Hughes, Michael

From: Jackson, Bill [BJackson@ardaman.com]

Sent: Wednesday, August 24, 2005 10:54 AM

To: Hughes, Michael

Subject: RE: WCF gypsum stack remediation

Michael,

It was nice meeting you also. As requested, the following is some of my notes on the major issues discussed during our meeting at the Widows Creek gypsum stack construction site on August 9, 2005. Others attending included Kenny Lowery, Robert Knox, Missy Hedgecoth and "Shorty", the onsite supervisor. Lonnie Clymer, the superintendent for the trenching contractor (STT Construction Group) was also present for some discussions. Some of the following was observed and/or discussed.

- At the time of my visit, the toe drain had already been installed by the trenching contractor across the north end of Pond 3 and portions of the lower slope had been regraded to approximately the proposed final geometry. The south end of the drain pipe, near Station 265+00, was open to the ditch and flowing well. The north end of the drain, near Station 230+00, was elevated well above the the drain invert elevation and was not flowing. No drain outlets were installed at that time. It was recommended that the outlets be installed as quickly as possible to allow the lower slope to start draining to facilitate slope grading operations.

- The trencher was installing toe drain from about Station 147+00 on the east side to Pond 2A, working to the south and west, across the south side of Pond 1. A previous attempt to provide a working bench for the trencher around the southeast side of Pond 3, near Station 148+00, however, had not been successful due to the very wet and soft condition of the gypsum-fly ash deposits encountered at this location. It is our understanding that the sedimented deposits at this location essentially liquefied and became unstable under the weight and dynamic loads generated by the D-6 dozer. The wet area extends from about the northeast corner of Pond 2A to the south end of the blanket drain section on the north end of the Pond 3 east wall, about Stations 209+00 to 220+00.

It was discussed that installation of the first bench drain would help drain the lower slope and improve conditions at the toe somewhat, but it is our understanding that TVA does not intend to install the first bench drain until October of this year. It was subsequently agreed that an intermediate level drain would be installed on the lower slope from a more elevated and stable working bench while the trenching equipment was still on site. The objective was to provide a more elevated working platform (above the existing seepage spring line) and trench in a somewhat deeper drain that would help dry up the toe of the stack and facilitate installation of the toe drain at some future date, most likely after the first bench drain is installed later this year. A stable test bench was subsequently excavated on the side slope of the stack that varied in elevation from about 646.7 to 648.2 feet, NGVD. Lonnie Clymer said that the trenching equipment that he had on site could be modified to install the drain to a total depth of about 18 feet. It was agreed on the following day to grade to intermediate bench to elevation 647 feet, NGVD, and to install the drain 18 feet deep, using an 8-foot gravel collection zone that is consistent with the toe drain design. This will give a drain pipe invert elevation of about 629.5 feet, NGVD, which is only 4 to 5 feet above the design invert elevation of the toe drain.

- It was agreed that it would be impractical to install the toe drain on the west side of the Pond 2B and the northwest corner of Pond 1 at this time due to the presence of multiple gypsum slurry pipelines and the discharge pipes from the two decant structures. The side slopes of the gypsum stack in this area remains stable with no indications of heavy seepage or signs of instability. Since the slope is stable now, it will only become more stable once the recommended setback bench is established and the first bench drain is installed, potentially eliminating the need for installation of the toe drain in the future. The performance of the west wall slope will need to be monitored and reevaluated after the first bench drain is installed.

- The toe drain had not been installed at the southwest corner of Pond 3 (across north end of stilling pond) and the side slope of the gypsum stack in the corner between Pond 2B and Pond 3 is much steeper than desired. It was recommended that the area be stabilized by providing a setback in the southwest corner of Pond 3 (infill the corner of the pond with gypsum to establish the setback distance shown on the construction drawings) and that the remaining section of toe drain be installed across the north end of the stilling pond. The internal decant between Ponds 3 and 2B may need to be moved farther to the east to accommodate the setback bench.

- Although the drain gravel needs to be relatively fine to act as a filter to the gypsum-fly ash deposits, the gravel delivered to the site is somewhat "dirty" and has more fines (material passing the No. 200 sieve size) than desired, which can potentially reduce the coefficient of permeability and effectiveness of the drain. Laboratory tests indicate as much as 8% by dry weight passing the No. 200 sieve size. A laboratory permeability test of the supplied sample, however, indicates a measured coefficient of permeability of 1.3 x 10-1 cm/sec, which should be more than adequate relative to the gypsum coefficient of permeability, which is on the order of 1 x 10-4 cm/sec. It is still recommended, however, that a cleaner filter gravel be used in all subsequent drain installations.

- One of the old drain pipes located on the north wall of Pond 3 is continuing to flow over the top of the toe drain working bench. The end of this pipe will need to be located and extended downslope into the toe ditch. The pipe extension should be buried below the slope surface so as not to interfere with routine maintenance activities (mowing). Although this was the only case noted, any other occurrences should be handled in a similar manner.

These are the major items that I recall from my field notes. Please let me know if you need additional clarification on any the items discussed. Thanks.

Bill Jackson
Ardaman & Associates, Inc.

> -----Original Message-----
> **From:** Hughes, Michael [mailto:mhughes2@tva.gov]
> **Sent:** Tuesday, August 16, 2005 9:05 AM
> **To:** Jackson, Bill
> **Subject:** WCF gypsum stack remediation
>
> Good morning, Bill, it was nice meeting you and getting a chance to work with you last week.
>
> Did you by any chance happen to make some notes and kind of outline what was talked about last week and the steps we are going to take to try and correct the wet areas in the stack and allow us to install toe drains? What were the stations we talked about for the area in which to install the upper drains? Could you send me a quick few notes on this? I'd appreciate it.
>
> Thanks again for your help
>
> Michael S. Hughes, P.E.
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WIDOWS CREEK FOSSIL PLANT
GYPSUM STACK REMEDIATION
SITE VISIT AUGUST 9, 2005
OBSERVATIONS AND ACTIONS

OBSERVATIONS

- Toe drain is installed along the north end of Pond 3, lower slope regraded to near final elevations and grades.

- The south end of the drain pipe near station 265+00 was open and flowing. The north end of the drain pipe near station 230+00 was not flowing, no outlet drains had been installed.

- The trencher was installing toe drain on the east side of Pond A from station 147+00 working to the south and west.

- A wet area in the stack occurs on the northeast corner of Pond 2A to the south end of the blanket drain section of the north end of Pond 3 east wall, approximate stations 209+00 to 220+00.

- Toe drain had not been installed at the southwest corner of Pond 3. The side slope of the gypsum stack in the corner of Pond 2B and Pond 3 is much steeper than desired.

- The drain gravel is to be fine to act as a filter to the gypsum-fly ash deposits, however the gravel delivered to the site is somewhat "dirty" (more fines material passing the No. 200 sieve size).

- An old drain pipe on the north wall of Pond 3 flows over the top of the toe drain working bench.

ACTION ITEMS

- Install outlet drains as quickly as possible in the areas noted to facilitate drainage and slope grading operations.

- An intermediate level (not the drain at the first bench)drain should be installed in the wet area noted, from a more stable and elevated working bench to be cut. This should provide a more elevated working platform above the existing seepage line. Trenching a somewhat deeper drain line should help dry up the toe of the stack and facilitate installation of the toe drain. The intermediate drain will be trenched to a depth of about 18 ft. to an elevation of about 629.5 (about 4 to 5 feet above the design elevation of the toe drain).

- Provide a setback in the southwest corner of Pond 3 (infill the corner of the pond with gypsum to establish the setback distance shown on construction drawings) and install the remaining section of toe drain across the north end of the stilling pond.

- Use cleaner filter gravel in all subsequent drain installations.

- Locate the end of the old drain pipe and extend it downslope into the toe ditch. Bury the pipe extensions below the slope surface to avoid interference with routine maintenance.

ARDAMAN & ASSOCIATES, INC.

MEMORANDUM

TO: Mike Hughes, Tennessee Valley Authority, Chattanooga

FROM: Bill Jackson

DATE: March 2, 2006

SUBJECT: Preliminary Assessment of Seepage Collection Drains at TVA Widows Creek Gypsum - Fly Ash Storage Facility

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The following is a preliminary summary of field observations and measurements made on the Widows Creek toe drain manholes during my site visit of 22 and 23 February, 2006. Please find attached the following figures (in PDF 11 x 17 inch format) that will help clarify the discussion and comments presented below:

1. Plan view of site showing design layout of toe and first bench drains, with manhole nomenclature added for clarity (Figure 1).

2. Summary table of manhole field survey data (Table 1)

3. Three hand-drawn figures (Figures 2 through 4) graphically illustrating the data presented in Table 1.

4. Copy of Figure 4.7 from the Ardaman engineering report, showing the seepage phreatic surface assuming that the first bench drain is not installed.

Field Observations and Notes

The first bench drain has not yet been installed. In reference to Figure 1 (which also shows the as-built location and nomenclature used for the drain outlet manholes), the toe drain has been installed from outlet 10 near the northeast corner of the stack to outlet 15 near the north end of the stilling basin, and from outlet 3 near the southwest corner of the stack to outlet 7 near the middle of the south wall.

Portions of the toe drain on the east end of the north wall do not appear to be operating properly, as evidenced by a relatively high seepage spring line and sloughing, or subsidence of the lower slope (toe of slope) along portions of the toe ditch alignment. A visual inspection of outlets 12E (east) and 12W (west) on February 22 indicated that outlet 12E had been installed incorrectly (rotated 90 degrees) and was not, in fact, connected to the slotted drain pipe section of the adjacent drain. The discharge pipe for outlet 12W was not flowing and there was only a foot or so of no water in the riser pipe, at an elevation that was well below the seepage spring line.

Outlet 12E had standing water in the riser pipe and what appeared to be several feet of gypsum sediment. The riser pipe was tilted substantially toward the toe ditch. A portable, gasoline powered, 2-inch diameter centrifugal pump was used to pump the water level down in the manhole. Even though the suction hose for the pump was not long enough to reach the bottom of the manhole (later measured as 17.7 feet deep), the pump was able to draw and pump continuously from the riser structure for a period of approximately 2 and 1/2 hours, at which point the pump ran out of gas. The pump discharge was initially turbid as sediment was sucked from the riser structure, but was relatively clear and free of sediment toward the end of the pumping period. Subsequent depth measurements indicated that the top of the remaining sediment, after pumping, was below the outlet pipe elevation and near the invert elevation of the drain collector pipe. Even after the sediment had been removed below the outlet pipe elevation, the outlet pipe was still not flowing freely, with only a trickle of water. It was surmised by those present that the outlet pipe was most likely "pinched off" as a result of the riser structure tilt, or possibly dislodged from the connection.

Outlet 11W, which is the easternmost outlet for the section of drain connected to outlet 12E, was also inspected and noted that the top section of the riser pipe had been pushed over and that the riser structure was infilled with gypsum sediments.

Based on the initial observations, it was recommended and agreed that all of the toe drain manholes should be inspected and measured to document depth to water, depth/thickness of sediment in the riser structure and total depth of the manhole relative to the proposed design. Bill Jackson with a 2-man support crew provided by TVA made physical measurements of all the manholes on the morning of February 23, 2006, relative to top of pipe elevations, which were later surveyed by a TVA survey crew. The results of the physical measurements are summarized in the attached Table 1, which also includes calculated elevations for the key components of the drain and outlet structure (water elevation, bottom elevation of riser structure, drain pipe invert elevation and outlet pipe invert elevation). The estimated, as-built invert elevation of the installed drain pipe is also compared in Table 1 to the design invert elevation.

It should be noted that the field measurements were made with a tape measure and survey rod placed along the inside face of the manhole riser structure, many of which were tilted and/or distorted to varying degrees. No correction was made in Table 1 for tilt or angle of the measuring rod and the elevations presented therein should be considered approximate only. If the manhole is tilted, for example, the measured depth along the structure will be greater than true vertical change in elevation.

The results of the field measurements summarized in Table 1 are presented schematically in Figures 2 through 4. The following key points are noted:

North Wall Drains

Outlet 10
- water level in riser below outlet pipe invert elevation
- estimated drain invert is 1.83 feet higher than design elevation
- riser structure is less than 10 feet high (lateral position of the drain incorrect or slope not graded correctly)

Outlet 11E
- sediment in riser structure above drain pipe invert elevation
- water level in riser well above outlet pipe invert, indicating possible blockage
- end of discharge pipe buried in toe ditch, but with some visible flow
- estimated drain pipe invert elevation is slightly lower than design level
- total depth of riser in excess of 16 feet

Outlet 11W
- top of riser pipe dislodged and tilted over sharply
- measured total depth of 12.96 feet is not consistent with outlet 11E and should be validated by additional field measurement (probe through bottom sediments)
- sediment in riser structure, possibly above drain pipe invert elevation if depth not correct
- water level in riser is above level in adjacent outlet 11E
- end of discharge pipe buried in toe ditch
- if depth measurement is correct, drain pipe invert elevations is 3.5 feet higher than design

Outlet 12E
- sediment in riser structure above drain pipe invert elevation
- water level in riser well above outlet pipe invert, indicating possible blockage of outlet pipe
- end of discharge pipe buried in toe ditch, but with some visible flow
- estimated drain pipe invert elevation is higher than design level (riser tilted)
- total depth of riser in excess of 17 feet

Outlet 12W
- riser structure installed incorrectly, not connected to drain pipe
- estimated drain pipe invert elevation is 2.71 feet higher than design level
- total depth of riser just under 16 feet

Outlet 13E
- water in riser pipe just above outlet pipe invert and appears to be flowing properly, although end of pipe is under water and flow quantity can not be verified visually
- estimated drain pipe invert elevation is 2.39 feet above design level

Outlet 13W
- water in riser pipe just above outlet pipe invert but end of pipe is under water and does not appear to be flowing
- estimated drain pipe invert elevation is 1.67 feet above design level

Outlet 14E
- water in riser pipe just above outlet pipe invert and appears to be flowing properly, although end of pipe is partially covered
- discharge is clear water with no apparent turbidity
- estimated drain pipe invert elevation is 0.62 feet above design level

Outlet 14W
- water in riser pipe is below outlet pipe invert elevation, with no flow
- estimated drain pipe invert elevation is 0.47 feet higher than design level

Outlet 15E
- water in riser pipe just above outlet pipe invert and appears to be flowing properly
- discharge is clear water with no apparent turbidity
- estimated drain pipe invert elevation is 1.0 foot above design level

Outlet 15W
- water in riser pipe just above outlet pipe invert and appears to be flowing properly
- discharge is clear water with no apparent turbidity

South Wall Drains

As a general note, all of the south wall manhole riser pipes are on the order of 10 feet deep, which is less than the design height of 14 feet, indicating possible misalignment of the drain (located too close to the toe ditch) or an improperly graded side slope.

Outlet 3N

- water level in riser is above outlet pipe invert by 1.27 feet, which may indicate some restriction in outlet pipe, although pipe is flowing approximately same rate as adjacent outlet 3S
- discharge is clear water with no apparent turbidity

Outlet 3S

- water in riser pipe is just above outlet pipe invert and appears to be flowing properly
- discharge is clear water with no apparent turbidity
- estimated drain pipe invert elevation is 1.38 feet above design level
- limited sediment in riser pipe sump below outlet pipe invert

Outlet 4W

- water in riser pipe is just above outlet pipe invert and appears to be flowing properly
- discharge is clear water with no apparent turbidity
- estimated drain pipe invert elevation is slightly below design level

Outlet 4E

- water in riser pipe is just above outlet pipe invert and appears to be flowing properly
- discharge is clear water with no apparent turbidity
- estimated drain pipe invert elevation is only slightly above design level

Outlet 5W

- water in riser pipe is just above outlet pipe invert and appears to be flowing, although outlet is under water
- estimated drain pipe invert elevation is 1.33 feet below design level

Outlet 5E

- water in riser pipe is above outlet pipe and flow appears to be restricted by end of discharge pipe buried in ditch
- estimated drain pipe invert elevation is 0.68 feet below design level

Outlet 6W

- water in riser pipe is below outlet pipe invert elevation, with no flow
- estimated drain pipe invert elevation is 1.16 feet above design level

Outlet 6E

- water in riser pipe is just above outlet pipe invert elevation, end of discharge pipe is buried with no apparent flow
- estimated drain pipe invert elevation is 4.08 feet above design level (Note: need to verify top of pipe elevation, which indicates that outlet 6E is 2.97 feet above outlet 6W)

Outlet 7W

- water level in riser is just above outlet pipe invert elevation and appears to be flowing normally
- discharge is clear water with no apparent turbidity
- estimated drain pipe invert elevation is 1.43 feet above design level

Outlet 7E

- outlet was completely buried, making inspection impossible
- some flow was coming from outlet pipe

The blanket drain at the northeast corner of the stack also appears to be non-functional, due to the presence of ponded water on top of the drain cover materials. Based on visual examination, it appears that the protective cover placed over the top of the completed drain section is a natural ground red clay, which will have a much lower coefficient of permeability than the gypsum that will eventually cover the drain. The presence of the low permeability clay layer will restrict seepage into the drain and make the drain ineffective relative to the proposed design.

Discussion

Although many of the drains are installed above the design invert elevation, it appears that most of the installed drain sections are working, with minor deviations, except for the drains on the east end of the north wall.

