collected on separate days if the discharge occurs over multiple days. The effluent composite sample collection duration and the static renewal protocol associated with the abbreviated sample collection must be documented in the full report required in Part 3 of this Section.

3. Reporting

All reports, tables, plans, summaries, and related correspondence required in any Part of this Section shall be submitted to the attention of the Water Quality Standards Team (MC 150) of the Water Quality Division. All DMRs, including DMRs with biomonitoring data, should be sent to the Enforcement Division (MC 224).

a. The permittee shall prepare a full report of the results of all tests conducted pursuant to this permit in accordance with the Report Preparation Section of "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, Fourth Edition" (EPA-821-R-02-013), or the most recent update thereof, for every valid and invalid toxicity test initiated whether carried to completion or not. All full reports shall be retained for 3 years at the plant site and shall be available for inspection by TCEQ personnel.

b. A full report must be submitted with the first valid biomonitoring test results for each test species and with the first test results any time the permittee subsequently employs a different test laboratory. Full reports need not be submitted for subsequent testing unless specifically requested. The permittee shall routinely report the results of each biomonitoring test on the Table 1 forms provided with this permit. All Table 1 reports must include the information specified in the Table 1 form attached to this permit.

1) Annual biomonitoring test results are due on or before January 20th for biomonitoring conducted during the previous 12 month period.

2) Semiannual biomonitoring test results are due on or before July 20th and January 20th for biomonitoring conducted during the previous 6 month period.

3) Quarterly biomonitoring test results are due on or before April 20th, July 20th, October 20th, and January 20th, for biomonitoring conducted during the previous calendar quarter.

4) Monthly biomonitoring test results are due on or before the 20th day of the month following sampling.

c. Enter the following codes on the DMR for the appropriate parameters for valid tests only:

1) For the water flea, Parameter TLP3B, enter a "1" if the NOEC for survival is less than the critical dilution; otherwise, enter a "0."

2) For the water flea, Parameter TOP3B, report the NOEC for survival.

3) For the water flea, Parameter TXP3B, report the LOEC for survival.

4) For the water flea, Parameter TWP3B, enter a "1" if the NOEC for reproduction is less than the critical dilution; otherwise, enter a "0."

5) For the water flea, Parameter TPP3B, report the NOEC for reproduction.

6) For the water flea, Parameter TYP3B, report the LOEC for reproduction.

7) For the fathead minnow, Parameter TLP6C,enter a "1" if the NOEC for survival is less than the critical dilution; otherwise, enter a "0."

8) For the fathead minnow, Parameter TOP6C, report the NOEC for survival.

9) For the fathead minnow, Parameter TXP6C, report the LOEC for survival.

10) For the fathead minnow, Parameter TWP6C,enter a "1" if the NOEC for growth is less than the critical dilution; otherwise, enter a "0."

11) For the fathead minnow, Parameter TPP6C, report the NOEC for growth.

12) For the fathead minnow, Parameter TYP6C, report the LOEC for growth

d. Enter the following codes on the DMR for retests only:

1) For retest number 1, Parameter 22415, enter a "1" if the NOEC for survival is less than the critical dilution; otherwise, enter a "0."

2) For retest number 2, Parameter 22416, enter a "1" if the NOEC for survival is less than the critical dilution; otherwise, enter a "0."

4. Persistent Toxicity

The requirements of this Part apply only when a test demonstrates a significant effect at the critical dilution. A significant effect is defined as a statistically significant difference, at the 95% confidence level, between a specified endpoint (survival, growth, or reproduction) of the test organism in a specified effluent dilution when compared to the specified endpoint of the test organism in the control. Significant lethality is defined as a statistically significant difference in survival at the critical dilution when compared to the survival of the test organism in the control. Significant sublethality is defined as a statistically significant difference in growth/reproduction at the critical dilution when compared to the growth/reproduction of the test organism in the control.

a. The permittee shall conduct a total of 2 additional tests (retests) for any species that demonstrates a significant effect (lethal or sublethal) at the critical dilution. The two retests shall be conducted monthly during the next two consecutive months. The permittee shall not substitute either of the two retests in lieu of routine toxicity testing. All reports shall be submitted within 20 days of test completion. Test completion is defined as the last day of the test. The retests shall also be reported on the DMRs as specified in Part 3.d.

b. If the retests are performed due to a demonstration of significant lethality, and one or both of the two retests specified in item 4.a. demonstrates significant lethality, the permittee shall initiate the TRE requirements as specified in Part 5. The provisions of item 4.a. are suspended upon completion of the two retests and submittal of the TRE Action Plan and Schedule defined in Part 5.

If neither test demonstrates significant lethality and the permittee is testing under the reduced testing frequency provision of Part 1.e., the permittee shall return to a quarterly testing frequency for that species.

c. If the two retests are performed due to a demonstration of significant sublethality, and one or both of the two retests specified in item 4.a. demonstrates significant lethality, the permittee shall again perform two retests as stipulated in item 4.a.

d. If the two retests are performed due to a demonstration of significant sublethality, and both retests pass, the permittee shall continue testing at the quarterly frequency until such time that the permittee can invoke the reduced testing frequency provision specified in Part 1.e.

e. Regardless of whether retesting for lethal or sublethal effects, or a combination of the two, no more than one retest per month is required for a species.

5. Toxicity Reduction Evaluation

a. Within 45 days of the last test day of the retest that demonstrates significant lethality, the permittee shall submit a General Outline for initiating a TRE. The outline shall include, but not be limited to, a description of project personnel, a schedule for obtaining consultants (if needed), a discussion of influent and/or effluent data available for review, a sampling and analytical schedule, and a proposed TRE initiation date.

b. Within 90 days of the last test day of the retest that demonstrates significant lethality, the permittee shall submit a TRE Action Plan and Schedule for conducting a TRE. The plan shall specify the approach and methodology to be used in performing the TRE. A Toxicity Reduction Evaluation is a step-wise investigation combining toxicity testing with physical and chemical analysis to determine actions necessary to eliminate or reduce effluent toxicity to a level not effecting significant lethality at the critical dilution. The TRE Action Plan shall lead to the successful elimination of significant lethal effects at the critical dilution for both test species defined in item 1.b. As a minimum, the TRE Action Plan shall include the following:

1) Specific Activities - The TRE Action Plan shall specify the approach the permittee intends to utilize in conducting the TRE, including toxicity characterizations, identifications, confirmations, source evaluations, treatability studies, and/or alternative approaches. When conducting characterization analyses, the permittee shall perform multiple characterizations and follow the procedures specified in the document entitled, "Toxicity Identification Evaluation: Characterization of Chronically Toxic Effluents, Phase I" (EPA/600/6-91/005F), or alternate procedures. The permittee shall perform multiple identifications and follow the methods specified in the documents entitled, "Methods for Aquatic Toxicity Identification Evaluations, Phase II Toxicity Identification Procedures for Samples Exhibiting Acute and Chronic Toxicity" (EPA/60-0/R-92/080) and "Methods for Aquatic Toxicity Identification Evaluations, Phase III Toxicity Confirmation Procedures for Samples Exhibiting Acute and Chronic Toxicity" (EPA/600/R-92/081). All characterization, identification, and confirmation tests shall be conducted in an orderly and logical progression;

2) Sampling Plan - The TRE Action Plan should describe sampling locations, methods, holding times, chain of custody, and preservation techniques. The effluent sample volume collected for all tests shall be adequate to perform the toxicity characterization/ identification/ confirmation procedures, and chemical-specific analyses when the toxicity tests show significant lethality. Where the permittee has identified or suspects specific pollutant(s) and/or source(s) of effluent toxicity, the permittee shall conduct, concurrent with toxicity testing, chemical-specific analyses for the identified and/or suspected pollutant(s) and/or source(s) of effluent toxicity;

3) Quality Assurance Plan - The TRE Action Plan should address record keeping and data evaluation, calibration and standardization, baseline tests, system blanks, controls, duplicates, spikes, toxicity persistence in the samples, randomization, reference toxicant control charts, as well as mechanisms to detect artifactual toxicity; and

4) Project Organization - The TRE Action Plan should describe the project staff, project manager, consulting engineering services (where applicable), consulting analytical and toxicological services, etc.

c. Within 30 days of submittal of the TRE Action Plan and Schedule, the permittee shall implement the TRE with due diligence.

d. The permittee shall submit quarterly TRE Activities Reports concerning the progress of the TRE. The quarterly reports are due on or before April 20th, July 20th, October 20th, and January 20th. The report shall detail information regarding the TRE activities including:

1) results and interpretation of any chemical specific analyses for the identified and/or suspected pollutant(s) performed during the quarter;

2) results and interpretation of any characterization, identification, and confirmation tests performed during the quarter;

3) any data and/or substantiating documentation which identifies the pollutant(s) and/or source(s) of effluent toxicity;

4) results of any studies/evaluations concerning the treatability of the facility's effluent toxicity;

5) any data which identifies effluent toxicity control mechanisms that will reduce effluent toxicity to the level necessary to meet no significant lethality at the critical dilution; and

6) any changes to the initial TRE Plan and Schedule that are believed necessary as a result of the TRE findings.

Copies of the TRE Activities Report shall also be submitted to the U.S. EPA Region 6 office.

e. During the TRE, the permittee shall perform, at a minimum, quarterly testing using the more sensitive species; testing for the less sensitive species shall continue at the frequency specified in Part 1.b.

f. If the effluent ceases to effect significant lethality (herein as defined below) the permittee may end the TRE. A "cessation of lethality" is defined as no significant lethality for a period of 12 consecutive months with at least monthly testing. At the end of the 12 months, the permittee shall submit a statement of intent to cease the TRE and may then resume the testing frequency specified in Part 1.b. The permittee may only apply the "cessation of lethality" provision once.

This provision accommodate situations where operational errors and upsets, spills, or sampling errors triggered the TRE, in contrast to a situation where a single toxicant or group of toxicants cause lethality. This provision does not apply as a result of corrective actions taken by the permittee. "Corrective actions" are herein defined as proactive efforts which eliminate or reduce effluent toxicity. These include, but are not limited to, source reduction or elimination, improved housekeeping, changes in chemical usage, and modifications of influent streams and/or effluent treatment.

The permittee may only apply this cessation of lethality provision once. If the effluent again demonstrates significant lethality to the same species, the permit will be amended to add a WET limit with a compliance period, if appropriate. However, prior to the effective date of the WET limit, the permittee may apply for a permit amendment removing and replacing the WET limit with an alternate toxicity control measure by identifying and confirming the toxicant and/or an appropriate control measure.

g. The permittee shall complete the TRE and submit a Final Report on the TRE Activities no later than 28 months from the last test day of the retest that confirmed significant lethal effects at the critical dilution. The permittee may petition the Executive Director (in writing) for an extension of the 28-month limit. However, to warrant an extension the permittee must have demonstrated due diligence in their pursuit of the TIE/TRE and must prove that circumstances beyond their control stalled the TIE/TRE. The report shall provide information pertaining to the specific control mechanism(s) selected that will, when implemented, result in reduction of effluent toxicity to no significant lethality at the critical dilution. The report will also provide a specific corrective action schedule for implementing the selected control mechanism(s). A copy of the TRE Final Report shall also be submitted to the U.S. EPA Region 6 office.

h. Based upon the results of the TRE and proposed corrective actions, this permit may be amended to modify the biomonitoring requirements, where necessary, to require a compliance schedule for implementation of corrective actions, to specify a WET limit, to specify a BMP, and/or to specify CS limits.

TABLE 1 (SHEET 1 OF 4)

BIOMONITORING REPORTING OUTFALL 001

CERIODAPHNIA DUBIA SURVIVAL AND REPRODUCTION

			Date Time		Date Time
Dates and Times Composites Collected	No. 1	FROM:	________	TO:	________
	No. 2	FROM:	________	TO:	________
	No. 3	FROM:	________	TO:	________

Test initiated:________________am/pm ________________date

Dilution water used: _______ Receiving Water ______ Synthetic Dilution Water

NUMBER OF YOUNG PRODUCED PER ADULT AT END OF TEST

	Percent effluent (%)					
REP	0%	8%	10%	14%	18%	24%
A						
B						
C						
D						
E						
F						
G						
H						
I						
J						
Surviv. Mean						
Total Mean						
CV%*						
PMSD	Acceptable Range 13-47					

*coefficient of variation = standard deviation x 100/mean (calculation based on young of the surviving adults)

Designate males (M), and dead females (D), along with number of neonates (x) released prior to death.

TABLE 1 (SHEET 2 OF 4)

BIOMONITORING REPORTING OUTFALL 001

CERIODAPHNIA DUBIA SURVIVAL AND REPRODUCTION TEST

1. Dunnett's Procedure or Steel's Many-One Rank Test or Wilcoxon Rank Sum Test (with Bonferroni adjustment) or t-test (with Bonferroni adjustment) as appropriate:

   Is the mean number of young produced per adult significantly less (p=0.05) than the number of young per adult in the control for the % effluent corresponding to significant nonlethal effects?

   CRITICAL DILUTION (18%): ______ YES ______ NO

PERCENT SURVIVAL

	Percent effluent (%)					
Time of Reading	0%	8%	10%	14%	18%	24%
24h						
48h						
End of Test						

2. Fisher's Exact Test:

   Is the mean survival at test end significantly less (p=0.05) than the control survival for the % effluent corresponding to lethality?

   CRITICAL DILUTION (18%): ______ YES ______ NO

3. Enter percent effluent corresponding to each NOEC\LOEC below :

   a.) NOEC survival = _________% effluent

   b.) LOEC survival = _________% effluent

   c.) NOEC reproduction = _________% effluent

   d.) LOEC reproduction = _________% effluent

TABLE 1 (SHEET 3 OF 4)

BIOMONITORING REPORTING OUTFALL 001

FATHEAD MINNOW LARVAE GROWTH AND SURVIVAL

			Date Time		Date Time
Dates and Times Composites Collected	No. 1	FROM:	______________	TO:	______________
	No. 2	FROM:	______________	TO:	______________
	No. 3	FROM:	______________	TO:	______________

Test initiated:_________________am/pm _________________date

Dilution water used: _______ Receiving Water _______ Synthetic Dilution Water

FATHEAD MINNOW GROWTH DATA

Effluent Concentration (%)	Average Dry Weight in milligrams in replicate chambers					Mean Dry Weight	CV%*
	A	B	C	D	E		
0%							
8%							
10%							
14%							
18%							
24%							
PMSD	Acceptable Range 12-30						

* coefficient of variation = standard deviation x 100/mean

1. Dunnett's Procedure or Steel's Many-One Rank Test or Wilcoxon Rank Sum Test (with Bonferroni adjustment) or t-test (with Bonferroni adjustment) as appropriate:

   Is the mean dry weight (growth) at 7 days significantly less (p=0.05) than the control's dry weight (growth) for the % effluent corresponding to significant nonlethal effects?

   CRITICAL DILUTION (18%): ______ YES ______ NO

TABLE 1 (SHEET 4 OF 4)

BIOMONITORING REPORTING OUTFALL 001

FATHEAD MINNOW GROWTH AND SURVIVAL TEST

FATHEAD MINNOW SURVIVAL DATA

Effluent Concentration (%)	Percent Survival in replicate chambers					Mean percent survival			CV%*
	A	B	C	D	E	24h	48h	7 day	
0%									
8%									
10%									
14%									
18%									
24%									

* coefficient of variation = standard deviation x 100/mean

2. Dunnett's Procedure or Steel's Many-One Rank Test or Wilcoxon Rank Sum Test (with Bonferroni adjustment) or t-test (with Bonferroni adjustment) as appropriate:

   Is the mean survival at 7 days significantly less (p=0.05) than the control survival for the % effluent corresponding to lethality?

   CRITICAL DILUTION (18%): ______ YES ______ NO

3. Enter percent effluent corresponding to each NOEC/LOEC below:

   a.) NOEC survival = _________% effluent

   b.) LOEC survival = _________% effluent

   c.) NOEC growth = _________% effluent

   d.) LOEC growth = _________% effluent

TABLE 1 (SHEET 1 OF 4)

BIOMONITORING REPORTING OUTFALL 003

CERIODAPHNIA DUBIA SURVIVAL AND REPRODUCTION

			Date Time		Date Time
Dates and Times Composites Collected	No. 1	FROM:	______________	TO:	______________
	No. 2	FROM:	______________	TO:	______________
	No. 3	FROM:	______________	TO:	______________

Test initiated:____________________am/pm ____________________date

Dilution water used: _______ Receiving Water ______ Synthetic Dilution Water

NUMBER OF YOUNG PRODUCED PER ADULT AT END OF TEST

	Percent effluent (%)					
REP	0%	32%	42%	56%	75%	100%
A						
B						
C						
D						
E						
F						
G						
H						
I						
J						
Surviv. Mean						
Total Mean						
CV%*						
PMSD	Acceptable Range 13-47					

*coefficient of variation = standard deviation x 100/mean (calculation based on young of the surviving adults)

Designate males (M), and dead females (D), along with number of neonates (x) released prior to death.

TABLE 1 (SHEET 2 OF 4)

BIOMONITORING REPORTING OUTFALL 003

CERIODAPHNIA DUBIA SURVIVAL AND REPRODUCTION TEST

1. Dunnett's Procedure or Steel's Many-One Rank Test or Wilcoxon Rank Sum Test (with Bonferroni adjustment) or t-test (with Bonferroni adjustment) as appropriate:

   Is the mean number of young produced per adult significantly less (p=0.05) than the number of young per adult in the control for the % effluent corresponding to significant nonlethal effects?

   CRITICAL DILUTION (18%): ______ YES ______ NO

PERCENT SURVIVAL

	Percent effluent (%)					
Time of Reading	0%	32%	42%	56%	75%	100%
24h						
48h						
End of Test						

2. Fisher's Exact Test:

   Is the mean survival at test end significantly less (p=0.05) than the control survival for the % effluent corresponding to lethality?

   CRITICAL DILUTION (100%): ______ YES ______ NO

3. Enter percent effluent corresponding to each NOEC\LOEC below :

   a.) NOEC survival = _________% effluent

   b.) LOEC survival = _________% effluent

   c.) NOEC reproduction = _________% effluent

   d.) LOEC reproduction = _________% effluent

TABLE 1 (SHEET 3 OF 4)

BIOMONITORING REPORTING OUTFALL 003

FATHEAD MINNOW LARVAE GROWTH AND SURVIVAL

			Date Time		Date Time
Dates and Times Composites Collected	No. 1	FROM:	________________	TO:	________________
	No. 2	FROM:	________________	TO:	________________
	No. 3	FROM:	________________	TO:	________________

Test initiated:______________________am/pm ______________________date

Dilution water used: _______ Receiving Water _______ Synthetic Dilution Water

FATHEAD MINNOW GROWTH DATA

Effluent Concentration (%)	Average Dry Weight in milligrams in replicate chambers					Mean Dry Weight	CV%*
	A	B	C	D	E		
0%							
32%							
42%							
56%							
75%							
100%							
PMSD	Acceptable Range 12-30						

* coefficient of variation = standard deviation x 100/mean

1. Dunnett's Procedure or Steel's Many-One Rank Test or Wilcoxon Rank Sum Test (with Bonferroni adjustment) or t-test (with Bonferroni adjustment) as appropriate:

   Is the mean dry weight (growth) at 7 days significantly less (p=0.05) than the control's dry weight (growth) for the % effluent corresponding to significant nonlethal effects?

   CRITICAL DILUTION (100%): ______ YES ______ NO

TABLE 1 (SHEET 4 OF 4)

BIOMONITORING REPORTING OUTFALL 003

FATHEAD MINNOW GROWTH AND SURVIVAL TEST

FATHEAD MINNOW SURVIVAL DATA

Effluent Concentration (%)	Percent Survival in replicate chambers					Mean percent survival			CV%*
	A	B	C	D	E	24h	48h	7 day	
0%									
32%									
42%									
56%									
75%									
100%									

* coefficient of variation = standard deviation x 100/mean

2. Dunnett's Procedure or Steel's Many-One Rank Test or Wilcoxon Rank Sum Test (with Bonferroni adjustment) or t-test (with Bonferroni adjustment) as appropriate:

   Is the mean survival at 7 days significantly less (p=0.05) than the control survival for the % effluent corresponding to lethality?

   CRITICAL DILUTION (100%): ______ YES ______ NO

3. Enter percent effluent corresponding to each NOEC/LOEC below:

   a.) NOEC survival = _________% effluent

   b.) LOEC survival = _________% effluent

   c.) NOEC growth = _________% effluent

   d.) LOEC growth = _________% effluent

24-HOUR ACUTE BIOMONITORING REQUIREMENTS: FRESHWATER

The provisions of this Section apply individually and separately to Outfalls 001 and 003 for whole effluent toxicity testing (biomonitoring). No samples or portions of samples from one outfall may be composited with samples or portions of samples from another outfall.

1. Scope, Frequency and Methodology

a. The permittee shall test the effluent for lethality in accordance with the provisions in this Section. Such testing will determine compliance with the Surface Water Quality Standard, 30 TAC §307.6(e)(2)(B), of greater than 50% survival of the appropriate test organisms in 100% effluent for a 24-hour period.

b. The toxicity tests specified shall be conducted once per six months. The permittee shall conduct the following toxicity tests utilizing the test organisms, procedures, and quality assurance requirements specified in this section of the permit and in accordance with "Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, Fifth Edition" (EPA-821-R-02-012), or the most recent update thereof:

1) Acute 24-hour static toxicity test using the water flea (*Daphnia pulex* or *Ceriodaphnia dubia*). A minimum of five replicates with eight organisms per replicate shall be used in the control and in each dilution.

2) Acute 24-hour static toxicity test using the fathead minnow (*Pimephales promelas*). A minimum of five replicates with eight organisms per replicate shall be used in the control and in each dilution.

The permittee must perform and report a valid test for each test species during the prescribed reporting period. An invalid test must be repeated during the same reporting period. An invalid test is herein defined as any test failing to satisfy the test acceptability criteria, procedures, and quality assurance requirements specified in the test methods and permit. All test results, valid or invalid, must be submitted as described below.

c. In addition to an appropriate control, a 100% effluent concentration shall be used in the toxicity tests. Except as discussed in item 2.b., the control and/or dilution water shall consist of a standard, synthetic, moderately hard, reconstituted water.

d. This permit may be amended to require a Whole Effluent Toxicity (WET) limit, a Best Management Practice (BMP), Chemical-Specific (CS) limits, additional toxicity testing, and/or other appropriate actions to address toxicity. The permittee may be required to conduct additional biomonitoring tests and/or a Toxicity Reduction Evaluation (TRE) if biomonitoring data indicate multiple numbers of unconfirmed toxicity events.

2. Required Toxicity Testing Conditions

a. Test Acceptance - The permittee shall repeat any toxicity test, including the control, if the control fails to meet a mean survival equal to or greater than 90%.

b. Dilution Water - In accordance with item 1.c., the control and/or dilution water shall normally consist of a standard, synthetic, moderately hard, reconstituted water. If the permittee utilizes the results of a 48-Hour Acute test or a Chronic test to satisfy the requirements in item 1.e., the permittee may use the receiving water or dilution water that meets the requirements of item 2.a. as the control and dilution water.

c. Samples and Composites

1) The permittee shall collect one flow-weighted 24-hour composite sample from Outfall 001and Outfall 003. A 24-hour composite sample consists of a minimum of 12 effluent portions collected at equal time intervals representative of a 24-hour operating day and combined proportional to flow, or a sample continuously collected proportional to flow over a 24-hour operating day.

2) The permittee shall collect the 24-hour composite samples such that the samples are representative of any periodic episode of chlorination, biocide usage, or other potentially toxic substance discharged on an intermittent basis.

3) The permittee shall initiate the toxicity tests within 36 hours after collection of the last portion of the 24-hour composite sample. Samples shall be maintained at a temperature of 0-6 degrees Centigrade during collection, shipping, and storage.

4) If the Outfall ceases discharging during the collection of the effluent composite sample, the requirements for the minimum number of effluent portions are waived. However, the permittee must have collected a composite sample volume sufficient for completion of the required test. The abbreviated sample collection, duration, and methodology must be documented in the full report required in Part 3 of this Section.

3. Reporting

All reports, tables, plans, summaries, and related correspondence required in any Part of this Section shall be submitted to the attention of the Water Quality Standards Team (MC 150) of the Water Quality Division. All DMRs, including DMRs with biomonitoring data, should be sent to the Enforcement Division (MC 224).

a. The permittee shall prepare a full report of the results of all tests conducted pursuant to this permit in accordance with the Report Preparation Section of "Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, Fifth Edition" (EPA-821-R-02-012), or the most recent update thereof, for every valid and invalid toxicity test initiated. All full reports shall be retained for three years at the plant site and shall be available for inspection by TCEQ personnel.

b. A full report must be submitted with the first valid biomonitoring test results for each test species and with the first test results any time the permittee subsequently employs a different test laboratory. Full reports need not be submitted for subsequent testing unless specifically requested. The permittee shall routinely report the results of each biomonitoring test on the Table 2 forms provided with this permit. All Table 2 reports must include the information specified in the Table 2 form attached to this permit.

1) Semiannual biomonitoring test results are due on or before January 20th and July 20th for biomonitoring conducted during the previous 6 month period.

2) Quarterly biomonitoring test results are due on or before January 20th, April 20th, July 20th, and October 20th, for biomonitoring conducted during the previous calendar quarter.

c. Enter the following codes on the DMR for the appropriate parameters for valid tests only:

1) For the water flea, Parameter TIE3D, enter a "0" if the mean survival at 24-hours is greater than 50% in the 100% effluent dilution; if the mean survival is less than or equal to 50%, enter a "1."

2) For the fathead minnow, Parameter TIE6C, enter a "0" if the mean survival at 24-hours is greater than 50% in the 100% effluent dilution; if the mean survival is less than or equal to 50%, enter a "1."

d. Enter the following codes on the DMR for retests only:

1) For retest number 1, Parameter 22415, enter a "0" if the mean survival at 24-hours is greater than 50% in the 100% effluent dilution; if the mean survival is less than or equal to 50%, enter a "1."

2) For retest number 2, Parameter 22416, enter a "0" if the mean survival at 24-hours is greater than 50% in the 100% effluent dilution; if the mean survival is less than or equal to 50%, enter a "1."

4. Persistent Mortality

The requirements of this Part apply when a toxicity test demonstrates significant lethality, here defined as a mean mortality of 50% or greater to organisms exposed to the 100% effluent concentration after 24-hours.

a. The permittee shall conduct two additional tests (retests) for each species that demonstrates significant lethality. The two retests shall be conducted once per week for two weeks. Five effluent dilution concentrations in addition to an appropriate control shall be used in the retests. These additional effluent concentrations are 6%, 13%, 25%, 50% and 100% effluent. The first retest shall be conducted within 15 days of the laboratory determination of significant lethality. All test results shall be submitted within 20 days of test completion of the second retest. Test completion is defined as the 24th hour. The retests shall also be reported on the DMRs as specified in Part 3.d.

b. If one or both of the two retests specified in item 4.a. demonstrates significant lethality, the permittee shall initiate the TRE requirements as specified in Part 5 of this Section.

5. Toxicity Reduction Evaluation

a. Within 45 days of the retest that demonstrates significant lethality, the permittee shall submit a General Outline for initiating a TRE. The outline shall include, but not be limited to, a description of project personnel, a schedule for obtaining consultants (if needed), a discussion of influent and/or effluent data available for review, a sampling and analytical schedule, and a proposed TRE initiation date.

b. Within 90 days of the retest that demonstrates significant lethality, the permittee shall submit a TRE Action Plan and Schedule for conducting a TRE. The plan shall specify the approach and methodology to be used in performing the TRE. A Toxicity Reduction Evaluation is a step-wise investigation combining toxicity testing with physical and chemical analysis to determine actions necessary to eliminate or reduce effluent toxicity to a level not effecting significant lethality at the critical dilution. The TRE Action Plan shall lead to the successful elimination of significant lethality for both test species defined in item 1.b. As a minimum, the TRE Action Plan shall include the following:

1) Specific Activities - The TRE Action Plan shall specify the approach the permittee intends to utilize in conducting the TRE, including toxicity characterizations, identifications, confirmations, source evaluations, treatability studies, and/or alternative approaches. When conducting characterization analyses, the permittee shall perform multiple characterizations and follow the procedures specified in the document entitled, "Methods for Aquatic Toxicity Identification Evaluations: Phase I Toxicity Characterization Procedures" (EPA/600/6-91/003), or alternate procedures. The permittee shall perform multiple identifications and follow the methods specified in the documents entitled, "Methods for Aquatic Toxicity Identification Evaluations, Phase II Toxicity Identification Procedures for Samples Exhibiting Acute and Chronic Toxicity" (EPA/60-0/R-92/080) and "Methods for Aquatic Toxicity Identification Evaluations, Phase III Toxicity Confirmation Procedures for Samples Exhibiting Acute and Chronic Toxicity" (EPA/600/R-92/081). All characterization, identification, and confirmation tests shall be conducted in an orderly and logical progression;

2) Sampling Plan - The TRE Action Plan should describe sampling locations, methods, holding times, chain of custody, and preservation techniques. The effluent sample volume collected for

all tests shall be adequate to perform the toxicity characterization/ identification/ confirmation procedures, and chemical-specific analyses when the toxicity tests show significant lethality. Where the permittee has identified or suspects specific pollutant(s) and/or source(s) of effluent toxicity, the permittee shall conduct, concurrent with toxicity testing, chemical-specific analyses for the identified and/or suspected pollutant(s) and/or source(s) of effluent toxicity;

3) Quality Assurance Plan - The TRE Action Plan should address record keeping and data evaluation, calibration and standardization, baseline tests, system blanks, controls, duplicates, spikes, toxicity persistence in the samples, randomization, reference toxicant control charts, as well as mechanisms to detect artifactual toxicity; and

4) Project Organization - The TRE Action Plan should describe the project staff, project manager, consulting engineering services (where applicable), consulting analytical and toxicological services, etc.

c. Within 30 days of submittal of the TRE Action Plan and Schedule, the permittee shall implement the TRE with due diligence.

d. The permittee shall submit quarterly TRE Activities Reports concerning the progress of the TRE. The quarterly TRE Activities Reports are due on or before April 20th, July 20th, October 20th, and January 20th. The report shall detail information regarding the TRE activities including:

1) results and interpretation of any chemical-specific analyses for the identified and/or suspected pollutant(s) performed during the quarter;

2) results and interpretation of any characterization, identification, and confirmation tests performed during the quarter;

3) any data and/or substantiating documentation which identifies the pollutant(s) and/or source(s) of effluent toxicity;

4) results of any studies/evaluations concerning the treatability of the facility's effluent toxicity;

5) any data which identifies effluent toxicity control mechanisms that will reduce effluent toxicity to the level necessary to eliminate significant lethality; and

6) any changes to the initial TRE Plan and Schedule that are believed necessary as a result of the TRE findings.

Copies of the TRE Activities Report shall also be submitted to the U.S. EPA Region 6 office.

e. During the TRE, the permittee shall perform, at a minimum, quarterly testing using the more sensitive species; testing for the less sensitive species shall continue at the frequency specified in Part 1.b.

f. If the effluent ceases to effect significant lethality (herein as defined below) the permittee may end the TRE. A "cessation of lethality" is defined as no significant lethality for a period of 12 consecutive weeks with at least weekly testing. At the end of the 12 weeks, the permittee shall submit a statement of intent to cease the TRE and may then resume the testing frequency specified in Part 1.b. The permittee may only apply the "cessation of lethality" provision once.

This provision accommodate situations where operational errors and upsets, spills, or sampling errors triggered the TRE, in contrast to a situation where a single toxicant or group of toxicants cause lethality. This provision does not apply as a result of corrective actions taken by the permittee. "Corrective actions" are herein defined as proactive efforts which eliminate or reduce effluent toxicity. These include, but are not limited to, source reduction or elimination, improved housekeeping, changes in chemical usage, and modifications of influent streams and/or effluent treatment.

The permittee may only apply this cessation of lethality provision once. If the effluent again demonstrates significant lethality to the same species, the permit will be amended to add a WET limit with a compliance period, if appropriate. However, prior to the effective date of the WET limit, the permittee may apply for a permit amendment removing and replacing the WET limit with an alternate toxicity control measure by identifying and confirming the toxicant and/or an appropriate control measure.

g. The permittee shall complete the TRE and submit a Final Report on the TRE Activities no later than 18 months from the last test day of the retest that demonstrates significant lethality. The permittee may petition the Executive Director (in writing) for an extension of the 18-month limit. However, to warrant an extension the permittee must have demonstrated due diligence in their pursuit of the TIE/TRE and must prove that circumstances beyond their control stalled the TIE/TRE. The report shall specify the control mechanism(s) that will, when implemented, reduce effluent toxicity as specified in item 5.g. The report will also specify a corrective action schedule for implementing the selected control mechanism(s). A copy of the TRE Final Report shall also be submitted to the U.S. EPA Region 6 office.

h. Within 3 years of the last day of the test confirming toxicity, the permittee shall comply with 30 TAC 307.6.(e)(2)(B), which requires greater than 50% survival of the test organism in 100% effluent at the end of 24-hours. The permittee may petition the Executive Director (in writing) for an extension of the 3-year limit. However, to warrant an extension the permittee must have demonstrated due diligence in their pursuit of the TIE/TRE and must prove that circumstances beyond their control stalled the TIE/TRE.

The requirement to comply with 30 TAC 307.6.(e)(2)(B) may be exempted upon proof that toxicity is caused by an excess, imbalance, or deficiency of dissolved salts. This exemption excludes instances where individually toxic components (e.g. metals) form a salt compound. Following the exemption, the permit may be amended to include an ion-adjustment protocol, alternate species testing, or single species testing.

i. Based upon the results of the TRE and proposed corrective actions, this permit may be amended to modify the biomonitoring requirements where necessary, to require a compliance schedule for implementation of corrective actions, to specify a WET limit, to specify a BMP, and/or to specify a CS limit.

TABLE 2 (SHEET 1 OF 2)

WATER FLEA SURVIVAL

GENERAL INFORMATION

	Time (am/pm)	Date
Composite Sample Collected		
Test Initiated		

PERCENT SURVIVAL

Time	Rep	Percent effluent (%)					
		0%	6%	13%	25%	50%	100%
24h	A						
	B						
	C						
	D						
	E						
	MEAN*						

Enter percent effluent corresponding to the LC50 below:

24 hour LC50 = _______% effluent

95% confidence limits: _______________

Method of LC50 calculation:____________

* If 24-hour survivorship data from the chronic *Ceriodaphnia dubia* test is being used, the mean survival per dilution for all 10 replicates shall be reported on this row.