Based on our field observations and discussion with TVA personnel, it is surmised that the toe drains on the east end of the north wall are not working due to flow restrictions at the manhole and discharge pipe locations, that most likely can be attributed to installation difficulties associated with the wet working conditions encountered when the manholes were installed. It is our understanding from conversations with the on-site installers that the manholes were installed using a trench box to support the excavation and that the portable pump provided to dewater the construction area could not keep up with the drain flow, requiring the installers to stand in "knee deep" water. Under these conditions it is unlikely that the foundation or backfill around the riser pipe is adequately compacted or capable of providing adequate support to the structure, as evidenced by the observed tilting, misalignment and possible differential settlement of the installed outlet structures.

Since it takes some period of time for the saturated slope along the drain alignment to dewater once the drain outlet is installed, the outlets were most likely installed and backfilled before the drain flows reached equilibrium conditions, with the lower slopes of the gypsum stack still fully saturated. Either due to tilting, subsidence or displacement of the outlet structure, it can be surmised that the drains on the east end of the north wall were obstructed at the outlets shortly after installation, restricting drain flow and preventing the toe of the gypsum stack from adequately dewatering prior to slope grading operations (i.e., toe of slope was most likely saturated at time of side slope grading and deepening and widening toe ditch).

Wet conditions at the toe of the stack are compounded by the fact that the installed elevation of the toe drain collector pipe could be as much as 2 to 3 feet higher than the design elevation, further increasing seepage gradient into the toe ditch. Repeated attempts to clean out the toe ditch have disturbed and re-worked the saturated gypsum at the toe of the slope to the point that the material currently has a wet, soupy consistency, with very low strength and a very low angle of repose. Although the Widows Creek gypsum has a relatively high undisturbed strength, continuously re-working the material in a saturated condition will result in a significant loss in strength. A loss of material strength at the toe of the stack, in conjunction with the abnormally high seepage gradients associated with the non-functioning drains have lead to progressive failure (subsidence or sloughing) of the toe of the stack below the drain alignment.

The stack operator is currently in a vicious cycle trying to keep the ditch cleaned out while repairing the saturated slope, which continues to slough back into the ditch, further re-working the material, with a continuing reduction in strength.

Recommendations

Immediate attention needs to be paid to getting the toe drain on the east end of the north wall back into operation. This will require removing and replacing several of the damaged outlets in a more controlled environment. As a minimum, it appears that outlets 11E, 11W, 12E and 12W will need to be reset. Since the short-term pump test performed in manhole 12E on February 22 indicates that the adjacent drain section is flowing freely, it should be possible to pump from one or more of the manholes in advance of manhole replacement to dewater the drain and lower slope of the gypsum stack prior to manhole installation. For example, when manhole 12W is being replaced the drain section west of the manhole could be pumped from manhole 13E, and the drain section on the west side of 12W could be pumped from either 12E or 11W if the sediment is cleaned from the riser pipe.

The drain will need to be pumped continuously until equilibrium flow conditions are established. Since the drain is not flowing freely at this time, the gravel and gypsum slope surrounding the drain pipe are fully saturated and will initially produce a much higher flow than will be present after equilibrium is established (equilibrium flow from one drain section could be on the order of 25 to 30 gallons per minute). A more reliable pumping system will be required than the small portable, gasoline powered pump used in the previous pumping test. If the pump runs out of gas or stops for any reason, the drain and slope will resaturate and the pumping operations will need to be started all over again. The drain must be pumped continuously until equilibrium flow is achieved and continuously throughout the manhole installation period.

Gypsum in the bottom of the excavation below the drain elevation will remain saturated and will most likely be very soft and not provide adequate foundation support for the manhole riser pipe. The soft material beneath and in the immediate vicinity of the outlet structure and along the discharge pipe alignment will need to be over-excavated and replaced with a gravel base that will provide greater saturated strength and stability. The excavation around the riser pipe should likewise be backfilled with gravel that extends to the slope face and toe of slope in the ditch alignment. The gravel should be a graded filter to the gypsum (similar to stockpiled material used in drain installation) or, if a coarser gravel is used, separated from the gypsum by a non-woven filter fabric.

Portions of the drain appear to have been installed to invert elevations that could be as much as 2 to 3 feet higher than the design level. As it is our understanding that the toe ditch was excavated to the original design elevation, the depth of the ditch is currently too deep relative to the drain invert elevation, resulting in increased seepage gradients at the toe of slope along the ditch alignment. The increased seepage in conjunction with the low strength gypsum in the ditch bottom (reworked material resulting from continual ditch cleaning operations) makes the toe of the gypsum stack unstable and subject to continual sloughing and progressive failure of the gypsum stack side slope. In addition to repairing the damaged drain outlets, it will also be necessary to stabilize the toe of the gypsum stack along the entire ditch alignment.

There are several possible solutions to toe stabilization. One would be to raise the invert elevation of the perimeter ditch to be consistent with increased elevation of the highest drain pipe invert elevation. This would require that all of the drain outlet pipes be reset to the higher elevation and would limit the hydraulic capacity of the perimeter ditch system. The ditch is designed to handle runoff from the increased side slope area that will occur at final build-out (end-of-life geometry). The hydraulic capacity of the elevated toe ditch would most likely be adequate for current conditions (much less side slope area and runoff reporting directly to ditch) but would need to be reevaluated for end-of-life conditions. Additional capacity, if needed, could be added at a later date by raising the crest elevation of the perimeter road or, possibly, by making the ditch wider.

Another variation of raising the ditch bottom would be to first connect the drain outlet pipes to a header pipe that would be buried when the ditch bottom is raised. The advantage of this option is that the toe drain outlets would not discharge into the toe ditch, but into the buried header pipe. This would eliminate the immediate need to keep the toe ditch cleaned out continuously to keep the drains flowing, which will be an ongoing problem until the side slopes of the stack are grassed and vegetation established. If this option is used, the header pipe would most likely need to bedded and covered with gravel fill (possibly with an excavation warning tape) to minimize the potential for damage when ditch maintenance is being performed.

A third option would be to keep the ditch geometry as originally designed and stabilize the toe of the stack below the seepage spring line with an external gravel drain (wedge of gravel or rock placed at toe of stack) that would have greater strength than the reworked gypsum and stabilize the toe of the stack in the presence of seepage. The gravel would need to a graded filter to the gypsum, or if coarser material is used, would need to separated from the gypsum by a non-woven filter fabric. The drains on the east end of the north wall would still need to be repaired prior to implementing this option.

As a general note, the overall stability of the Widows Creek gypsum stack is based on timely installation and proper operation of the proposed seepage collection drains as the height of the stack increases. The height of the stack is currently well above the recommended elevation of the first bench drain (bench at EL 650 feet) and the drain has not yet been installed. The attached Figure 4.7, taken from the Ardaman engineering report, shows the approximate position of the seepage phreatic surface assuming that the first bench drain is not installed. The seepage analysis indicates that the upper slope, with the drain, will become saturated with a seepage spring line well above first bench elevation. The higher phreatic surface will reduce the stability factor of safety and, due to the higher degree of saturation, make the stack more susceptible to liquefaction in the event of seismic activity. Delaying installation of the bench drain is also complicating the actual construction process, which will require much deeper excavation due to the increased stack height. As a side note, the quantity of seepage flow collected by the toe drain is increased by a factor greater than 2 if the bench drain is not installed.

Recommended Actions

1. Probe bottom sediments in Manhole 11W to confirm total depth of manhole
2. Check survey information for Manhole 6E
3. Uncover Manhole 7E and obtain all needed dimensions and inspect for proper drain operation.
4. Pump or otherwise remove sediments from Outlets 11E, 11W and 12E
5. Pump the drain section between Outlets 10 and 11 and Outlets 11 and 12 on a continuous basis to lower the phreatic surface and spring line at the toe of the stack (needed to help stabilize toe of stack).
6. Continue to repair and stabilize toe of gypsum stack until more permanent repairs can be made (i.e., prevent progress failure of the gypsum stack side slope). Consideration should be given to temporarily stabilizing toe with filter gravel, as discussed during the site visit on 22 February.
7. More accurately survey bottom elevation of north wall manholes to better establish as-built invert elevation of drain pipe.
8. Decide on repair approach and complete any needed engineering analyses or design changes.

9. Pump all remaining drain sections to remove existing sediments and to confirm proper operation of the drain between manhole locations. Record water levels in both manholes, then pump from one end only and observe water level drawdown in manhole at other end.
10. Pump at least on section of drain on the north wall and one section on the south wall on a continuous basis until equilibrium flow conditions are achieved and measure steady state flow, in gallons per minute (needed to confirm design assumptions and design of header pipe, if needed).
11. Remove clay cover from blanket drain near northeast corner of the stack prior to placing gypsum in the area. Upper geotextile (filter fabric) will mostly likely be contaminated and need also need to be replaced.

TVA Widows Creek Gypsum Flyash Stack
File 04-056C

Table 1

Summary of Manhole Survey Data

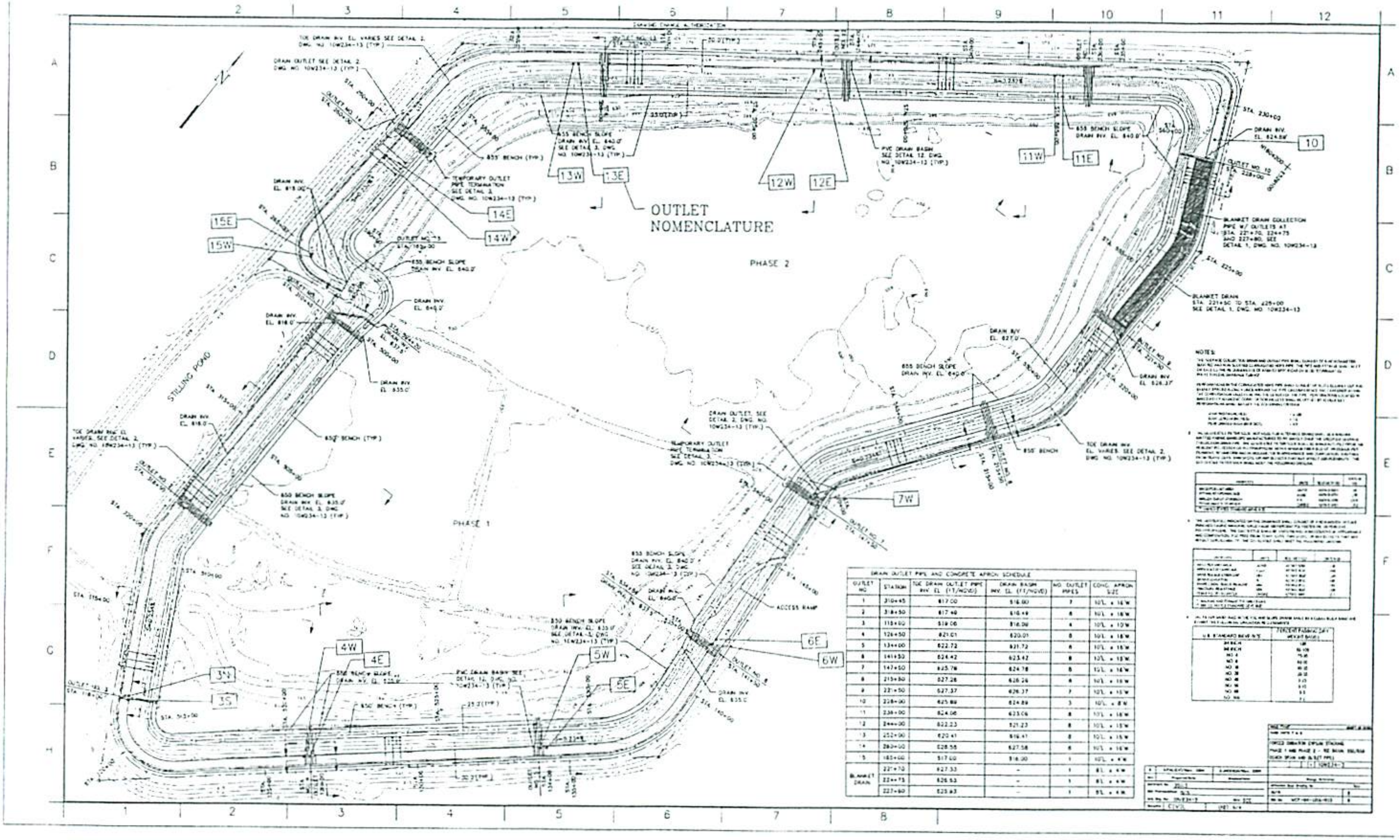
Site Visit February 22 and 23, 2006

Well Number	Top of Pipe Elevation (feet, NGVD)*	Depth to Water (feet)	Water Elevation (feet, NGVD)	Depth to Bottom or Riser Pipe (feet)	Riser Bottom Elevation (feet, NGVD)	Depth to Top of Sediment (feet)	Sediment Thickness (feet)**	Design Toe Ditch Invert (feet, NGVD)	Design Drain Pipe Invert (feet, NGVD)	Calculated Drain Invert (feet, NGVD)***	Difference Rel. to Design (feet)	Comments
3N	627.07	6.52	620.55	10.29	616.78	10.25	0.04	618.08	618.58	618.28	-0.30	Outlet Open, Flowing Clear Water, 1/16 full
3S	628.75	7.58	621.17	10.29	618.46	9.52	0.77	618.08	618.58	619.96	1.38	Outlet Open, Flowing Clear Water, 1/16 full, @ invert in riser
4W	628.91	7.83	621.08	10.29	618.62	10.02	0.27	620.01	620.51	620.12	-0.39	Outlet Open, Flowing Clear Water, 1/16 full, @ invert in riser
4E	629.54	7.60	621.94	10.40	619.14	10.25	0.15	620.01	620.51	620.64	0.13	Outlet Open, Flowing Clear Water, 1/16 full, @ invert in riser
5W	629.74	7.79	621.95	10.33	619.41	10.00	0.33	621.72	622.22	620.91	-1.31	Small Flow, outlet under water
5E	630.29	6.81	623.48	10.25	620.04	10.10	0.15	621.72	622.22	621.54	-0.68	End of pipe plugged, too long
6W	633.91	8.54	625.37	10.33	623.58	10.17	0.16	623.42	623.92	625.08	1.16	Water below outlet, no flow
6E	636.88	7.73	629.15	10.38	626.50	10.35	0.03	623.42	623.92	628.00	4.08	End of pipe buried, no flow
7W	635.46	7.46	628.00	10.25	625.21	8.81	1.44	624.78	625.28	626.71	1.43	Water @ outlet, Flowing clear water, 1/8 full
7E	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Manhole buried, needs to be uncovered to examine
10	635.54	7.79	627.75	9.82	625.72	9.58	0.24	624.89	625.39	627.22	1.83	No apparent flow, end of outlet pipe under water
11E	637.51	10.60	626.91	16.15	621.36	14.29	1.86	623.06	623.56	622.86	-0.70	Riser tilted slightly, end of outlet pipe buried
11W	638.52	10.35	628.17	12.96	625.56	11.38	1.58	623.06	623.56	627.06	3.50	Top of riser pushed over, end of outlet pipe buried
12E	638.32	9.96	628.36	17.71	620.61	15.71	2.00	621.23	621.73	622.11	0.38	Manhole tilted to ditch - outlet pipe most likely pinched
12W	639.65	15.92	623.73	17.71	621.94	17.19	0.52	621.23	621.73	624.44	2.71	Manhole installed wrong - not connected to drain
13E	634.80	11.04	623.76	14.00	620.80	13.85	0.15	619.41	619.91	622.30	2.39	End of pipe under water, small flow
13W	634.04	11.38	622.66	13.96	620.08	13.83	0.13	619.41	619.91	621.58	1.67	End of pipe under water, no flow
14E	631.18	11.29	619.89	13.98	617.20	13.92	0.06	617.58	618.08	618.70	0.62	Outlet partially covered, flowing clear water, 1/8 full
14W	630.80	11.92	618.88	13.75	617.05	13.71	0.04	617.58	618.08	618.55	0.47	Water level below outlet, no flow, end buried
15E	630.15	11.17	618.98	13.83	616.32	13.79	0.04	616.32	616.82	617.82	1.00	Outlet Open, Flowing Clear Water, 1/16 full, @ invert in riser
15W	629.16	10.75	618.41	13.88	615.28	13.83	0.05	616.32	616.82	616.78	-0.04	Outlet Open, Flowing Clear Water, 1/8 full

* Surveyed elevations obtained on 2/23/06 by TVA surveying crew.

** Thickness of sediment at location 12E was measured after manhole was pumped on 2/22/06. Sediment thickness prior to pumping was in excess of 2 feet.

*** Based on assumed sump depth of 1.5 feet in prefabricated manhole. Drain pipe at Outlet 12W connected to manhole outlet pipe.