TABLE 2 (SHEET 2 OF 2)

FATHEAD MINNOW SURVIVAL

GENERAL INFORMATION

	Time (am/pm)	Date
Composite Sample Collected		
Test Initiated		

PERCENT SURVIVAL

Time	Rep	Percent effluent (%)					
		0%	6%	13%	25%	50%	100%
24h	A						
	B						
	C						
	D						
	E						
	MEAN						

Enter percent effluent corresponding to the LC50 below:

24 hour LC50 = _______% effluent

95% confidence limits: _______________

Method of LC50 calculation:_____________

Site Name:	**Southwestern Electric Power Co - Welsh Plant**	**Date:**	**30 June 2010**
Unit Name:	**Primary Ash Pond**	**Operator's Name:**	**American Electric Power**
Unit I.D.:		**Hazard Potential Classification:**	**High** ☐ **Significant** ☐ **Low** ☒
	Inspector's Name:	**Andrew Cueto, PE; Cleighton Smith**	

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	Annual [1]		18. Sloughing or bulging on slopes?		X
2. Pool elevation (operator records)?	333.5		19. Major erosion or slope deterioration?		X
3. Decant inlet elevation (operator records)?		n/a	20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	334 [2]		Is water entering inlet, but not exiting outlet?		n/a
5. Lowest dam crest elevation (operator records)?	340		Is water exiting outlet, but not entering inlet?		n/a
6. If instrumentation is present, are readings recorded (operator records)?		Adj weir [3] & piezometer	Is water exiting outlet flowing clear?		n/a
7. Is the embankment currently under construction?		X	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation,stumps, topsoil in area where embankment fill will be placed)?	X [4]		From underdrain?		X
9. Trees growing on embankment? (If so, indicate largest diameter below)		X	At isolated points on embankment slopes?		X
10. Cracks or scarps on crest?		X	At natural hillside in the embankment area?		X
11. Is there significant settlement along the crest?		X	Over widespread areas?		X
12. Are decant trashracks clear and in place?		n/a	From downstream foundation area?		X
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		X	"Boils" beneath stream or ponded water?		X
14. Clogged spillways, groin or diversion ditches?		X	Around the outside of the decant pipe?		X
15. Are spillway or ditch linings deteriorated?		X	22. Surface movements in valley bottom or on hillside?		X
16. Are outlets of decant or underdrains blocked?		n/a	23. Water against downstream toe?	X [5]	
17. Cracks or scarps on slopes?		X	24. Were Photos taken during the dam inspection?	X	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Issue #	Comments
1	AEP conducts an annual internal inspection by a registered engineer, also regular inspections take place over the course of the year; Additionally, the Texas Commission on Environmental Quality conducts an independent annual inspection of the facilities in conjunction with their Industrial Wastewater NPDES permit review
2	Elevations are for the emergency spillway
3	Outlet has a sharp crested adjustable (stop logs) weir with one piezometer
4	Noted in original Construction specification under Clearing and Grubbing
5	Toe of berm falls below adjacent lake level however rip rap hardening is present

Coal Combustion Waste (CCW)

Impoundment Inspection

Impoundment NPDES Permit # TX 0063215 **INSPECTOR** Andrew Cueto, PE; Cleighton Smith

Date 30 June 2010
Impoundment Name Primary Ash Pond

Impoundment Company American Electric Power
EPA Region 6

State Agency (Field Office) Address Texas Commission on Environmental Quality
2916 Teague Dr.
Tyler, TX 75701-3734

Name of Impoundment Primary Pond

(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New ☐ **Update** ☒

	Yes	**No**
Is impoundment currently under construction?	☐	☒
Is water or ccw currently being pumped into the impoundment?	☒	☐

IMPOUNDMENT FUNCTION: The Primary Ash Settling Pond functions as a settling basin for wastewater containing bottom and economizer ash slurry. It also serves as a stormwater settling pond for runoff from the power plant's coal storage yard.

Nearest Downstream Town Name: Cason, TX

Distance from the impoundment: 1.0 miles

Location:

Latitude	33	Degrees	02	Minutes	59.10	Seconds	**N**
Longitude	94	Degrees	50	Minutes	46.89	Seconds	**W**

State TX **County** Titus

	Yes	No
Does a state agency regulate this impoundment?	☒	☐

If So Which State Agency? Texas Commission on Environmental Quality

HAZARD POTENTIAL *(In the event the impoundment should fail, the following would occur):*

☐ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

☒ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

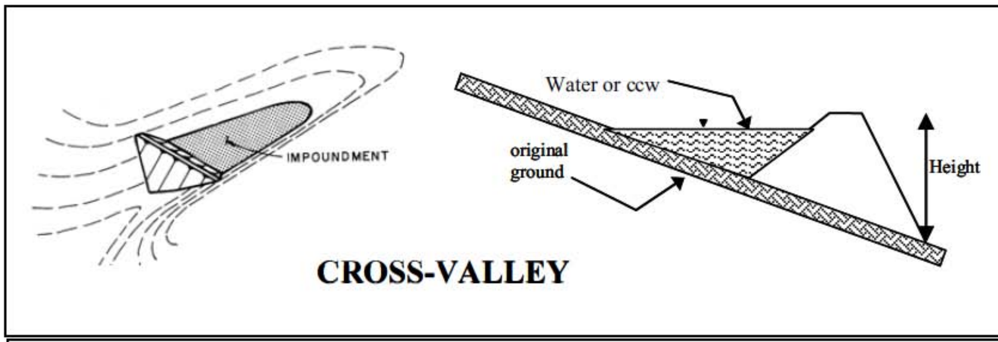
☐ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

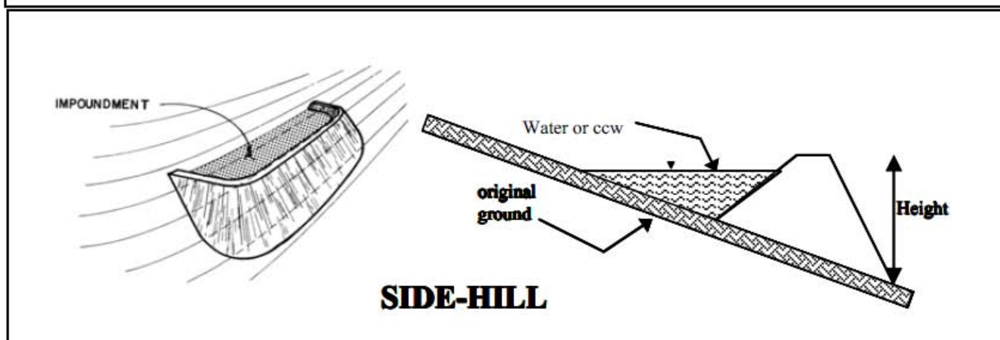
☐ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

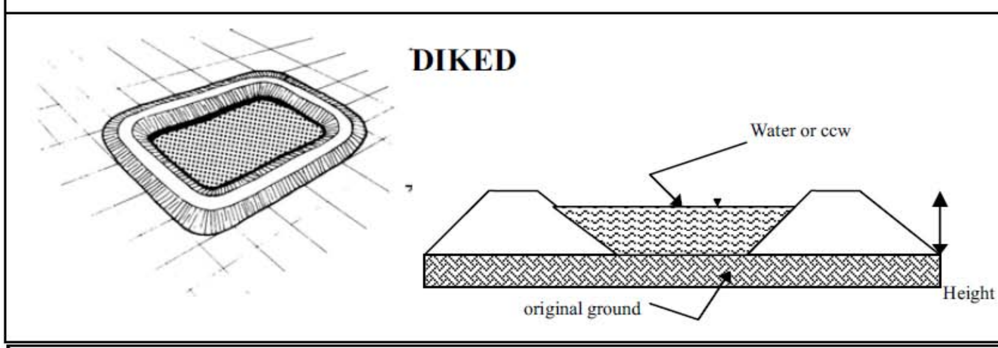
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

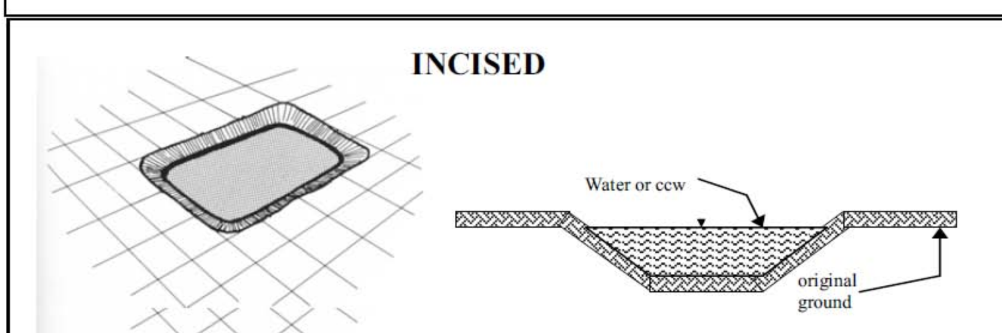
Failure of this structure could release directly or indirectly into the Welsh Reservoir Cooling Lake. A release may disrupt power generation and cause minor environmental damage - A release would be contained within Welsh Reservoir due to the extensive storage capacity in comparison to the capacity of the ponds.

CONFIGURATION:









- [x] Cross-Valley
- [ ] Side-Hill
- [ ] Diked
- [ ] Incised (form completion optional)
- [ ] Combination Incised/Diked

Embankment Height (ft)	20	**Embankment Material**	Native clay/select fill
Pool Area (ac)	98.1	**Liner**	Native clay
Current Freeboard (ft)	6.5	**Liner Permeability**	less than 10^{-7} - Approximately

TYPE OF OUTLET (Mark all that apply)

☐ **Open Channel Spillway**

☐ Trapezoidal

☐ Triangular

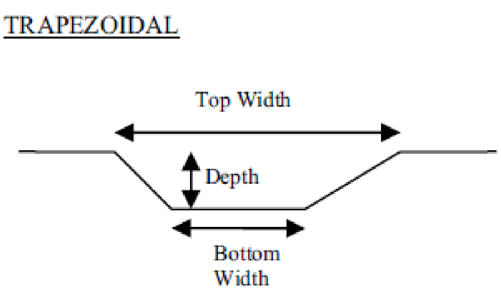
☐ Rectangular

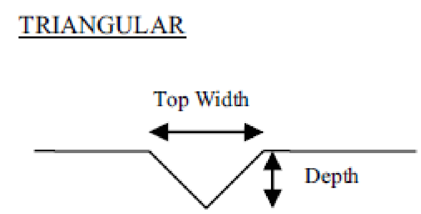
☐ Irregular

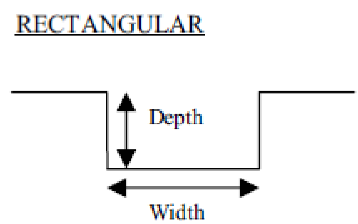
depth (ft)

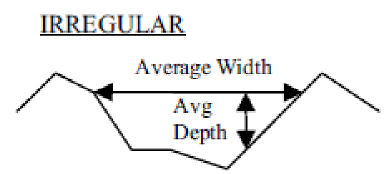
average bottom width (ft)

top width (ft)



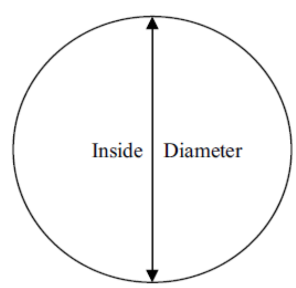






☒ **Outlet**

48” inside length– Sharp Crested Rectangular Weir



Material

☐ corrugated metal

☐ welded steel

☒ concrete

☐ plastic (hdpe, pvc, etc.)

☐ other (specify):

	Yes	No
Is water flowing through the outlet?	☒	☐

☐ **No Outlet**

☐ **Other Type of Outlet** (specify):

The Impoundment was Designed By **Sargent Lundy – Chicago**

	Yes	No
Has there ever been a failure at this site?	☐	☒
If So When?		

If So Please Describe :

	Yes	No
Has there ever been significant seepages at this site?	☐	☒
If So When?		

If So Please Describe :

	Yes	No
Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site?	☒	☐

If so, which method (e.g., piezometers, gw pumping,...)? 48” Sharp crested weir

If So Please Describe :

48” Sharp crested weir using Stop Logs to control flow with one piezometer at outfall (entry into Secondary Ash Pond)

ADDITIONAL INSPECTION QUESTIONS

Concerning the embankment foundation, was the embankment construction built over wet ash, slag, or other unsuitable materials? If there is no information just note that.

The embankment was constructed over a subgrade consisting of natural clay, and rock fill materials.

Did the dam assessor meet with, or have documentation from, the design Engineer-of-Record concerning the foundation preparation?

Copies of Construction Drawings and specifications were provided by the Owner. There was no contact with the design Engineer of Record.

From the site visit or from photographic documentation, was there evidence of prior releases, failures, or patchwork on the dikes?

The embankments seemed to be in tack and undisturbed. It was reported by plant personnel that the embankment was in its original condition and has been undisturbed since its construction in 1972.

Site Name:	**Southwestern Electric Power Co - Welsh Plant**	**Date:**	**30 June 2010**
Unit Name:	**Active Bottom Ash Storage Pond**	**Operator's Name:**	**American Electric Power**
Unit I.D.:		**Hazard Potential Classification:**	**High** ☐ **Significant** ☐ **Low** ☒
	Inspector's Name:	**Andrew Cueto, PE; Cleighton Smith**	

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	Annual [1]		18. Sloughing or bulging on slopes?		X
2. Pool elevation (operator records)?	350.5		19. Major erosion or slope deterioration?		X
3. Decant inlet elevation (operator records)?	350.5		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	358.0 [2]		Is water entering inlet, but not exiting outlet?		X
5. Lowest dam crest elevation (operator records)?	360		Is water exiting outlet, but not entering inlet?		X
6. If instrumentation is present, are readings recorded (operator records)?		n/a	Is water exiting outlet flowing clear?		X
7. Is the embankment currently under construction?		X	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation, stumps, topsoil in area where embankment fill will be placed)?	X [3]		From underdrain?		X
9. Trees growing on embankment? (If so, indicate largest diameter below)	X [4]		At isolated points on embankment slopes?		X
10. Cracks or scarps on crest?		X	At natural hillside in the embankment area?		X
11. Is there significant settlement along the crest?		X	Over widespread areas?		X
12. Are decant trashracks clear and in place?		n/a	From downstream foundation area?		X
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		X	"Boils" beneath stream or ponded water?		X
14. Clogged spillways, groin or diversion ditches?		X	Around the outside of the decant pipe?		X
15. Are spillway or ditch linings deteriorated?		X	22. Surface movements in valley bottom or on hillside?		X
16. Are outlets of decant or underdrains blocked?		X	23. Water against downstream toe?		X
17. Cracks or scarps on slopes?		X	24. Were Photos taken during the dam inspection?	X	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Issue #	Comments
1	AEP conducts an annual internal inspection by a registered engineer, also regular inspections take place over the course of the year; Additionally, the Texas Commission on Environmental Quality conducts an independent annual inspection of the facilities in conjunction with their Industrial Wastewater NPDES permit review
2	Elevations are for the emergency spillway
3	Noted in original Construction specification under Clearing and Grubbing
4	Some small woody vegetation all less than 1”. Operator noted an active maintenance program of mowing and chemical control.

Coal Combustion Waste (CCW)

Impoundment Inspection

Impoundment NPDES Permit # TX 0063215 **INSPECTOR** Andrew Cueto, PE; Cleighton Smith

Date 30 June 2010
Impoundment Name Active Bottom Ash Storage Pond

Impoundment Company American Electric Power
EPA Region 6

State Agency (Field Office) Address Texas Commission on Environmental Quality
2916 Teague Dr.
Tyler, TX 75701-3734

Name of Impoundment Primary Pond

(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New ☐ **Update** ☒

	Yes	No
Is impoundment currently under construction?	☐	☒
Is water or ccw currently being pumped into the impoundment?	☒	☐

IMPOUNDMENT FUNCTION: The Active Bottom Ash Storage Pond functions as a dewatering and settling basin for dredging spoils dredged out of Primary Ash Pond. The Pond effluent discharges by gravity back to the head of the Primary Pond unit.

Nearest Downstream Town Name: Cason, TX

Distance from the impoundment: 1.0 miles

Location:

Latitude	33	Degrees	02	Minutes	39.33	Seconds	**N**
Longitude	94	Degrees	50	Minutes	38.45	Seconds	**W**

State TX **County** Titus

	Yes	No
Does a state agency regulate this impoundment?	☒	☐

If So Which State Agency? Texas Commission on Environmental Quality

HAZARD POTENTIAL *(In the event the impoundment should fail, the following would occur):*

☐ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

☒ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

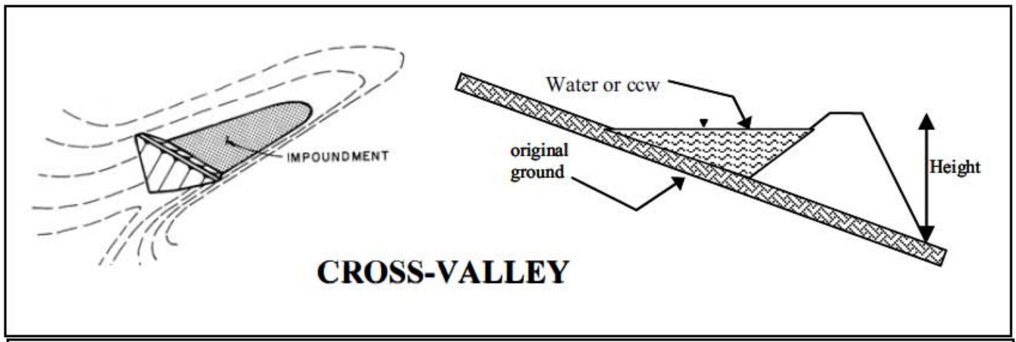
☐ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

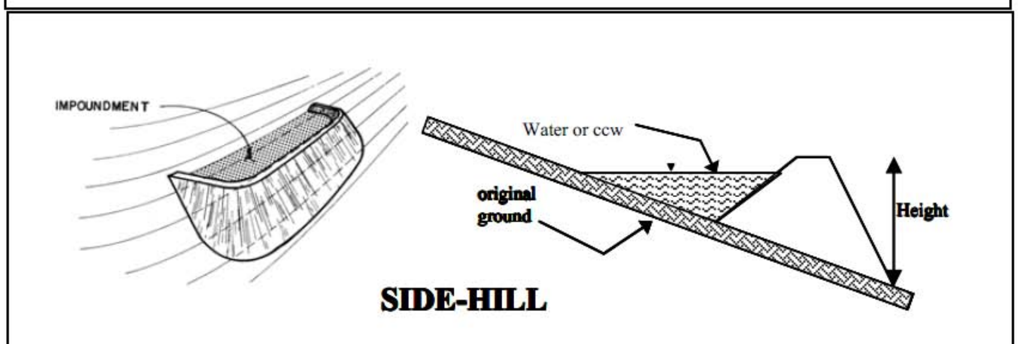
☐ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

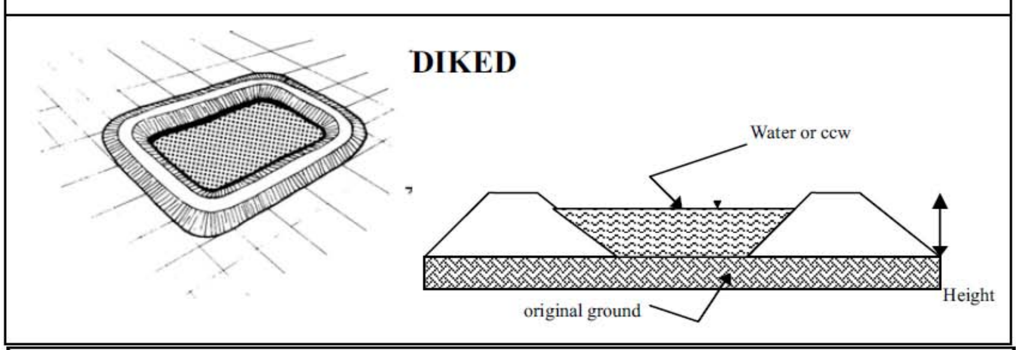
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

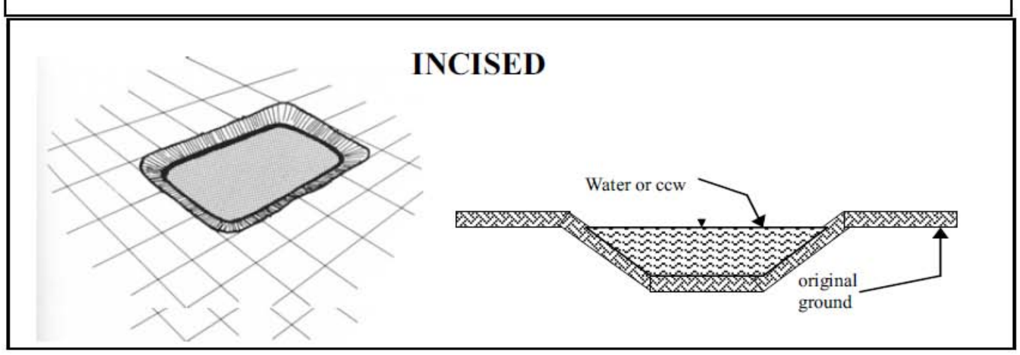
Failure of this structure could release directly or indirectly into the Welsh Reservoir Cooling Lake. A release may disrupt power generation and cause minor environmental damage - A release would be contained within Welsh Reservoir due to the extensive storage capacity in comparison to the capacity of the ponds.

CONFIGURATION:









☐ Cross-Valley ☒ Side-Hill ☐ Diked

☐ Incised (form completion optional) ☐ Combination Incised/Diked

Embankment Height (ft)	15.9 (varies)	**Embankment Material**	Native clay/select fill
Pool Area (ac)	20	**Liner**	HDPE – 60 mil
Current Freeboard (ft)	7.5	**Liner Permeability**	less than 10^{-7}

TYPE OF OUTLET (Mark all that apply)

☐ **Open Channel Spillway**

☐ Trapezoidal

☐ Triangular

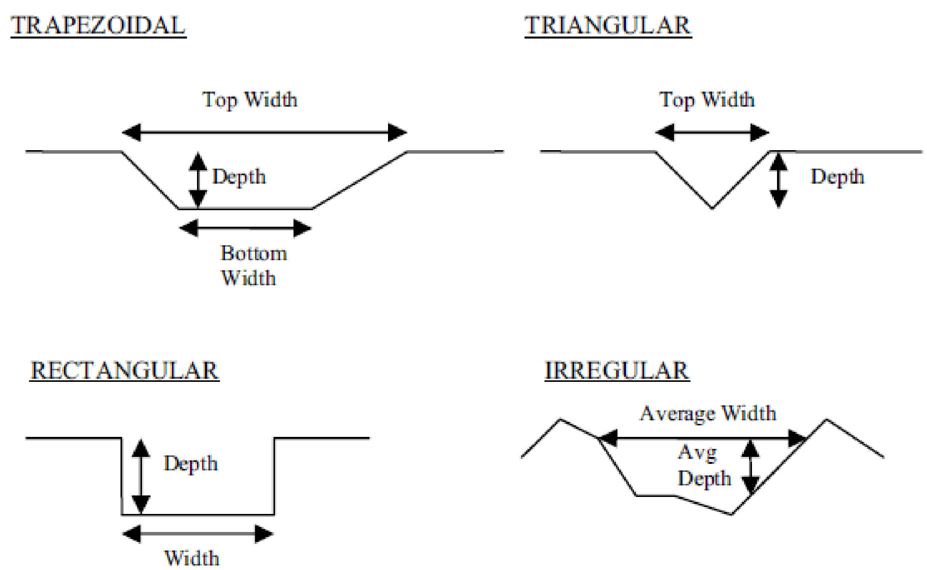
☐ Rectangular

☐ Irregular

depth (ft)

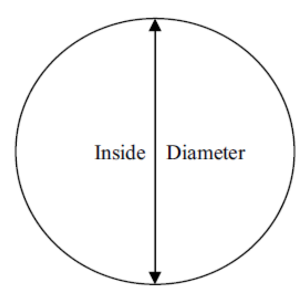
average bottom width (ft)

top width (ft)



☒ **Outlet**

18” inside diameter
(SDR 17 – smooth lined – 19.5” OD)



Material

☐ corrugated metal

☐ welded steel

☐ concrete

☒ plastic (hdpe, pvc, etc.)

☐ other (specify):

	Yes	No
Is water flowing through the outlet?	☒	☐

☐ **No Outlet**

☐ **Other Type of Outlet** (specify):

The Impoundment was Designed By **AEP – in house personnel**

	Yes	No
Has there ever been a failure at this site?	☐	☒
If So When?		

If So Please Describe :

	Yes	No
Has there ever been significant seepages at this site?	☐	☒
If So When?		

If So Please Describe :

	Yes	No
Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site?	☐	☒
If so, which method (e.g., piezometers, gw pumping,...)?		

If So Please Describe :

ADDITIONAL INSPECTION QUESTIONS

Concerning the embankment foundation, was the embankment construction built over wet ash, slag, or other unsuitable materials? If there is no information just note that.

The embankment was constructed over a subgrade consisting of natural clay, and rock fill materials.

Did the dam assessor meet with, or have documentation from, the design Engineer-of-Record concerning the foundation preparation?

Copies of Construction Drawings and specifications were provided by the Owner. There was no contact with the design Engineer of Record.

From the site visit or from photographic documentation, was there evidence of prior releases, failures, or patchwork on the dikes?

The embankments seemed to be in tack and undisturbed. It was reported by plant personnel that the embankment was in its original condition and has been undisturbed since its construction in 2000.

Site Name:	**Southwestern Electric Power Co - Welsh Plant**	**Date:**	**30 June 2010**
Unit Name:	**Secondary Ash Pond**	**Operator's Name:**	**American Electric Power**
Unit I.D.:		**Hazard Potential Classification:**	**High** ☐ **Significant** ☐ **Low** ☒
	Inspector's Name:	**Andrew Cueto, PE; Cleighton Smith**	

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	Annual [1]		18. Sloughing or bulging on slopes?	Complete sloughing [5]	
2. Pool elevation (operator records)?	330.25		19. Major erosion or slope deterioration?		X
3. Decant inlet elevation (operator records)?		n/a	20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	332 [2]		Is water entering inlet, but not exiting outlet?		n/a
5. Lowest dam crest elevation (operator records)?	340		Is water exiting outlet, but not entering inlet?		n/a
6. If instrumentation is present, are readings recorded (operator records)?		Adj weir [3] & piezometer	Is water exiting outlet flowing clear?		n/a
7. Is the embankment currently under construction?	Under repair [4]		21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation, stumps, topsoil in area where embankment fill will be placed)?	X [5]		From underdrain?		X
9. Trees growing on embankment? (If so, indicate largest diameter below)		X	At isolated points on embankment slopes?		X
10. Cracks or scarps on crest?		X	At natural hillside in the embankment area?		X
11. Is there significant settlement along the crest?		X	Over widespread areas?		X
12. Are decant trashracks clear and in place?		n/a	From downstream foundation area?		X
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		X	"Boils" beneath stream or ponded water?		X
14. Clogged spillways, groin or diversion ditches?		X	Around the outside of the decant pipe?		X
15. Are spillway or ditch linings deteriorated?		X	22. Surface movements in valley bottom or on hillside?		X
16. Are outlets of decant or underdrains blocked?		n/a	23. Water against downstream toe?	X [6]	
17. Cracks or scarps on slopes?		X	24. Were Photos taken during the dam inspection?	X	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Issue #	Comments
1	AEP conducts an annual internal inspection by a registered engineer, also regular inspections take place over the course of the year; Additionally, the Texas Commission on Environmental Quality conducts an independent annual inspection of the facilities in conjunction with their Industrial Wastewater NPDES permit review
2	Elevations are for the emergency spillway
3	Outlet has a sharp crested adjustable (stop logs) weir with three piezometer
4	Sloughing (14 Sept 09) on Northern embankment after 4” rain event; stabilization design consisted of 40’ driven sheet piling containment wall then rebuilt in 9” compacted lifts of selected clay fill
5	Noted in original Construction specification under Clearing and Grubbing
6	Toe of berm falls below adjacent lake level however rip rap hardening is present

Coal Combustion Waste (CCW)

Impoundment Inspection

Impoundment NPDES Permit # TX 0063215 **INSPECTOR** Andrew Cueto, PE; Cleighton Smith

Date 30 June 2010
Impoundment Name Secondary Ash Pond

Impoundment Company American Electric Power
EPA Region 6

State Agency (Field Office) Address Texas Commission on Environmental Quality
2916 Teague Dr.
Tyler, TX 75701-3734

Name of Impoundment Primary Pond

(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New ☐ **Update** ☒

	Yes	**No**
Is impoundment currently under construction?	☐	☒
Is water or ccw currently being pumped into the impoundment?	☒	☐

IMPOUNDMENT FUNCTION: The Secondary Ash Settling Pond functions as a settling basin for wastewater containing bottom and economizer ash slurry. The Pond follows the Primary Pond unit in series. It also serves as a stormwater settling pond for runoff from the power plant's coal storage yard.

Nearest Downstream Town Name: Cason, TX

Distance from the impoundment: 1.0 miles

Location:

Latitude	33	Degrees	02	Minutes	54.55	Seconds	**N**
Longitude	94	Degrees	50	Minutes	29.56	Seconds	**W**

State TX **County** Titus

	Yes	No
Does a state agency regulate this impoundment?	☒	☐

If So Which State Agency? Texas Commission on Environmental Quality

HAZARD POTENTIAL *(In the event the impoundment should fail, the following would occur):*

☐ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

☒ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

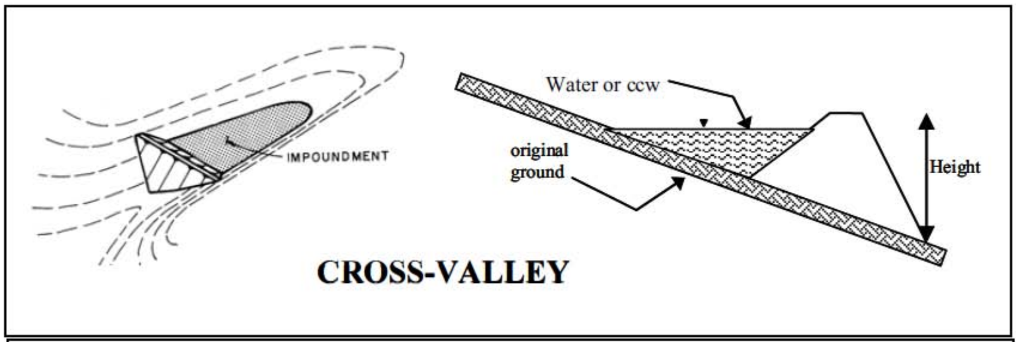
☐ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

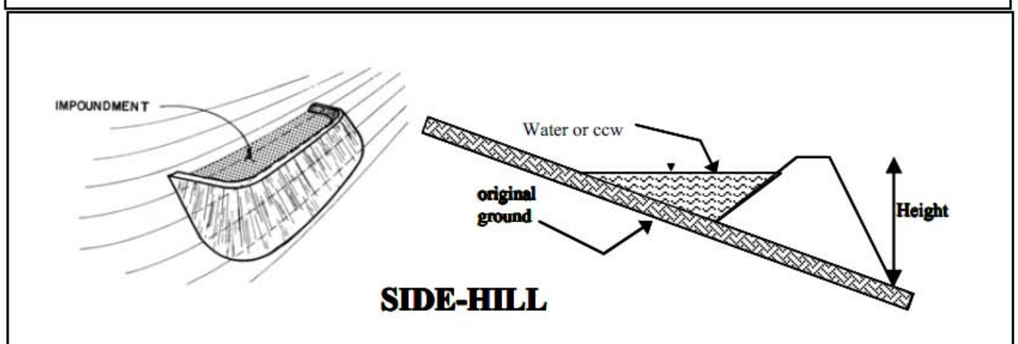
☐ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

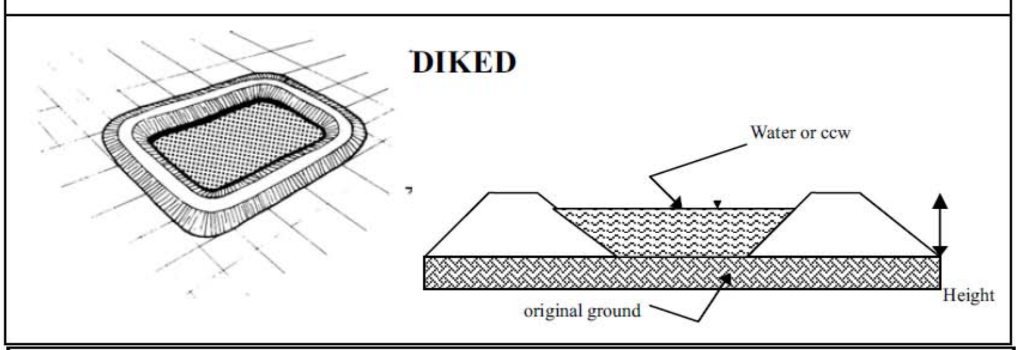
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

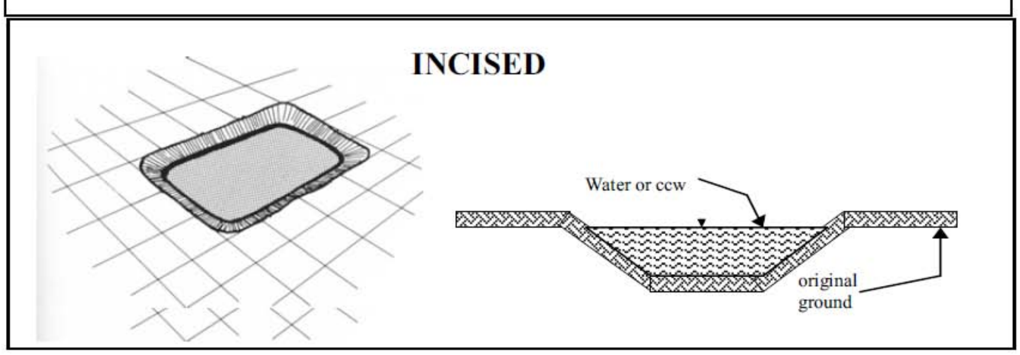
Failure of this structure could release directly or indirectly into the Welsh Reservoir Cooling Lake. A release may disrupt power generation and cause minor environmental damage - A release would be contained within Welsh Reservoir due to the extensive storage capacity in comparison to the capacity of the ponds.