DRAIN OUTLET PIPE AND CONCRETE APRON SCHEDULE					
OUTLET NO.	STATION	TOE DRAIN OUTLET PIPE INV. EL. (FT/NGVD)	DRAIN BASIN INV. EL. (FT/NGVD)	NO. OUTLET PIPES	CONC. APRON SIZE
1	310+45	617.00	616.00	7	10'L x 16'W
2	318+50	617.40	616.40	8	10'L x 18'W
3	118+00	619.06	618.06	4	10'L x 10'W
4	126+50	621.01	620.01	8	10'L x 18'W
5	134+00	622.72	621.72	6	10'L x 14'W
6	141+50	624.42	623.42	8	10'L x 18'W
7	147+50	625.78	624.78	6	10'L x 14'W
8	215+50	627.26	626.26	4	10'L x 10'W
9	221+50	627.37	626.37	7	10'L x 16'W
10	228+00	625.89	624.89	3	10'L x 8'W
11	236+00	624.06	623.06	8	10'L x 18'W
12	244+00	622.23	621.23	8	10'L x 18'W
13	252+00	620.41	619.41	8	10'L x 18'W
14	260+00	628.58	627.58	6	10'L x 14'W
15	103+00	617.00	616.00	1	10'L x 4'W
BLANKET DRAIN	221+70	627.33	–	1	8'L x 4'W
	224+75	626.53	–	1	8'L x 4'W
	227+60	625.93	–	1	8'L x 4'W

FIGURE 1

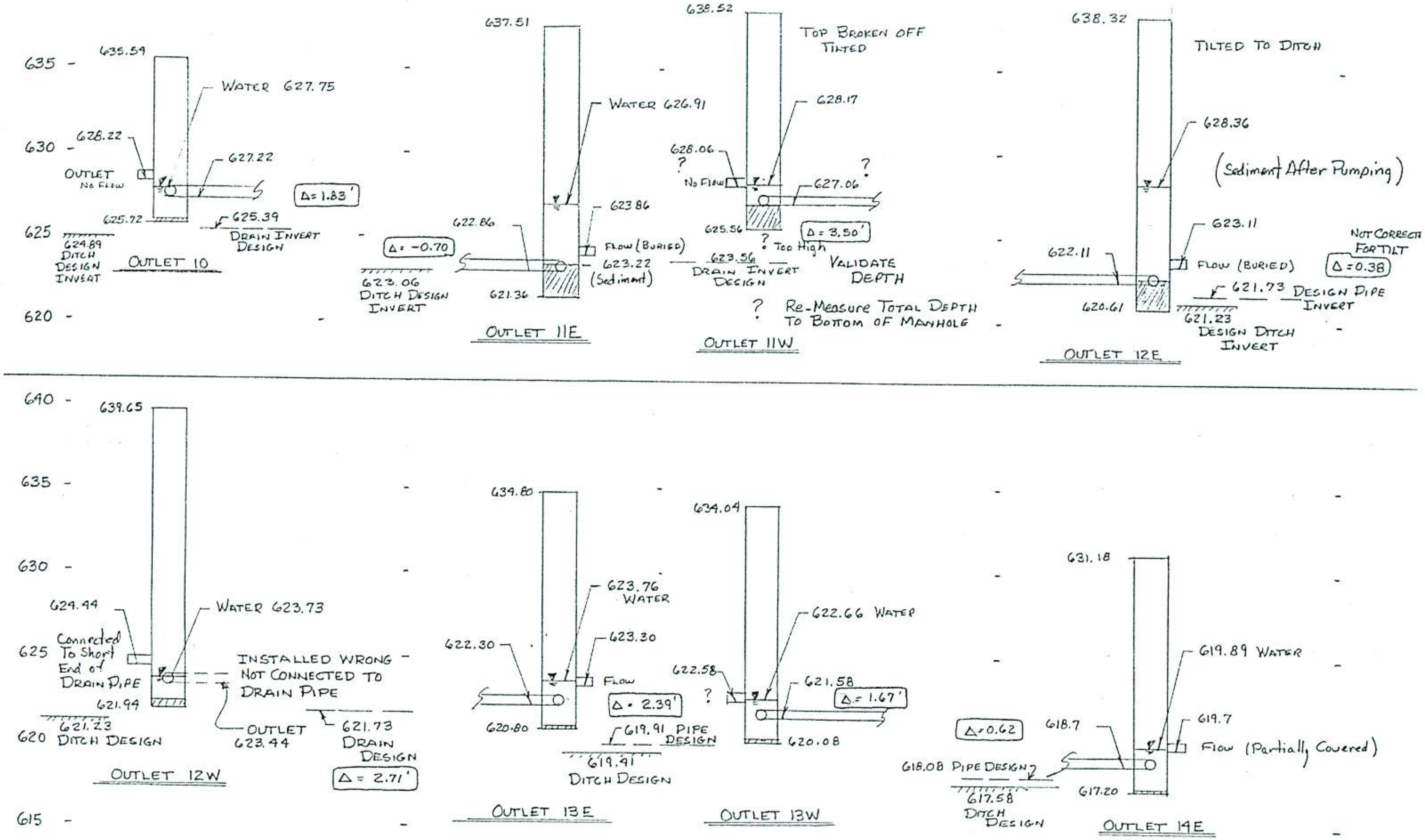
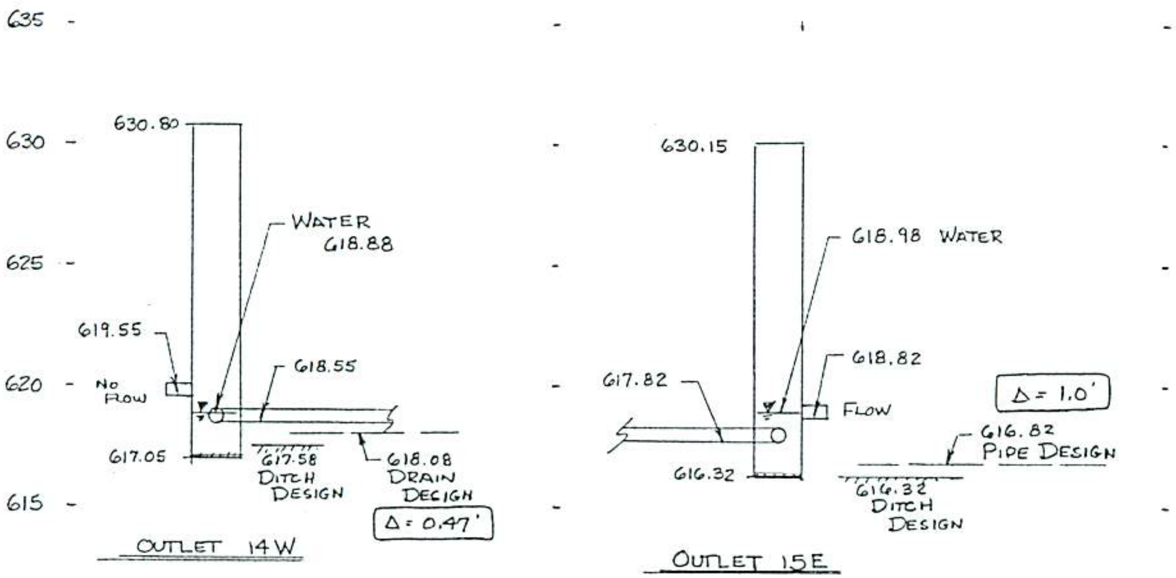


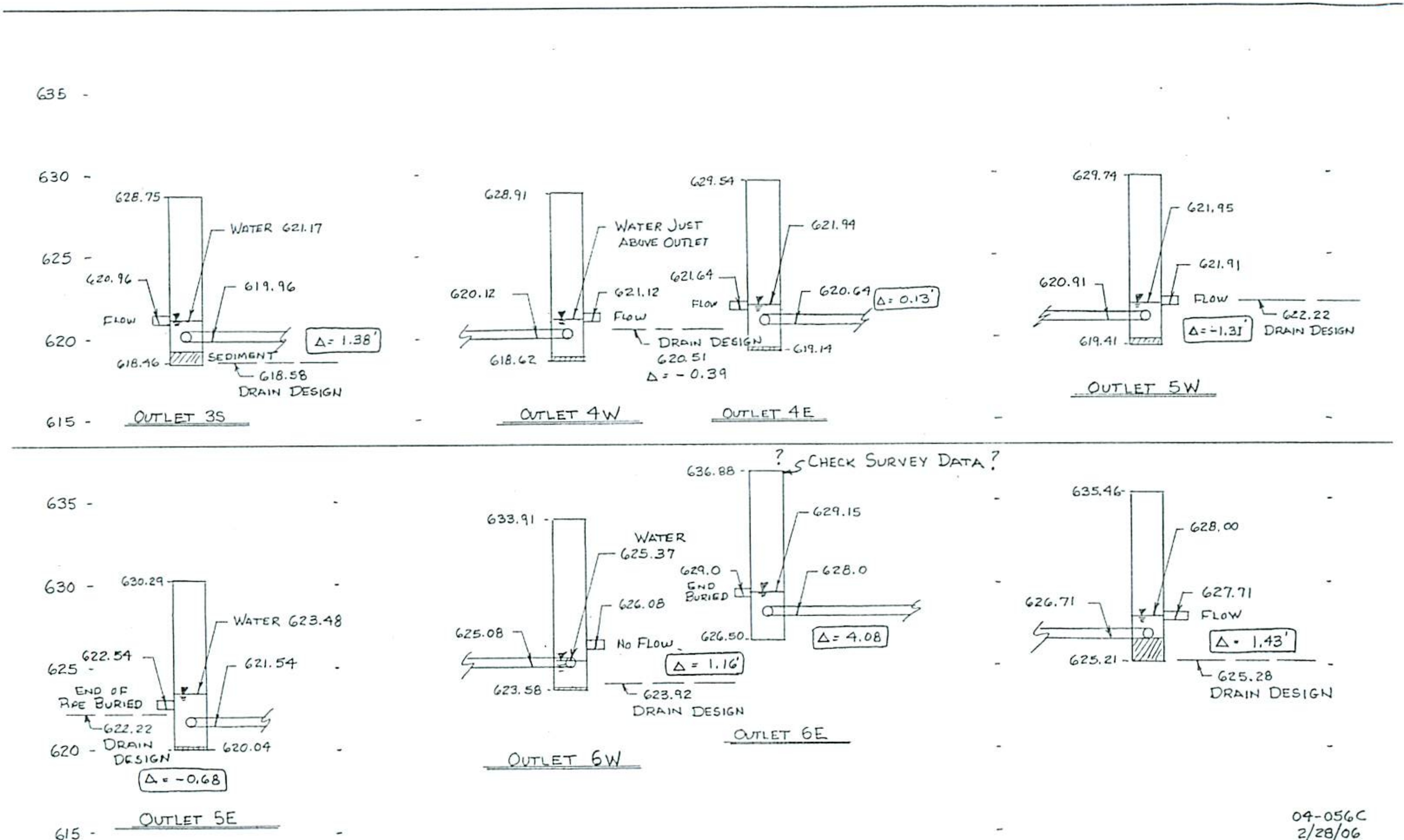
FIGURE 2

04-056C
2/27/06
B. J.



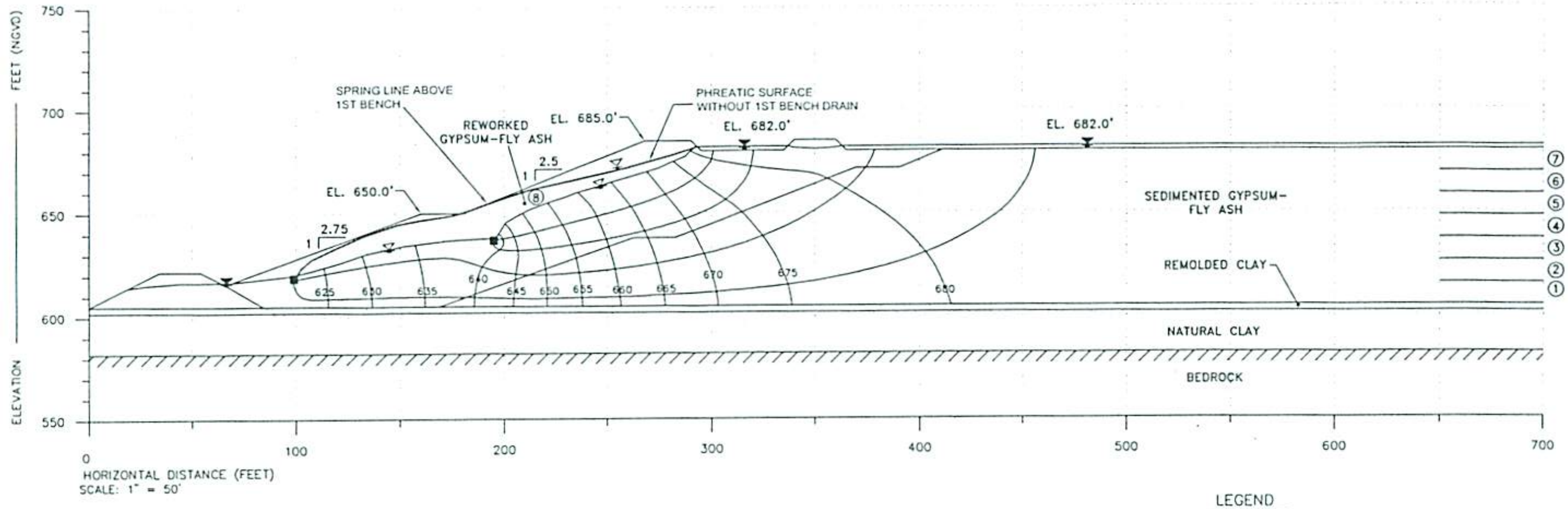
04-056C
2/27/06
B.J.

FIGURE 3



04-056C
2/28/06
B.J.

FIGURE 4



SEEPAGE ANALYSES FOR PROPOSED SLOPE
OF GYPSUM-FLY ASH STORAGE FACILITY
(INTERMEDIATE POND ELEVATION 682 FEET)

LEGEND

- 680— PIEZOMETRIC ELEVATION CONTOUR (FEET)
- ■ PROPOSED SEEPAGE COLLECTION DRAIN
- ▽ PHREATIC SURFACE
- ▼ POND LEVEL

GYPSUM-FLY ASH MIX PROPERTIES

LAYER NUMBER	DESCRIPTION	γ_d (1) (pcf)	k_v (cm/sec)	k_h (cm/sec)	Void Ratio (2)
①	SEDIMENTED GYPSUM-FLY ASH	92.0	9.52×10^{-5}	1.90×10^{-4}	0.70
②		90.4	1.12×10^{-4}	2.24×10^{-4}	0.73
③		88.9	1.32×10^{-4}	2.64×10^{-4}	0.76
④		87.3	1.55×10^{-4}	3.10×10^{-4}	0.79
⑤		85.3	1.90×10^{-4}	3.80×10^{-4}	0.83
⑥		83.4	2.32×10^{-4}	4.64×10^{-4}	0.87
⑦		81.8	2.72×10^{-4}	5.45×10^{-4}	0.91
⑧	REWORKED GYPSUM -FLY ASH	95	1.00×10^{-4}	2.00×10^{-4}	0.70

NOTES

(1)-SEE FIGURE 3.1

(2)-BASED ON THE AVERAGE SPECIFIC GRAVITY OF THE GYPSUM-FLY ASH

k_h-HORIZONTAL HYDRAULIC CONDUCTIVITY

k_v-VERTICAL HYDRAULIC CONDUCTIVITY

γ_d-DRY UNIT WEIGHT

SEEPAGE ANALYSES
FOR INTERMEDIATE HEIGHT
(WITH DRAINS)

Ardaman & Associates, Inc
Geotechnical, Environmental and Materials Consultants

GYPSUM-FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

DRAWN BY: SR | CHECKED BY: | DATE: 10/08/04
FILE NO. 04-056A | APPROVED BY: | FIGURE: 4.7

Petty, Harold L.

From: NDavies@GeoSyntec.com

Sent: Monday, March 27, 2006 10:24 PM

To: Purkey, Ronald E.

Cc: Petty, Harold L.

Subject: Widows Creek - draft report

Ron and Lynn:
Please find attached a draft report for the Widows Creek project. I would appreciate it if you could give this a review and let me know if this is sufficiently detailed for your present needs. I have a couple of questions for Mike Hughes relative to the first bench drain and the blanket drain. I would like to discuss these items prior to finalizing the report.

Please give me a call when convenient, I should be in the office all week.

Best regards
Neil

DRAFT

R. Neil Davies, C.Eng., MICE, P.E.
Principal/Branch Manager

GeoSyntec Consultants, Inc.
1255 Roberts Blvd. Suite 200
Kennesaw, GA 30144

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GEOSYNTEC CONSULTANTS

1255 Roberts Blvd., Suite 200
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Tel (678) 202-9500 Fax (678) 202-9501

27 March 23, 2006

DRAFT

Mr. Ronald E. Purkey, P.E.
Manager, Civil Engineering
Tennessee Valley Authority
1101 Market Street LP3J
Chattanooga, TN 37402

Subject: **Widows Creek Gypsum-Fly Ash Storage Facility**
Summary Report of Findings (DRAFT)

Dear Mr. Purkey:

GeoSyntec Consultants, Inc (GeoSyntec) is pleased to provide TVA with this summary report of our findings regarding our site visit and review of current conditions at the Gypsum-Fly Ash Storage Facility at TVA's Widows Creek Fossil Plant, located near Stevenson, Alabama.

This work was performed by GeoSyntec based on a verbal request made by Mr. Ron Purkey, P.E. and as generally outlined in our letter to TVA dated 23 March 2006. The work was performed in accordance with Contract no. 50771.

1. Background

GeoSyntec understands that TVA has experienced problems with the underdrain and dike toe drain system associated with the Gypsum-Fly Ash Storage Facility at TVA's Widows Creek Fossil Plant, located near Stephenson, Alabama. Specifically, significant areas of the lower portions of the outer dikes that form the perimeter of the storage facility have exhibited signs of excessive seepage and sloughing.

Based on conversations with TVA personnel, it is our understanding that the originally designed underdrain system may not have been installed when the facility was originally constructed. To rectify this situation, we understand that drainage improvements, consisting of toe drains, bench drains, and an area of drainage blanket were designed by Ardaman and Associates, Inc (Ardaman). We further understand that some of these measures were implemented in 2005. However, subsequent inspections have indicated that these measures may not have been constructed in accordance with the design intent. As a result, areas of the facility are still showing signs of excessive seepage and sloughing.

Mr. Neil Davies, P.E. of GeoSyntec conducted a site visit/inspection on 17 March 2006. Mr Davies was escorted by Mr. Mike Hughes of TVA. During the visit, Mr. Hughes described the various measures implemented in 2005 to improve drainage. In addition, a visual inspection was performed of the facility's outer gypsum/fly ash dikes, paying particular attention to the condition of the lower portions of the dikes.

In preparing this summary report, GeoSyntec also reviewed the following documents:

- *"Report of Geotechnical Drilling, Gypsum-Fly ash Storage Facility, Widows Creek Fossil Plant, Stevenson, Alabama"*, Mactec, Inc., 23 June, 2004.
- Drawings titled *"Forced Oxidation Gypsum Stacking, Phase I and Phase II"*, TVA Drawing No. 10W234 series, dated November 2004.
- *"Engineering Evaluation and Design Recommendations for Renovation of Widows Creek Gypsum-Fly Ash Storage Facility"*, Ardaman and Associates, May 2005.
- "WCF Gypsum Stack Remediation", memorandum from Mr. Bill Jackson of Ardaman and Associates, Inc. to Mr. Mike Hughes (TVA) dated 24 August 2005.
- *"Preliminary Assessment of Seepage Collection Drains at TVA Widows Creek Gypsum-Fly Ash Storage Facility"*, memorandum from Mr. Bill Jackson of Ardaman and Associates, Inc. to Mr. Mike Hughes (TVA) dated 2 March 2006
- Various portions of TVA's project file related to this issue.

2. Summary of Findings

According to the report prepared by Ardaman [2005], three significant recommendations were made to improve drainage conditions associated with the facility, i.e., (i) deepening and widening of the perimeter toe ditch for improved surface water control as the height of the stack increases; (ii) installation of a seepage collection toe drain around the entire perimeter of the stack and additional drains at each of the setback bench elevations as the height of the stack increases; and (iii) regrading of the existing side slopes to establish a more stable configuration consistent with design assumptions. GeoSyntec has conducted a summary level review of the evaluations presented in this report and the details of the general recommendations outlined above. Based on GeoSyntec's review of the Ardaman report and other supporting documentation, we concur that these recommendations were reasonable and appropriate based on the conditions that we understand existed at that time.

Based on our review of other documents cited above, and on discussions with TVA personnel, it is our understanding that some significant implementation difficulties were experienced at the time the toe ditch and seepage collection drain modifications were implemented. Some of these difficulties are documented in memoranda from Mr. Bill Jackson (Ardaman) to Mr. Mike Hughes (TVA) dated 24 August, 2005 and 2 March 2006. In summary, we understand that the Contractor experienced difficulties in establishing a stable working bench for the trenching machine. In addition, it appears that difficulties were encountered in controlling the invert elevation of the installed drains. While the exact circumstances are not described in the memoranda, this appears to be in part caused by wet conditions resulting from excessive seepage on the dike sideslopes at the time of installation. We also note that the 24 August 2005 memorandum refers to the gravel drainage media as being "somewhat dirty" having more fines than desired. However, the laboratory test information provided with the media indicated an adequate coefficient of permeability of 1.3 x 10^{-3} cm/sec.

The memorandum dated 2 March, 2006 also documents a number of issues associated with the installation of the toe drain, particularly along the north wall. Observations relative to seepage and sloughing appear to be generally consistent with those made by GeoSyntec during our 17 Mach 2007 site visit. Detailed information is provided in the 2 March memorandum relative to each of the seepage drain outlets on both the north wall (i.e., outlets 10, 11E, 11W, 12E, 12W, 13E, 13W, 14E, 14W, 15E, and 15W) and the south wall (i.e., 3N, 3S, 4W, 4E, 5W, 5E, 6W, 6E, 7W, and 7E).

Measurements taken by Ardaman generally indicate that that the toe drain along the north wall was installed at elevations higher than the design elevation (typically 0.5 to 3.5 ft higher than designed). The memorandum also indicates that outlet 12W was installed incorrectly and is apparently not connected to the drain pipe. The toe drain on the south wall appears to have been generally installed closer to the design elevations with fewer locations noted as being above the design elevation (when compared to the north wall). While these measurements are useful and provide a general indication of the elevations at which the toe drain was installed, they do not provide information relative to the elevation of the toe drain at other points along its alignment. Since it is likely that greater care was taken in controlling the constructed elevations at the locations of outlets, one can speculate that the elevation of the drain at points remote from the outlets may be less well controlled.

Observations made during our 17 March 2006 site visit confirmed that excessive seepage and sloughing is still an issue particularly along the north wall of the gypsum-fly ash disposal facility between the toe drain outlets labeled as 13E/13W and 11E/11W (see figure 1). Seepage and sloughing are generally worse from the center of the north wall towards the east end (i.e., outlets 12E/12W to outlets 11E/11W). Photographs taken during the site visit are provided as Attachment A. At the time of our inspection, most of the toe drain outlets along the north wall were either buried or otherwise obstructed to varying degrees. Although some flow of water was evident in the vicinity of the outlets, most were not flowing freely and unobstructed. Several issues were also noted with respect to the manholes located at the outlet locations. In the case of outlet 11W, the upper section of the riser has become dislodged and is tilted over. Sediment (presumably gypsum and fly ash) appeared to be present in several of the risers that were inspected on the north wall. We believe this may have resulted from displacement of the risers.

We understand that several efforts have been made to grade the lower slope since installation of the toe drain, but wet conditions combined with re-working of the gypsum/fly ash have resulted in soft/low strength conditions that make access with mechanical equipment difficult.

3. Discussion

Based on a review of the information provided and additional information gathered during the site visit, it appears that elevation control during installation of the toe drain appears to have been problematic and is likely contributing to the current seepage problems. While the drain appears to be functioning adequately over several portions of its total length, the toe drain located along the north wall appears to be problematic, particularly in the center and eastern portions of this run. Excessive seepage is likely the cause of localized slope instability or sloughing over the lower portions of the slope. Excessive seepage is likely the result of the toe drain being constructed at elevations above the design elevation compounded by several of the drain outlets being obstructed or non-functional. The net result is an increase in the seepage gradient towards the perimeter ditch and an overall rise in the phreatic surface within the dike.

We note that the 24 August memorandum (Ardaman) contains a recommendation to install the first bench drain. This memorandum indicates that TVA was not intending to install this drain until October 2004. The 2 March 2006 memorandum (Ardaman) also indicates that the first bench drain was apparently not installed at that date. GeoSyntec agrees that installation of the first bench drain would likely improve conditions by reducing the quantity of seepage flowing to lower portions of the dike and by reducing the hydraulic gradient in the lower portion of the dike. In addition, as indicated by Ardaman, *"the overall stability of the stack is based on timely installation and proper operation of the proposed seepage drains as the height of the stack is increased"* At the time of preparing this draft report, we are uncertain as to whether this drain has been installed. If it has not yet been installed, GeoSyntec strongly recommends that this drain be installed as soon as practical. We believe that installation of this drain will: (i) improve conditions at the toe over time; (ii) minimize the risk of similar conditions occurring above the level of the first bench; and (iii) reduce the risk of instability of the stack as its elevation is increased.

4. Alternatives for Toe Drain Improvements

GeoSyntec recommends that TVA address the deficiencies identified with the current toe drain configuration. If not addressed, continued and progressively larger failures of the lower slope of the north wall are likely. As the stack elevation is raised, the situation will likely become more problematic and more difficult to rectify. To aid TVA in selecting an appropriate approach to improving the toe drain, we have identified several potential alternative approaches. The following section of this report briefly describes the alternatives and presents a brief evaluation of the advantages and disadvantages associated with each alternative. Figure 2 presents the current toe drain configuration and is presented as a baseline for comparison

> ***Baseline Alternative – No Action (other than maintenance of current toe drain) -*** This baseline alternative involves no major modifications to the current toe drain other than the following maintenance activities: (i) clean out current outlets; (ii) correct the outlet at 12W (pipe not currently connected to the outlet); (iii) repair the riser at outlet 11W; (iv) clean out/pump out all outlets and risers; (iv) ensure all outlets are clear and unobstructed; (v) construct concrete aprons per original design; (vi) repair dike sideslopes, place interim cover soils and establish vegetation to minimize future erosion.
>
> ***Alternative 1 – Retro-fit Buttress Drains –*** This alternative makes use of the currently installed toe drain. The vertical alignment of the existing drain would be surveyed using a pipe profiler. This involves floating a line through the existing toe drain and winching a profiler through the system to establish a profile along the existing pipe. This information would be used to establish the number and location of supplemental buttress drains. Existing outlets and intermediate locations (determined after evaluation of the existing drain profile) would be retro-fitted with buttress drains. Construction of each buttress drain would involve localized excavation of gypsum/fly ash from the toe area and replacement a course aggregate drainage media separated from the sidewalls and base of the excavation using an appropriately designed geotextile filter fabric. This alternative is illustrated conceptually in figures 3 and 4. To be effective, the buttress drains would need to be in intimate contact with the existing toe drain media. The number and location of supplemental drains would be determined based on the results of profiling the existing pipe, but would generally be located coincident with wet areas, ~~high points~~, and low points along the existing pipe such that hydraulic pressures are relieved.
>
> ***Alternative 2 – Raise Ditch Invert and Perimeter Dike/Road Elevation –*** This alternative also makes use of the currently installed toe drain. Similar to alternative 1, the vertical alignment of the existing drain would be surveyed using a pipe profiler to determine the locations of high and low points. Using this information, the perimeter ditch could be re-designed such that the elevation of the ditch invert is raised to be approximately coincident with the highest point on the current toe drain. This would likely involve re-designing/re-evaluating a significant portion of the perimeter ditch to ensure that it will have sufficient capacity under final build-out conditions. Raising the elevation of the perimeter ditch will have the effect of buttressing the toe of the outer gypsum/fly ash dike

and will establish the phreatic surface in a similar configuration to that assumed in the original design (relative to the dike profile). Depending upon the extent of filling required, it may be necessary to re-set some of the existing outlets and/or provide a header pipe embedded in gravel in the base of the perimeter ditch. It may also be necessary to raise the elevation of the outer perimeter dike and access road to provide sufficient surface water capacity under final build-out conditions. Alternative 2 is illustrated conceptually in figure 5.

Alternative 3 – Continuous Buttress Toe Drain – This alternative is similar to alternative 1, but involves replacing the toe of the outer gypsum/fly ash dike with a continuous rock or a coarse aggregate buttress drain. The buttress drain would be constructed in areas that are currently showing signs of excessive seepage. The existing toe of the gypsum/fly ash slope would be removed in short lengths. The drainage media would be separated from the gypsum/fly ash with an appropriately designed geotextile filter fabric. This continuous buttress would extend into the slope a sufficient distance to connect to the existing toe drain.

All alternatives described above should have the common element of installing the first bench drain (if not already installed) for the reasons discussed in Section 4.

Table 1 presents a brief summary of the advantages and disadvantages associated with each alternative.

Table 1
Summary of Advantages and Disadvantages for Each Toe Drain improvement Alternative

Alternative	Description	Advantages	Disadvantages
Baseline	No action other than maintenance of as designed system	• Lowest capital cost • Least intrusive	• Does not address vertical alignment issues associated with existing toe drain • Performance uncertain • If unsuccessful, other alternatives may need to be implemented
1	Retro-fit buttress drains	• Moderate initial capital cost • Can be implemented in stages to assess effects • Actively addresses vertical alignment issues associated with existing toe drain • Uses conventional construction methods	• May require shoring to limit disturbance of existing toe drain and sideslopes
2	Raise Ditch Invert and Perimeter Dike/Road	• Moderate to high initial capital cost • Raising of dike (if needed) could be postponed until a later time • Uses conventional construction methods	• May require significant work to adjust alignment of existing perimeter ditch
3	Continuous Buttress Toe Drain	• Most likely alternative to succeed • Conventional approach • Uses conventional construction methods	• Highest initial capital cost • Requires significant construction effort

5. Recommendations

Based on our review of the documents provided and our understanding of current conditions associated with seepage and slope stability of the Widows Creek Gypsum-Fly Ash Storage Facility, GeoSyntec recommends the following actions:

1. First Bench Drain – if not currently installed, GeoSyntec recommends installation of the first bench drain in accordance with the design drawings as soon as practical. This action is necessary to reduce the risk of future instability of the stack and should over time improve conditions at the base of the stack.

2. North Face Toe Drain – GeoSyntec recommends implementing improvements to the existing toe drain in areas where excessive seepage is evident (i.e., north wall). Section 4 of this summary report provides a discussion of potential alternatives available to TVA.

3. Vegetation – once items 1 and 2 have been addressed, GeoSyntec recommends fine grading the dike slopes to the design grades, placing an intermediate soil cover over the sideslopes, and establishing vegetation over the sideslopes to minimize erosion and future sloughing of the dike sideslopes.

6. Closure

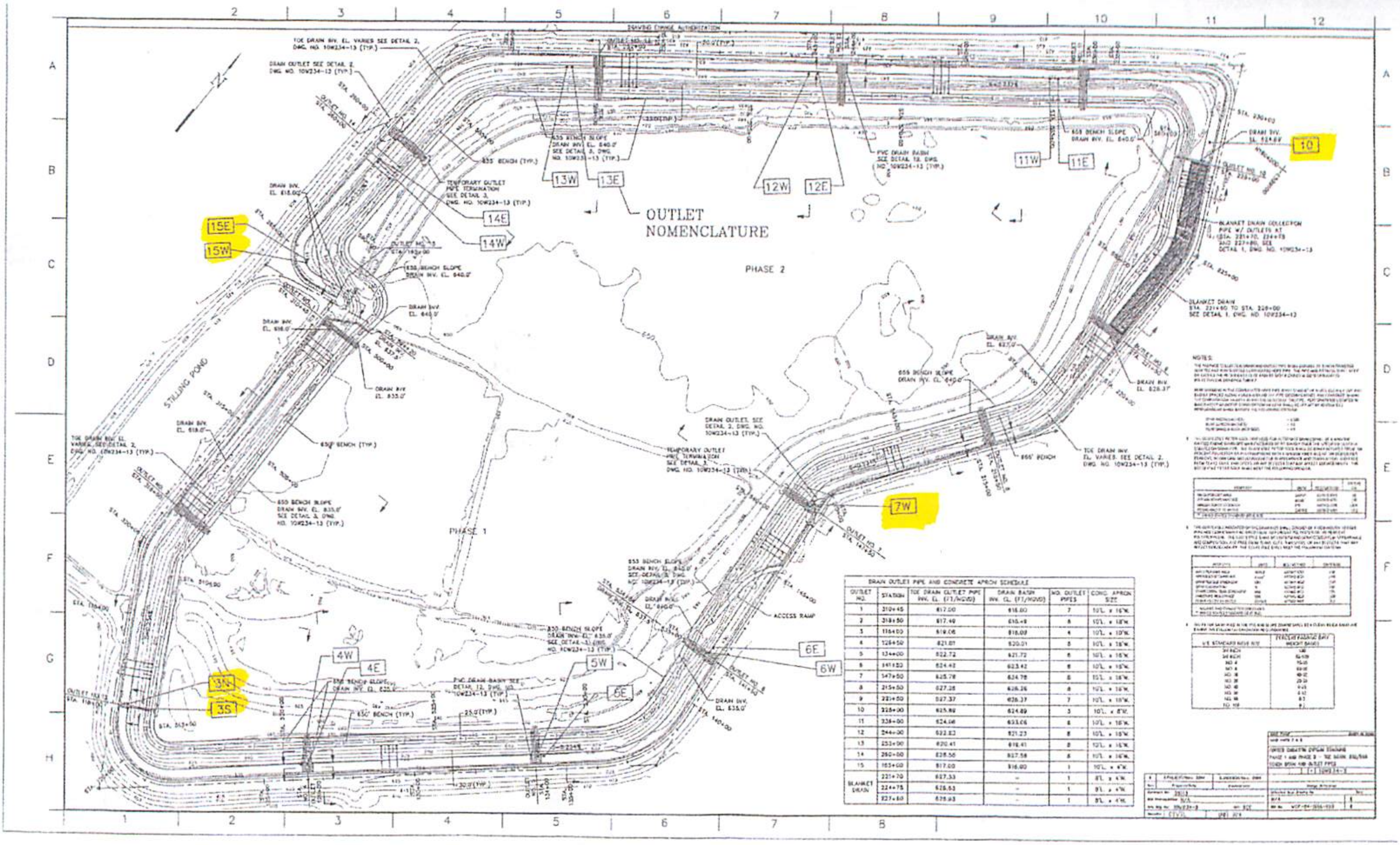
GeoSyntec greatly appreciates the opportunity to be of service to TVA on this important project. We look forward to working with you and your staff to identify the optimum solution for TVA. Please do not hesitate to contact me at 678-202-9545 if you have any questions.