CONFIGURATION:









☐ Cross-Valley ☒ Side-Hill ☐ Diked

☐ Incised (form completion optional) ☐ Combination Incised/Diked

Embankment Height (ft)	20	**Embankment Material**	Native clay/select fill
Pool Area (ac)	4.2	**Liner**	Native clay
Current Freeboard (ft)	9.75	**Liner Permeability**	less than 10^{-7} - Approximately

TYPE OF OUTLET (Mark all that apply)

☐ **Open Channel Spillway**

☐ Trapezoidal

☐ Triangular

☐ Rectangular

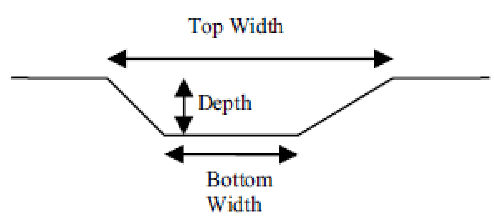
☐ Irregular

depth (ft)

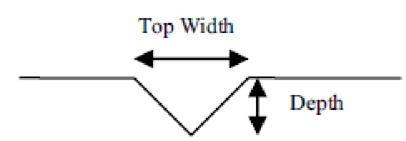
average bottom width (ft)

top width (ft)

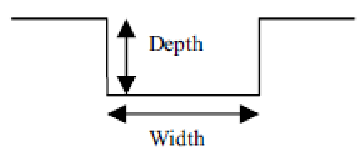
TRAPEZOIDAL



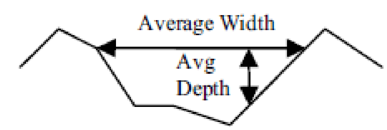
TRIANGULAR



RECTANGULAR

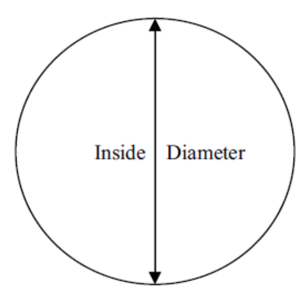


IRREGULAR



☒ **Outlet**

48” inside length– Sharp Crested Rectangular Weir



Material

☐ corrugated metal

☐ welded steel

☒ concrete

☐ plastic (hdpe, pvc, etc.)

☐ other (specify):

	Yes	No
Is water flowing through the outlet?	☒	☐

☐ **No Outlet**

☐ **Other Type of Outlet** (specify):

The Impoundment was Designed By **Sargent Lundy – Chicago**

	Yes	No
Has there ever been a failure at this site?	☐	☒

If So When?

If So Please Describe :

Unit has never had a complete failure in 38 years since its original construction. Sloughing took place on northern embankment after 4” rain event on 14 Sept 2009. Currently stabilization design by a professional engineer is under construction. The stabilization consisted of 40’ driven sheet piling containment wall. Behind the containment wall the embankment is being rebuilt in 9” compacted lifts of selected clay fill.

	Yes	No
Has there ever been significant seepages at this site?	☐	☒
If So When?		

If So Please Describe :

Question	Yes	No
Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site?	☒	☐
If so, which method (e.g., piezometers, gw pumping,...)?	48" Sharp crested weir	

If So Please Describe :

Discharge consist of a 48" Sharp crested weir using Stop Logs to control flow. Also there are three piezometers at outfall and a flow chart at the discharge (entry into cooling lake).

ADDITIONAL INSPECTION QUESTIONS

Concerning the embankment foundation, was the embankment construction built over wet ash, slag, or other unsuitable materials? If there is no information just note that.

The embankment was constructed over a subgrade consisting of natural clay, and rock fill materials.

Did the dam assessor meet with, or have documentation from, the design Engineer-of-Record concerning the foundation preparation?

Copies of Construction Drawings and specifications were provided by the Owner. There was no contact with the design Engineer of Record.

From the site visit or from photographic documentation, was there evidence of prior releases, failures, or patchwork on the dikes?

The embankments seemed to be in tack and undisturbed. It was reported by plant personnel that the embankment was in its original condition and has been undisturbed since its construction in 1972. Unit has never had a complete failure in 38 years since its original construction. Sloughing took place on northern embankment after 4" rain event on 14 Sept 2009. Currently stabilization design by a professional engineer is under construction. The stabilization consisted of 40' driven sheet piling containment wall. Behind the containment wall the embankment is being rebuilt in 9" compacted lifts of selected clay fill.

APPENDIX F: MISCELLANEOUS DOCUMENTS

RKANA

'd. 4-8-74

Reserve Material
North of Bldg. (B)

95.3
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39.1

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SOUTHWESTERN LABORATORIES

[illegible] MIDLAND BEAUMONT TEXARKANA

CONSULTING ANALYTICAL CHEMISTS
AND TESTING ENGINEERS

Texarkana, Texas April 12, 1974

File No.

Report of tests on: Soil

To: Murray, Link, Thomas & Griffin

Received from: Same

Date Rec'd. 4-8-74

Identification Marks: SWEPCO's Welsh Power Plant

The follwoing samples were taken in order to depict the material available to construct the Ash Pit Dike. Based on the information we have received, it is believed that the higher clay content soils should be used in the core of the dike. We have located some moderate to high plasticity index material lying adjacent to the Ash Pit Dike. The following results were obtained on these materials.

Sieve Sizes % Passing	Gray Clay	Red & Gray Clay
No. 40	100.0	100.0
80	98.9	98.8
100	97.7	98.0
200	97.0	95.2
Liquid Limit	49	48
Plasticity Index	25	24

cc: 2: Murray, Link, Thomas & Griffin
1: Mr. Bill Millard
1: Mr. Emil Rizzio
1: Mr. Ed Bargaineer

Lab. No. 14475

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FORM NO. 130-A

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Date Rec'd. 6-3-74

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CONSULTING ANALYTICAL CHEMISTS
AND TESTING ENGINEERS

Texarkana, Texas June 4,1974 File No.

Report of tests on: Soil

To: Murray,Link,Thomas & Griffin

Received from: Same Date Rec'd 5-31-

Identification Marks: SWEPCO Walsh Power Plant, Casco,Texas

FIELD DENSITY TESTS

No.	Location	Percent Moisture	Dry Density Lbs. Cu Ft	Perce Procto
463	Sta. 7+00 Right of Centerline Primary dike 3' above natural ground	21.0	105.2	96.
464	Sta. 5+75 Right of Centerline Primary dike 2½' above natural ground	22.0	104.3	15.
465	Sta. 4+80 Centerline of primary dike 3' below natural ground	20.1	105.2	96.

Maximum Dry Density at Optimum Moisture 109.4 Lbs. Cu Ft

Optimum Moisture 19.0

cc: 3: Murray,Link,Thomas & Griffin
1: Mr. Emil Rizzio
1: Mr. Bill Millard
1: Mr. Ed Bargainner

Lab No. 14730

SOUTHWESTERN LABORATORIES

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e No.

Date Rec'd. 6-4-74

Dry Density Lbs./Cu.Ft.	Percent Proctor
115.7	96.6
115.1	96.1
114.2	95.3

bs./Cu. Ft.

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CONSULTING ANALYTICAL CHEMISTS
AND TESTING ENGINEERS

Texarkana, Texas June 4,1974 File No.

Report of tests on: Soil

To: Murray,Link,Thomas & Griffin

Received from: Same — Date Rec'd 5-30-74

Identification Marks: SWEPCO Welsh Power Plant,Cason,Texas

FIELD DENSITY TESTS

No.	Location	Percent Moisture	Dry Density Lbs. Cu. Ft.	Percent Proctor
460	Sta. 5+70 Centerline of primary dike 5½' above natural ground	19.6	106.3	97.2
461	Sta. 6+00 3½' above natural ground left of primary dike	20.1	105.9	96.8
462	Sta. 7+00 Left of Centerline, primary dike 3' above natural ground	19.2	106.6	97.4

PROCTOR SERIES

Maximum Dry Density at Optimum Moisture: 109.4 Lbs. Cu. Ft.

Optimum Moisture: 19.0 %

cc: 3: Murray,Link,Thomas & Griffin
1: Mr. Emil Rizzio
1: Mr. Bill Millard
1: Mr. Ed Burgeiner

Lab No 14729

SOUTHWESTERN LABORATORIES

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JUN 25 1974

OFFICE OF
W. H. HOLLEY

SOUTHWESTERN LABORATORIES

FORT WORTH DALLAS HOUSTON MIDLAND BEAUMONT TEXARKANA

CONSULTING ANALYTICAL CHEMISTS
AND TESTING ENGINEERS

Texarkana, Texas June 6, 1974 File No.

Report of tests on: Soil

To: Murray, Thomas & Griffin

Received from: Same — Date Rec'd 6-1-74

Identification Marks: SWEPCO Welsh Power Plant-Cason, Texas

FIELD DENSITY TESTS

No.	Location	Percent Moisture	Dry Density Lbs./Cu.Ft	Percent Proctor
466	Sta. 5+50 Rt. Primary Dike 3' Above Natural Ground	22.0	106.1	97.0
467	Sta. 8+00 Lt. Primary Dike 3½ Ft. Above Natural Ground	21.3	105.9	96.8
468	Sta. 7+00 Lt. Primary Dike 3½ Ft. above	20.7	105.1	96.0
469	Sta. 6+00 Rt. Primary Dike 3' above natural ground	20.4	106.4	97.2
470	Sta. 8+00 Rt. Primary Dike 2' Above Natural Ground	20.6	105.6	97.4

PROCTOR SERIES

Maximum Dry Density at Optimum Moisture	109.4	Lbs. Cu. Ft
Optimum Moisture	19.0	%

cc: 3: Murray, Thomas & Griffin
1: Mr. Emil Rismio
1: Mr. Ed Burgalneer
1: Mr. Bill Millard

Lab. No. 14731

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File No.

Date Rec'd. 5-20-74

Dry Density Lbs./Cu.Ft.	Percent Proctor
105.5	96.4
106.2	97.1
106.0	96.9
107.4	98.2
106.5	97.4
105.3	96.3

Lbs./Cu.Ft.

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FORT WORTH DALLAS HOUSTON MIDLAND BEAUMONT TEXARKANA

CONSULTING ANALYTICAL CHEMISTS AND TESTING ENGINEERS

Texarkana, Texas May 23,1974 File No.

Report of tests on: Soil

To: Murray,Link,Thomas & Griffin

Received from: Same

Identification Marks: SWEPCO Welsh Power Plant, Cason,Texas

Date Rec'd 5-21-74

FIELD DENSITY TESTS

No.	Location	Percent Moisture	Dry Density Lbs. Cu.Ft.	Percent Proctor
437	Sta. 6+80 Left of Centerline, primary dike 4' above natural ground	19.8	106.3	97.2
438	Sta. 5+20 Centerline of primary dike 4' above natural ground	20.4	106.1	97.0
439	Sta. 7+00 Center of primary dike 4' above natural ground	20.2	105.9	96.8
440	Sta. 8+10 Core of primary dike 4' below natural ground	22.1	104.9	95.9

PROCTOR SERIES

Maximum Dry Density at Optimum Moisture 109.4 Lbs. Cu. Ft.

Optimum Moisture 19.0

cc: 2: Murray,Link, Thomas & Griffin
1: Mr. Emil Rizzio
1: Mr. Bill Millard
1: Mr. Ed Burgmaier

Lab No. 14666

SOUTHWESTERN LABORATORIES

Dean M. Mylord

RATORIES
BEAUMONT TEXARKANA
NISTS

File No.

Date Rec'd. 5-18-74

Dry Density Lbs./Cu.Ft.	Percent Proctor
106.2	97.1
104.6	95.6
105.9	96.8

Lbs./Cu. Ft.
%

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FORT WORTH DALLAS HOUSTON MIDLAND BEAUMONT TEXARKANA

CONSULTING, ANALYTICAL CHEMISTS AND TESTING ENGINEERS

Texarkana, Texas May 21, 1974 File No.

Report of tests on: Soil

To: Murray, Link, Thomas & Griffin

Received from: Same

Identification Marks: SWEPCO Welsh Power Plant, Cason, Texas

Date Rec'd. 5-20-74

FIELD DENSITY TESTS

No.	Location	Percent Moisture	Dry Density Lbs./Cu.Ft.	Percent Proctor
431	Sta. 2+00 Core of primary dike 4' below natural ground	21.1	105.5	96.4
432	Sta. 3+00 Core of primary dike 4' below natural ground	19.8	106.2	97.1
433	Sta. 4+20 core of primary dike 3' below natural ground	20.2	106.0	96.9
434	Sta. 5+50 Centerline of primary 3' above natural ground	19.3	107.4	98.2
435	Sta. 6+00 right of centerline, primary dike 3' above natural ground	20.7	106.5	97.4
436	Sta. 6+10 left of centerline, primary dike natural gound elevation	19.9	105.3	96.3

PROCTOR SERIES

Maximum Dry Density at Optimum Moisture: 109.4 Lbs./Cu. Ft.

Optimum Moisture: 19.0 %

cc: 2: Murray, Link, Thomas & Griffin
1: Mr. Emil Rizzio
1: Mr. Bill Millard
1: Mr. Ed Bargaineer

Lab No. 14659

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— File No. ______

Date Rec'd. 5-17-74

Dry Density Lbs./Cu.Ft.	Percent Proctor
105.5	96.4
106.3	97.2
106.0	96.9
105.9	96.8

4 Lbs./Cu.Ft.
0 %

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SOUTHWESTERN LABORATORIES

FORT WORTH DALLAS HOUSTON MIDLAND BEAUMONT TEXARKANA

CONSULTING, ANALYTICAL CHEMISTS AND TESTING ENGINEERS

Texarkana, Texas May 21,1974 File No. ______

Report of tests on: Soil

To: Murray,Link,Thomas &Griffin

Received from: Same

Date Rec'd 5-18-7[illegible]

Identification Marks: SWEPCO, Welsh Power Plant-Cason,Texas

FIELD DENSITY TESTS

No.	Location	Percent Moisture	Dry Density Lbs./Cu.Ft.	Percent Proctor
428	Sta. 7+00 Core of primary dike 2' above natural ground	20.7	106.2	97.[illegible]
429	Sta. 6+80 natural ground core of primary dike	21.0	104.6	95.[illegible]
430	Sta. 6+80 2' above natural ground right side of primary dike	19.8	105.9	96.[illegible]

PROCTOR SERIES

Maximum Dry Density at Optimum Moisture: 109.4 Lbs. Cu. Ft.

Optimum Moisture: 19.0 %

cc: 2: Murray,Link,Thomas & Griffin
1: Mr. Emil Rizzio
1: Mr. Bill Millard
1: Mr. Ed Burgainecr

Lab No. 14658

SOUTHWESTERN LABORATORIES

Swepco

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Rec'd. 5-16-74

ty Ft.	Percent Proctor
	92.4
	95.9
	97.1

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FORT WORTH   DALLAS   HOUSTON   MIDLAND   BEAUMONT   TEXARKANA

CONSULTING, ANALYTICAL CHEMISTS
AND TESTING ENGINEERS

Texarkana, Texas May 21,1974   File No. ______

Report of tests on: Soil

To: Murray,Link,Thomas & Griffin

Received from: Same   Date Rec'd. 5-17-74

Identification Marks: SWEPCO Welsh Power Plant, Cason,Texas

FIELD DENSITY TESTS

No.	Location	Percent Moisture	Dry Density Lbs./Cu.Ft.	Percent Proctor
424	Sta. 7+00 Natural Ground Elev. Core of Primary Dike			
425	Sta. 6+25 1' below natural ground core of primary dike	21.4	105.5	96.4
426	Sta. 7+10 Below natural ground core of primary dike	20.7	106.3	97.2
427	Sta. 6+75 Right side of primary dike 1' above natural ground	21.3	106.0	96.9
		20.9	105.9	96.8

PROCTOR SERIES

Maximum Dry Density at Optimum Moisture: 109.4 Lbs. Cu. Ft.

Optimum Moisture: 19.0 %

cc: 2: Murray,Link,Thomas & Griffin
1: Mr. Emil Rizzio
1: Mr. Bill Millard
1: Mr. Ed Bargainner

Lab No. 14657

SOUTHWESTERN LABORATORIES

Don M. Miller

Form No. [illegible]

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SOUTHWESTERN LABORATORIES

FORT WORTH DALLAS HOUSTON MIDLAND BEAUMONT TEXARKANA

CONSULTING, ANALYTICAL CHEMISTS AND TESTING ENGINEERS

Texarkana, Texas May 21, 1974 File No.

Report of tests on: Soil

To: Murray, Link, Thomas & Griffin

Received from: Same

Date Rec'd. 5-16-74

Identification Marks: SWEPCO, Walsh Power Plant, Carm, Texas

FIELD DENSITY TESTS

No.	Location	Percent Moisture	Dry Density Lbs./Cu.Ft.	Percent Proctor
421	Sta. 6+50 Core of Dike 3' below natural ground primary dike	21.0	101.1	92.4
422	Sta. 7+00 Core of Dike 3' Below natural ground primary Dike	22.4	104.9	95.9
423	Sta. 6+50 Retest	20.8	106.2	97.1

PROCTOR SERIES

Maximum Dry Density at Optimum Moisture: 109.4 Lbs. Cu. Ft.

Optimum Moisture: 19.0 %

cc: 2: Murray, Link, Thomas & Griffin
1: Mr. Emil Rizzio
1: Mr. Bill Millard
1: Mr. Al Burgaineer

Lab No. 14656

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[illegible signature]

Our letters and reports are for the exclusive use of the clients to whom they are addressed. [illegible]

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FORT WORTH DALLAS HOUSTON MIDLAND BEAUMONT TEXARKANA

CONSULTING ANALYTICAL CHEMISTS
AND TESTING ENGINEERS

Texarkana, Texas April 22, 1974 File No. ______

Report of tests on: Soil

To: Murray, Link, Thomas & Griffin

Received from: Same

Identification Marks: SWEPCO Welsh Power Plant, Cason, Texas

Date Rec'd. 4-19-74

Sample # 1 Centerline of Dike-Sta. 7+00
Orange Sandy Clay With Iron Ore

% Passing # 40	89.9
% Passing # 60	84.9
% Passing # 100	66.5
% Passing # 200	49

Atterberg Limits

Liquid Limit	28.0
Plasticity Index	12

Sample # 2-Sta. 0+00 N, Sta. ~~0+00~~ 345o W West
Red Sandy Clay

% Passing # 40	99.4
% Passing # 60	98.6
% Passing # 100	90.0
% Passing # 200	71.2

Atterberg Limits

Liquid Limit	36
Plasticity Index	18

RECEIVED
1974

cc: 2: Murray, Link, Thomas & Griffin
1: Mr. Emil Rizzio
1: Mr. Ed Bargaineer
1: Mr. Bill Millard

Lab No 14525

SOUTHWESTERN LABORATORIES

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

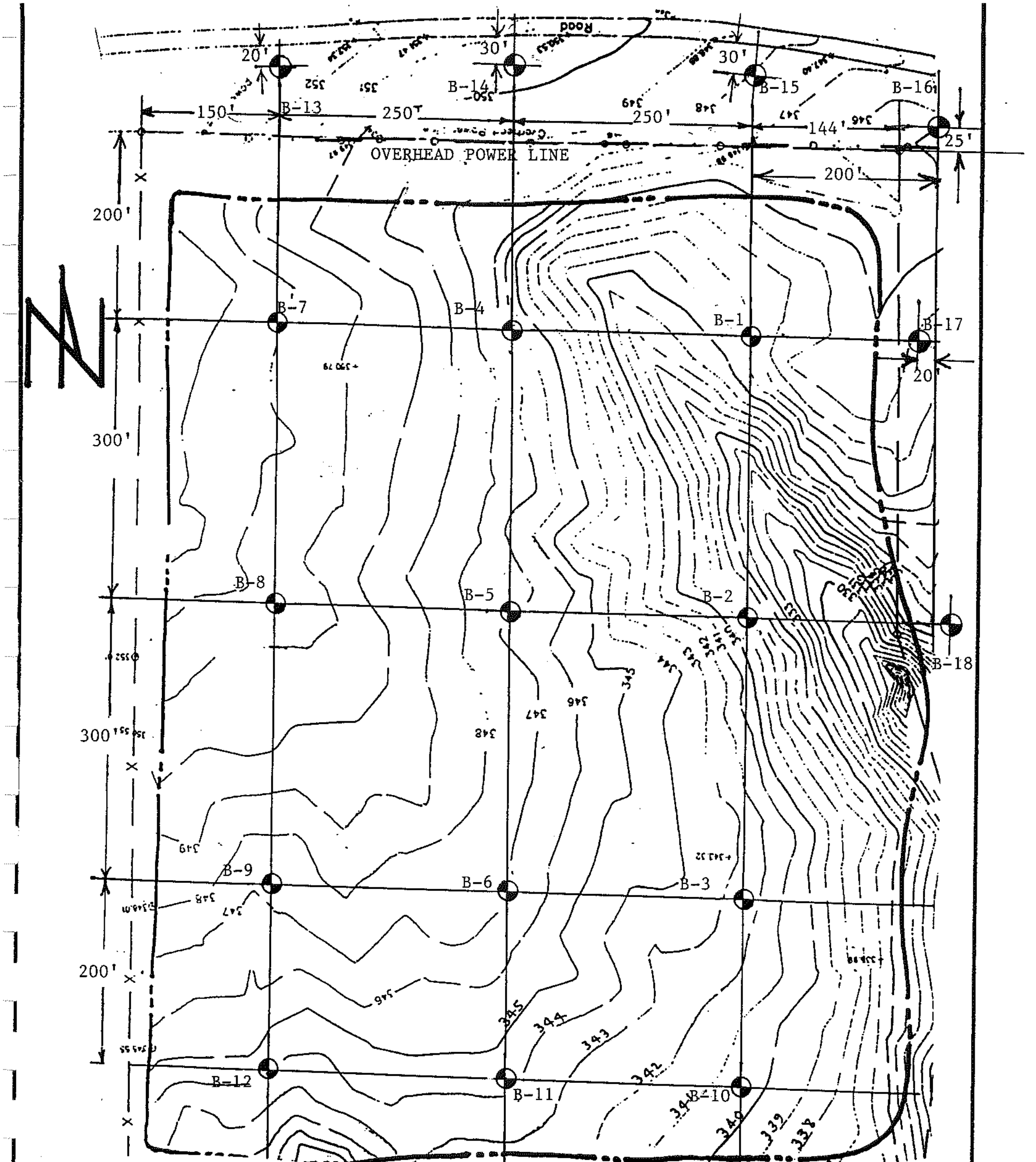
Gene Gardner, P.E.
Geotechnical Manager

STATE OF TEXAS
R. E. GARDNER
56016
REGISTERED
PROFESSIONAL ENGINEER

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.

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
				20					55				Tan to red clayey sandy silt (ML)
				18		25	18	7					
	5			14		21	17	4	57				-- Reddish tan
				10									8.0
				20					63				Tan to gray sandy silt (ML)
	10			26									13.0
			▽	30					30				Tan and gray silty sand (SM)
	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-2

PROJECT: Ash Storage Area Phase II-Welsh Power Plant

CLIENT: Southwestern Electric Power Company

DATE: 4/6/00

SHEET 1 of 1

LOCATION: Cason, Texas

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									
	10			16		20	17	3					8.0 — Tan and gray clayey sandy silt (ML)
				22									
				24									12.0 — Gray sandy silt (ML)
	15												15.0 — Bottom of boring
	20												
	25												

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

REMARKS:

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									Red to tan clayey sandy silt (ML)
				18		23	18	5					4.0
	5			16		27	18	9					Red and light tan very sandy silty clay (CL)
				17		31	19	12					8.0
				12									Tan and gray clayey silty sand (SC)
	10			13					42				
				19									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												

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

REMARKS:

000444

MAXIM TECHNOLOGIES, INC.

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.

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
			19					50				Tan silty sand (SM)	2.0
			19		27	18	9					Reddish tan silty sandy clay (CL)	
			13					70					
5			15										
			12										10.0
10			20					51				Tan sandy silt (ML)	
			26										15.0
15												Bottom of boring	
20													
25													

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

REMARKS:

000444

MAXIM TECHNOLOGIES, INC.

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

Depth (ft)	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
0.5											Six (6) inches of tan clayey sandy silt topsoil
		23									Reddish tan silty sandy clay (CL)
		19		29	19	10					
		19		26	18	8					
6.0		14									Tan silty sand (SM)
		15					49				
		18									
		11					34				-- Light tan and gray
15.0											Bottom of boring

Depth scale: 5, 10, 15, 20, 25

REMARKS:

Sample type legend: TUBE SAMPLE; AUGER SAMPLE; SPLIT-SPOON; ROCK CORE; THD CONE PEN.; NO RECOVERY

000444

MAXIM TECHNOLOGIES, INC.

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.

Depth (ft)	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
0.5										Six (6) inches of tan clayey sandy silt topsoil
	18									Tan to red silty sandy clay (CL)
	19		27	18	9					
	17									
5										
	17		28	19	9					
	14									
10.0	17		16	16	NP	53				Reddish tan sandy silt (ML)
										-- Tan
	17									
15.0										Bottom of boring
20										
25										

Field data columns: SOIL & ROCK SYMBOL; DEPTH (FT); SAMPLE TYPE; N: SPT, BLOWS/FT; T: THD, BLOWS/FT; P: HAND PEN, TSF

Sample type legend: 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												
				16									Reddish tan clayey sandy silt (ML)
	5												
				12		25	18	7					-- Red
				12									
	10			19		22	17	5					-- Red and tan
	11.0												
													Tan to gray silty sand (SM)
				22					39				
	15			24									-- Tan
				25									
	20.0												Bottom of boring
	25												

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

REMARKS:

MAXIM TECHNOLOGIES, INC.

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.

DEPTH (FT)	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
0.5											Six (6) inches of tan clayey sandy silt topsoil
		21									Red to reddish tan silty sandy clay (CLS)
		22		34	20	14					
		20									-- Gray and red
5											
		17		34	20	14					-- Red to reddish tan
8.0		13									Reddish tan sandy silt (ML)
10		13		NP	NP	NP					
11.0											Tan silty sand (SM)
		23									
15		23									
	⊻										
		26		NP	NP	NP	44				
20.0											Bottom of boring
25											

Sample types: TUBE SAMPLE, AUGER SAMPLE, SPLIT-SPOON, ROCK CORE, THD CONE PEN., NO RECOVERY

REMARKS:

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

DEPTH (FT)	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
0.5											Six (6) inches of tan clayey sandy silt topsoil
		16									Tan clayey sandy silt (ML)
		18									
		16		25	18	7					
5.0											Red and reddish tan silty sand (SM)
		10									
		12		NP	NP	NP					
9.0											Tan silty sandy clay (CL)
		16		35	20	15					
12.0											Tan silty sand (SM)
		22									
	▽ (14 ft)										
15.0											Bottom of boring

Depth scale: 5, 10, 15, 20, 25

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

REMARKS:

MAXIM TECHNOLOGIES, INC.

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.

Depth (ft)	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	N: SPT, Blows/Ft; T: THD, Blows/Ft; P: Hand Pen, TSF
	17									
	18		31	19	12					
	14		34	20	14					
	16									
	15		28	19	9					
	17									
	20		30	19	11					

DESCRIPTION OF STRATUM

Description	Depth (ft)
Six (6) inches of tan clayey sandy silt topsoil	0.5
Reddish tan silty sandy clay (CL) -- Reddish gray to tannish gray -- Tan -- Reddish tan -- Tannish gray	14.0
Tan clayey sand (SC)	15.0
Bottom of boring	

REMARKS:

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

MAXIM TECHNOLOGIES, INC.

000444

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.

Depth (ft)	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	N: SPT, Blows/Ft; T: THD, Blows/Ft; P: Hand Pen, TSF	Description of Stratum
0.5											Six (6) inches of clayey sandy silt topsoil
0.5–4.0	18										Tan to tan gray silty sandy clay (CL)
	17		29	19	10						
4.0–13.0	16		32	19	13						Gray and tan sandy silty clay (CL)
	14										
	14		29	19	10						
	16										
13.0–15.0	19		17	16	1						Light tan clayey silty sand (SC)
15.0											Bottom of boring

Sample type legend: TUBE SAMPLE, AUGER SAMPLE, SPLIT-SPOON, ROCK CORE, THD CONE PEN., NO RECOVERY

REMARKS:

MAXIM TECHNOLOGIES, INC.

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.

Depth (ft)	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	Depth to bottom of stratum
0–0.5											Six (6) inches of tan clayey sandy silt topsoil	0.5
0.5–6.0		18									Reddish tan silty sandy clay (CL)	6.0
		20		41	21	20						
		15		37	20	17						
6.0–8.0		14					47				Yellowish tan to tannish gray slightly clayey silty sand (SC)	8.0
8.0–13.0		13		36	20	16					Tan and gray sandy silty clay (CL)	13.0
		15										
13.0–15.0	▽ (water at 14 ft)	15		17	16	1					Tan and gray slightly clayey silty sand (SC)	15.0
15.0											Bottom of boring	

Sample type legend: TUBE SAMPLE, AUGER SAMPLE, SPLIT-SPOON, ROCK CORE, THD CONE PEN., NO RECOVERY

REMARKS:

000444

MAXIM TECHNOLOGIES, INC.

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

Depth (ft)	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
0.5											Six (6) inches of tan clayey sandy silt topsoil (ML)
		21									Mottled red and tan sandy silty clay (CL)
		21		28	19	9					
		21					74				
5		20		39	21	18					
		19									
10		19		32	19	13					
		18		36	20	16					-- Tan and gray
15		19									
		18									
20.0											Bottom of boring
25											

Sample type key: TUBE SAMPLE; AUGER SAMPLE; SPLIT-SPOON; ROCK CORE; THD CONE PEN.; NO RECOVERY

REMARKS:

000444

MAXIM TECHNOLOGIES, INC.

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.

Depth (ft)	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
0.5										Six (6) inches of tan clayey sandy silt topsoil (ML)
	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)
	19									
5										
	19		36	20	16					
	20									
10	18									
	19		30	19	11					
15	21									
18.0	64					70				Tan clayey sandy silt
20.0										Bottom of boring
25										

FIELD DATA: SOIL & ROCK SYMBOL; DEPTH (FT); SAMPLE TYPE; N: SPT, BLOWS/FT; T: THD, BLOWS/FT; P: HAND PEN, TSF

LABORATORY DATA

Sample type legend: TUBE SAMPLE | AUGER SAMPLE | SPLIT-SPOON | ROCK CORE | THD CONE PEN. | NO RECOVERY

REMARKS:

000444

MAXIM TECHNOLOGIES, INC.

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.

DEPTH (FT)	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									Reddish tan silty sandy clay (CL)
		16		32	19	13					-- with iron ore nodules -- red and gray mottled
		18		33	20	13					
5											
		14									
		12		32	19	13					10.0
10		12					18				Tan fine silty sand (SM) 13.0
		18									Tan and gray very silty clay (CL)
15		21									
		22		28	19	9					-- With gray silty clay stringers 20.0
20											Bottom of boring
25											

REMARKS:

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

000444

MAXIM TECHNOLOGIES, INC.

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.

DEPTH (FT)	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
0.5										Six (6) inches of tan clayey silty sand topsoil (SC)
	13					61				Reddish tan and gray silty sandy clay (CL)
	16									
	16		32	19	13					
6.0	15		25	18	7					Tan clayey sandy silt (ML)
	19									
	20									
	20					59				
	20									-- With thin clay stringers
	21									
20.0										Bottom of boring

Field data columns: SOIL & ROCK SYMBOL; DEPTH (FT); SAMPLE TYPE; N: SPT, BLOWS/FT; T: THD, BLOWS/FT; P: HAND PEN, TSF

REMARKS:

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

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
	0.5												Six (6) inches of tan clayey silty sand topsoil (SC)
				16					50				Tan clayey silty sand (SC)
				16		25	18	7					
				12									
	5			10									
				10									
	9.0												Tan silty sand (SM)
	10												
				17					51				-- With clayey sand pockets
	15.0												Bottom of boring
	20												
	25												

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

REMARKS:

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.

DEPTH (FT)	MOISTURE CONTENT, %	MINUS NO. 200 SIEVE, %	DESCRIPTION OF STRATUM
0–0.5			Six (6) inches of tan clayey silty sand topsoil (SC) — 0.5
0.5–8.0	15	35	Tan silty sand (SM) with red and gray clay lumps
	15		
	11		
	10		— 8.0
8.0–15.0	14	42	Gray silty sand (SM)
	19		
	24	82	— 15.0
15.0			Bottom of boring

Column headings — FIELD DATA: SOIL & ROCK SYMBOL; DEPTH (FT); SAMPLE TYPE; N: SPT, BLOWS/FT; T: THD, BLOWS/FT; P: HAND PEN, TSF. LABORATORY DATA: 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.

Depth scale: 5, 10, 15, 20, 25

Sample legend: TUBE SAMPLE; AUGER SAMPLE; SPLIT-SPOON; ROCK CORE; THD CONE PEN.; NO RECOVERY

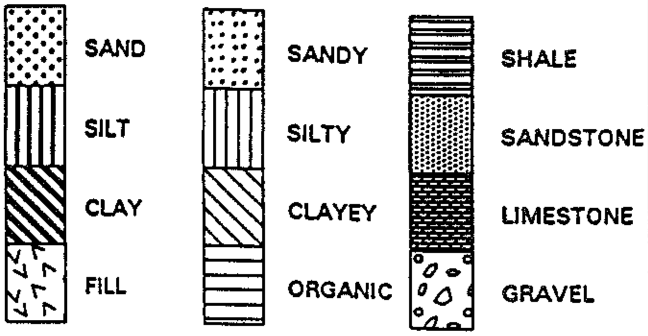
REMARKS:

MAXIM TECHNOLOGIES, INC.

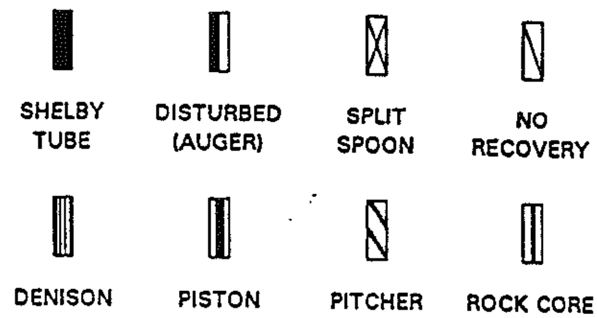
000444

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.

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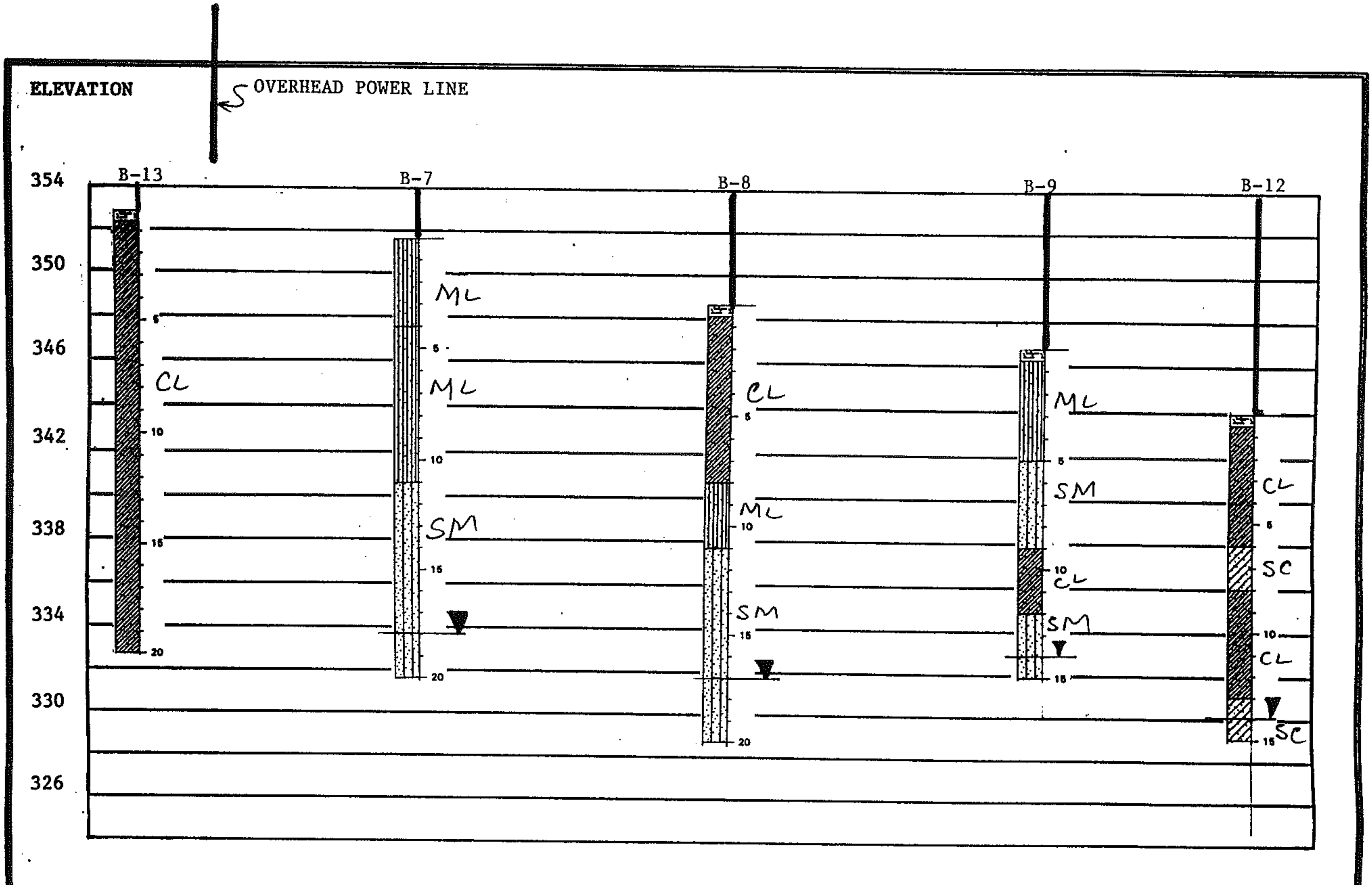

HORIZONTAL SCALE: 3/4 inch = 100 FEET

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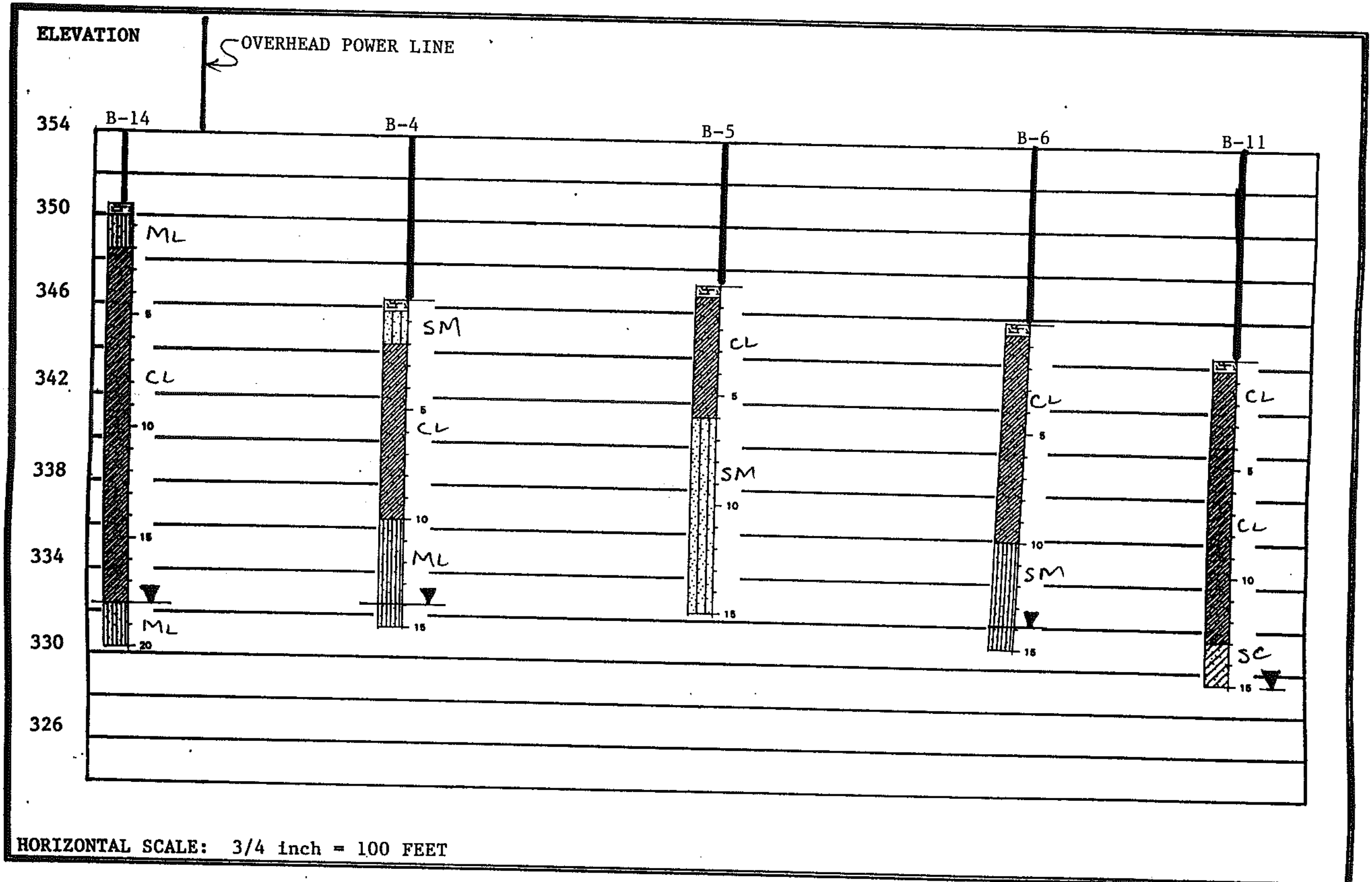
MAXIM FILE #000444



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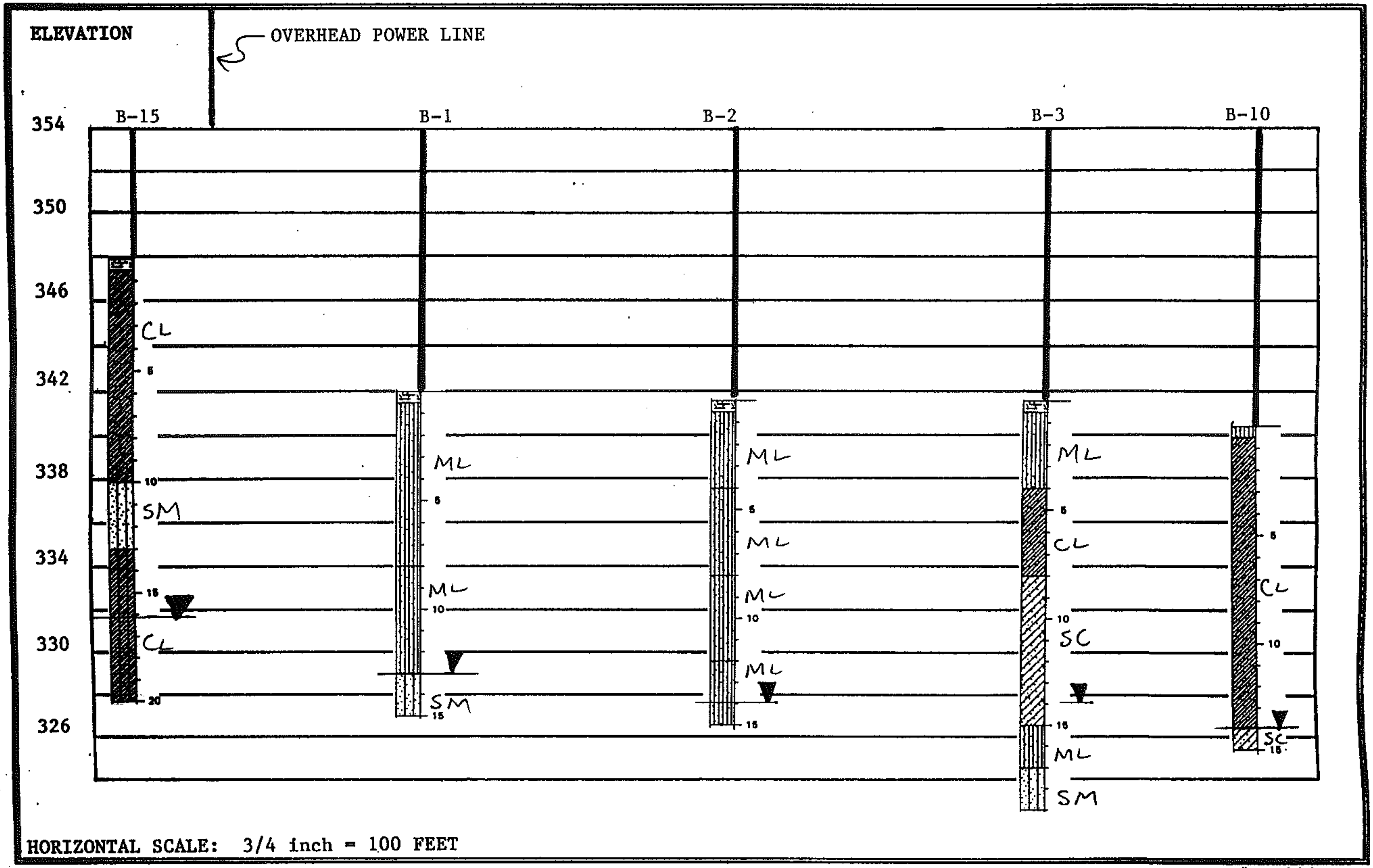

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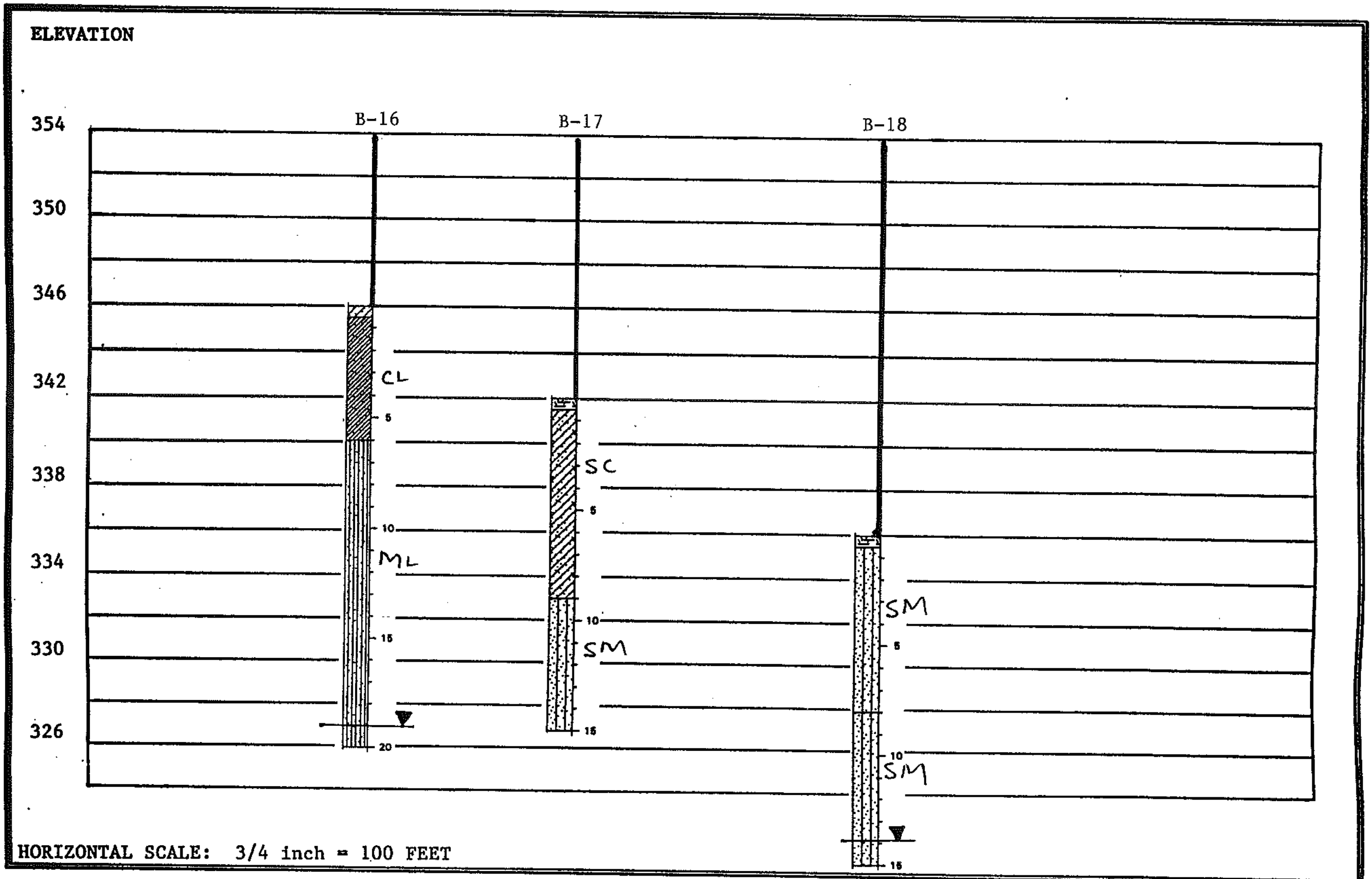

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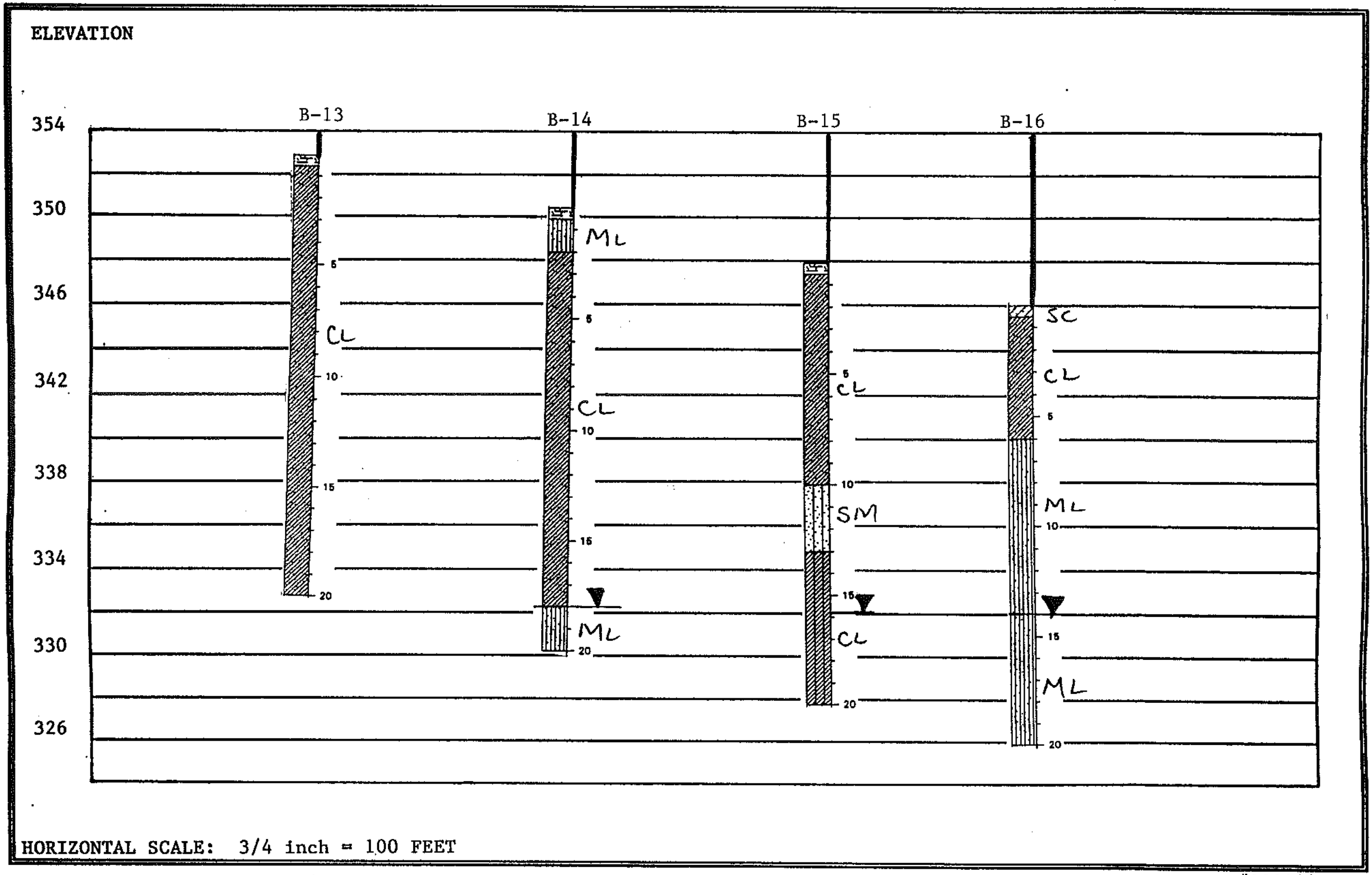

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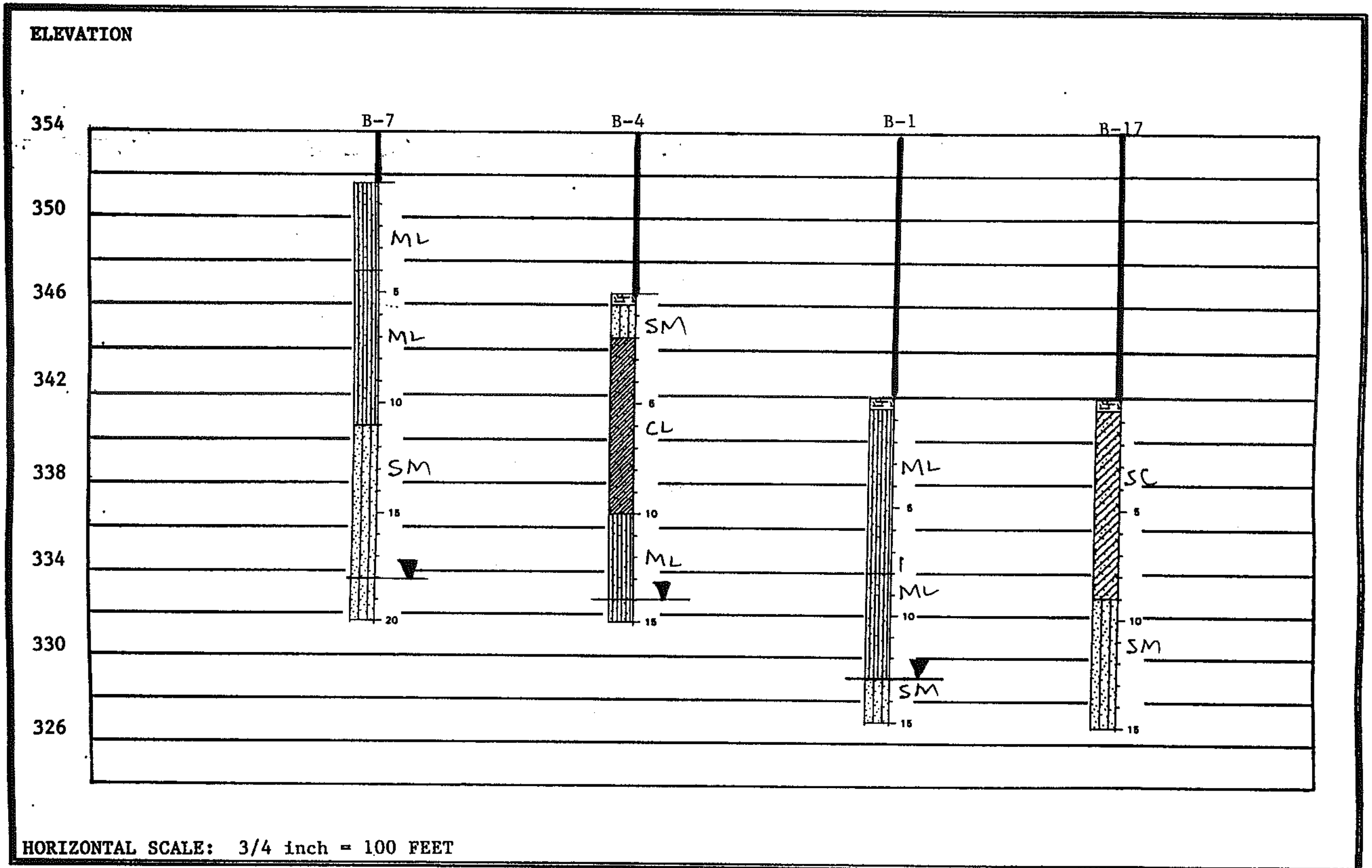

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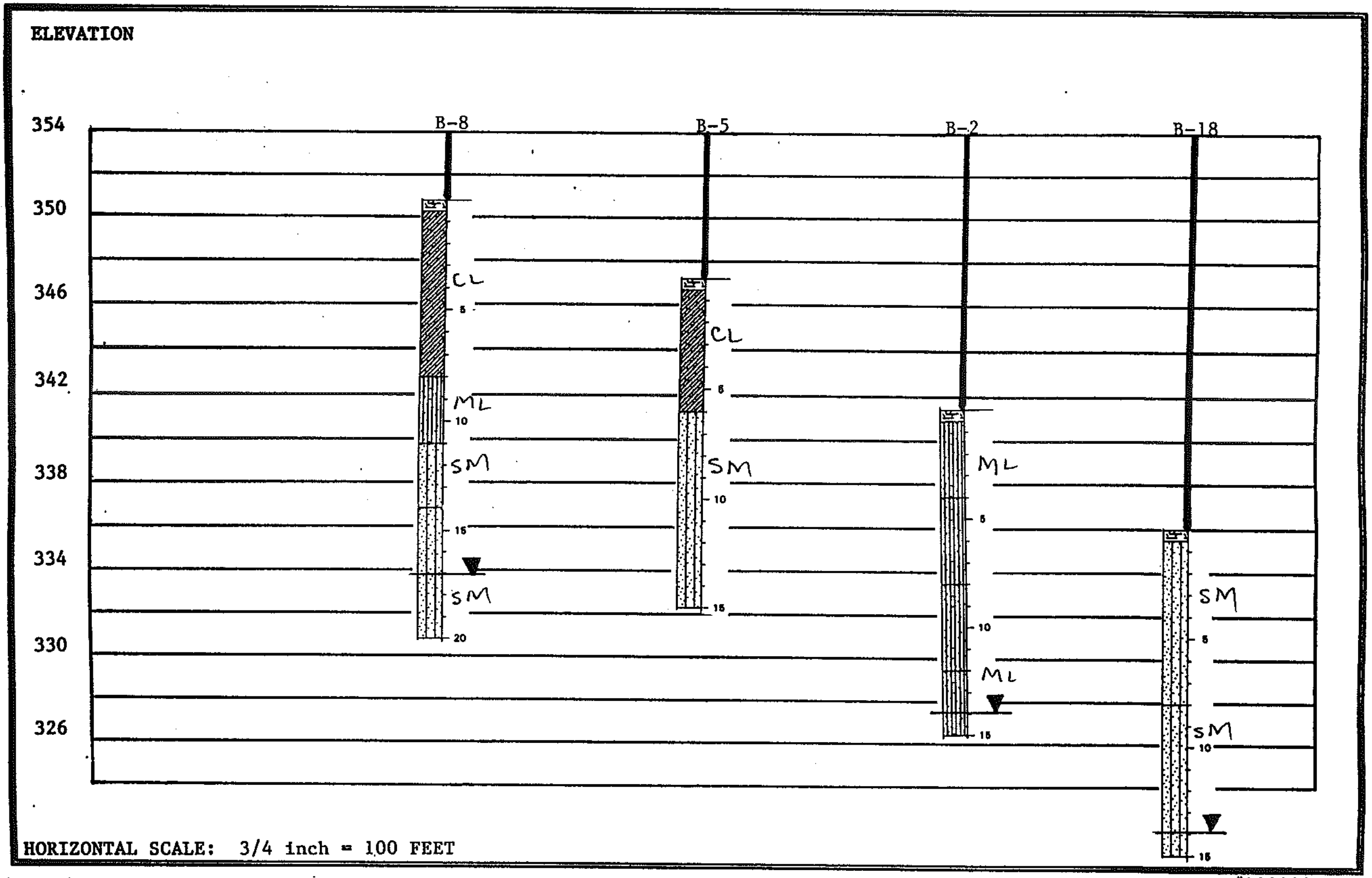

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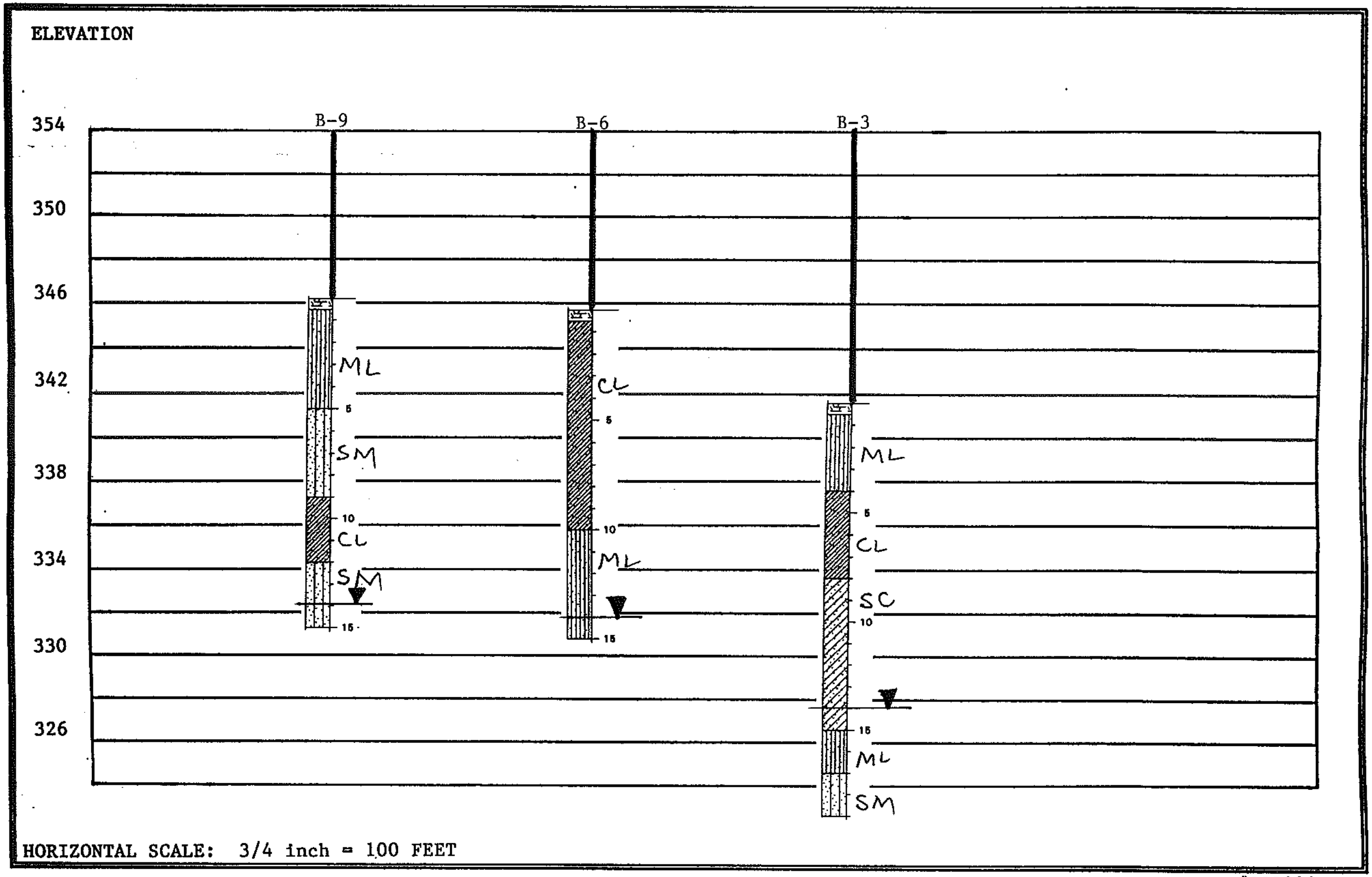
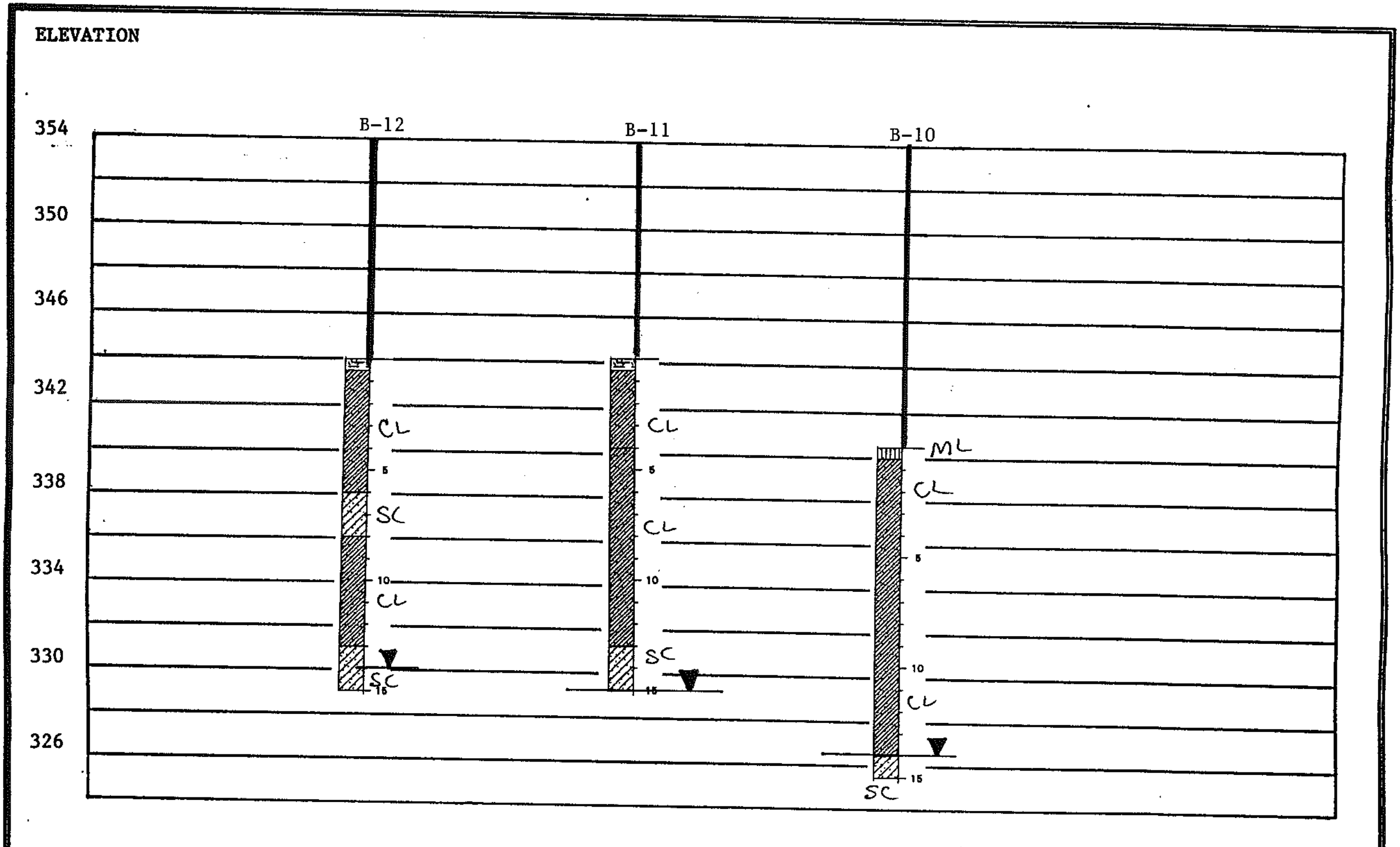


MAXIM TECHNOLOGIES, INC.

MAXIM FILE #000444



HORIZONTAL SCALE: 3/4 inch = 100 FEET

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

<u>Preliminary Report</u>
<u>Soils Investigation</u>
<u>Welsh Power Plant</u>
<u>Cason, Texas</u>

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.