Sincerely,

R. Neil Davies.

R. Neil Davies, C.Eng., MICE, P.E.
Principal/Branch Manager
GeoSyntec Consultants, Inc.

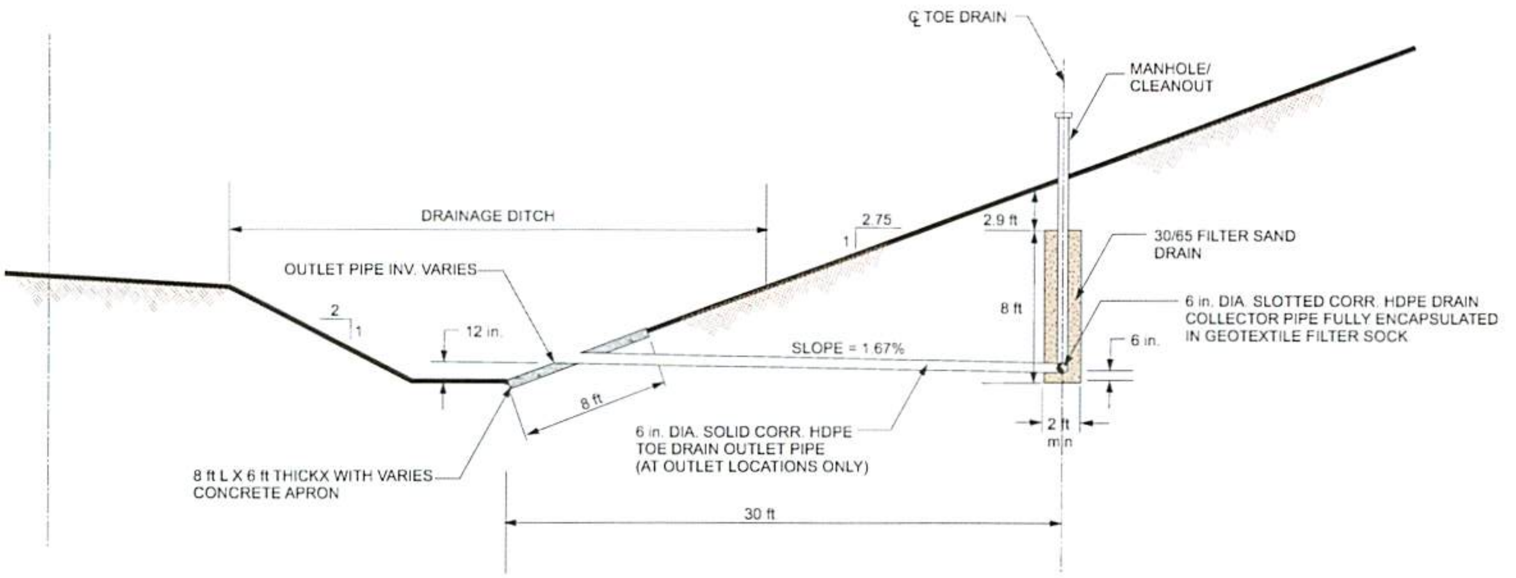
Copy to: Mr. Lynn Petty (TVA)



DRAIN OUTLET PIPE AND CONCRETE APRON SCHEDULE

OUTLET NO.	STATION	TOE DRAIN OUTLET PIPE INV. EL. (FT/NGVD)	DRAIN BASIN INV. EL. (FT/NGVD)	NO. OUTLET PIPES	CONC. APRON SIZE
1	310+45	617.00	616.00	7	10'L. x 16'W.
2	318+50	617.49	616.49	8	10'L. x 18'W.
3	116+00	619.06	618.06	4	10'L. x 10'W.
4	126+50	621.01	620.01	8	10'L. x 18'W.
5	134+00	622.72	621.72	6	10'L. x 16'W.
6	141+50	624.42	623.42	6	10'L. x 16'W.
7	147+50	625.78	624.78	6	10'L. x 16'W.
8	215+50	627.26	626.26	6	10'L. x 16'W.
9	221+50	627.37	626.37	7	10'L. x 18'W.
10	228+00	625.89	624.89	3	10'L. x 8'W.
11	236+00	624.06	623.06	6	10'L. x 16'W.
12	244+00	622.23	621.23	6	10'L. x 16'W.
13	253+00	620.41	619.41	6	10'L. x 16'W.
14	260+00	618.56	617.56	6	10'L. x 16'W.
15	163+00	617.00	616.00	1	10'L. x 4'W.
BLANKET DRAIN	221+70	627.33	-	1	8'L. x 4'W.
	224+75	626.53	-	1	8'L. x 4'W.
	227+60	625.93	-	1	8'L. x 4'W.

FIGURE 1

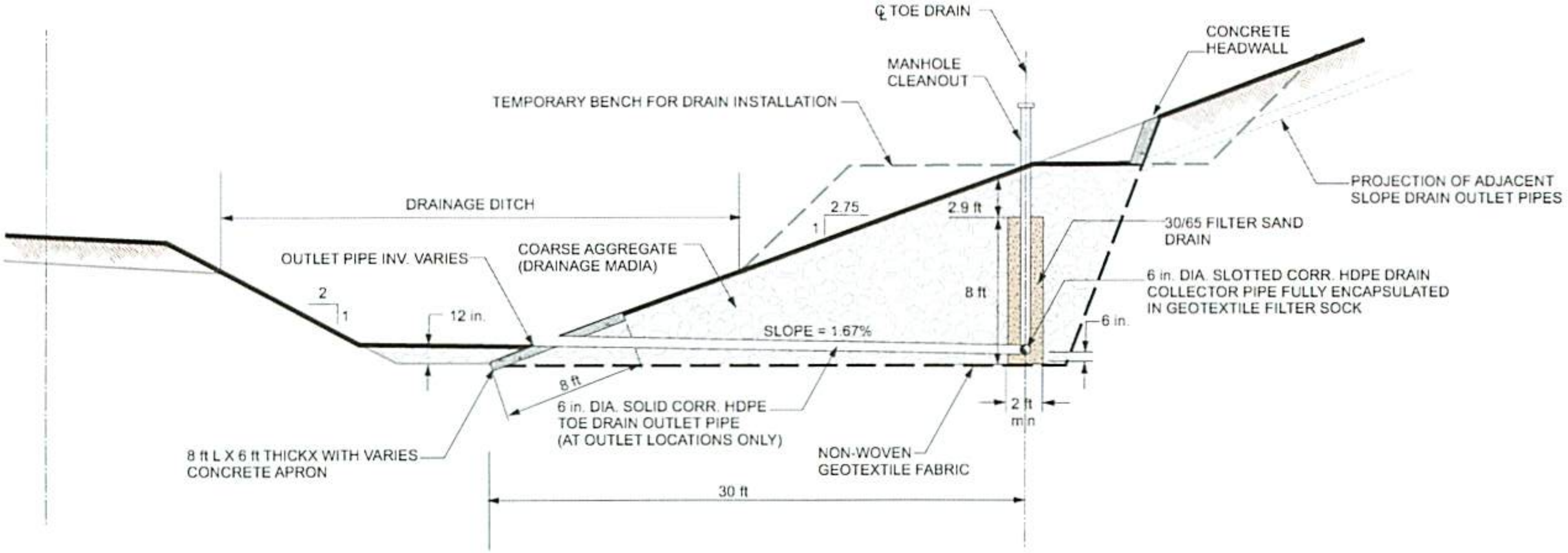


NOTE:
1. TAKEN FROM FIGURE 4.15 ARDAMAN [2004]

AS DESIGN CONDITIONS

GEOSYNTEC CONSULTANTS
ATLANTA, GEORGIA

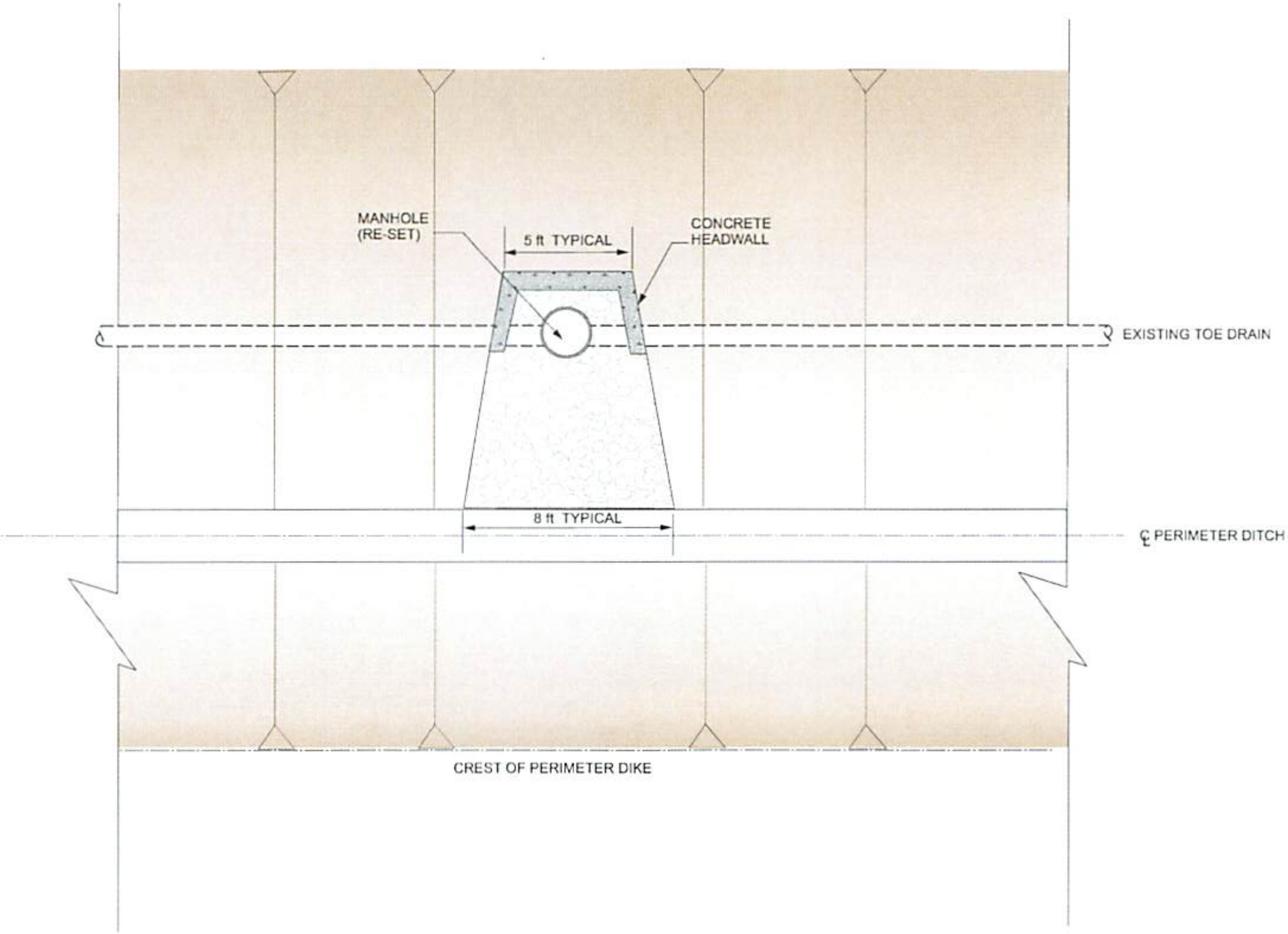
FIGURE NO.	2
PROJECT NO.	GR3731-06
DOCUMENT NO.	GA060000
DATE	MARCH 2006
FILE NO.	FIGURES.cdr



ALTERNATIVE 1
RETRO-FIT BUTTRESS DRAINS

GEOSYNTEC CONSULTANTS
ATLANTA, GEORGIA

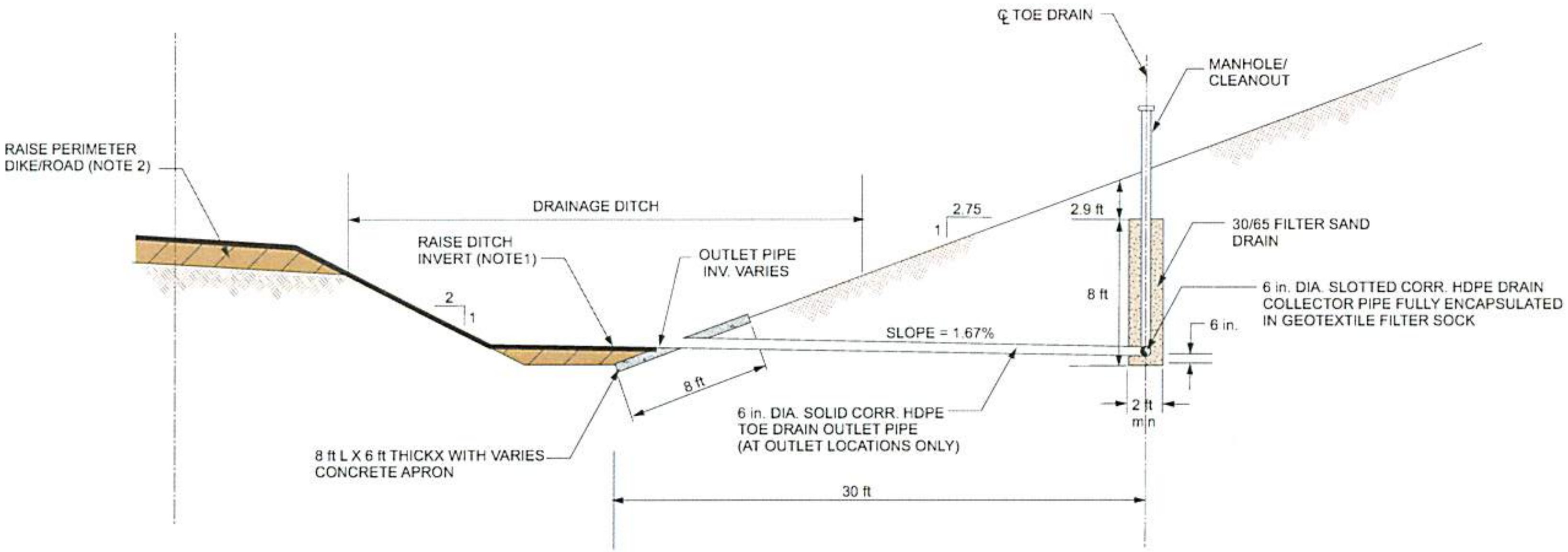
FIGURE NO.	3
PROJECT NO.	GR3731-06
DOCUMENT NO.	GA060000
DATE	MARCH 2006
FILE NO.	FIGURES.cdr



ALTERNATIVE 1
PLAN VIEW - BUTTRESS DRAIN

GeoSyntec Consultants
ATLANTA, GEORGIA

FIGURE NO.	4
PROJECT NO.	GR3731-06
DOCUMENT NO.	GA060000
DATE	MARCH 2006
FILE NO.	FIGURES.cdr



NOTES:

1. FILL DITCH INVERT TO MATCH ELEVATION OF TOE DRAIN INVERT.
2. RAISE PERIMETER DIKE/ROAD TO PROVIDE ADEQUATE DITCH CAPACITY.

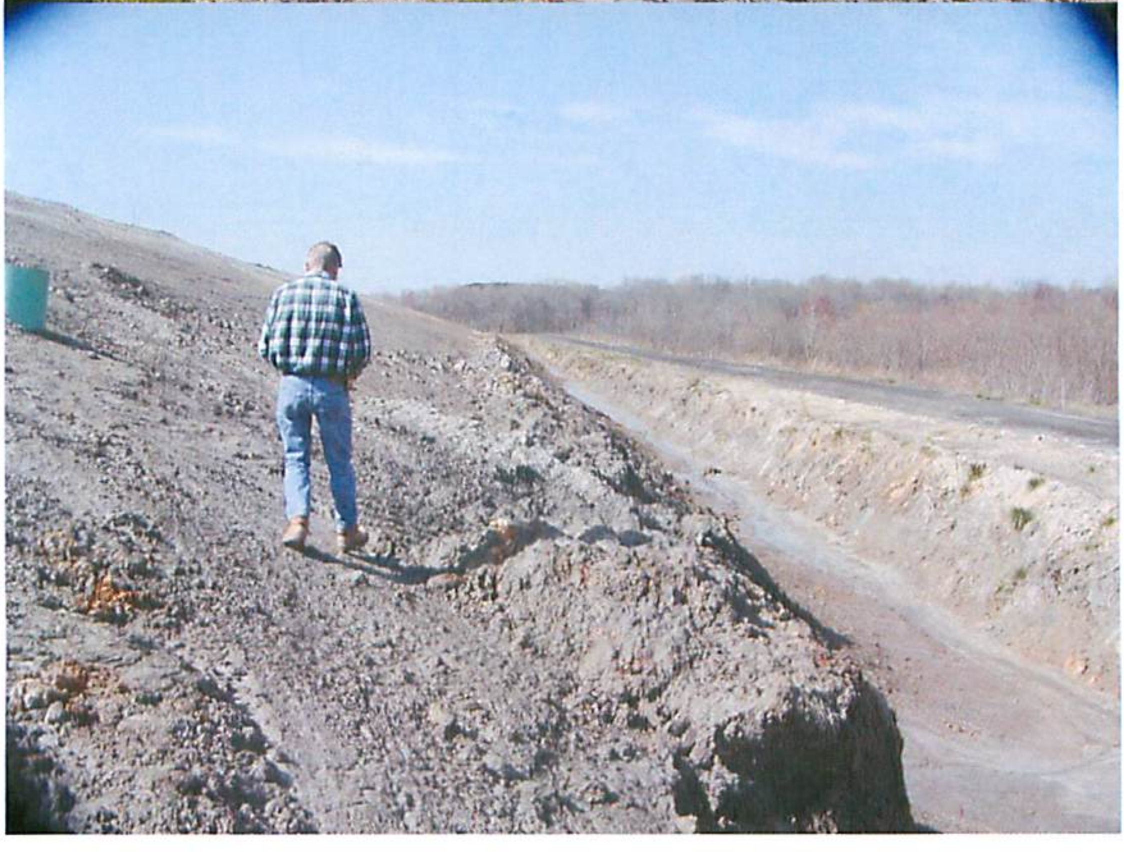
ALTERNATIVE 2
RAISE DITCH INVERT AND PERIMETER DIKE/ROAD ELEVATION

GEOSYNTEC CONSULTANTS
ATLANTA, GEORGIA

FIGURE NO.	5
PROJECT NO.	GR3731-06
DOCUMENT NO.	GA060000
DATE	MARCH 2006
FILE NO.	FIGURES.cdr

Attachment A

Photographs Taken During 17 March, 2006 Site Visit



Interim Report on Evaluation of FGD Gypsum-Flyash Wet-Stacking Disposal Facility
Widows Creek Steam Plant
Stevenson, Alabama

Ardaman & Associates, Inc.