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SEP 4 - 1973
OFFICE OF
W. H. HOLLEY

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

Clarence J. Ehlers, P.E.
Project Manager

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

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

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	COHESION, TON/SQ FT / PLASTIC LIMIT – WATER CONTENT, % – LIQUID LIMIT	-#200,%
0	Tan sandy silt	3-6-5			
5	Very stiff red & light gray sandy clay with ferrous nodules	11-18-35			
8	Red silty fine sand				50
	-with clay seams and pockets and sandstone nodules, 13' to 19'	10-9-10			16
	-gray below 18'	7-24-22			21
	-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			
		17-40-60/3"			
		33-60/6"			
42	Gray sandy silt with organic pockets and seams	33-48-60/5"		Non-Plastic	
46	Hard brown and gray clay with sand pockets and partings	24-42-60/6"	109	2.0	65

(Continued on next page)

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Form 106-2 (57) Job No. 73-085

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 (0.2–1.4); PLASTIC LIMIT, WATER CONTENT, %, LIQUID LIMIT (10–70)	-#200, %
			Gray silty fine sand				
55		☒		42-60/5"			
60		☒		31-60/6"		Non-Plastic	
65		☒		40-60/6"			
			Hard gray clay -with sandy silt partings and pockets to 70.5' -with sandstone seams and layers below 70.5'				
70		☒		25-38-60/5"			
75							
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

Form 106-1 (57) Job No. 73-085

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

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT – WATER CONTENT, % – LIQUID LIMIT (10–70)	-#200,%
	SURF. EL: 338.8'				
0–5	Very stiff red and tan sandy clay -with sand pockets and seams at 2.5' to 5'	1-1-3 8-9-10			
5–23	Red silty fine sand -with sandy clay pockets and seams to 15' -with ferrous nodules to 16' -with light gray clay seams, 9' to 15' -sandstone layer, 16.5' to 17' -gray below 17' -lignite layer, 21' to 23'	16-13-16 4-5-7 9-14-18			28
23–33	Very stiff gray clay -with sand pockets and seams to 25' -with silt partings, seams, & pockets below 25'	11-14-13 7-14-18		1.35+	
33–36	Gray fine sand				
36–42	Hard gray clay with sand pockets and partings	15-32-60/4"		4.0	
42–50	Gray silty fine sand -with clay pockets to 49' -clayey sand layer, 48.5' to 49'	20-30-60/3" 28-60/6"			

(Continued on next page)

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PLATE 3

LOG OF BORING NO. P-2 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT, WATER CONTENT, %, LIQUID LIMIT (10–70)	-#200,%
52–66	Gray silty fine sand				
55		29-46-60/3"			
60		29-37-60/3"			24
	-with clay pockets, 61.5' to 64'				
65		22-31-60/3"			
66–74.5	Hard gray clay with sand pockets and mica				
70	-sandstone layer, 68' to 68.5'	16-24-48		2.8 ⊗→	
74		33-60/3"			

COMPLETION DEPTH: 74.5'
DATE: April 28, 1973

DEPTH TO WATER IN BORING: 13.3'

DATE: May 3, 1973

McCLELLAND ENGINEERS

Form 108-- (57) Job No. 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

SURF. EL: 329.4'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT
0–5	Stiff red clay with sand pockets and seams -with ferrous partings, 3.5' to 4.5'			
5–21	Red silty fine sand with ferrous nodules and sandy clay seams and partings -with sandstone nodules, 8' to 13' -with sandstone layer, 14' to 15' -with coarse sand and gravel, 18.5' to 19'			
21–38	Hard gray clay -with sand pockets to 28' -with silt partings and pockets below 28'		99	4.2, 3.3, 4.6
38–42	Gray silty fine sand with clay pockets and seams	35-50/6"		
42–46	Hard gray sandy clay with sand pockets		110	
46–50	Gray silty fine sand -lignite layer, 49.5' to 50'			

Chart scales: 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

(Continued on next page)

McCLELLAND ENGINEERS

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

LOG OF BORING NO. P-3 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ 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		3.3
65	Gray sandy silt	50/5"		
70	Hard gray sandy clay -with silt pockets to 70'		109	3.5
75				4.5

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

COMPLETION DEPTH: 75'
DATE: April 17, 1973

DEPTH TO WATER IN BORING: 10.4'

DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 4a

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

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

DEPTH, FT	DESCRIPTION OF MATERIAL (SURF. EL: 343.7')	BLOWS PER FT	UNIT DRY WT LB/CU FT	-#200, %
0–2	Tan silty fine sand			
2–4	Very stiff red and tan very silty clay -with sand pockets to 4'			
4–13	Stiff red and tan very sandy clay -with sandstone seams and nodules, 6' to 8.5'		112	
13–18	Tan and light gray silty fine sand with clay seams and pockets and scattered gravel			48 70
18–26	Stiff tan and light gray sandy clay with sand and ferrous seams -gray below 23.5'	13-6-10		
26–34	Gray silty fine sand with sandstone nodules	18-50/9"		
34–43	Very stiff gray clay -with sandy silt pockets, partings, and seams to 43'	11-14-25 17-50/8"		
43–50	Gray silty fine sand -clayey fine sand, 46' to 53'	43-50/5"	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

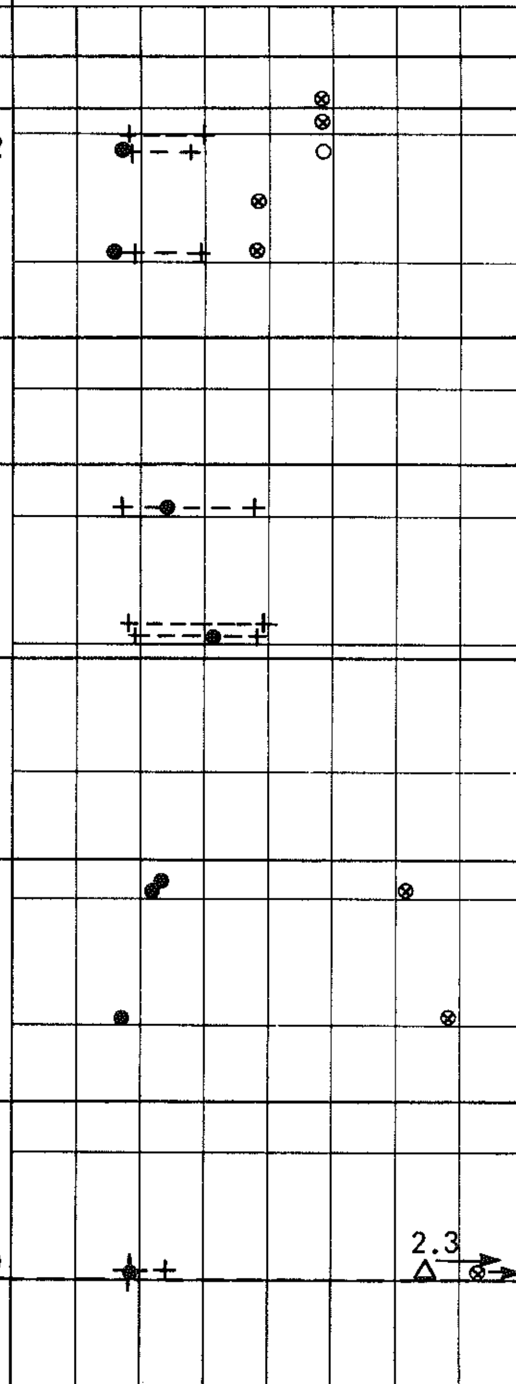

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PLATE 5

LOG OF BORING NO. P-4 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT
	Gray silty fine sand -clayey to 53'			
59		50-50/4"		
64		50-50/3"		
69	-clayey below 68'	25-50/5"		
74		33-50/5"		
78	-sandstone below 78'			
80	Hard gray sandy clay with sand pockets and partings -with silt partings and pockets to 93'	32-50/4"		
84				1.35+
89				1.35+
94				1.35+
99				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

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

LOG OF BORING NO. P-5

WELSH POWER PLANT
CASON, TEXAS

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

SURF. EL: 344.1'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	-#200, %
0–4.5	Very stiff red & tan very sandy clay -with sandstone nodules to 2.5' -with ferrous deposits, 2' to 4'			
4.5–28	Red and tan silty fine sand with light gray clay partings, pockets and seams -with sandstone nodules to 23' -tan, 13' to 23' -with ferrous partings and seams, 17' to 23' -gray below 23' -gray clay, 23' to 23.5'	10-20-23		32 33
28–33	Hard gray sandy clay with sand pockets and partings		103	
33–38	Gray silty fine sand -with clay pockets and seams to 35'			
38–41.5	Hard gray sandy clay		110	
41.5–50	Gray clayey fine sand	30-50/6"		
50	(Continued on next page)			

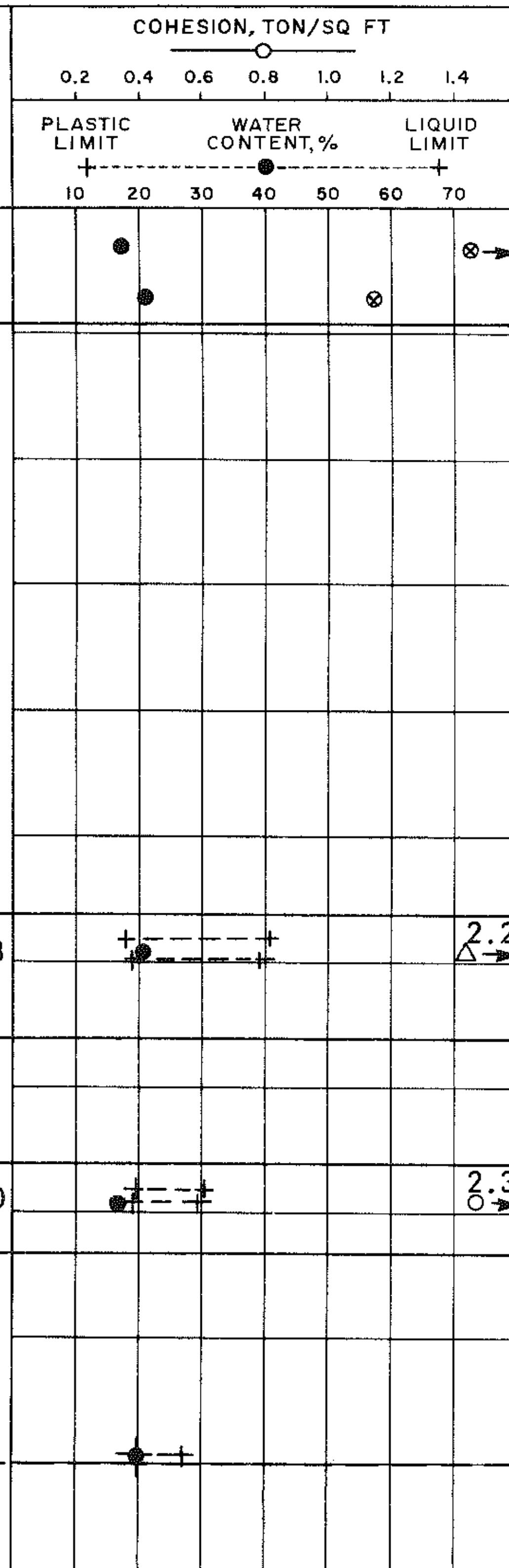

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PLATE 6

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

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PLATE 6a

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

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	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT
0–7.5	Fill: Tan and light gray clay, intermixed with sandy silt			
7.5–15.5	Very stiff tan & light gray clay -with sand partings and ferrous nodules to 10' -with sand pockets to 15' -sandstone layer, 15' to 15.5'			1.35+ 1.35+ 1.35+
15.5–23	Gray silty fine sand with sandstone nodules			
23–27	Very stiff clay with sand pockets			⊗
27–36	Gray silty fine sand with clay seams and pockets	14-50/8" 22-100/5"		
36–43	Very stiff gray silty clay with silt partings and pockets			⊗
43–46	Gray sandy silt with clay seams	15-56/12"		
46–49	Hard gray clay with silt seams and partings			⊗
49–	Gray silty fine sand	26-20/6"		

(Continued on next page)

Water content scale: 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

PLATE 7

Form 108-5 (57) Job No. 73-085

LOG OF BORING NO. P-6 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ 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"		
65–70	Hard gray clay -with lignite partings and seams to 66.5' -with silty sand partings & pockets below 66.5'	30-53/6" 36-58/6"		1.35+
75	Gray silty sand with sandy clay seams			
80	Gray cemented sand -with sandstone seams and layers to 78.5'	31-100/7"		1.35+
85–90	Hard gray sandy clay with sand pockets and mica	53-87/6" 100/9"		1.35+
95–100	Gray sandy silt with mica	40-60/3" 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

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 (57) 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	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
0–1	Tan silty sand		
1–7	Stiff red and tan sandy clay -very sandy at 4'		
7–20	Tan silty fine sand -with sandstone nodules to 10' -with clay pockets to 15' -tan and light gray at 18'		
20–38	Stiff light gray clay with sand pockets and partings -with ferrous nodules and seams to 30' -very stiff gray sandy clay with sand seams and pockets below 33'		91
38–48	Gray clayey fine sand with sand-stone nodules and clay pockets	12-50/4"	
48–50	Very stiff gray sandy clay		

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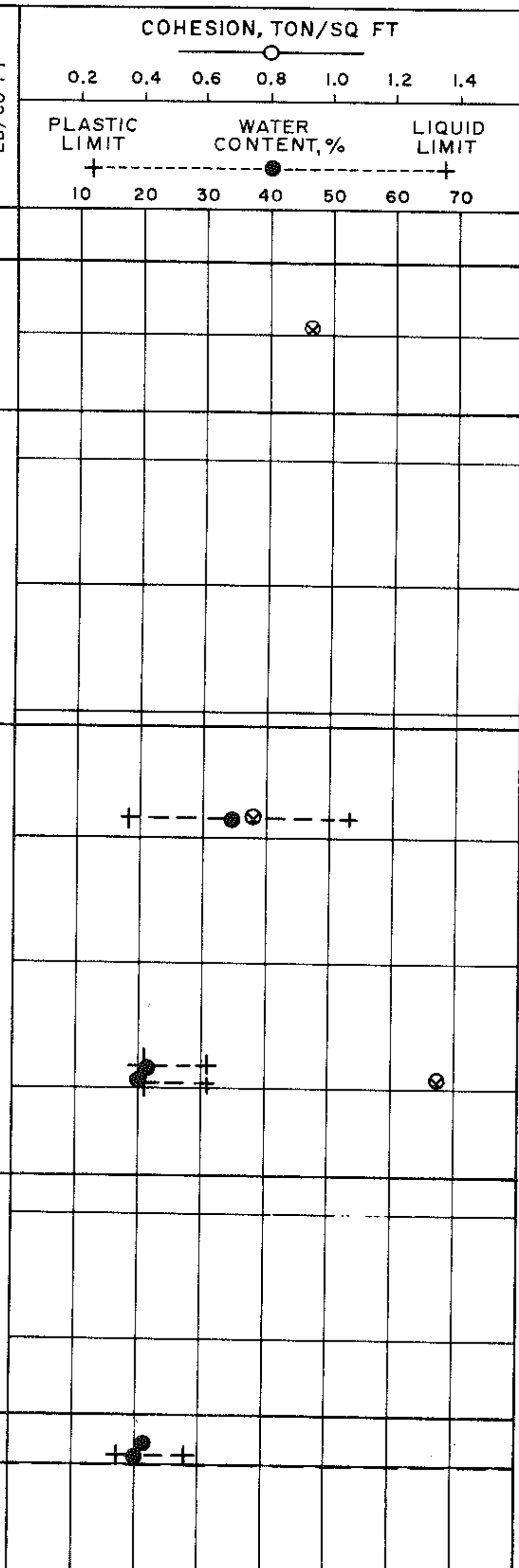


McCLELLAND ENGINEERS

Form 108-5 1971 Job No. 73-085

LOG OF BORING NO. P-7 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT, WATER CONTENT, %, LIQUID LIMIT
52–55	Very stiff gray sandy clay			
55–63	Gray silty fine sand with clay pockets			
63–68	Hard gray sandy clay with sand pockets	22-50/6"		
68–73	Gray clayey fine sand		108	
73–76.5	Gray silty fine sand			
76.5–83	Black lignite	100/6"		
83–99	Hard gray sandy clay -with sandy silt pockets to 90' -with siltstone nodules, 89.5' to 90' -sandstone, 98.5' to 99'	100/3"		1.35+

COMPLETION DEPTH: 99'
DATE: March 29, 1973

DEPTH TO WATER IN BORING: 25.0' Caved at: 74'

DATE: April 23, 1973

McCLELLAND ENGINEERS

PLATE 8a

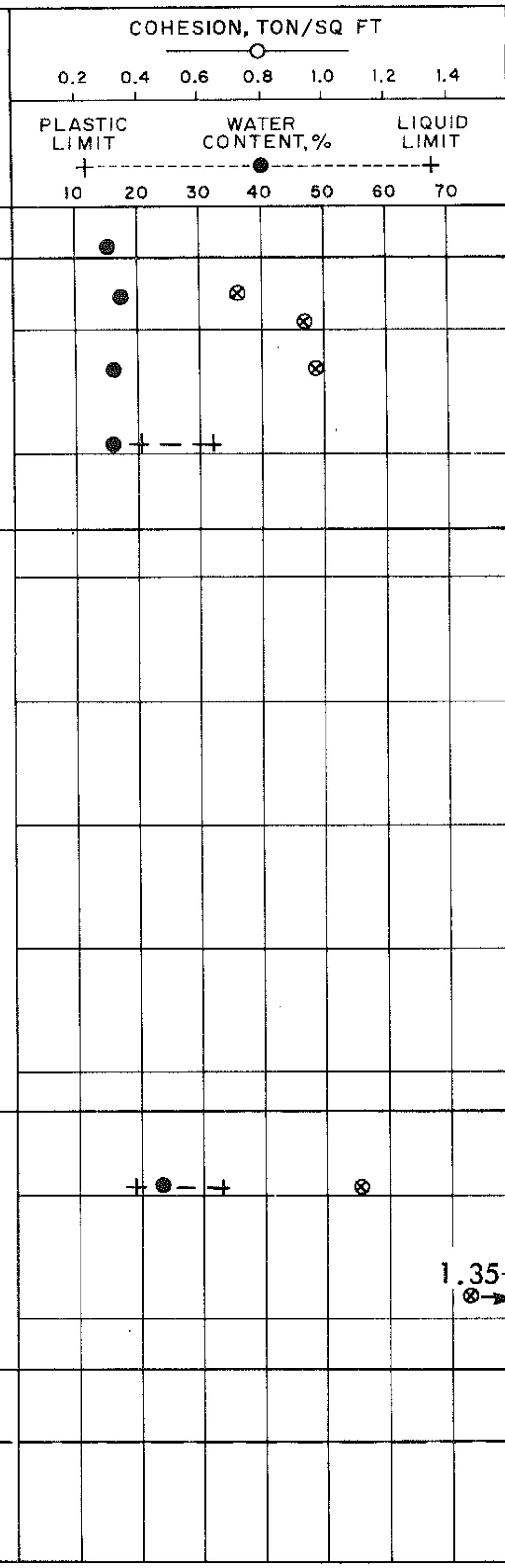
Form OB-1 (57) Job No. 73-085

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

SURF. EL: 346.5'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	-#200,%
0–2	Tan & light gray clayey fine sand			
2–13	Stiff tan sandy clay -with ferrous nodules and sand pockets to 8' -red and tan at 6'			
13–36	Light gray silty fine sand with clay seams -with ferrous nodules to 20.5' -red, 29' to 33.5'	11-21-22 (at 35')		32 (at 15'), 20 (at 25'), 31 (at 35')
36–47	Very stiff gray sandy clay with silt partings and pockets -with sandstone seams, 39' to 42'			
47–50	Gray silty fine sand			



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McCLELLAND ENGINEERS

LOG OF BORING NO. P-8 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	-#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 sand-stone 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				

Cohesion scale: 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

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
0–20	Stiff red and tan sandy clay			
	-becomes very stiff by 13'			1.35+
				1.35+
20–28	Tan fine sand	8-10-15		
28–38	Very stiff light gray clay			
	-with silt partings to 30'		96	
	-gray sandy clay with sand pockets and partings below 33'		98	1.6
38–48	Gray silty fine sand with gray clay seams and partings	15-33-50/3"		
		15-50/7"		
48–	Very stiff gray sandy clay with silt partings	10-50/8"		
	-with sand pockets to 50'			

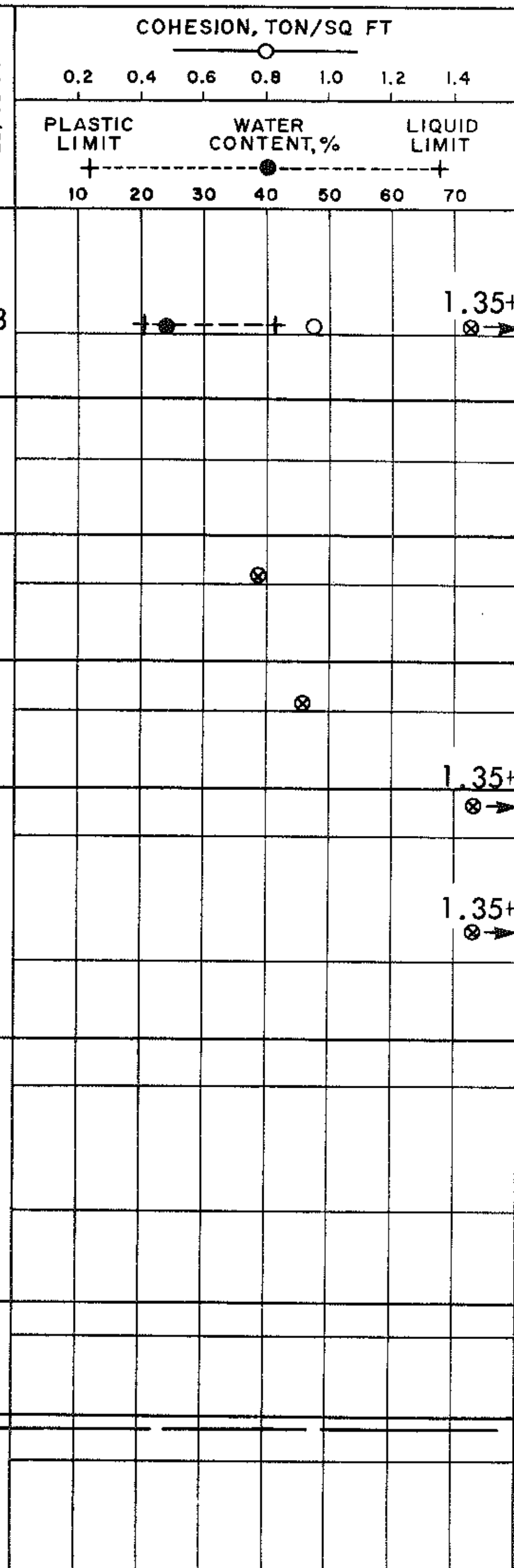
(Continued on next page)

Chart scales: 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

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

LOG OF BORING NO. P-9 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
50–58	Very stiff gray sandy clay -with sandy silt seams below 53'		103
58–63	Gray fine sand		
63–68	Stiff gray sandy clay -with sand pockets to 68'		
68–73	Tan clayey fine sand with clay seams and layers		
73–83	Hard gray clay -with sand seams below 78'		
83–93.5	Gray silty fine sand	50/5"	
93.5–98	Hard gray sandy clay	26-50/5"	
98–98.5	Gray sandstone layer		



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

TYPE: 3" thin-wall-tube & 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	COHESION, TON/SQ FT
0–8	Very stiff red and tan clay with sand pockets			1.35+
8–23	Red and tan fine sand -slightly clayey to 13' -with sandstone nodules, 14' to 15' -with ferrous deposits, 19' to 20'			
23–27.5	Light gray sandy silt -with sand pockets and seams	3-5-5		
27.5–41	Tan silty fine sand -with ferrous seams at 34' -gray with clay seams below 36.5'	6-3-5 10-16-26		
41–50	Very stiff gray sandy clay with silt partings and seams		102 105	1.7 1.35+

(Continued on next page)

Chart scales: 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

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

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

WELSH POWER PLANT
CASON TEXAS

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT
	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
	-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"		
85	-lignite, 84' to 85.5'	50/5"		
	Hard gray clay -with silt partings and pockets to 90'			1.35+
				1.35+
				1.35+
100	(Continued on next page)			

Cohesion scale: 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

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	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT
100–111	Hard gray clay -with sand pockets below 100'			
111–135	Gray silty fine sand -with clay seams and pockets to 128'	50/6"		
		50/5"		
	-light gray at 128'	50/3"		
135–146	Hard gray clay, slightly silty -with silt partings to 138.5'			1.35+
146–148	Soft gray silty clay -with rock cuttings to 148'			
148–158	Hard gray shaley clay			1.35+
158–165	Light gray silty sand			
165–173	Hard gray clay with silt partings and pockets			1.35+
173–184	Hard brown and tan lignite			1.35+
184–198.5	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

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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	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT
0–4.5	Stiff tan and light gray clay, slightly sandy with ferrous and organic matter and sand pockets			1.35+
4.5–12.5	Very stiff tan and light gray sandy clay -with ferrous and organic matter to 6' -tan at 6'			1.35+ 1.35+ 1.35+
12.5–37.5	Tan fine sand -with ferrous partings and seams to 18' -with clay seams to 30' -sandstone layer, 19' to 19.5' -gray below 27' -ferrous and sandstone seams, 34' to 34.5'	28-50/2" 6-50/10" 10-13-25		
37.5–48.5	Hard gray clay -with silt partings to 40' -with sand pockets below 43.5'			1.35+ 1.35+
48.5–	Gray clayey fine sand			

Chart scales: 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

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

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT
Gray clayey fine sand			
Hard gray clay with silt partings			1.35+
Gray silty fine sand with lignite and clay seams	50/4" 50/6"		
Hard gray clay with sandy silt partings and traces of mica	24-50/7"		
Hard gray sandy clay with sand pockets			1.35+ 1.35+ 1.35+
Hard gray silty clay -with silt seams and partings to 99'			1.35+
Gray and light gray silty sand -with clay partings to 99'			

Depth scale (ft): 55, 60, 65, 70, 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

COMPLETION DEPTH: 100'
DATE: April 8, 1973

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

McCLELLAND ENGINEERS

PLATE 12a

Form 08-(157) Job No. 73-085

LOG OF BORING NO. P-12

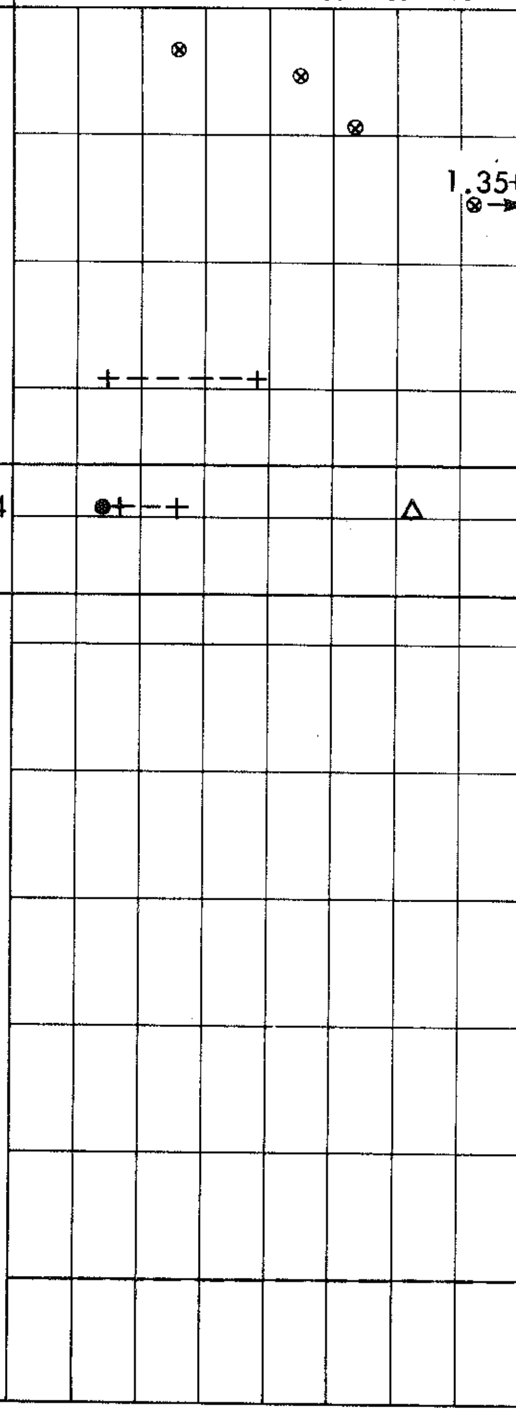
WELSH POWER PLANT
CASON, TEXAS

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

DEPTH, FT	DESCRIPTION OF MATERIAL (SURF. EL: 353.4')	BLOWS PER FT	UNIT DRY WT LB/CU FT	-#200,%
0–18	Stiff red and tan sandy clay -with sand pockets and seams to 8' -very stiff below 4'			
15		20-25-18		
18–23	Red and tan clayey fine sand with sand and clay pockets		114	
23–50	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'			
	-gray with clay seams below 38'	36-42/6"		
45		20-42-50/4"		37
	-sandstone, 48' to 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



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Form 10 Job No. 73-085

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

WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT + WATER CONTENT, % ● LIQUID LIMIT + (10–70)	- # 200, %
52–58	Gray silty fine sand				
58–78	Gray clayey fine sand with sand pockets	20-42-50/4"		++ ⊗	56
					53
78–93.5	Gray fine sand -with clay seams to 84'	100/4"			2
		100/6"			
	-sandstone below 92.5'			1.35+	
93.5–100	Hard gray sandy clay with sand pockets	24-50/7"		● ⊗→	
100				● 1.35+ ⊗→	

Depths shown on the scale: 55, 60, 65, 70, 75, 80, 85, 90, 95, 100

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 / PLASTIC LIMIT, WATER CONTENT, %, LIQUID LIMIT	-#200, %
0	Firm tan and light gray clay				
	Very stiff tan and light gray sandy clay				
8	-with silt pockets and partings below 8'				
12	Tan silty fine sand				21
					32
23.5	-with coarse sand layer at 23.5'	23-50/4"			
30		2-6-11			21
34	-gray below 34'				
35.5	-with gravel layer at 35.5'				
39	Hard gray clay	23-50/10"			
42	Gray silty fine sand				20
50	(Continued on next page)				

McCLELLAND ENGINEERS

Form 108-?-1971 Job No. 73-1985

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 (0.2–1.4) / PLASTIC LIMIT – WATER CONTENT, % – LIQUID LIMIT (10–70)	-#200, %
52–58			Gray silty fine sand				38
58–60			Hard gray clay with silt partings			1.35+	
60–69			Gray silty fine sand with lignite seams and mica	50/3"			

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'

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

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McCLELLAND ENGINEERS

Job No. 73-085

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

WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	-#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 ⊗→	

Cohesion scale: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4. Plastic limit – Water content, % – Liquid limit scale: 10, 20, 30, 40, 50, 60, 70.

Depth scale continues: 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

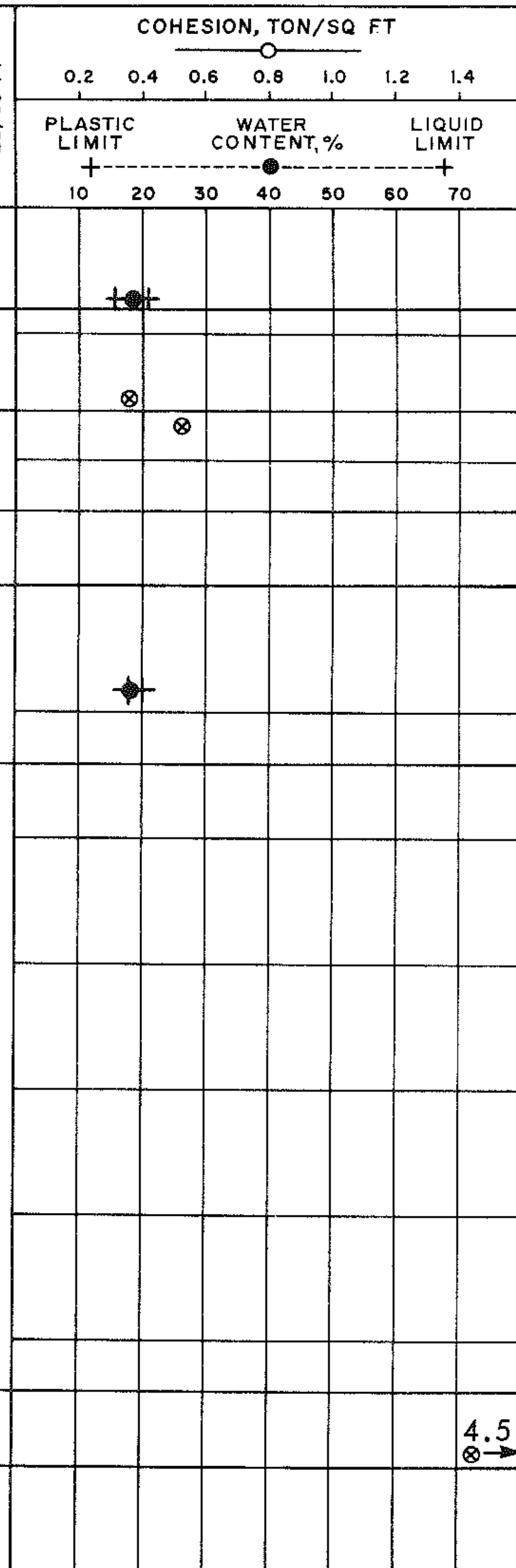
LOG OF BORING NO. P-20

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	UNIT DRY WT LB/CU FT
0	Tan clayey sand	1-1-3	
4	Firm tan and light gray sandy clay with ferrous deposits	2-2-3	
8	Stiff light gray clay with ferrous seams and partings		
12	Gray silty fine sand	17-24-37	
15	Gray clayey sand -with clay pockets to 18'	15-24-60/4"	
22	Gray silty fine sand	28-60/6"	
		29-54-60/3"	
		24-54-60/2"	
	-with clay pockets, 39' to 44'	19-60/6"	
	-fractured sandstone layer, 44' to 45.5'	21-53-60/3"	
47	Hard gray clay with sand pockets and partings	14-26-48	



COMPLETION DEPTH: 50'
DATE: April 28, 1973

DEPTH TO WATER IN BORING: 2.7'

DATE: May 3, 1973

McCLELLAND ENGINEERS

LOG OF BORING NO. P-21

WELSH POWER PLANT
CASON, TEXAS

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

SURF. EL: 323.6'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	-#200, %
0–7	Stiff red and light gray clay with sand partings and pockets -with ferrous nodules, 2' to 6'	3-3-6			
7–12	Tan silty fine sand with light gray clay seams and pockets	12-16-27			28
12–32	Hard gray clay -with silt partings to 20'			3.8	
	-brown, 18.5' to 19'	14-25-33		3.0	
	-with sand pockets & partings, 23' to 25'		106	4.0	
	-with silt partings & pockets, 28' to 30'	12-19-23		4.0	
32–37	Gray silty fine sand	31-36-60/3"			
37–42	Hard gray sandy clay with sand pockets	10-21-60/5"			
42–60	Gray silty fine sand	21-60/6"			30
		26-60/5"			
		32-60/5"			21
	-sandstone layer, 57' to 57.5'	21-46-60/3"			

Note Scale Change (at 40 ft)

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

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

COMPLETION DEPTH: 60'
DATE: April 29, 1973

DEPTH TO WATER IN BORING: 11.6'
DATE: May 3, 1973

PLATE 17

McCLELLAND ENGINEERS

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

LOG OF BORING NO. P-22

WELSH POWER PLANT
CASON, TEXAS

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

SURF. EL: 338.1'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT
0–4	Stiff red and light gray sandy clay	4-4-7		1.6
4–46	Hard light gray and tan clay -with ferrous deposits to 10' -with sand pockets and partings to 18' -with silt partings, 7' to 28' -with vertical ferrous seams at 13.5' -gray below 16' -with lignite seams, 22' to 23' -with sand seams and pockets, 28' to 46' -sandstone layer, 38.5' to 39'	5-8-10 12-16-46 10-21-31	99 116	2.1 2.1 2.9 3.0 3.8 4.5
46–50	Hard gray sandy clay with sand pockets and seams	16-27-60/4"		

Chart scales: 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

COMPLETION DEPTH: 50'
DATE: April 30, 1973

DEPTH TO WATER IN BORING: 1.2'

DATE: May 3, 1973

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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

SURF. EL: 304.2'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	-# 200,%
0–1	Tan sandy silt				
1–18	Stiff tan sandy clay with sand pockets -with gray clay seams, 12' to 18' -red and tan below 12'		109		60
18–24	Gray silty fine sand with clay pockets and seams -sandstone layer, 23.5' to 24'	15-21-25 50/0"		4.4	24
24–53.75	Hard gray clay -with sandy silt partings and pockets to 30' -silty clay, 38' to 40' -with sand pockets and seams, 38' to 45'	21-50/4" 50/6" 40-50/3"	115	2.7 2.3 3.3 4.4	

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

COMPLETION DEPTH: 53.75'
DATE: April 22, 1973

DEPTH TO WATER IN BORING: 6.6'

DATE: May 3, 1973

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	DESCRIPTION OF MATERIAL (SURF. EL: 357.8')	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,%
0–4.5	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 4.1	
13–15	-with red fine sand seams and layers below 13'	8-17-16		1.2	
19.5	Tan silty fine sand				
25	-with ferrous nodules, 24' to 24.5'	11-10-10			32
30		18-23-18			
35	-with ferrous partings, 34' to 35'	21-50/9"			16
40		28-50/8"			
45	-with organic partings, 43' to 45.5' -gray below 43'	8-14-20			
50	-with clay seams, 49' to 54'	14-50/6"			

(Continued on next page)

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PLATE 20

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

LOG OF BORING NO. P-25 (Cont'd)
WELSH POWER PLANT
CASON, TEXAS

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT; PLASTIC LIMIT / WATER CONTENT, % / LIQUID LIMIT	-#200,%
53	Tan silty fine sand	50/6"			
58–59	-sandstone layer, 58' to 59'				
60		50/6"			14
64	-with clay seams and sandstone nodules below 64'	32-50/6"			
69		50/4"			
74		24-50/7"			

Depth scale: 55, 60, 65, 70, 75, 80, 85, 90, 95, 100

Cohesion scale: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4
Water content scale: 10, 20, 30, 40, 50, 60, 70

COMPLETION DEPTH: 74.5'
DATE: April 21, 1973

DEPTH TO WATER IN BORING: 5.3'
DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 20a

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

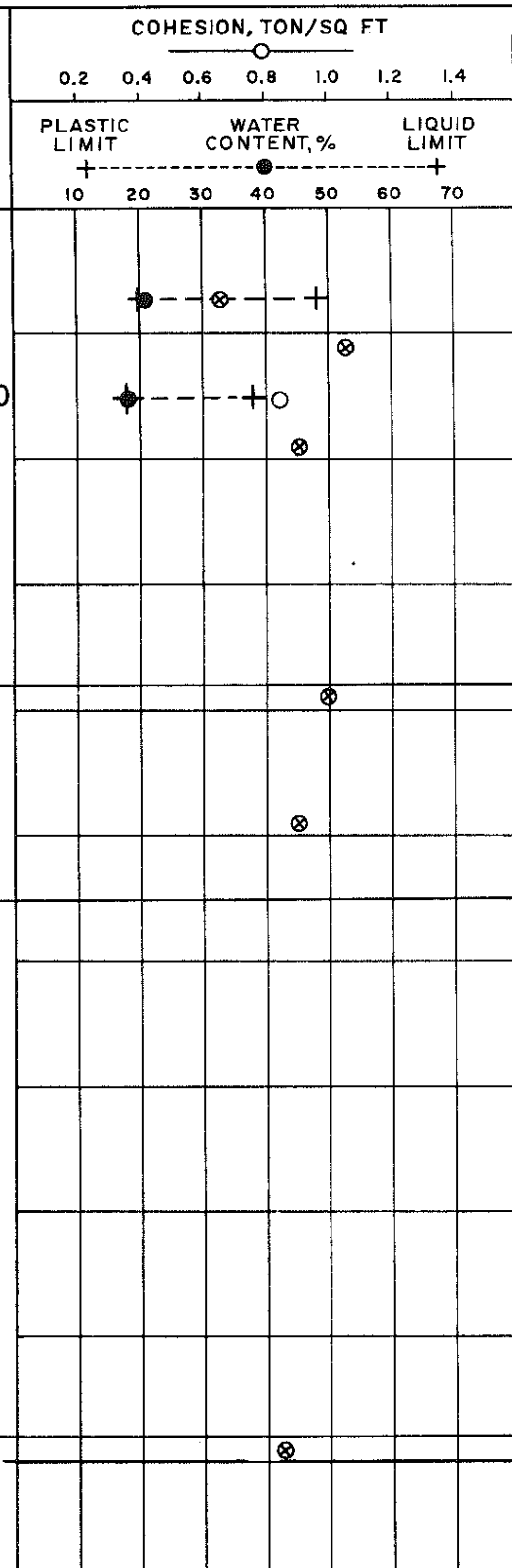
LOG OF BORING NO. P-26

WELSH POWER PLANT
CASON, TEXAS

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

SURF. EL: 346.2'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	-#200,%
0	Stiff tan sandy clay with sand pockets and seams			
	-with ferrous deposits, 4' to 10'			
	-red and tan below 6'		110	66
	-red fine sand layer, 13.5' to 14'	15-29-20		
	-with ferrous nodules below 14'			
19	Very stiff light gray and brown clay with ferrous partings and sand partings, seams and pockets			
	-gray below 24'	10-13-17		
27	Tan fine sand with clay seams and pockets	4-13-25		6
		28-35-15		
		6-4-7		27
		16-19-26		
		10-31-22		4
		10-10-25		
58	Stiff gray clay			



Note Scale Change (at 40 ft)

COMPLETION DEPTH: 60'
DATE: April 21, 1973

DEPTH TO WATER IN BORING: 19.7'

DATE: May 3, 1973

McCLELLAND ENGINEERS

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

LOG OF BORING NO. P-28

WELSH POWER PLANT
CASON, TEXAS

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

SURF. EL: 332.7'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / WATER CONTENT, %	-#200,%
0–2	Tan silty fine sand				
2–4.5	Very stiff tan and light gray sandy clay				
4.5–13.5	Tan fine sand -with light gray clay seams below 7.5'	13-18-17			
		15-22-44			6
13.5–42	Very stiff red and light gray clay with sand and silt pockets and partings -hard below 18'			4.0	
				4.3	
		13-18-22		3.3	
	-sandstone layer, 32.5' to 33'			4.2	
		20-35-60/5"			
42–46	Hard gray sandy clay	12-18-40			
46–50	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 (5?) 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

SURF. EL: 355.3'

Depth, ft	Description of Material	Blows per ft	Unit dry wt lb/cu ft
0–8	Stiff tan sandy clay -red and light gray below 6'		
8–12	Tan and light gray silty fine sand with clayey sand seams	30-50/6"	
12–18	Hard tan clay with ferrous partings		
18–24	Tan and light gray clayey sand	13-10-13	
24–25	Red and tan silty fine sand		

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

3.0

COMPLETION DEPTH: 25'
DATE: April 18, 1973

DEPTH TO WATER IN BORING: 19.0'   DATE: May 3, 1973

McCLELLAND ENGINEERS

PLATE 23

Form 108-1 (57) Job No. 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

DEPTH, FT	DESCRIPTION OF MATERIAL (SURF. EL: 358.1')	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT
0–5	Stiff red silty clay -with sandy silt pockets to 2' -firm at 2'			
5–15	Hard tan and light gray sandy clay with sand pockets -with ferrous nodules below 14.5'		116	2.6 2.2 2.8
15–25	Red silty fine sand with clay seams and ferrous partings	10-13-17		

Chart scales: 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

Depth scale: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50

COMPLETION DEPTH: 25'
DATE: April 18, 1973

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

McCLELLAND ENGINEERS

Form OP-- (67) Job No. 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

DEPTH, FT	DESCRIPTION OF MATERIAL (SURF. EL: 354.7')	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT
0–9	Stiff tan sandy clay with sand pockets -very stiff below 7'			
9–13	Red and tan silty fine sand with sandy clay pockets			
13–22	Hard tan and light gray clay with sand pockets -with ferrous pockets and sandy clay seams to 15'	12-19-27		2.5 2.3
22–25	Red silty fine sand with ferrous partings and clay seams	13-50/9"		

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

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	-# 200,%
0–8	Stiff red and tan sandy clay with sand pockets and ferrous pockets				
8–12	Red and tan sandy silt with sand pockets				64
12–42	Red silty fine sand with ferrous nodules and pockets				
	-with sandy clay seams and pockets to 30'	7-15-27			11
	-tan and light gray, 19' to 38'	16-17-30			14
		28-28-50			
		11-14-22			
	-with ferrous layer, 34.5' to 35'	14-77/12"			28
	-gray with clay seams below 38'	12-40-48			
42–47	Hard gray clay	22-50/2"		1.35+	
47–49	Gray silty fine sand	50/4"			

PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (scale 10 20 30 40 50 60 70); COHESION scale 0.2 0.4 0.6 0.8 1.0 1.2 1.4

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	Cohesion, ton/sq ft	-#200, %
0–5	Very stiff red and tan clay				
5–15	Red and tan silty fine sand	4-11-15			
	-with sandstone and red and light gray sandy clay below 8'	13-22-24			
15–19	Very stiff light gray clay with sand pockets and seams		105	1.7	
19–41	Light gray silty fine sand				
	-tan, 24' to 36'				
	-with clay seams and pockets below 24'	4-6-13			
	-with sandstone nodules, 26' to 38'	3-5-7			32
	-gray below 36'	8-5-4			
		9-14-21			
41–45	Hard gray sandy clay with silt seams and partings				49

COMPLETION DEPTH: 45'
DATE: May 1, 1973

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

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PLATE 27

Job No. 73-085

LOG OF BORING NO. P-35

WELSH POWER PLANT
CASON, TEXAS

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

SURF. EL: 341.5'

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT	-#200, %
0–5	Very stiff red and tan sandy clay				
5–22	Red and tan silty fine sand with sandstone seams and nodules				
	-tan with light gray clay seams below 13'	21-35-50			
	-with ferrous seams and partings, 17' to 19.5'	5-1-3			26
22–33	Hard gray sandy clay				
	-with sand pockets and partings to 25'	13-18-26		4.5	
	-with silt partings and pockets below 28'		102	3.2	
33–37	Gray silty fine sand with clay pockets and seams	8-7-50			
37–42	Hard gray sandy clay with sand pockets and seams		111	4.5	
42–45	Gray clayey sand	12-23-60/4"			

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 (57) 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

Note Scale Change

DEPTH, FT	DESCRIPTION OF MATERIAL (SURF. EL: 347.8')	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT – WATER CONTENT, % – LIQUID LIMIT	-#200,%
0–1	Tan silty fine sand				
1–8	Stiff red and tan sandy clay with sand pockets				
8–36	Red and tan silty fine sand	11-14-14			
	-with sandy clay seams to 14'				
	-with ferrous and sandstone nodules, 14.5' to 16'	8-8-8			22
	-with light gray clay seams, 18' to 20'	10-16-16			
		3-5-9			
		8-16-23			26
	-gray with lignite and clay seams below 32'	7-15-25			
36–49	Hard gray clay with sand seams and pockets			4.5	
	-with sandstone seams, 39.5' to 40'			4.5	
49–52	Gray silty fine sand	13-26-60/4"			
52–56	Hard gray sandy clay	29-60/5"		4.5	
56–60	Gray clayey sand	18-27-60/4"			

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	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT, WATER CONTENT, %, LIQUID LIMIT (10–70)
0–4.5	Stiff tan silty clay with sand pockets and seams	2-3-5; 4-8-9		
4.5–10	Stiff tan and light gray sandy clay with sand seams and pockets and sandstone nodules	3-4-6; 6-8-13; 4-6-11		
10–18	Tan silty fine sand -with sandy clay seams and pockets to 13'	8-14-15; 8-17-16		
18–23	Stiff tan and light gray sandy clay	4-3-5		+ ● - - +
23–38	Tan silty fine sand -gray below 32'	9-25-42; 10-5-3; 9-11-19		
38–42.5	Hard gray clay with sand seams and pockets			3.5 ⊗→
42.5–45	Gray silty fine sand	8-14-38		

COMPLETION DEPTH: 45'
DATE: May 1, 1973

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

McCLELLAND ENGINEERS

PLATE 30

Form 108-5 (57) Job No. 23-080

LOG OF BORING NO. P-38

WELSH POWER PLANT
CASON, TEXAS

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

LOCATION: See Plate 1

SURF. EL: 328.7'

DEPTH, FT	SYMBOL	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / PLASTIC LIMIT – WATER CONTENT, % – LIQUID LIMIT	ELEVATION, FT
	J1, a1	Stiff Red & Tan Sandy Clay w/ferrous deposits @ 1.5				
5	J2	Red & Tan Sandy Silt	9/16/14			
		- w/clay seams 4.5-9.5				
	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	6/10/12			
		- w/lignite seam @ 14.5 (3")				
		- w/sandstone layer 16'-17.5'				
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	29/37/60-2"			
	J11		24/34/60-2"			
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)

PRELIMINARY
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Form 108-5 (57) Job No. 73-086

LOG OF BORING NO. P-38 (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 (0.2–1.4); PLASTIC LIMIT, WATER CONTENT %, LIQUID LIMIT (10–70)	ELEVATION, FT
			Hard Gray Sandy Clay				
55		X		27/39/63-3"			
60		X		30/45/60-5"			
			-w/lignite layer 63.5'-64.5'				
65			-w/scattered lignite seams, 64.5-67'				
70		X		27/40-3"			
75		X		40-6"			
80		X	-w/clay and sand seams below 79'	40-6"			
		X		40-4"			
85			Gray Sandy Silt -w/clay seams below 84'				
90		X		40-5"			
95		X		40-3"			
100		X		50/4.5"			

PRELIMINARY
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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 108-5 (57) Job No. [illegible]

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	DESCRIPTION OF MATERIAL	BLOWS PER FT
	UP1	Stiff Red & TAN Sandy Clay	
5	J1	Red Sandy Silt w/clay pockets, 5' to 8'	22/24/39
	J2		22/24/55
10	J3		19/31/31
		- TAN below 13'	
15	J4	- w/gravel, 17'-17.5'	30/37/30
20	J5	- w/ Brown clay seams below 20'	7/14/20
	J6	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'	42/60-5"
30		- w/sandstone Nodules below 28.5	
	J8	- TAN & Red 33.5-45	30/60-6"
35		w/Lignite layer, 36' to 36.5'	
40	J9		14/19/30
45	J10	- Light Gray below 45	18/21/24
		Hard Gray Clay	
50	J11	w/SAND streaks @50	25/29/60

(Continued on next page)

Chart headings: 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). Further column headings: UNIT DRY WT LB/CU FT; ELEVATION, FT.

PRELIMINARY
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Form 108-5 (57) Job No. 73-085

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 (0.2–1.4); PLASTIC LIMIT – WATER CONTENT, % – LIQUID LIMIT (10–70)	ELEVATION, FT
	J12		Hard gray Clay				
55	J13		- laminated w/silt, 55' to 70'	30/34/60			
	J14B		-w/siltstone Nodules, 54.5-56				
60	J14A					1.35+	
	J14						
65	J15			27/40-3			
70	J16			24/40-6"			
75				45-5"			
80							
85							
90							
95							
100							

PRELIMINARY
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COMPLETION DEPTH: 75'
DATE: July 27, 1973

DEPTH TO WATER IN BORING:
DATE:

McCLELLAND ENGINEERS

Form 108-5 (57) Job No. 73-085

LOG OF BORING NO. P-40

Welsh Power Plant
Cason, Texas

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

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	DESCRIPTION OF MATERIAL (SURF. EL: 341.9')	BLOWS PER FT	UNIT DRY WT LB/CU FT
	UP1	Stiff Light Gray & Red Sandy Clay		
		-w/ferrous deposits 2'-3.5'		
5	J1	-w/ferrous seams 5'-14'	4/6/8	
		- light gray & tan 6.5'-20'		
	UP2			
10	J2	-w/sand seams and pockets below 10'	9/9/11	
	J3		23/28/60-4"	
15		-w/sand layer, 16'-16.5'		
20	J4, UP3	- Dark Gray below 20'	5/9/14	
		- w/organic matter 20.5'-22'		
		- Very Stiff below 21'		
25	J5, UP4		11/16/19	
30	J6, UP5		22/26/30	
35			42/60	
40	J7	Gray Silty Fine Sand w/organic matter 39'-40'	27/60-5"	
45	J8		27/26/60-5"	
50	J9		28/26/60-5"	

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

ELEVATION, FT

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

DEPTH TO WATER IN BORING:

DATE:

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Form 108-5 (57) Job No. 73-08

LOG OF BORING NO. P-41

WELSH POWER PLANT
CASON, TEXAS

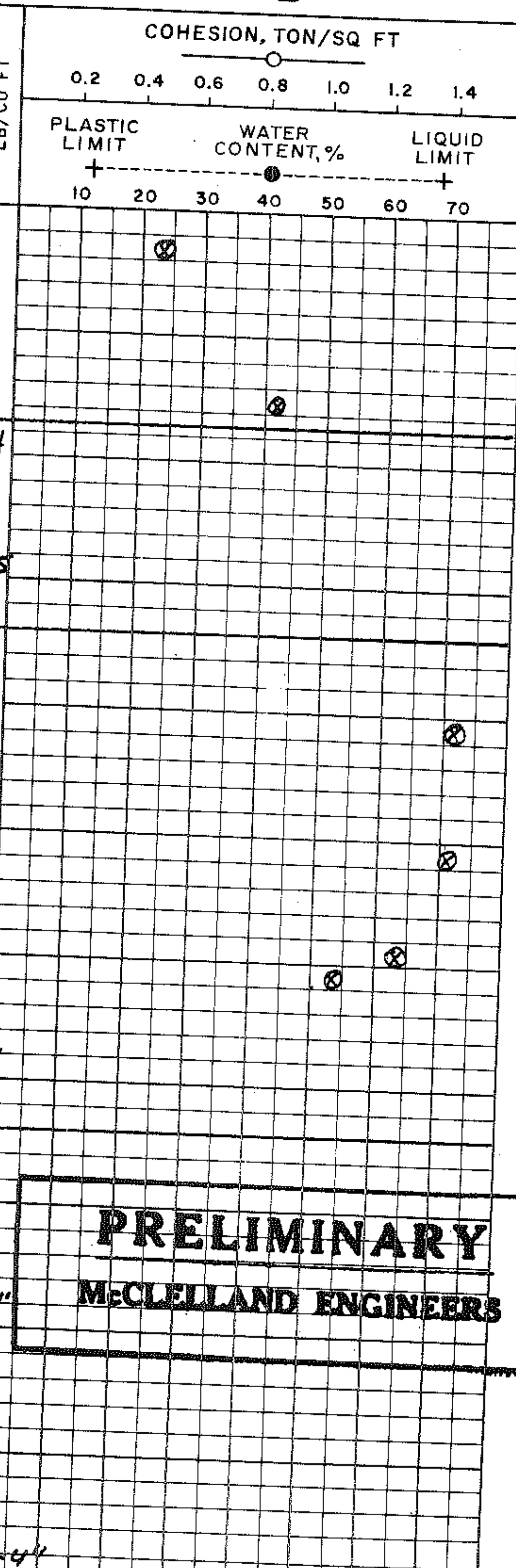
TYPE: 3" Thin-Wall-Tube
2" Split-Spoon

LOCATION: See Plate 1

SURF. EL: 347.7'

DEPTH, FT	SYMBOL	DESCRIPTION OF MATERIAL	BLOWS PER FT
	UP1	Stiff Red & TAN Sandy Clay	
5	J1	- w/ fervous 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	7/10/13
	UP4	- w/ silt streaks, 17'-20'	
		- w/ fervous deposits, 20'-21.5'	
25	J5		10/12/12
	UP5	- Dark Gray below 25'	
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"

UNIT DRY WT LB/CU FT



PRELIMINARY
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ELEVATION, FT

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

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

McCLELLAND ENGINEERS

PLATE 34

Form 108-5 (57) Job No.____

LOG OF BORING NO. P-42

WELSH POWER PLANT
CASON, TEXAS

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

LOCATION: See Plate 1

SURF. EL: 349.3'

DEPTH, FT	SYMBOL	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
	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	25/35/60-5"	
45	J10	- w/ organic matter and mica	45/48/60-3"	
50	J11		35/60-5"	
	J12		15/40-5"	

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+

ELEVATION, FT

PRELIMINARY
McCLELLAND ENGINEERS

COMPLETION DEPTH: 55'
DATE: July 30, 1973

DEPTH TO WATER IN BORING:

DATE:

McCLELLAND ENGINEERS

Form 108-5 (57) Job No. 73-085

LOG OF BORING NO. P-43

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

LOCATION: See Plate 1

DEPTH, FT	DESCRIPTION OF MATERIAL (SURF. EL: 351.8')	BLOWS PER FT
	Firm Red & Light Sand Clay	
	- stiff below 3'	
5		3/3/9
	- 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'	
	- w/ferrous deposit, 15'-20'	
20		11/16/23
	- dark gray below 20'	
25	- w/ sand pockets below 20'	15/26/60-5"
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"

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

ELEVATION, FT

(Continued on next page)

PRELIMINARY
McCLELLAND ENGINEERS

McCLELLAND ENGINEERS

Form 108-5 (57) Job No. 73-085

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
			Dark gray sandy silt				
55		☒		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 108-5 (57) 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

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2–1.4); PLASTIC LIMIT, WATER CONTENT, %, LIQUID LIMIT (10–70)	ELEVATION, FT
			SURF. EL: 361.5'				
			Stiff Tan & Red Sandy Clay				
5			-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							

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

Form 108-5 (57) Job No. 73085

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 / PLASTIC LIMIT – WATER CONTENT, % – LIQUID LIMIT	ELEVATION, FT
	UP1		Stiff red & light gray clay w/ sand pockets				
5	J1			5/7/9			
	UP2						
10	J2		Red Silty fine Sand -w/clay pockets	14/15/20			
	J3		Very stiff Light gray clay -w/ ferrous nodules, 14'-18'	5/8/10			
15	UP3					1.35+	
			-shale layer, 16 - 16.5				
	J4			7/8/12			
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'				
			-w/scatterd sand stone seams, 26'-30.5'				
30	J6			13/60=9"			
			Very stiff Gray clay w/sandy silt partings				
35	J7		w/sand stone below 32	18/24/39			
40							
45							
50							

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

WATER CONTENT scale: 10, 20, 30, 40, 50, 60, 70

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

Form | Job No. 85

LOG OF BORING NO. P-49

WELSH POWER PLANT
CASON, TEXAS

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

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	DESCRIPTION OF MATERIAL (SURF. EL:)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT / WATER CONTENT, %	ELEVATION, 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

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

Form 1 Job No. 7? 785

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 SURF. EL:	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			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 108-5 (57) 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 (SURF. EL:)	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
			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 41

Form 108-5 (57) Job No. 23-085

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 108-5 (57) Job No. 73-085

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 - Brown & Light Gray 11'-14' - Gray below 14'			
15						
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:

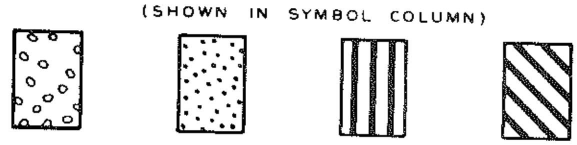
McCLELLAND ENGINEERS

PLATE 43

SYMBOLS AND TERMS USED ON BORING LOGS

SOIL TYPES

(SHOWN IN SYMBOL COLUMN)

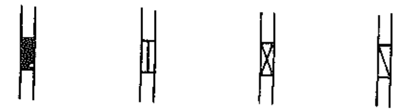


Gravel   Sand   Silt   Clay

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.

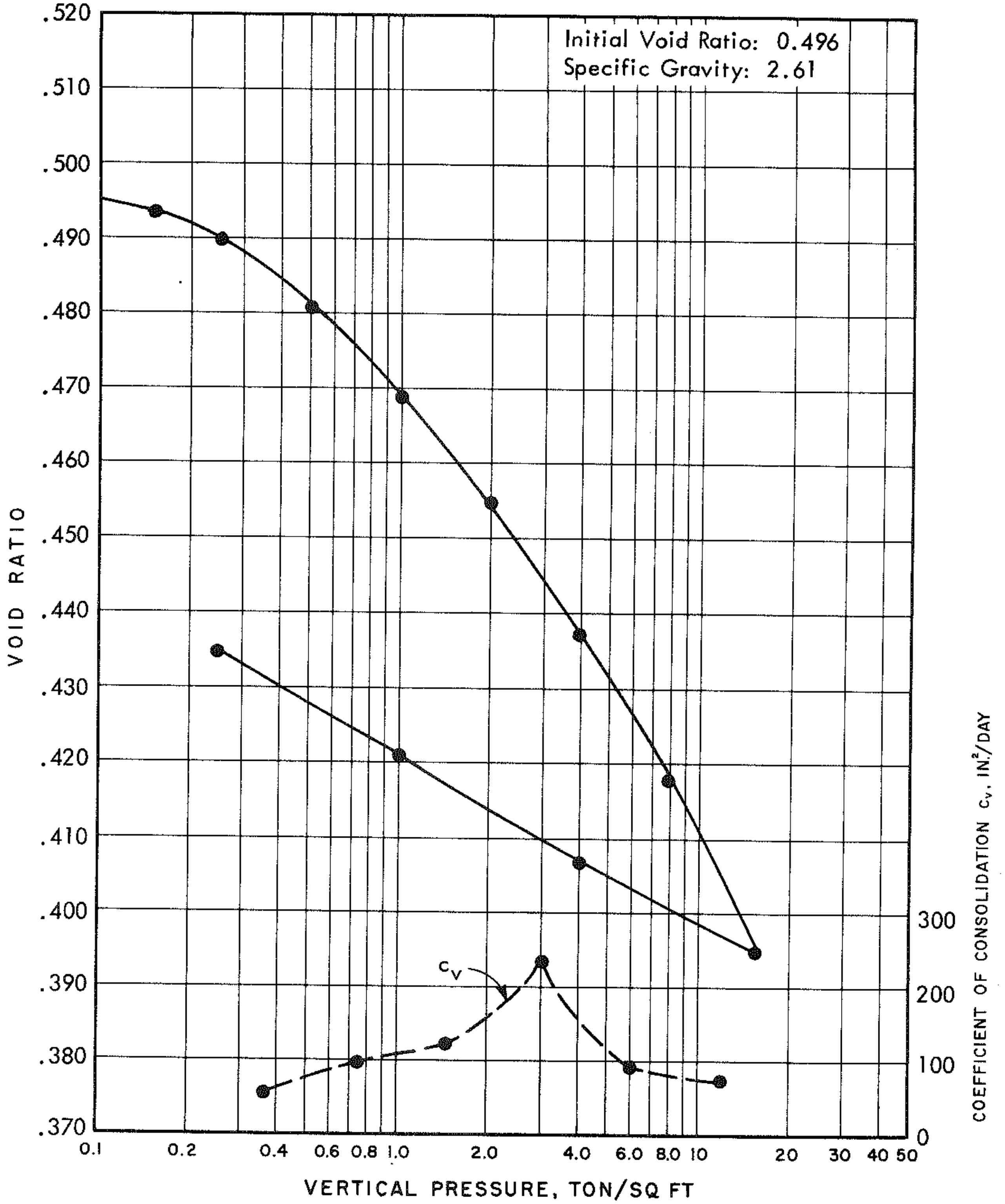
Poorly graded – predominantly of one grain size, or having a range of sizes with some intermediate size missing.

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.

McCLELLAND ENGINEERS

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



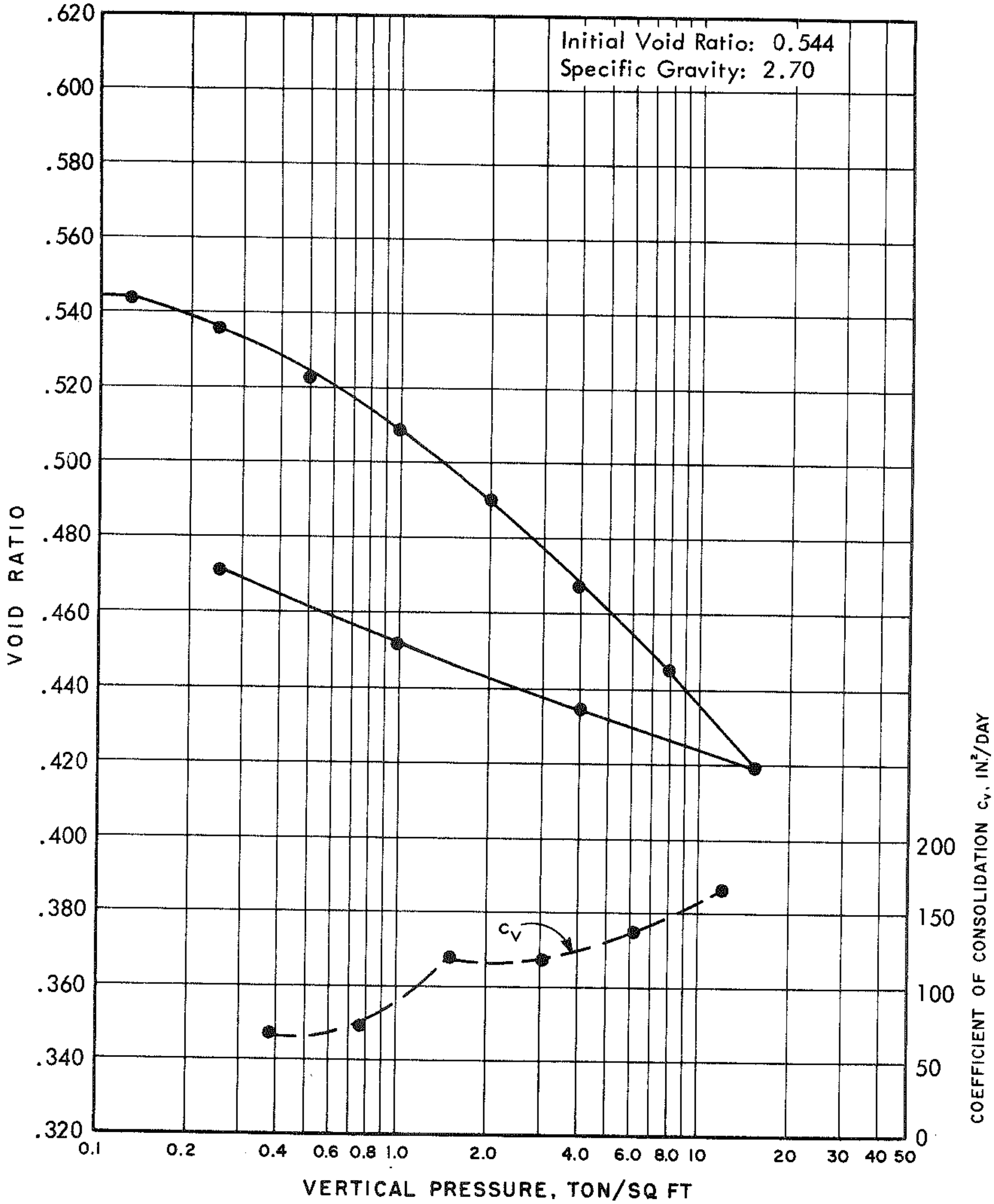
CONSOLIDATION TEST RESULTS

McCLELLAND ENGINEERS

Form 06-3 57 Job No 23-086

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'

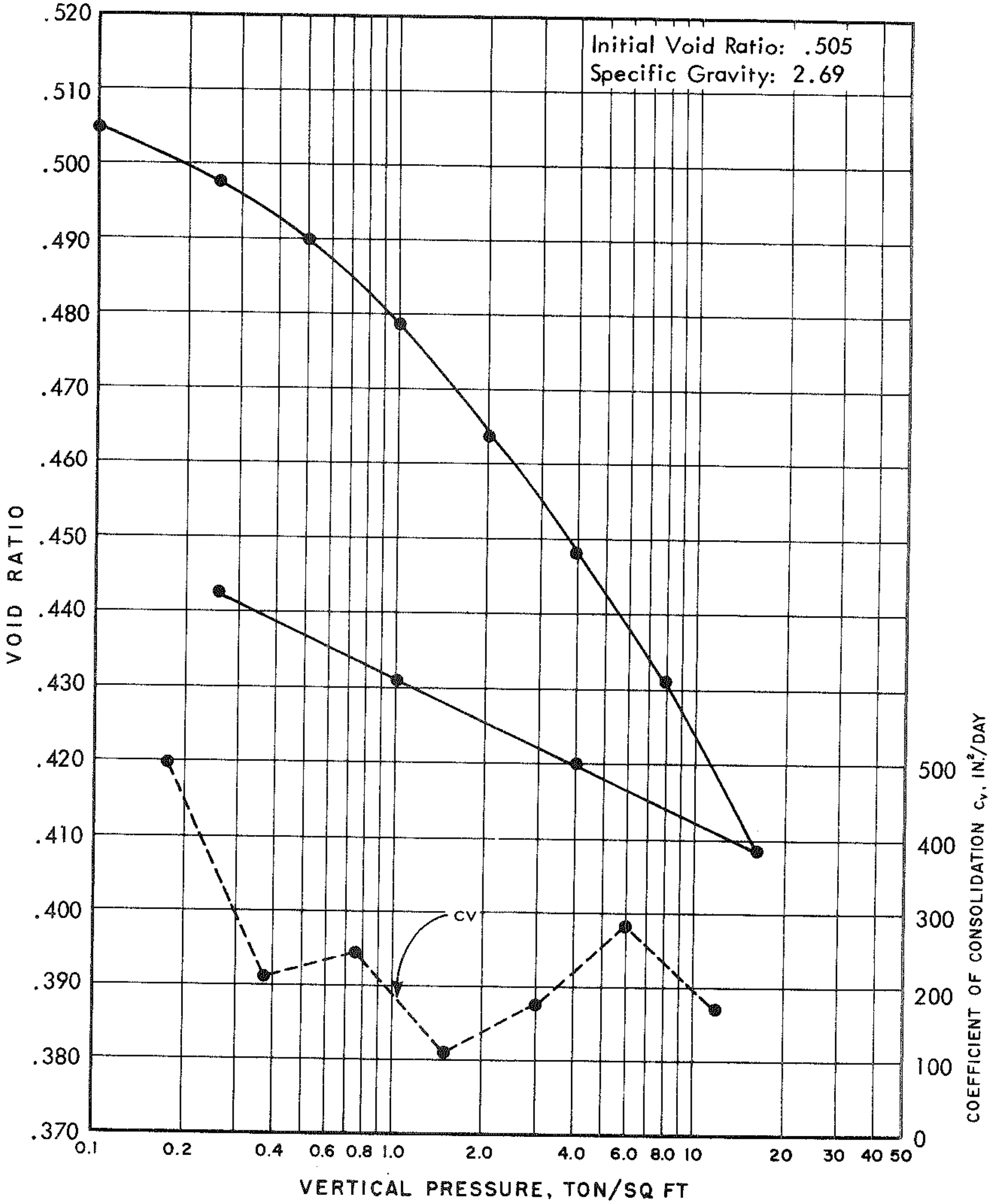
MATERIAL: Stiff red and tan very sandy clay