Interim Report on Evaluation of
FGD Gypsum-Flyash Wet-Stacking
Disposal Facility
Widows Creek Steam Plant
Stevenson, Alabama

Ardaman & Associates, Inc.

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Ardaman & Associates, Inc.

Consultants in Soils, Hydrogeology,
Foundations and Materials Testing

April 22, 1991
File Number 90-059

Tennessee Valley Authority
2 North 83A Blue Ridge Place
Chattanooga, Tennessee 37402-2801

Attention: Mr. J.S. Baugh, Supervisor
Performance Evaluation Section

Subject: Interim Report on Evaluation of the FGD Gypsum-Flyash Waste Wet-Stacking Disposal Facility, Widows Creek Steam Plant, Stevenson, Alabama, Contract No. 90PKA-89214B

Gentlemen:

This interim report documents the results of the field and laboratory testing programs and the engineering evaluations performed in conjunction with Tasks A and B of our proposal dated April 12, 1990, and authorized by Contract No. 90PKA-89214B.

Included in this interim report are the results of the field exploration program and site evaluation performed to document the existing stack slope and subsurface conditions, the results of the laboratory testing program undertaken on the gypsum-flyash to characterize its physical properties relevant to wet-stacking, and recommendations for operating, filling and raising the Phase I gypsum-flyash stack. This report has been prepared for the exclusive use of the Tennessee Valley Authority in accordance with generally accepted geotechnical engineering practices for specific application to the above referenced project. No other warranty, expressed or implied, is made.

If you have any questions or require additional information, please contact us.

Very truly yours,
ARDAMAN & ASSOCIATES, INC.

Thomas S. Ingra
for Bill E. Jackson, P.E.
Senior Project Engineer
Florida Registration No. 23479

John E. Garlanger
John E. Garlanger, Ph.D., P.E.
Principal

EJW/TSI:cc

9A-90059.JEG/9A-90059.TBL

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Section 1

EXISTING STACK CONDITIONS, PROJECT OBJECTIVES AND SCOPE OF WORK

1.1 Existing Stack Conditions

Based upon a review of topographic maps, design drawings, photographs and other information supplied by the Tennessee Valley Authority (TVA) and our site visits of October 26, 1990 and March 15, 1991, we observe that TVA is presently operating the Widows Creek Steam Plant Phase I gypsum-flyash disposal area as two separate ponds, designated Pond 1 and Pond 2, with a central earthen divider dike generally trending in an east-west direction separating the two pads. Pond 1 is located on the south side of the Phase I disposal area and Pond 2 on the north side. Pond 1 is further divided in about half by a north-south trending cast gypsum-flyash divider dike. Each pond has a surface area of approximately 32 acres.

Pond 1 was initially used for gypsum-flyash disposal while the western end of Pond 2 was used as a clarification pond. The gypsum-flyash was introduced into Pond 1 at about the mid-point of the west wall. The August 15, 1990 topographic map provided by TVA, and reproduced herein as Figure 1.1, indicates that, as of that date, Pond 1 was filled with gypsum-fly ash waste to approximately Elevation 640 feet (MSL) on the west end of the pond, and about 632 feet (MSL) on the eastern, remote (i.e., relative to the gypsum-flyash inlet) end of the pond. The bottom of the disposal area was originally constructed at elevations ranging from a maximum of 624 feet (MSL) in the eastern portion of the site, to a minimum of 600 feet (MSL) in the western portion of the site. Accordingly, as of August 1990, the thickness of the gypsum-flyash waste within Pond 1 varied from about 8 feet on the east end to 40 feet on the west end.

The earthen starter dike surrounding the Phase I disposal area has a design crest elevation of 622 feet (MSL). The August 1990 topographic map indicates that the gypsum-fly ash waste has been cast into a perimeter dike up to Elevation 645 feet (MSL) on the western end of the stack and up to Elevation 635 feet (MSL) along the eastern end of the stack, or about 14 to 23 feet above the earthen starter dike. The slopes of the stacked material range from about 1.5 horizontal:1.0 vertical (1.5H:1.0V) in steeply stacked areas, to about 6.0H:1.0V in areas with relatively flat slopes.

1.2 Originally Projected Phase I and Phase II Stack Geometry and Design Life

To accommodate the disposal needs of the plant, our files* indicate that the Phase I area (i.e., the combined area of both Ponds 1 and 2) was originally conceived to reach Elevation 710 feet (MSL) with 3.0H:1.0V side slopes while the Phase I area was only in operation, and a final elevation of 750 feet (MSL) when the combined Phase I and Phase II area was in operation.

Based upon production rates provided by TVA the proposed Phase I and Phase II disposal areas, as originally designed, provide approximately 18 years of storage capacity. This estimate

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* Drawings prepared by TVA during conceptual planning of the disposal area which were previously reviewed by Ardaman & Associates, Inc. as part of our involvement with the demonstration project.

was based upon an average gypsum-flyash waste generation rate of 1,517,000 tons per year (based upon a 82% capacity factor), an average *in situ* dry density of 85 lb/ft^3 and stack side slopes of 3.0H:1.0V. As discussed in Section 4, all of these parameters have been revised based upon the findings of this study, with varying impacts on stack geometry and storage life.

1.3 Project Objectives and Scope of Work

As outlined in the request for proposal, the scope of work undertaken for this study included the following tasks:

- Task A: Evaluate the stability of the as-designed Phase I gypsum-fly ash wet-stack to determine if the stack should be constructed as presently planned, or if modifications to the stack are required to improve stability, including the performance of a field and laboratory testing program to determine the conditions of the existing gypsum-flyash stack.
- Task B: Prepare an operation and management plan for filling the Phase I area.
- Task C: Prepare recommendations for design and operation of the approximately 80-acre Phase II disposal area.

A field and laboratory testing program was undertaken as part of Task A to determine the *in situ* conditions and physical properties of the wet-stacked gypsum-flyash. The objectives of the field exploration program were to document the *in situ* consistency of the wet-stacked gypsum-flyash from Standard Penetration Test borings, and to recover undisturbed samples for measurement of the *in situ* density and for laboratory index, strength and permeability testing. The objective of the laboratory testing program was to characterize the engineering properties of the waste for comparison to the engineering properties previously measured during the Widows Creek demonstration project (Garlanger & Ingra, 1983)*, and to provide measurements of permeability and shear strength on undisturbed samples for use in performing stability analyses. Representative samples of the gypsum-flyash waste recovered during the field exploration program were also provided to the Tennessee Valley Authority for determination of the percentage of flyash, gypsum, unreacted limestone and calcium sulfite.

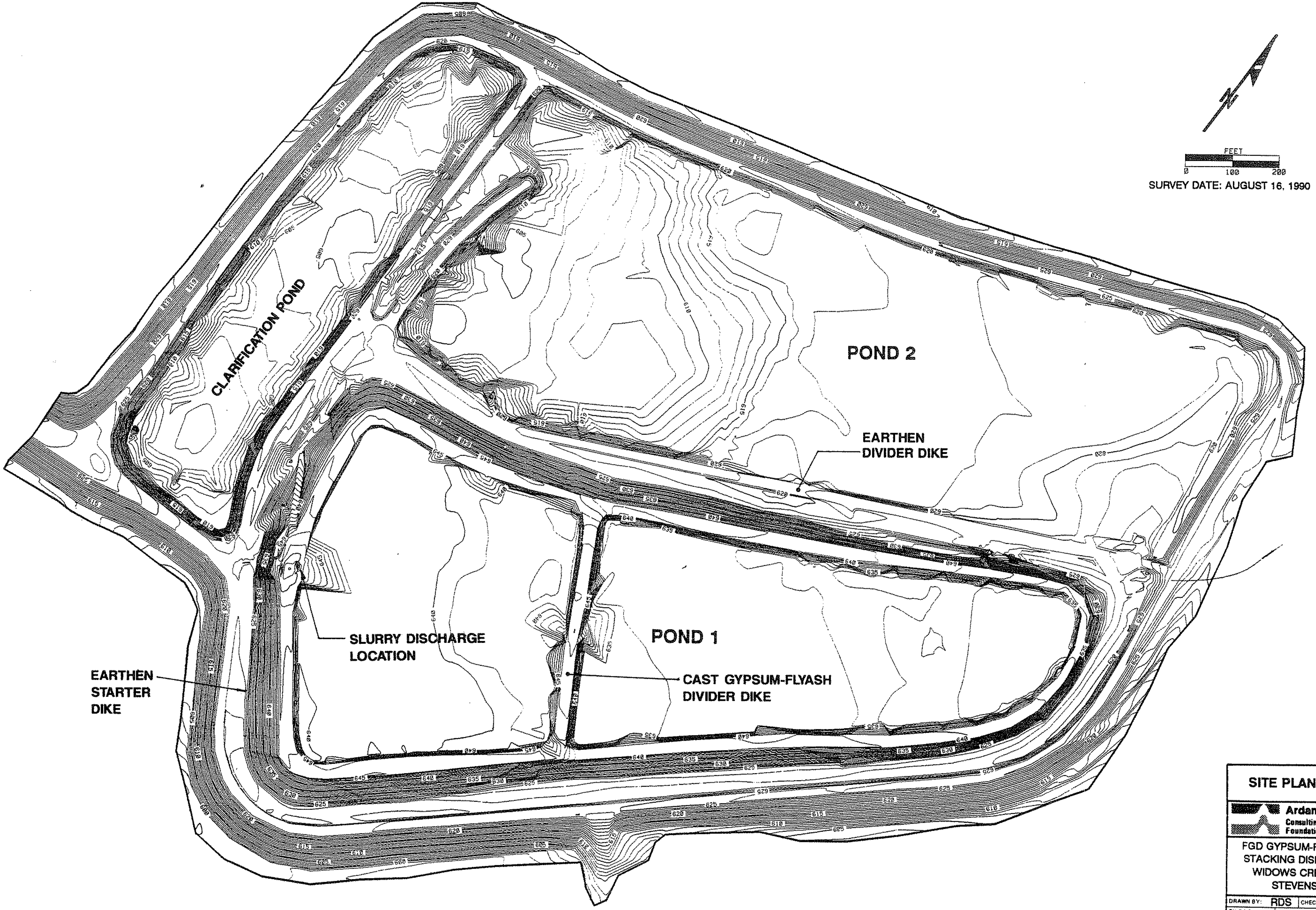
Engineering services provided as part of Tasks A and B included: (i) a review of the design drawings, site soils data and stability analyses previously performed by TVA for the disposal area; (ii) two visits to the site to undertake inspections of the facility and observe stacking operations; (iii) the performance of seepage and stability analyses to indicate if the as-designed Phase I stack slopes can be safely constructed as originally planned, or if modifications are required; and (iv) preparation of an operation and management plan for filling the Phase I area. This interim report presents the results of our Tasks A and B evaluations.

Using the results of the Task A field and laboratory testing program, recommendations for design and operation of the approximately 80-acre Phase II area will be provided as part of Task C. All

---

* Garlanger, J.E. and Ingra, T.S. (1983). "Evaluation of Engineering Properties and Wet Stacking Disposal of Widows Creek FGD Gypsum - Fly Ash Waste". Tennessee Valley Authority, Office of Power, Division of Energy Demonstrations and Technology.

hydrogeologic investigations, general civil design of the liner and earthen starter dikes, and permitting requirements for the Phase II area have already been or will be undertaken by TVA. As part of Task C, the slope at which the Phase II stack should be constructed to attain a top elevation of 750 feet (MSL) will be provided, the expected life of the proposed Phase II area based upon TVA projected plant utilization factors and corresponding waste generation rates will be addressed, and an operation plan will be provided including the use of compartments and rim-ditches to fill the Phase II area. If necessary, revisions to the layout/height of the Phase II area earthen starter dikes will be addressed to optimize the operation/filling of the area.



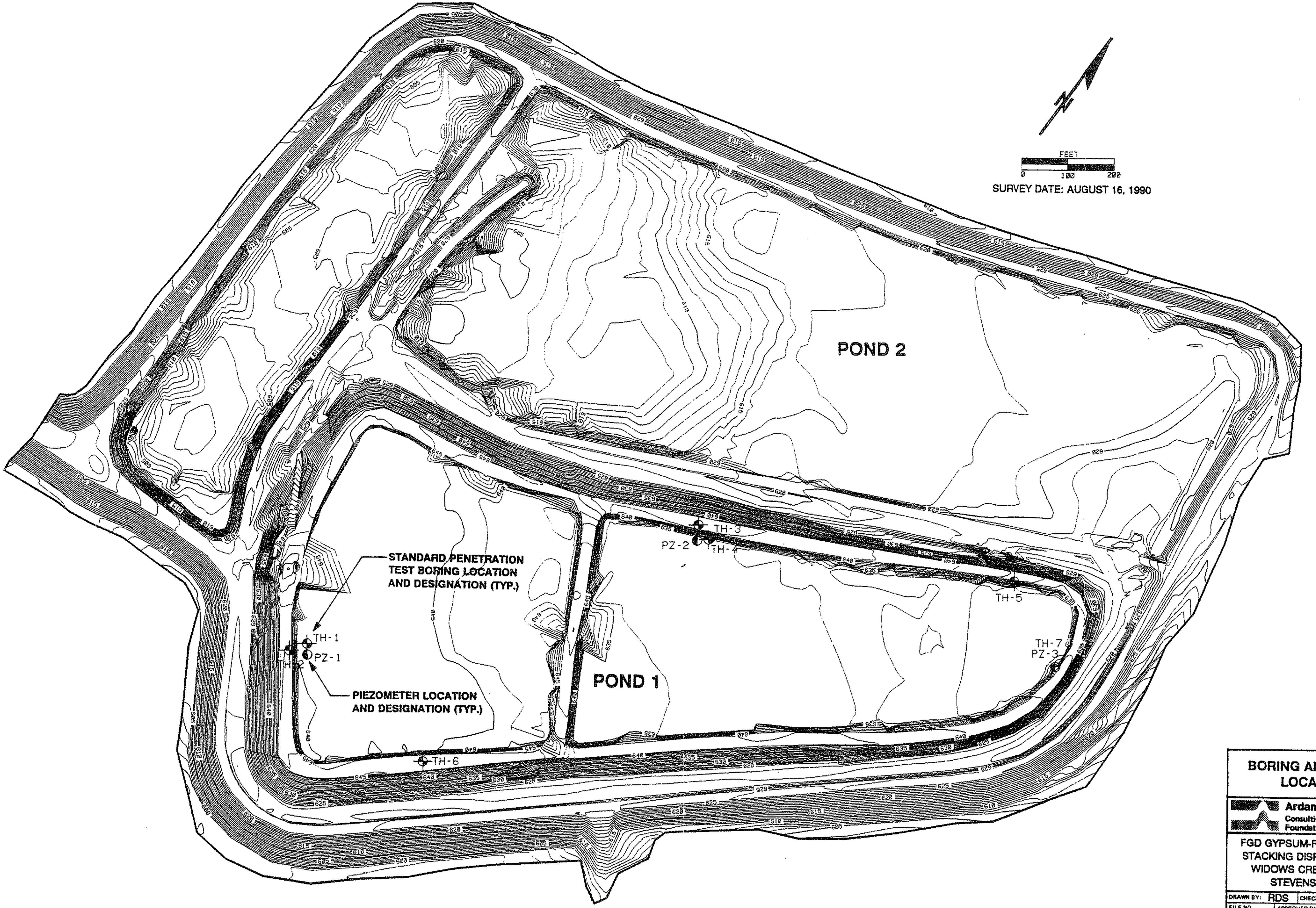
SITE PLAN - PHASE I AREA

Ardaman & Associates, Inc.
Consulting Engineers in Soils, Hydrogeology, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY:	RDS	CHECKED BY:	EJW	DATE:	4/11/91
FILE NO. 90-059	APPROVED BY: John E. Garlanger				

FIGURE 1.1



SURVEY DATE: AUGUST 16, 1990

STANDARD PENETRATION TEST BORING LOCATION AND DESIGNATION (TYP.)

PIEZOMETER LOCATION AND DESIGNATION (TYP.)

BORING AND PIEZOMETER LOCATION PLAN

Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-
STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY: RDS
CHECKED BY: EJW
DATE: 4/11/91
FILE NO. 90-059
APPROVED BY: John E. Garlanger

FIGURE 2.1

Section 2

SITE CONDITIONS AND SUBSURFACE EXPLORATION PROGRAM AT WIDOWS CREEK STEAM PLANT WET-STACKING DISPOSAL FACILITY

2.1 Site Visit and Field Observations

An initial site visit and visual inspection of the existing stack operations was made by Dr. John E. Garlanger and Mr. Thomas S. Ingra on October 26, 1990 and a subsequent site visit and inspection was made by Dr. Garlanger on March 15, 1991. The following observations were noted during those visits:

- The side slopes of the existing stack are very steep at some locations and are severely eroded by rainfall runoff and seepage related instability in the lower portion of the slope. It appears that the lower portion of the dike slope was originally cast too steeply and subsequently become unstable under the seepage gradients that occurred as the water level in the pond was raised. The seepage gradients caused the cast materials at the downstream toe of the dike to be eroded, thereby undermining the toe of the slope and causing the upper materials to progressively slough. This mechanism has resulted in an almost vertical scarp above the seepage spring line.

- The overall stability of the stack slope and foundation soils, however, appears adequate. No visual evidence of starter dike instability or instability of the foundation soils beyond the original earthen starter dike (i.e., an indication of deep seated failure of the stack through the foundation soils beneath the starter dike) was noted.

- The Phase I storage pond was divided into two long, narrow compartments, designated Pond 1 and Pond 2, divided by an earthen dike generally trending in an east-west direction. Pond 1 was further divided in about half by a north-south trending cast gypsum-flyash dike. Only the southern compartment (i.e., Pond 1) had been used for slurry deposition at the time of our initial visit on October 28, 1990. During our second site visit on March 15, 1991, the northern compartment was being used for waste disposal.

- A one-point slurry discharge procedure was being used instead of the originally recommended rim-ditch method of operation, with the point of slurry discharge on the west wall of Pond 1. Stack management can generally be improved by the use of a peripheral rim-ditch in conjunction with the upstream method of construction. Some ditching was noted on the inboard side of the starter dike in the western end of Pond 1, but the ditch did not have an "inner berm" or dike to contain and control the slurry flow. The existing ditch, therefore, generally does not meet the requirements of a rim-ditch.

- The slurry stream at some locations was meandering into the upstream slope of the perimeter starter dike and was causing erosion of the dike fill. The inside slope of the dike, however, was very steep and appeared to be near the angle of repose of the gypsum-flyash. Additionally, the fill at many locations appeared to be very loose and uncompacted, as though it was dozer placed or otherwise pushed into the edge of the pond from the top of the dike. Dozer-pushed, moist materials typically assume a "bulked" density (i.e., a density less than that achieved if the material was placed completely dry or completely saturated) and are subject to rapid changes in density and collapse of the "bulked" structure when saturated.

- It is our understanding that the starter dike fill on the east end of Pond 1 is comprised almost entirely of material hauled from the west end of the stack. Attempts to dragline excavate and cast the sedimented materials at the east end of Pond 1 for construction of the perimeter dike have, for the most part, been unsuccessful because the deposits are too soft and wet to handle.
- Clarification of the slurry decant water was also noted to be inadequate during our second site visit.

2.2 Subsurface Exploration Program

A subsurface exploration program was undertaken at the Widows Creek wet-stacking disposal facility to assess the consistency and composition of the *in situ* gypsum-flyash. The subsurface exploration program consisted of performing 7 Standard Penetration Test (SPT) borings in the Pond 1 portion of the Phase I disposal area. Piezometers were also installed in three of the boreholes to allow *in situ* measurement of the horizontal coefficient of permeability. Standard Penetration Test split-spoon samples and undisturbed Shelby tube samples of the gypsum-flyash were also obtained for laboratory testing.

The subsurface exploration program was performed during the period of October 30 through November 3, 1990 using an Ardaman & Associates, Inc. truck-mounted drill rig, with a 2-man drill crew and field geologist to supervise the field exploration, sampling and testing operations. Access to selected drilling locations on top of the stack (i.e., ramp roads into the pond area) was provided by the TVA. The objectives of the subsurface exploration program were to: (i) define the nature, extent, thickness and consistency of the existing gypsum-flyash in the Pond 1 portion of the disposal area; (ii) install piezometers to determine the depth to the equilibrium water table; (iii) determine the *in situ* horizontal coefficient of permeability of slurry deposits via slug tests in piezometers; and (iv) recover SPT split-spoon and undisturbed Shelby tube samples of the gypsum-flyash for laboratory testing.

2.2.1 Standard Penetration Test Borings

The location of each Standard Penetration Test boring and piezometer is shown in Figure 2.1 and simplified boring profiles are presented in Figures 2.2 through 2.7. The piezometer and test boring coordinates and ground surface elevations shown on Figures 2.2 through 2.7 were provided by the TVA. Each test boring fully penetrated the gypsum-flyash and was terminated in the surface of the clays and silty clays immediately underlying the pond. The test borings ranged in depth from 25.0 to 50.0 feet. Upon completion of drilling and sampling, the borings were grouted to the surface with cement-bentonite grout.

The Standard Penetration Test borings were completed in general accordance with ASTM standard D 1586. The Standard Penetration Test is a widely accepted method of *in situ* testing of soils. A 2-foot long, 2-inch O.D. split-spoon sampler attached to the end of a string of drilling rods is conventionally driven 18 inches into the ground by successive blows of a 140-pound hammer freely dropping 30 inches. The number of blows needed for each 6 inches of penetration is recorded. The sum of the blows required for penetration of the second and third 6-inch increments of penetration constitutes the penetration resistance or N-value. The split-spoon was typically driven the last 6-inch interval of the sampler to obtain additional gypsum-flyash for inspection. After the test, the sampler is extracted from the ground and opened to allow visual examination and classification of the retained sample.

The results of the 7 Standard Penetration Test borings are presented on the soil boring logs in Appendix A. The stratification lines indicated on the boring logs represent our interpretation of the contents of the field logs, and the results of laboratory observations and index tests on the recovered split-spoon samples. Laboratory index tests used to classify the gypsum-flyash are also shown on the boring logs (see Section 3). The test boring results are also presented in the simplified profiles in Figures 2.2 through 2.7.

The SPT N-value has been empirically correlated with various soil properties allowing estimates of the behavior of soils under load. The N-value has been correlated with the relative density of cohesionless soils (sands) and consistency of cohesive soils (clays) as outlined in the Terzaghi and Peck (1967) classification system presented below. These correlations are generally applicable to the natural ground soils underlying the pond and the correlations for the cohesionless soils are loosely applicable to the gypsum-flyash.

Relative Density of Sand Based on Standard Penetration Test		Consistency of Clay Based on Standard Penetration Test	
N-Value (blows/foot)	Relative Density	N-Value (blows/foot)	Consistency
0-4	Very Loose	<2	Very Soft
4-10	Loose	2-4	Soft
10-30	Medium	4-8	Medium
30-50	Dense	8-15	Stiff
>50	Very Dense	15-30	Very Stiff
		>30	Hard

A representative portion of the gypsum-flyash or underlying soil recovered in each split-spoon sample was saved in a sealed glass jar for laboratory examination and testing. A total of 86 split-spoon soil samples were recovered from the 7 test borings.

The SPT N-values in the sedimented gypsum-flyash at test borings TH-1 and TH-6 (Figures 2.2 and 2.3) near the west end of the stack (i.e., closest to influent) varied from a low of 1 blow/foot to a high of 66 blows/foot with overall average values of 24 and 31 blows/foot, respectively. The N-values generally indicate that the sedimented gypsum-flyash is relatively dense and compact, which is favorable for wet-stacking disposal, although some very loose material was encountered in the lower portion of both test holes. Cast gypsum-flyash in test boring TH-2 displaced an average N-value of 22 blows/foot, also characteristic of a dense material.

Test borings TH-3 and TH-4 (Figure 2.4) located east of the mid-point of Pond 1 had overall average blowcount values in the sedimented gypsum-flyash of 15 and 11 blows/foot, respectively. The cast gypsum-flyash at TH-3 had a higher average N-value of 27 blows/foot.

The lowest blowcount values encountered in the 7 test borings were measured in test boring TH-7 (Figure 2.6) located on the east end of the stack. The overall average N-value at this location was 5 blows/foot, with a low of 1 and a high of 13 blows/foot. Accordingly, there is a noted reduction in average blowcount values in the sedimented gypsum/flyash across Pond 1 as the distance from the point of slurry discharge increases.

Based on these Standard Penetration Test results, it appears that the sedimented gypsum-flyash at the east, remote end of Pond 1 offer less resistance to sampler penetration than the gypsum-flyash closer to the point of slurry discharge at the west end of Pond 1. The lower penetration resistance is indicative of a somewhat lower strength material, potentially from a change in material composition and/or particle size resulting from the hydraulic method of deposition. With the single-point discharge currently being used, the coarser gypsum and flyash particles will settle near the slurry discharge in the western end of Pond 1, while the finer-grained particles will settle at the eastern end of Pond 1.

2.2.2 Undisturbed Shelby Tube Sampling

In addition to the SPT split-spoon samples, undisturbed Shelby tube samples of the gypsum-flyash were also obtained for laboratory testing. A total of 21 undisturbed samples were recovered from the boring locations and depths tabulated below:

Boring	Sample	Depth (feet)	Sample Recovery* (%)
TH-1	US-1	4.0-6.0	75
TH-1	US-2	9.0-11.0	100
TH-1	US-3	14.0-16.0	100
TH-1	US-4	21.0-23.0	100
TH-2	US-1	12.0-14.0	75
TH-2	US-2	28.0-29.5	100
TH-2	US-3	33.0-34.25	100
TH-2	US-4	38.0-40.0	100
TH-2	US-5	43.0-45.0	100
TH-3	US-1	20.0-22.0	75
TH-3	US-2	24.0-26.0	100
TH-3	US-3	28.0-30.0	100
TH-4	US-1	6.0-8.0	50
TH-4	US-2	9.0-11.0	100
TH-4	US-3	14.0-16.0	100
TH-4	US-4	23.0-25.0	100
TH-6	US-1	10.0-12.0	100
TH-6	US-2	14.0-16.0	100
TH-7	US-1	10.5-12.5	100
TH-7	US-2	14.5-16.5	100
TH-7	US-3	18.5-20.5	100

*Where sample recovery is defined as the ratio of the length of gypsum-flyash recovered to the length of penetration of the Shelby tube (generally 24 inches).

The undisturbed samples were obtained in general accordance with ASTM standard D 1587 using a 2.875-inch inside diameter, 30-inch long, thin-walled, seamless steel Shelby tube. The location of each undisturbed sample is shown on the soil boring logs in Appendix A, and on the simplified profiles in Figures 2.2 through 2.7.

The undisturbed Shelby tube samples of the gypsum-flyash were used for laboratory testing to determine the *in situ* moisture content and density, and for performing triaxial and permeability tests. The results of the laboratory tests are discussed Section 3.

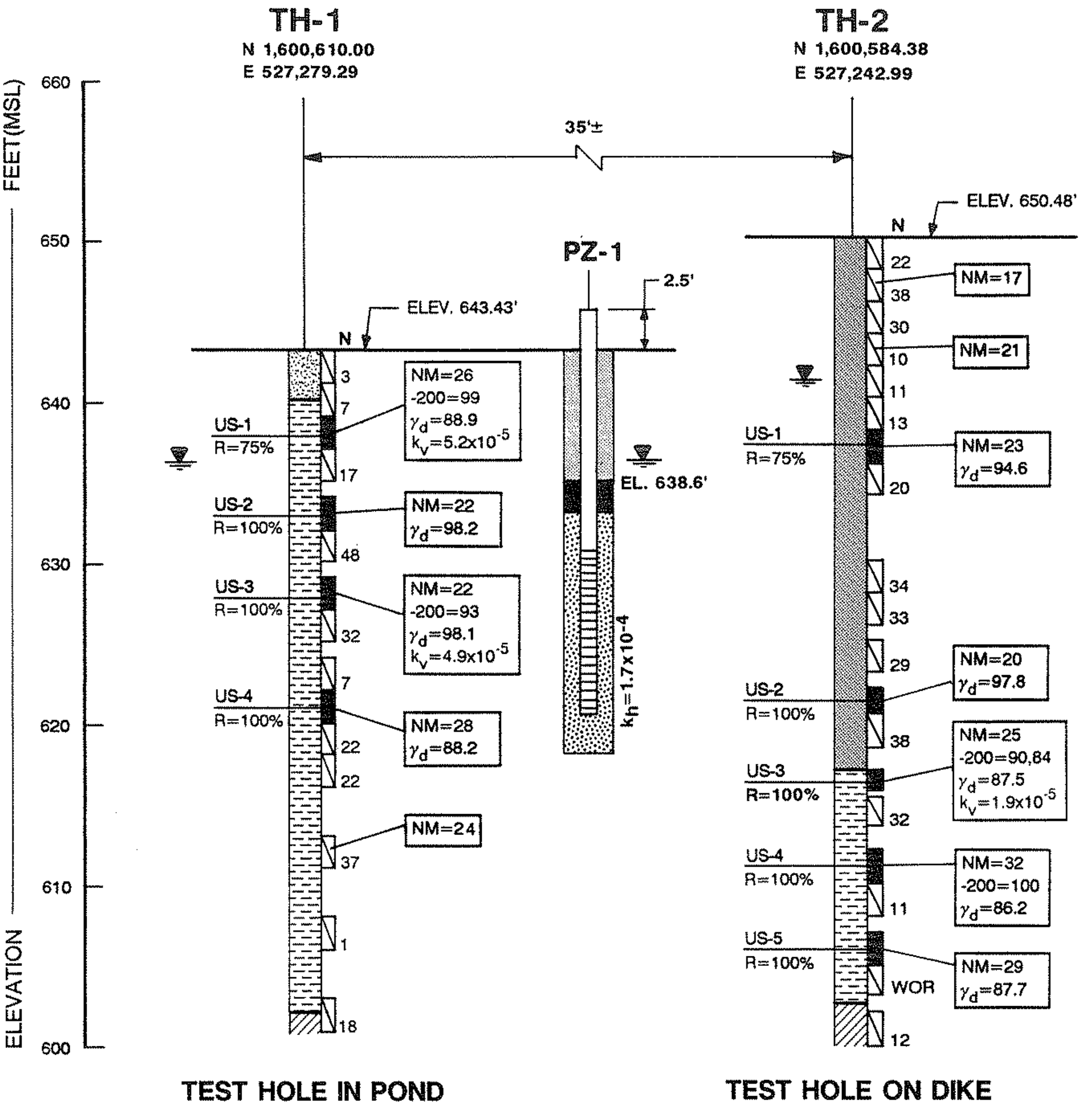
2.2.3 Piezometer Installations

Three, 1.5-inch diameter piezometers were installed in Pond 1 adjacent to borings TH-1, TH-4, and TH-7. The piezometers were installed in 6-inch diameter boreholes advanced by rotary wash techniques with the collection zone set in gypsum-flyash below the water table. The piezometers were subsequently developed by pumping or bailing until relatively clear water was obtained. Installation details for the piezometers are shown on the installation logs in Appendix B, and schematically indicated on Figures 2.2, 2.4 and 2.6.

Falling head permeability tests were performed in the piezometers to determine the *in situ* horizontal coefficient of permeability of the gypsum-flyash. The measured horizontal coefficient of permeability of the sedimented gypsum-flyash on the western, influent end of the Pond 1, as determined in piezometer PZ-1, equalled 1.7×10^{-4} cm/sec. The measured coefficients of permeability at the remaining two piezometers (i.e., PZ-2 and PZ-3), located near the middle and east end of Pond 1, were slightly lower, and equalled 5.2×10^{-5} and 8.0×10^{-5} cm/sec, respectively. These values are within the anticipated range of the coefficient of permeability for sedimented gypsum-flyash, and are reasonable for the measured *in situ* densities of the gypsum-flyash.

2.2.4 Depth to Water Table

The depth to the equilibrium water table was measured in each piezometer prior to performing the *in situ* permeability tests on November 3, 1990, and in each test boring. The measured water levels are indicated on the simplified boring profiles (Figures 2.2 through 2.7). As shown, the measured water tables in the piezometers PZ-1, PZ-2 and PZ-3 were 6.8, 4.8 and 1.7 feet below the surface, at corresponding elevations of about 638.6, 635.1 and 637.0 feet (MSL). Water elevations measured in the test borings ranged from about 634 to 637 feet (MSL). The indicated water levels represent the conditions present in the stack at the time the measurements were made, and will change as the water level atop the pond changes.