UNIT DRY WEIGHT: 112 LB/CU FT

WATER CONTENT: 17 %

LIQUID LIMIT: 29

PLASTIC LIMIT: 18



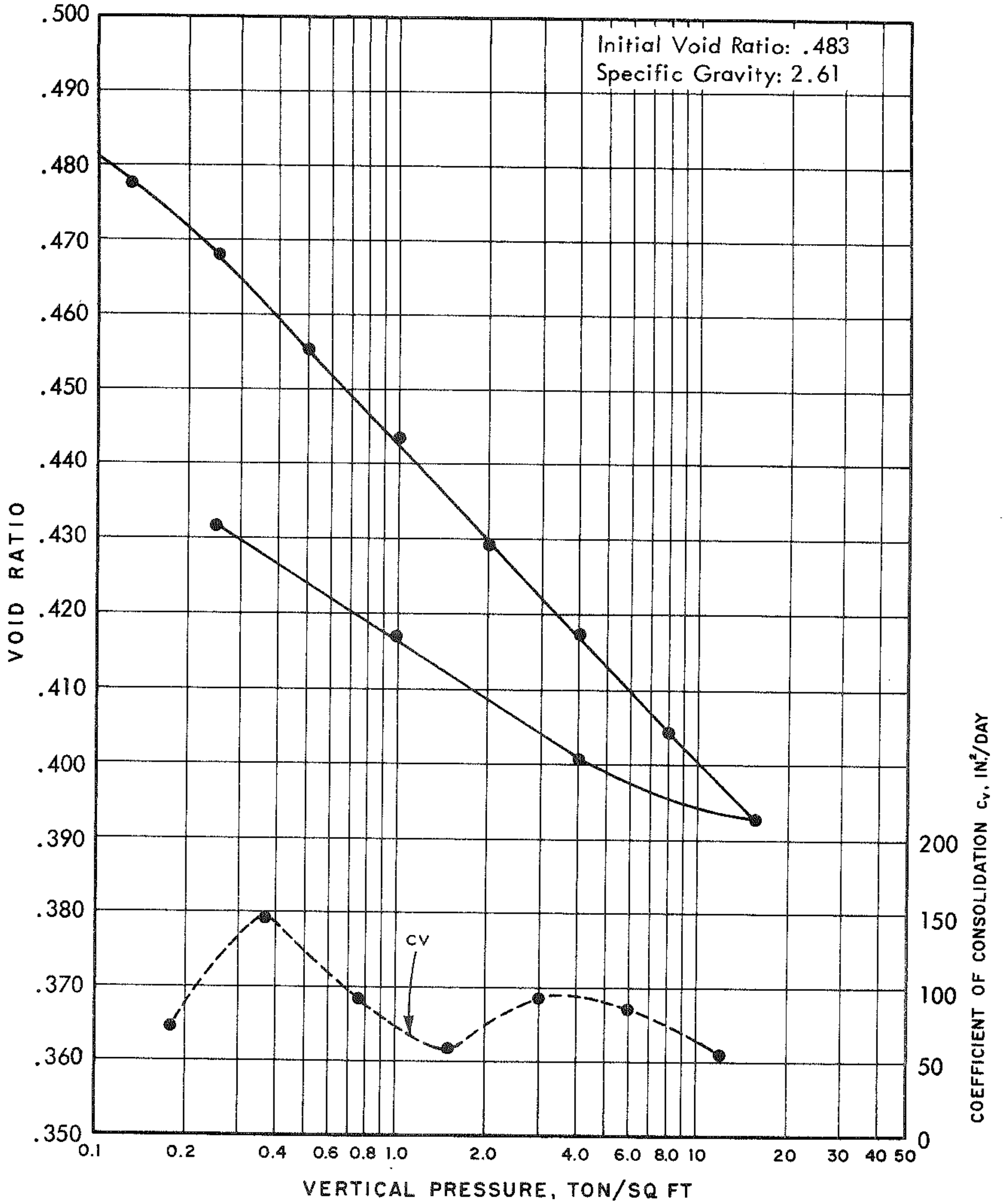
CONSOLIDATION TEST RESULTS

McCLELLAND ENGINEERS

Form 06-3 57 Job No. 73-085

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

Form 06-3 57 Job No. 73-085

Form 06-3 '57 Job No 73-085-

BORING: P-5 DEPTH: 30'

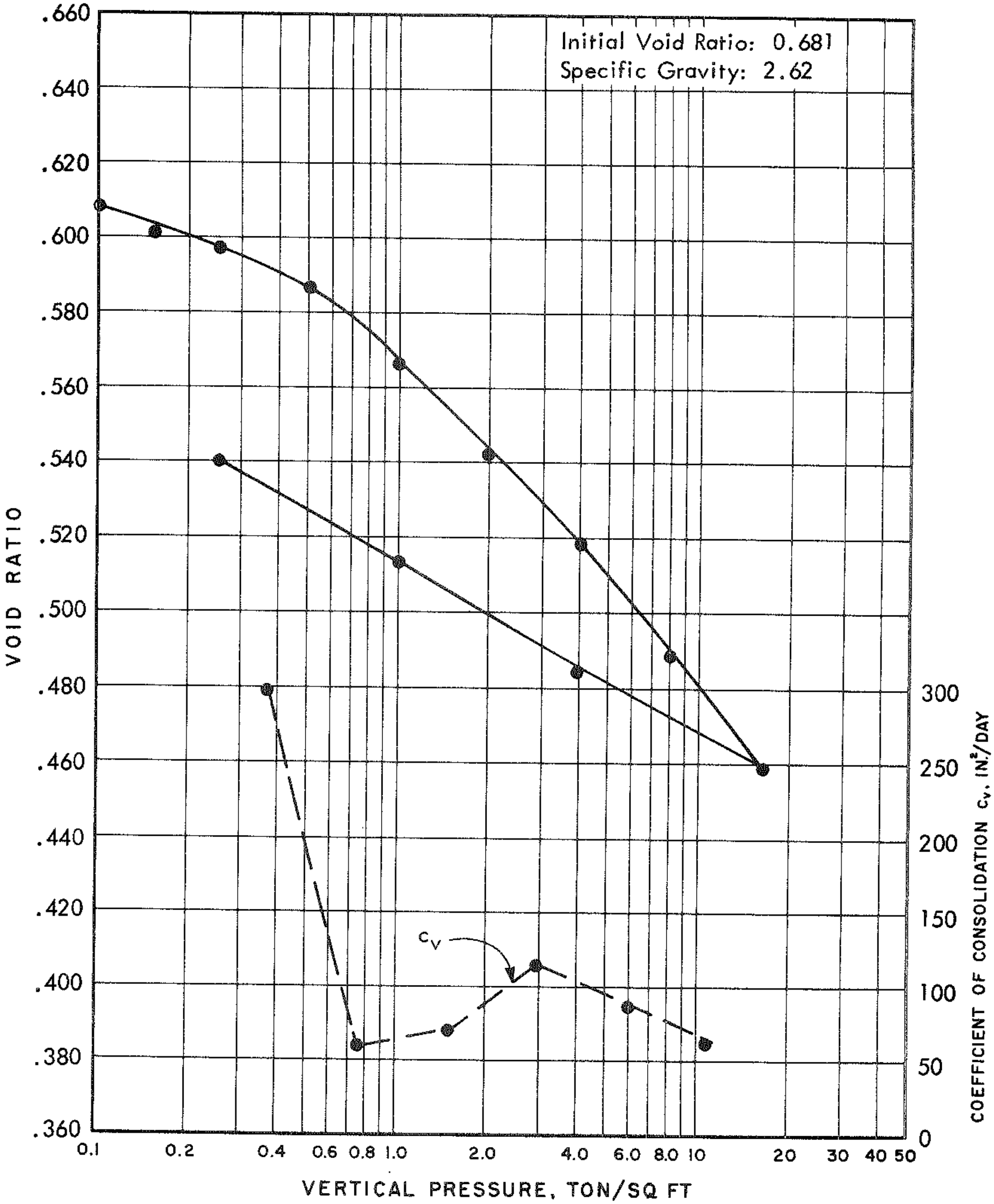
MATERIAL: Hard gray sandy clay with sand pockets and partings

UNIT DRY WEIGHT: 102 LB/CU FT

WATER CONTENT: 21 %

LIQUID LIMIT: 40

PLASTIC LIMIT: 19



CONSOLIDATION TEST RESULTS

Form 26 3 57 Job No. 73.085

BORING: P-7 DEPTH: 24.5'

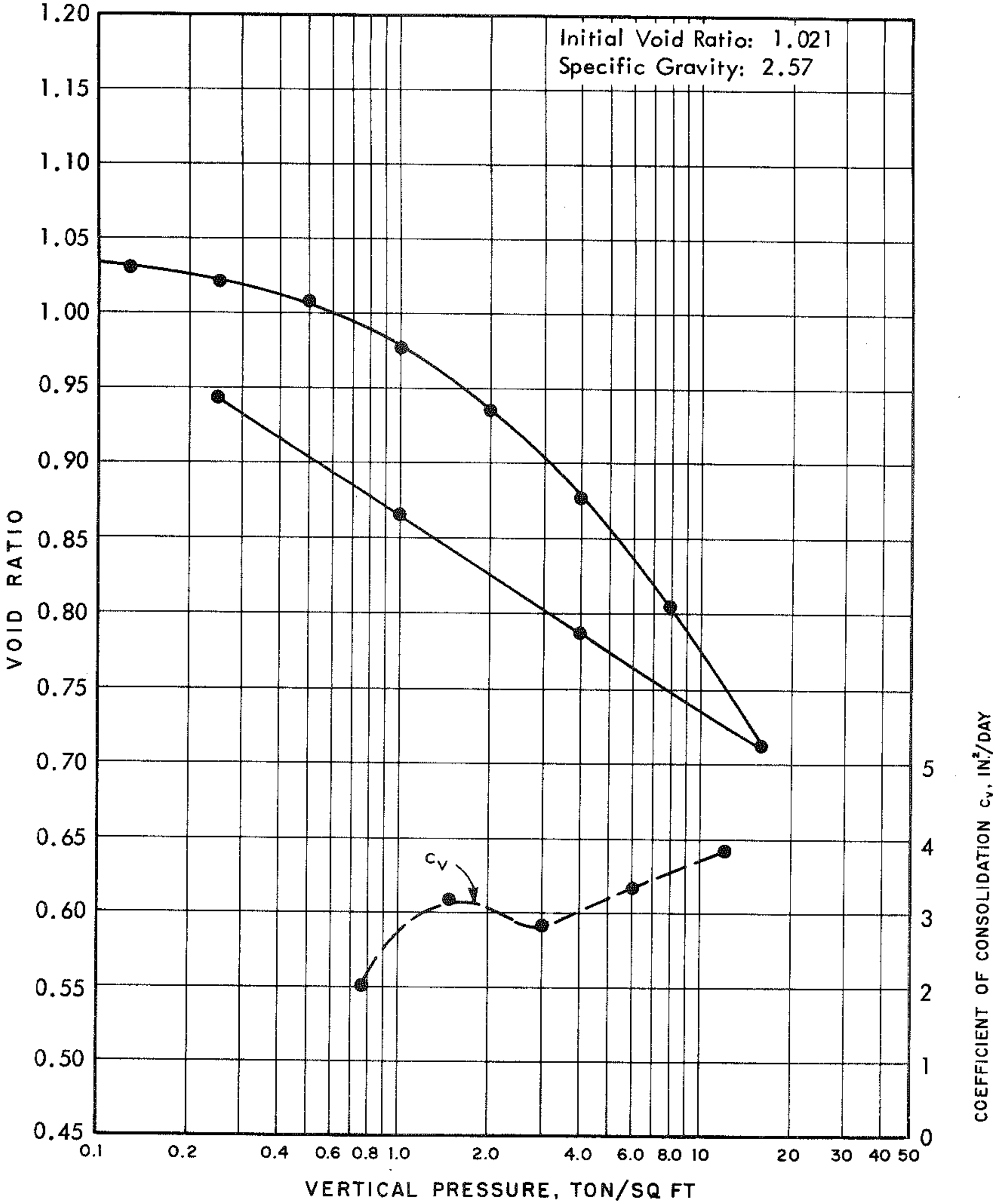
MATERIAL: Stiff light gray clay with sand pockets and ferrous nodules

UNIT DRY WEIGHT: 91 LB/CU FT

WATER CONTENT: 34 %

LIQUID LIMIT: 52

PLASTIC LIMIT: 18



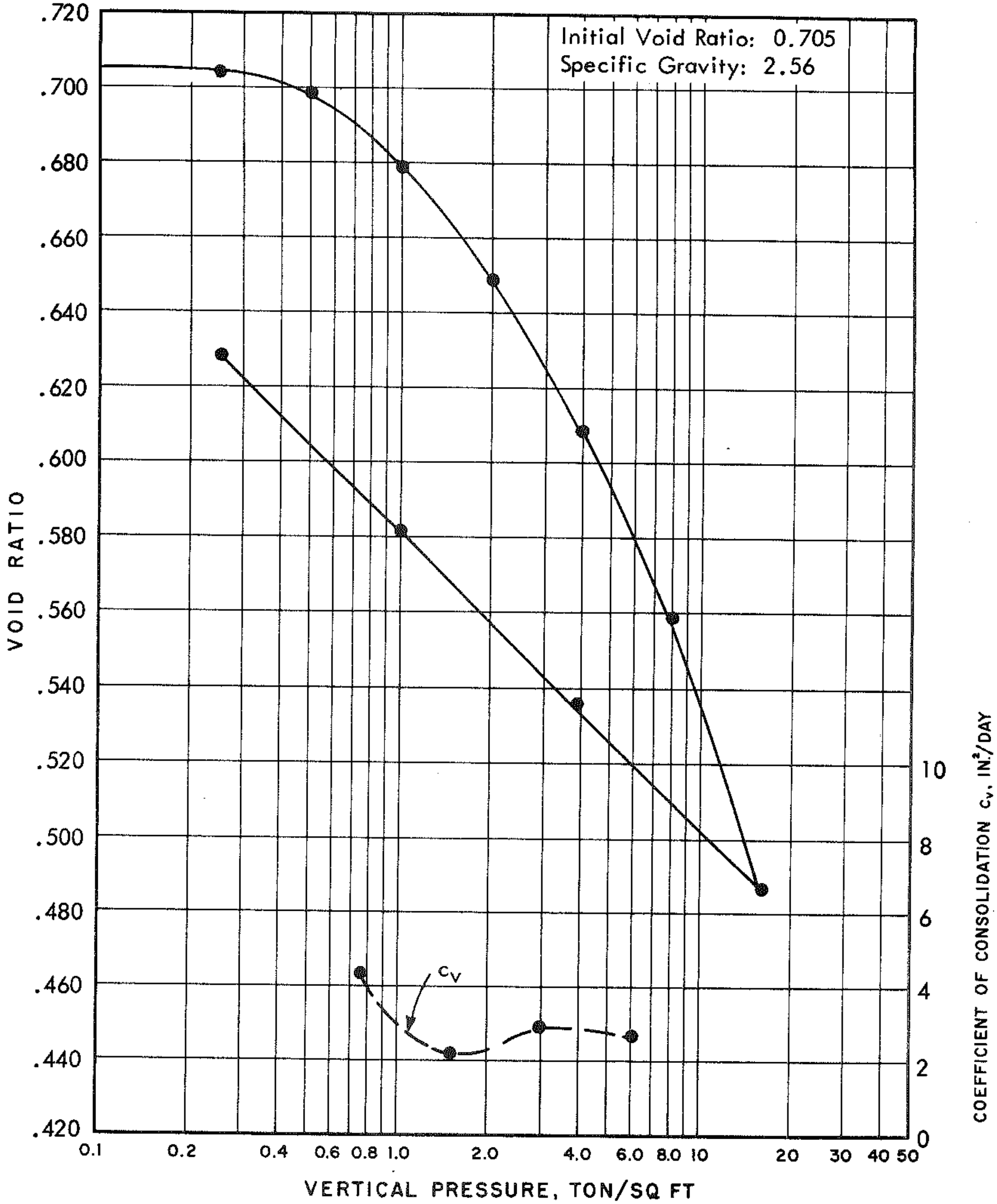
CONSOLIDATION TEST RESULTS

McCLELLAND ENGINEERS

Form 06-3 57 Job No. 23-085

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

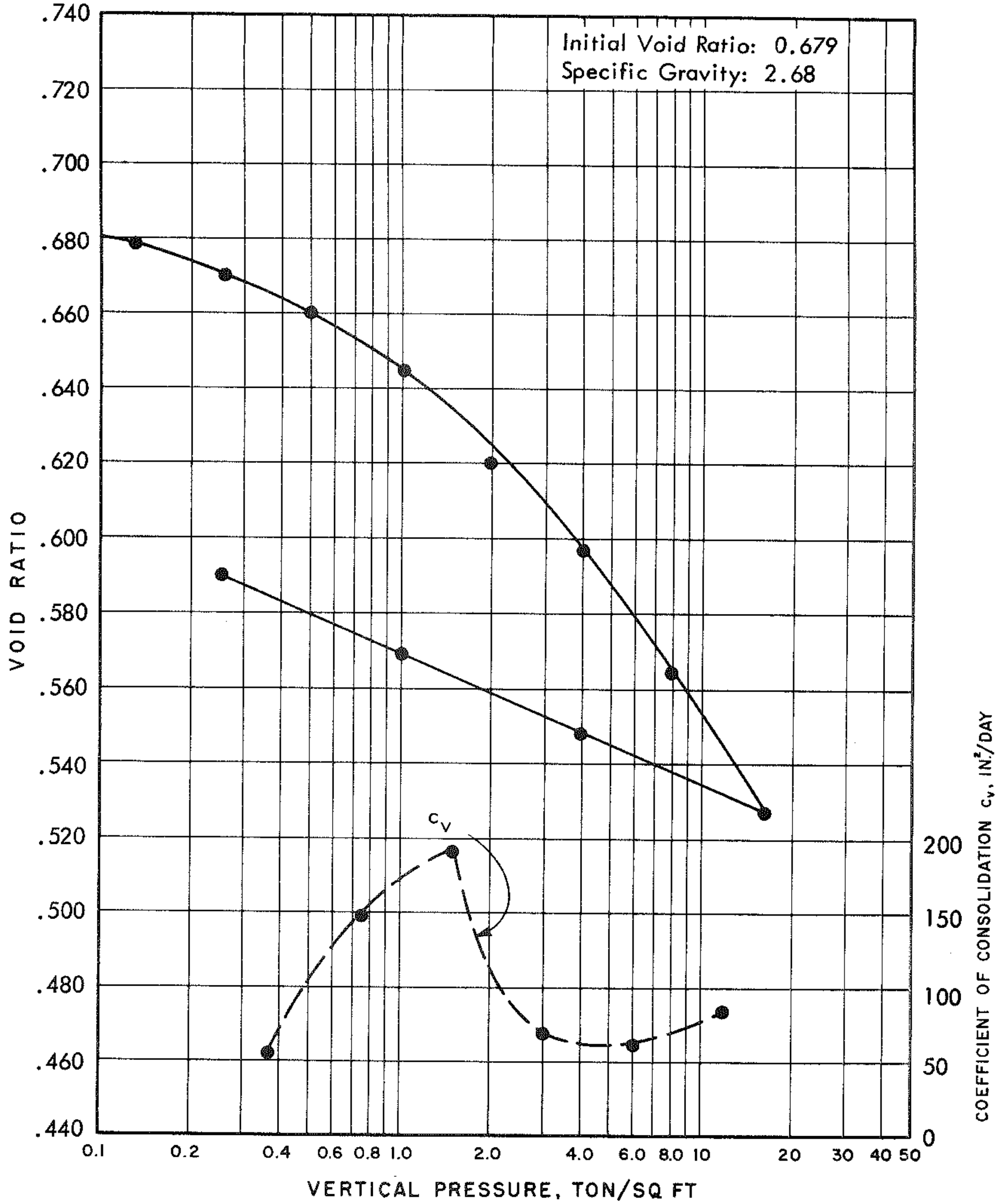
McCLELLAND ENGINEERS

PLATE 51

Form 56-3 57 Job No. 73045

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



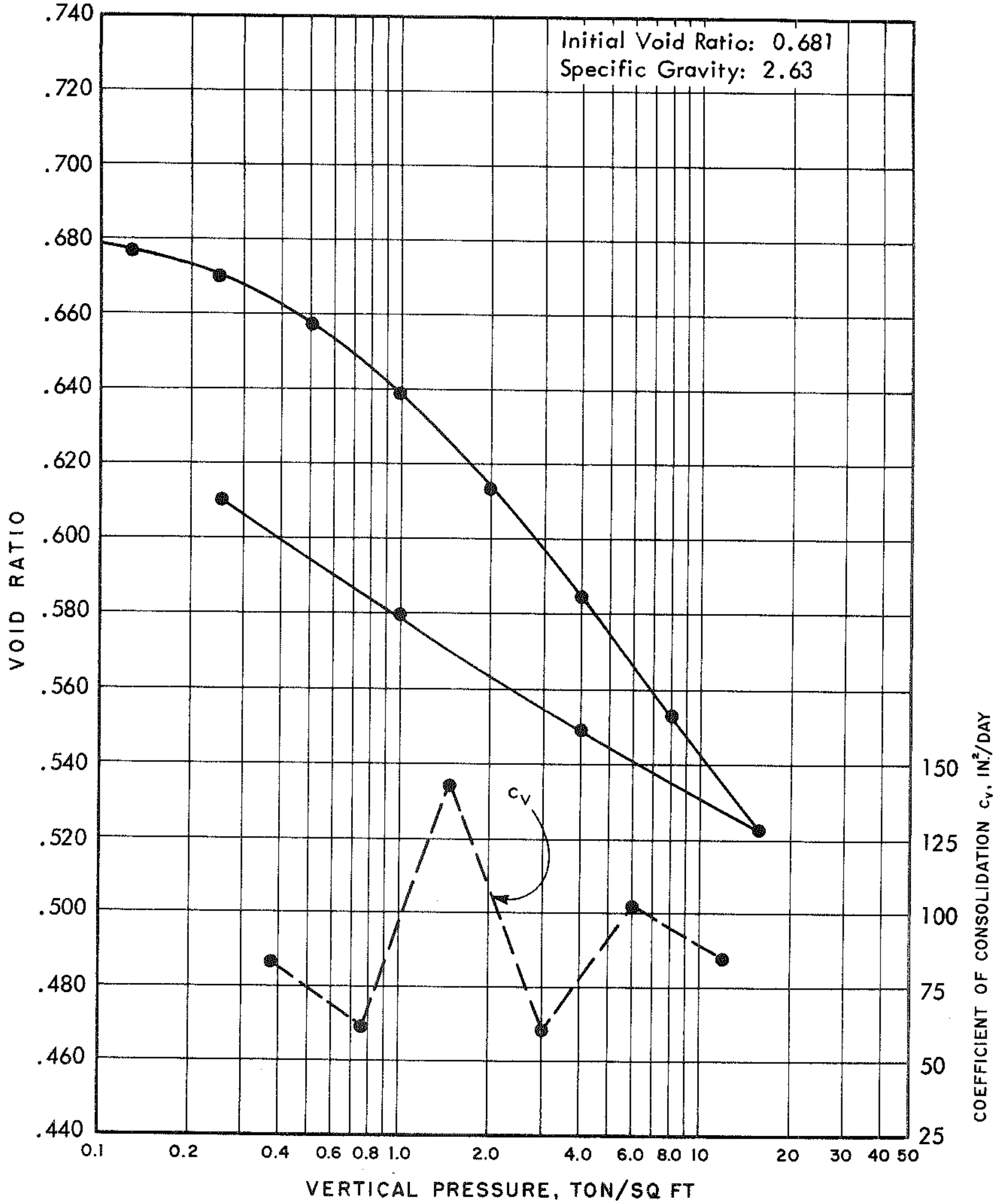
CONSOLIDATION TEST RESULTS

McCLELLAND ENGINEERS

Form 06-3 57 Job No 73085

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

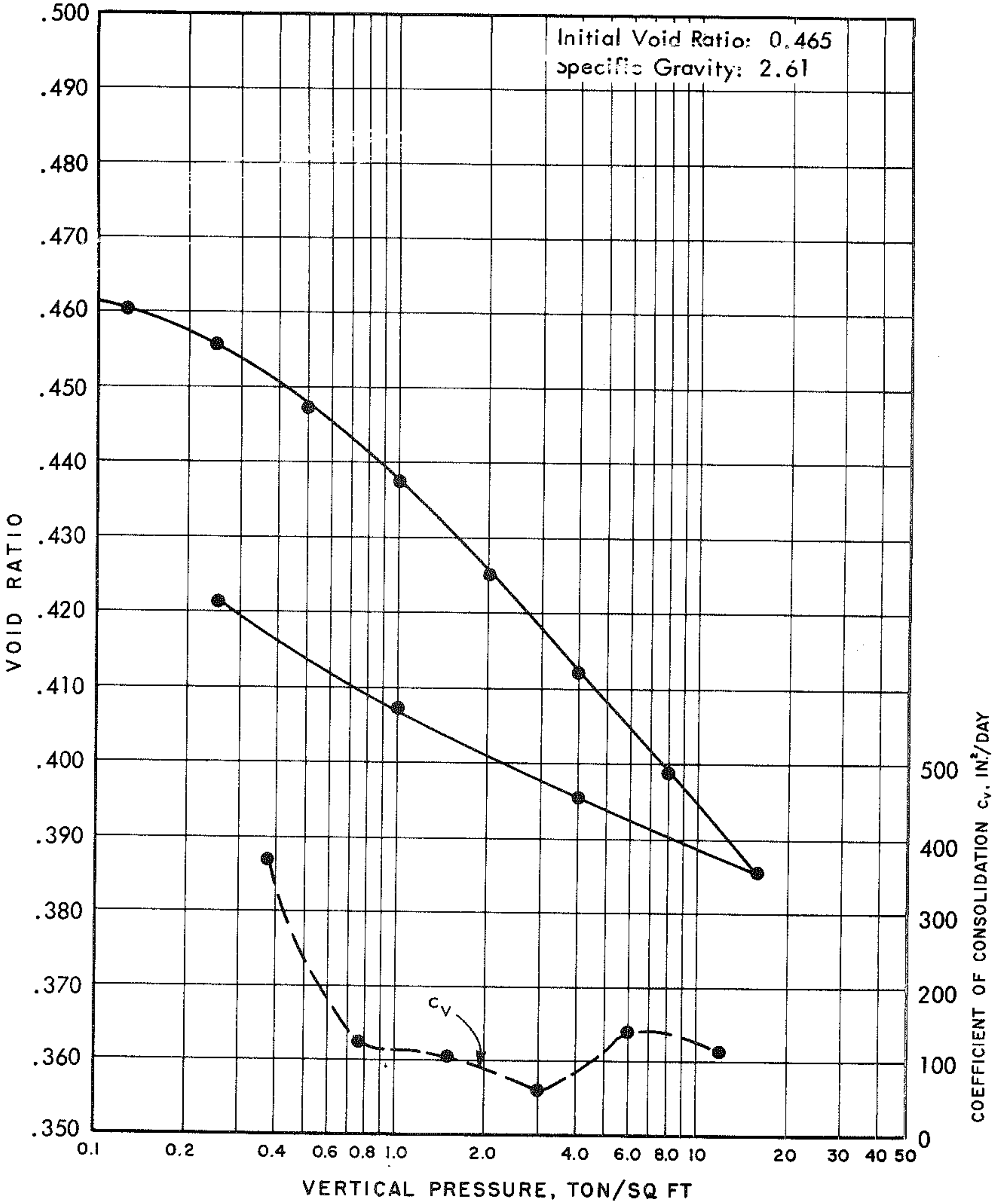
McCLELLAND ENGINEERS

PLATE 53

Form 05 3 57 Job No 73-085

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

23-085

BORING: P-12 DEPTH: 20'

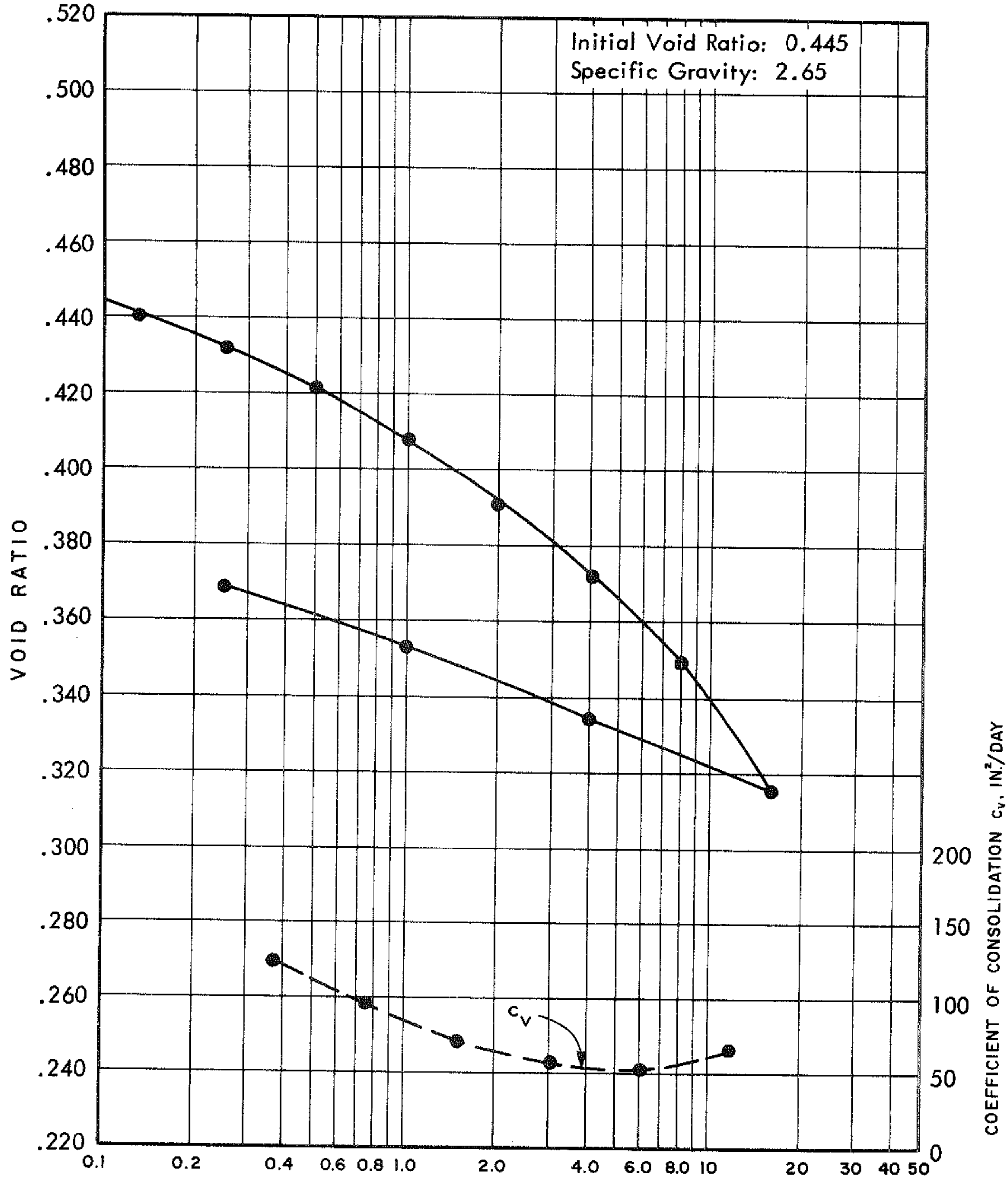
MATERIAL: Red and tan clayey fine sand with clay pockets

UNIT DRY WEIGHT: 115 LB/CU FT

WATER CONTENT: 16 %

LIQUID LIMIT: 26

PLASTIC LIMIT: 17



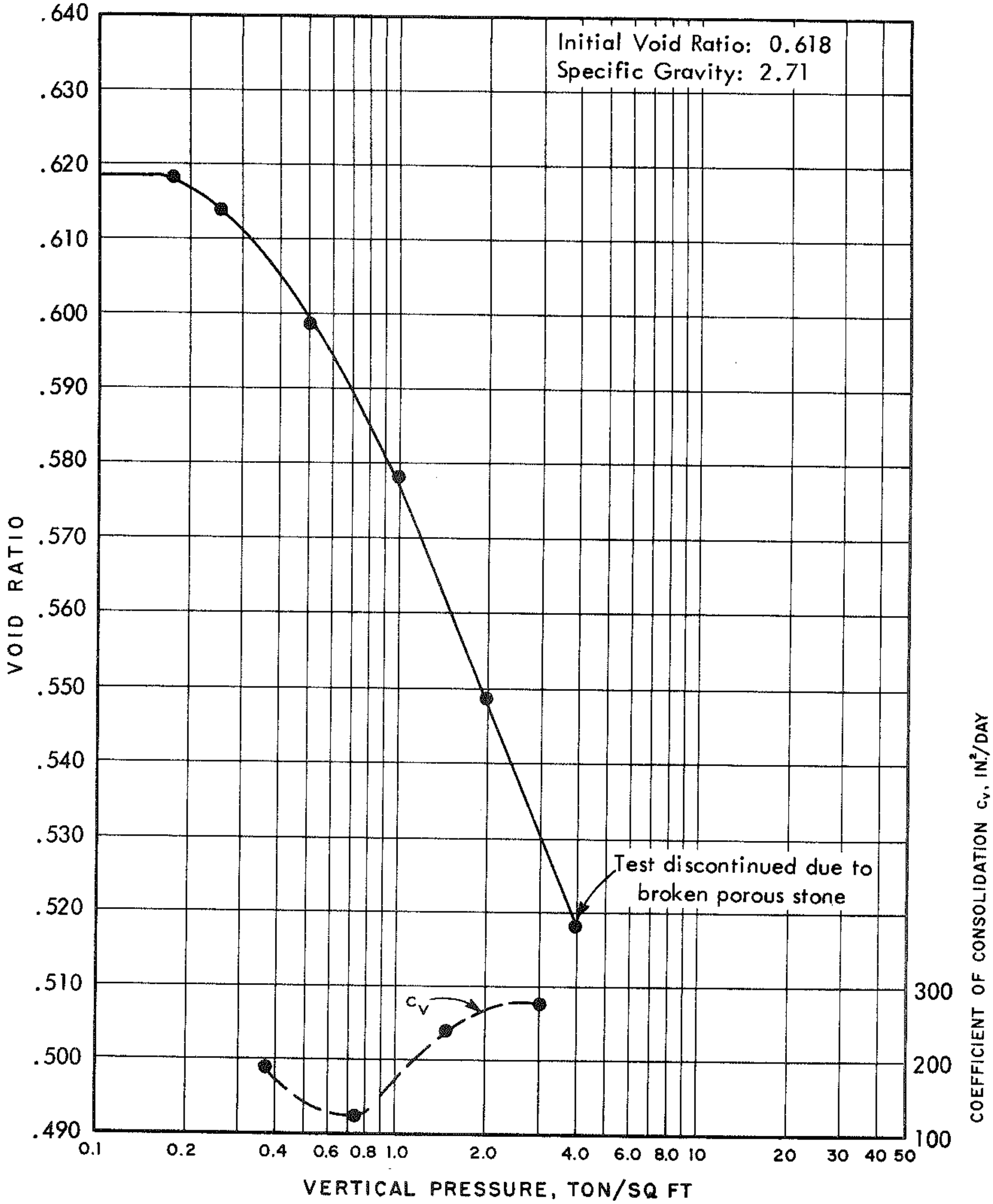
CONSOLIDATION TEST RESULTS

McCLELLAND ENGINEERS

Form ... Job No. 73-085

BORING: P-34 DEPTH: 18'
MATERIAL: Very stiff light gray clay with sand pockets and seams

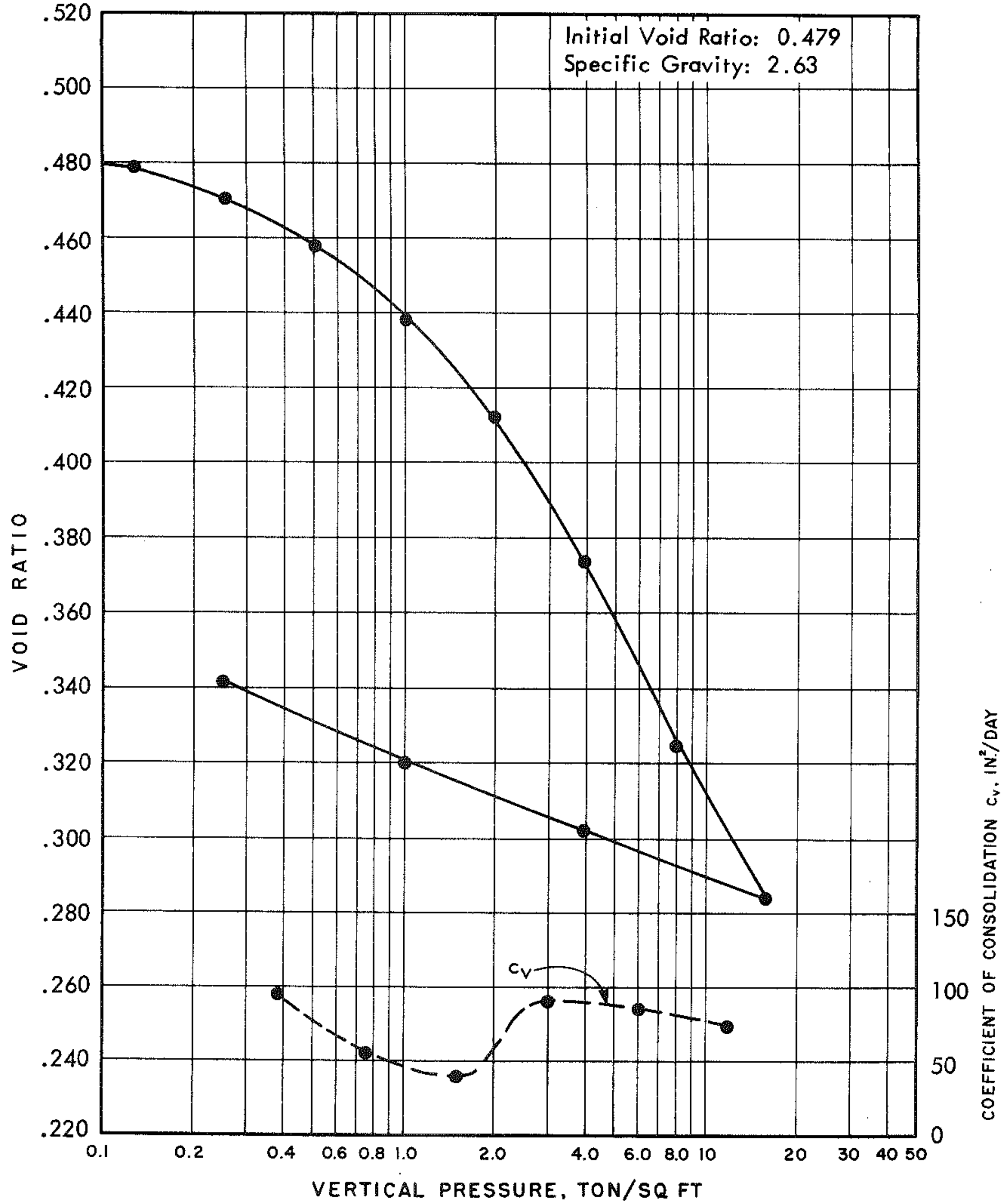
UNIT DRY WEIGHT: 104.5 LB/CU FT
WATER CONTENT: 13 %
LIQUID LIMIT: 31
PLASTIC LIMIT: 17



CONSOLIDATION TEST RESULTS

MCCLELLAND ENGINEERS

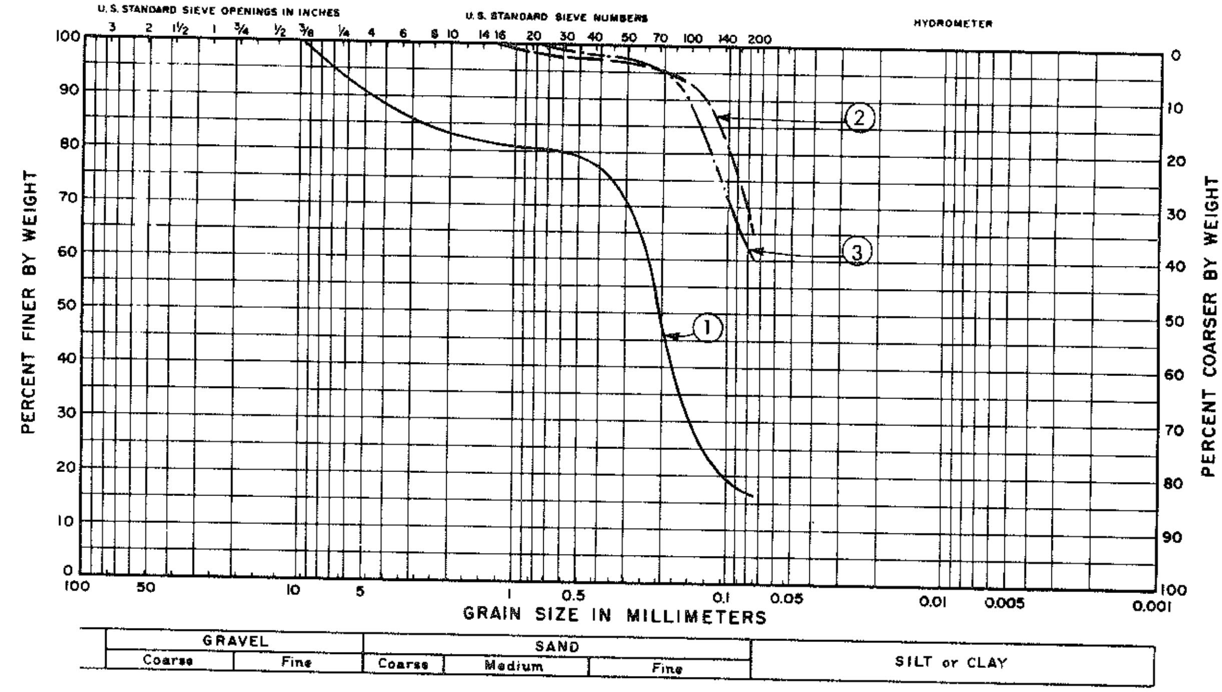
BORING: P-35 DEPTH: 39'		UNIT DRY WEIGHT:	111 LB/CU FT
MATERIAL: Hard gray sandy clay with sand pockets		WATER CONTENT:	18 %
		LIQUID LIMIT:	25
		PLASTIC LIMIT:	16



CONSOLIDATION TEST RESULTS

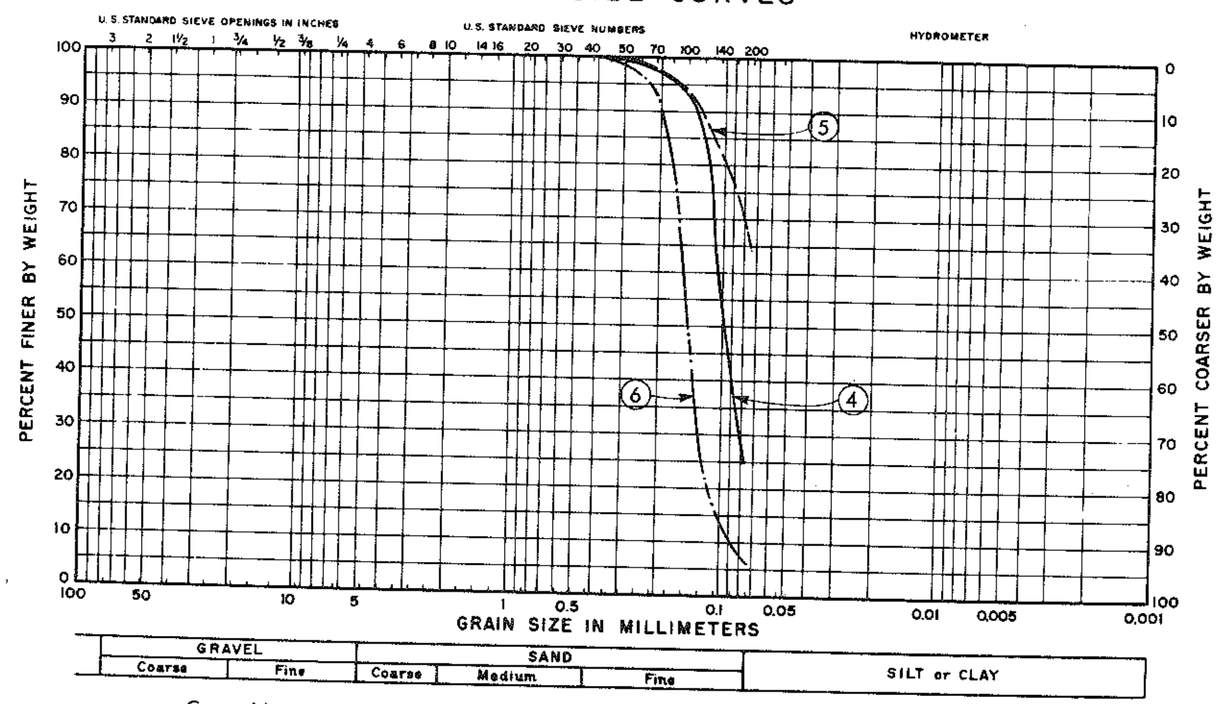
McCLELLAND ENGINEERS

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

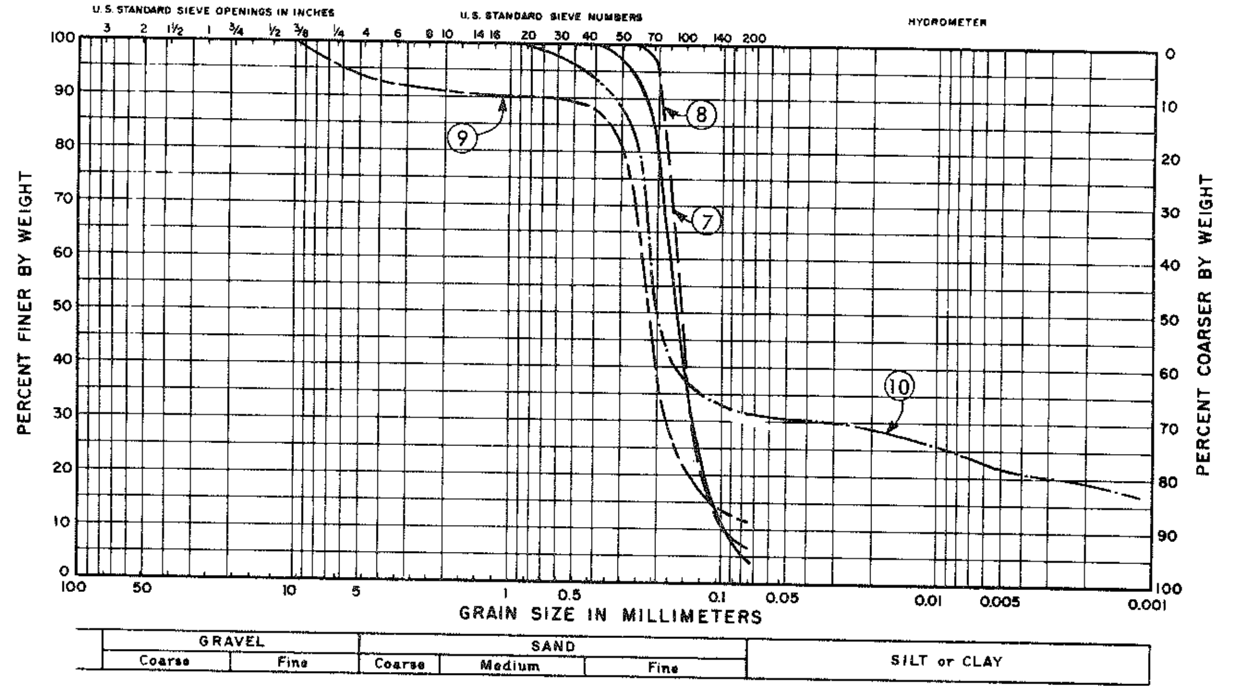
GRAIN SIZE CURVES



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

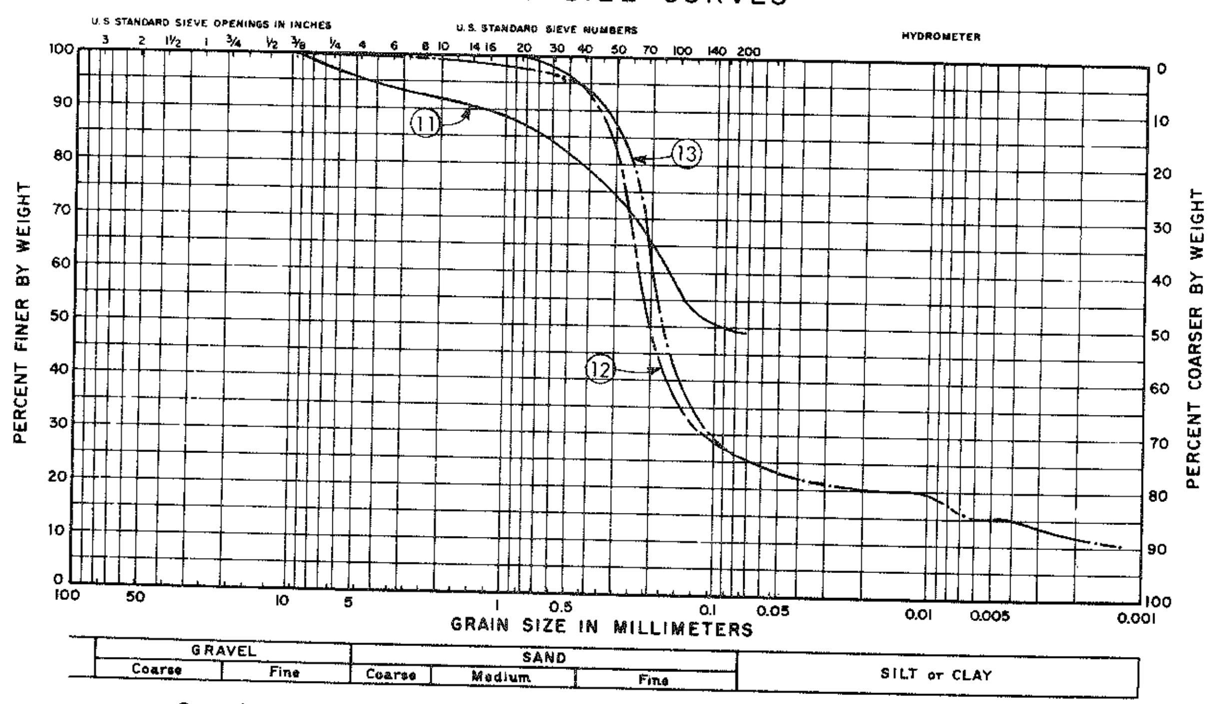
McCLELLAND ENGINEERS

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

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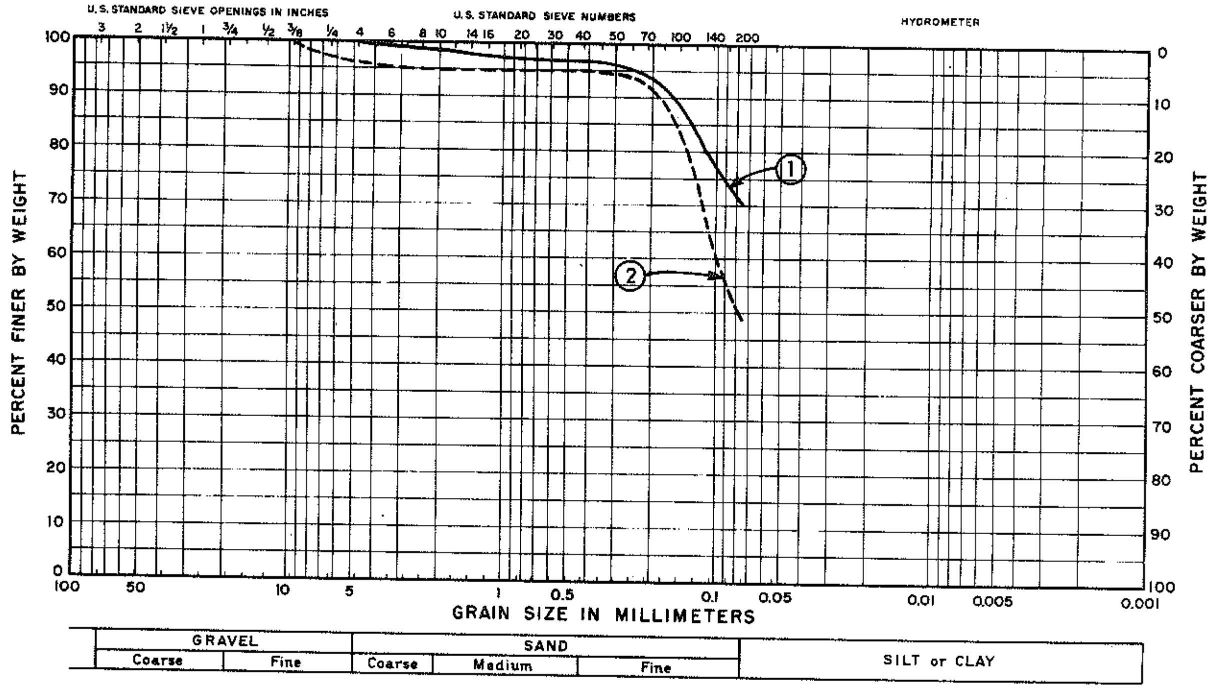
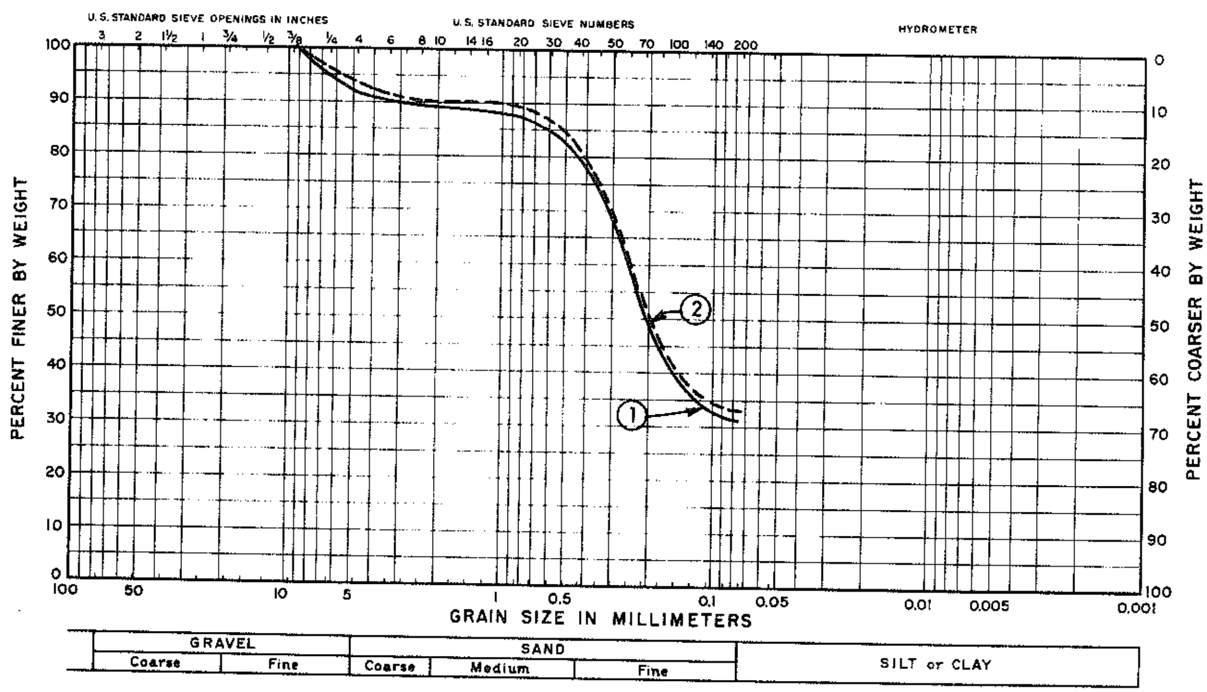
GRAIN SIZE CURVES



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

McCLELLAND ENGINEERS

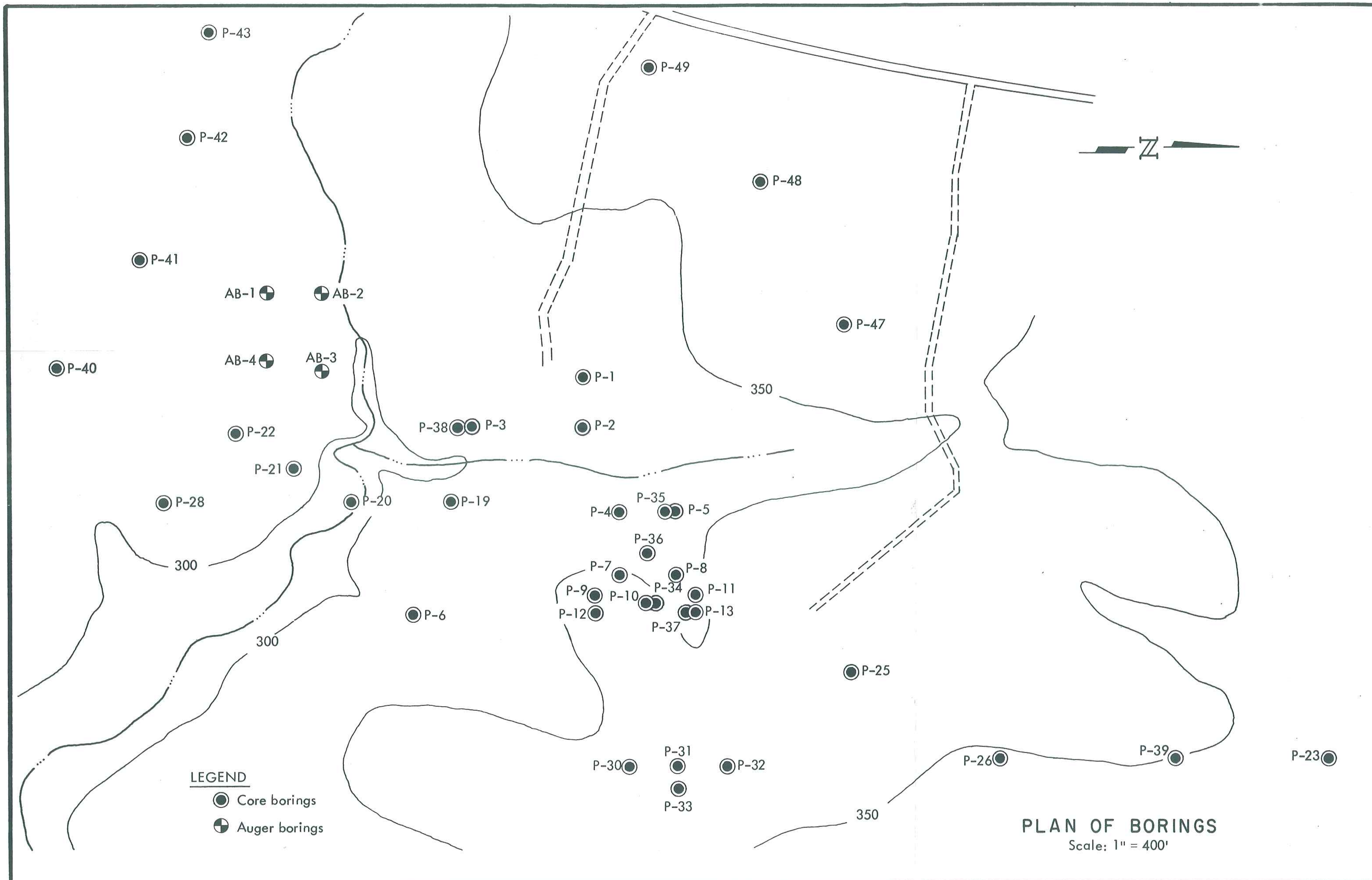
PRELIMINARY REPORT

SOILS INVESTIGATION
WELSH POWER PLANT
CASON, TEXAS

Report to

SOUTHWESTERN ELECTRIC POWER COMPANY
Shreveport, Louisiana

McClelland
engineers, inc.
geotechnical
consultants


P-43
P-49
P-42
P-48
P-41
AB-1
AB-2
P-47
P-40
AB-4
AB-3
P-1
350
P-38
P-3
P-2
P-22
P-21
P-28
P-20
P-19
P-35
P-4
P-5
P-36
300
P-7
P-8
P-34
P-9
P-10
P-11
P-12
P-13
P-37
P-6
300
P-25
P-31
P-30
P-32
P-26
P-39
P-23
P-33
350
LEGEND
Core borings
Auger borings
PLAN OF BORINGS
Scale: 1" = 400'

WELSH RESERVOIR DAM BREACH ANALYSIS

OCTOBER 2009

Prepared for:

AMERICAN ELECTRIC POWER

AEP06393

STATE OF TEXAS
HÉCTOR OLMOS
101213
LICENSED
PROFESSIONAL ENGINEER

HOlmos
10/13/2009

FREESE AND NICHOLS, INC.
TEXAS REGISTERED
ENGINEERING FIRM
F-2144

Prepared by

Freese and Nichols, Inc.
4055 International Plaza
Suite 200
Fort Worth, TX 76109
(817) 735-7300

HEC-HMS was then able to calculate the outflow hydrographs resulting at the dam from the 1-,3-, 6-, 12-, 24-, 48-, and 72-hour modified PMF events, which were used to determine the critical PMF event. This was accomplished by performing HEC-HMS runs for the different durations, and then comparing the resulting maximum water surface elevations in the reservoir for existing and proposed conditions. The critical event is defined to be the PMF event which causes the highest water surface elevation in the reservoir. This event was then used for all subsequent analyses. The water surface elevations in the reservoir resulting from each of the eight PMF events are shown in Table 3 below.

Table 3
Maximum Water Surface Elevation for the Modified PMF Analysis

Storm Duration (Hours)	Reservoir Water Surface Elevation Existing Conditions (Feet msl)	Reservoir Water Surface Elevation Proposed Conditions (Feet msl)
1	322.87	324.72
2	322.63	326.25
3	326.35	327.17
6	327.91	328.36
12	328.35	328.65
24	328.45	328.80
48	328.63	328.84
72	328.39	328.48

For existing conditions, the critical event was the 48-hour storm, which resulted in an elevation of 328.63 feet msl in the reservoir, approximately 6.37 feet below the top of the dam. The peak outflow at the dam resulting from this storm was 13,311 cfs.

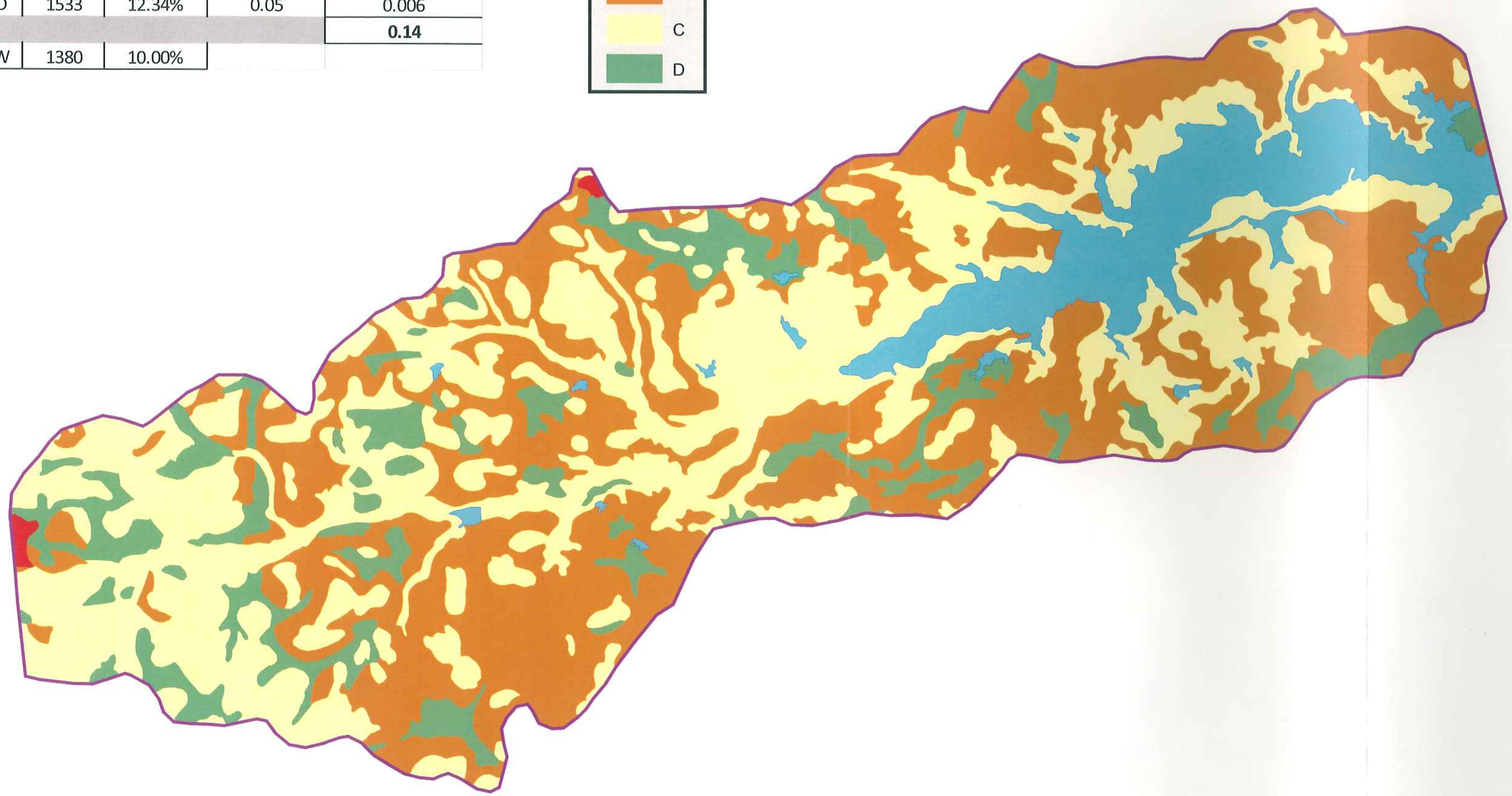
For proposed conditions, the critical event was also the 48-hour storm, which resulted in an elevation of 328.84 feet msl in the reservoir, approximately 6.16 feet below the top of the dam. The peak outflow at the dam resulting from this storm was 14,781 cfs.

HSG	Area (acres)	Percentage	Infiltration Rate (in/hr)	weighted infiltration rate (in/hr)
A	32.9	0.26%	0.35	0.001
B	5539	44.57%	0.2	0.089
C	5322	42.83%	0.1	0.043
D	1533	12.34%	0.05	0.006
				0.14
W	1380	10.00%		

Soils

HSG

- W
- A
- B
- C
- D



N E S W

Welsh Reservoir

Soils and infiltration rate

Exhibit 3

FN JOB NO	AEP06393
FILE	
DATE	October 2009
SCALE	1" = 4,000'
DESIGNED	HEO
DRAFTED	HEO

Freese and Nichols
4055 International Plaza Suite 200
Fort Worth, Texas 76109-4895
817-735-7300