LEGEND

▨ FILL ▤ SEDIMENTED GYPSUM-FLYASH

▩ CAST GYPSUM-FLYASH ▧ CLAY

k_h = HORIZONTAL COEFFICIENT OF PERMEABILITY (cm/sec)

k_v = VERTICAL COEFFICIENT OF PERMEABILITY (cm/sec)

NM = MOISTURE CONTENT (%)

-200 = FINES CONTENT (%)

γ_d = DRY DENSITY (PCF)

SIMPLIFIED BORING PROFILES FOR TH-1 & TH-2

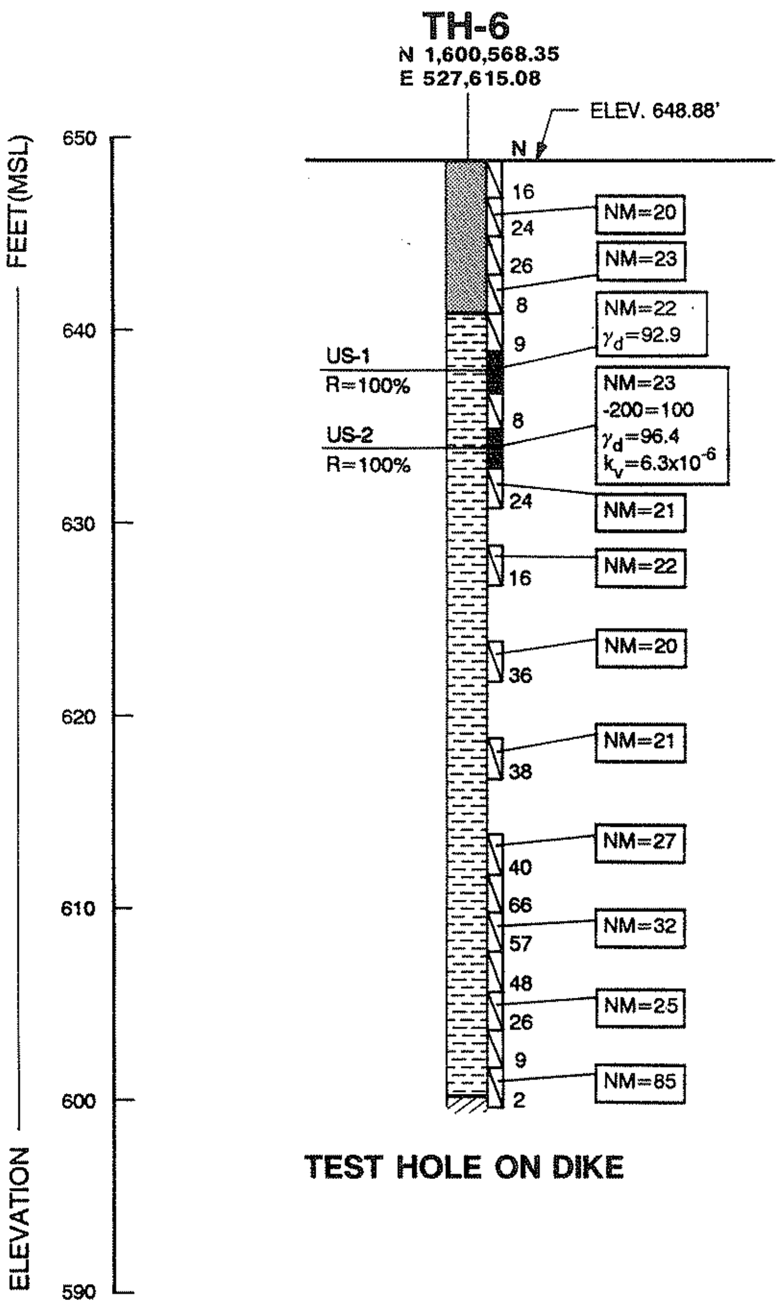
Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY: RBE	CHECKED BY: EJW	DATE: 4/18/91
FILE NO. 90-059	APPROVED BY:	

N39695

FIGURE 2.2



TEST HOLE ON DIKE

LEGEND

▒ FILL ☰ SEDIMENTED GYPSUM-FLYASH

▓ CAST GYPSUM-FLYASH ▨ CLAY

k_h = HORIZONTAL COEFFICIENT OF PERMEABILITY (cm/sec)

k_v = VERTICAL COEFFICIENT OF PERMEABILITY (cm/sec)

NM = MOISTURE CONTENT (%)

-200 = FINES CONTENT (%)

γ_d = DRY DENSITY (PCF)

SIMPLIFIED BORING PROFILE FOR TH-6

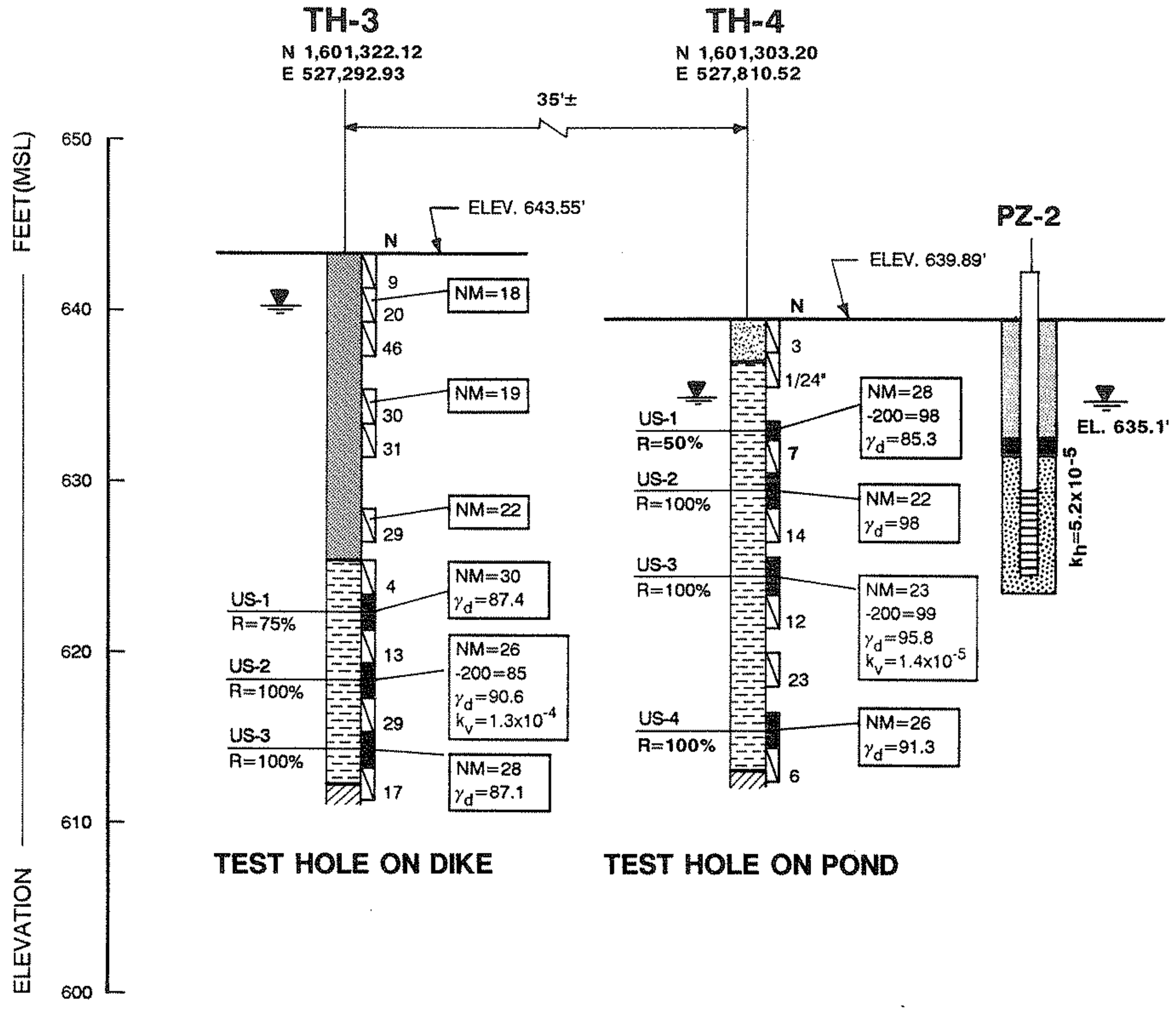
Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY: RBE	CHECKED BY: EJW	DATE: 4/18/91
FILE NO. 90-059	APPROVED BY:	

N36488

FIGURE 2.3



LEGEND

░ FILL

☰ SEDIMENTED GYPSUM-FLYASH

▒ CAST GYPSUM-FLYASH

▨ CLAY

k_h = HORIZONTAL COEFFICIENT OF PERMEABILITY (cm/sec)

k_v = VERTICAL COEFFICIENT OF PERMEABILITY (cm/sec)

NM = MOISTURE CONTENT (%)

-200 = FINES CONTENT (%)

γ_d = DRY DENSITY (PCF)

SIMPLIFIED BORING PROFILES FOR TH-3 & TH-4

Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

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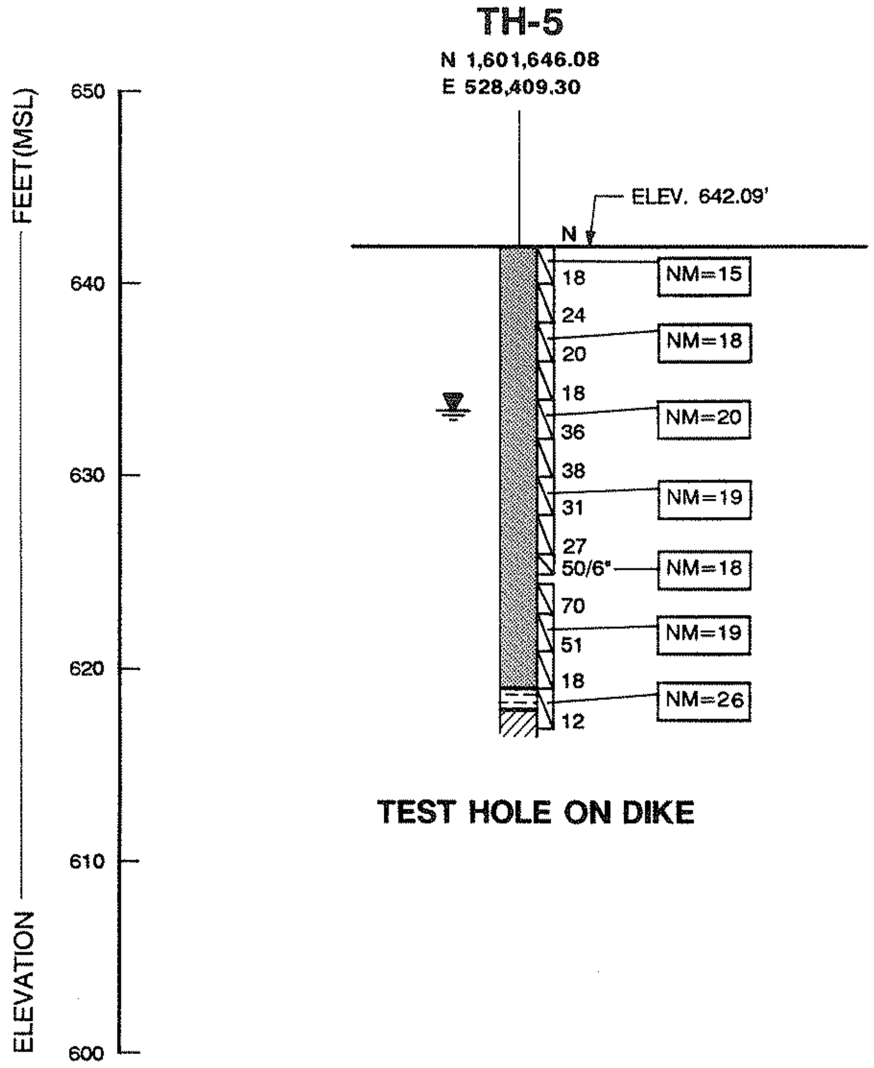
FILE NO. 90-059	APPROVED BY:	

FIGURE 2.4



TEST HOLE ON DIKE

LEGEND

▨	FILL	☰	SEDIMENTED GYPSUM-FLYASH
▩	CAST GYPSUM-FLYASH	▨	CLAY

k_h = HORIZONTAL COEFFICIENT OF PERMEABILITY (cm/sec)

k_v = VERTICAL COEFFICIENT OF PERMEABILITY (cm/sec)

NM = MOISTURE CONTENT (%)

-200 = FINES CONTENT (%)

γ_d = DRY DENSITY (PCF)

SIMPLIFIED BORING PROFILE FOR TH-5

Ardaman & Associates, Inc.
Consulting Engineers in Soils, Hydrogeology, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

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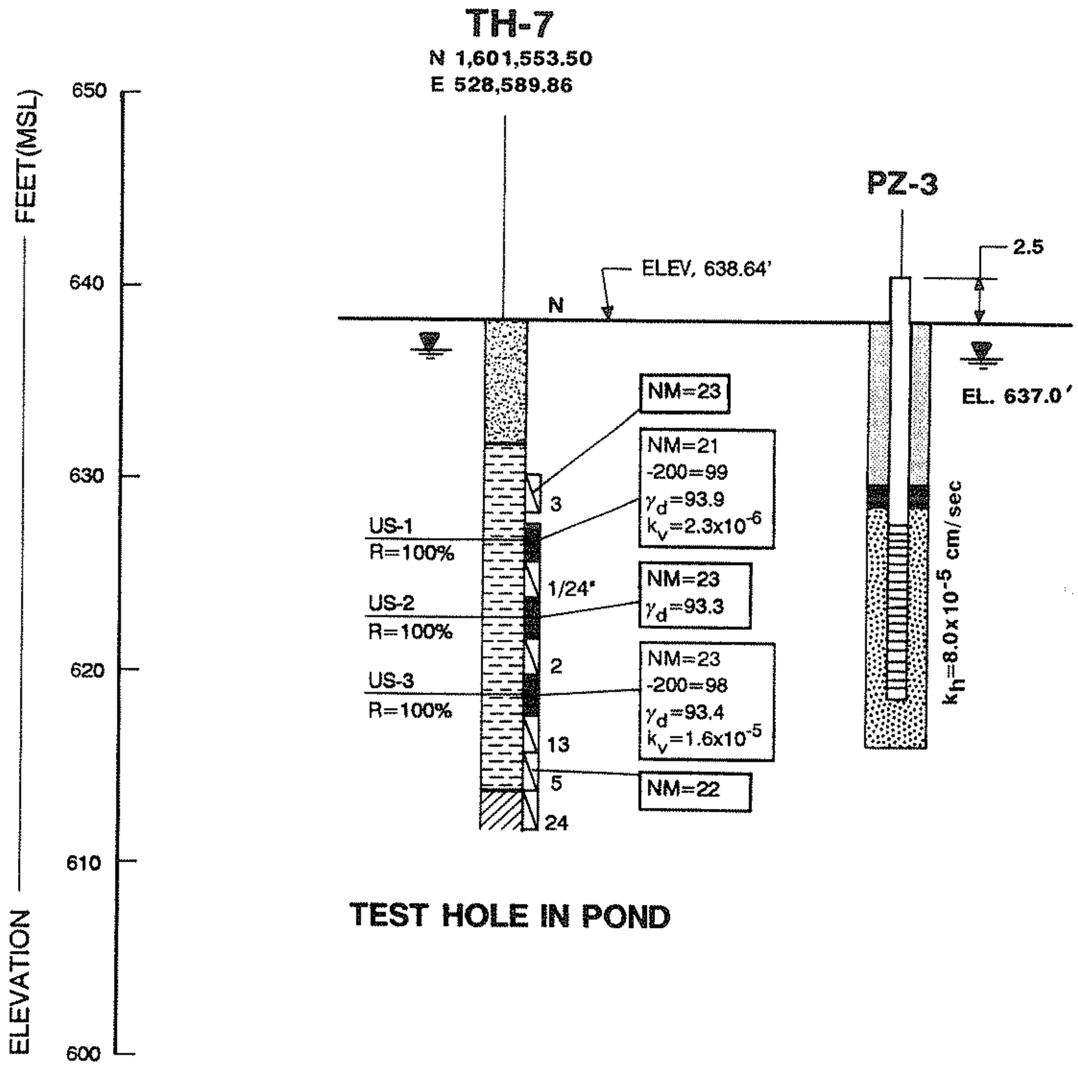
FILE NO. 90-059	APPROVED BY: John L. Ardaman	

N39695

FIGURE 2.5



LEGEND

▨ FILL ☰ SEDIMENTED GYPSUM-FLYASH

▩ CAST GYPSUM-FLYASH ▨ CLAY

k_h = HORIZONTAL COEFFICIENT OF PERMEABILITY (cm/sec)

k_v = VERTICAL COEFFICIENT OF PERMEABILITY (cm/sec)

NM = MOISTURE CONTENT (%)

-200 = FINES CONTENT (%)

γ_d = DRY DENSITY (PCF)

SIMPLIFIED BORING PROFILE FOR TH-7

Ardaman & Associates, Inc.
Consulting Engineers in Soils, Hydrogeology, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-
STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

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FIGURE 2.6

Section 3

LABORATORY TESTING PROGRAM AND CHARACTERIZATION OF WIDOWS CREEK FGD GYPSUM-FLYASH

Samples of gypsum-flyash recovered from the test borings were visually inspected and tested to characterize the *in situ* density and moisture content, index properties (i.e., particle size distribution and specific gravity), chemical composition, shear strength and permeability. Direct shear tests were also performed on remolded samples of the natural ground soils immediately underlying the gypsum-flyash to determine the shear strength of these materials for use in stability analyses.

3.1 *In situ* Moisture Content and Density

3.1.1 Natural Moisture Content

The natural moisture content of the gypsum-flyash was determined on 24 split-spoon samples and 21 undisturbed Shelby tube samples. The natural moisture content tests were performed using a procedure similar to that outlined in ASTM Standard D 2216, but with a lower drying temperature of 40°C to prevent the loss of the water of hydration in the gypsum.

The results of the moisture content tests are presented on the individual boring logs in Appendix A, summarized in Table 3-1 for the undisturbed samples, and plotted versus elevation in Figure 3.1. The average moisture contents calculated from these data for the cast and sedimented gypsum-flyash are tabulated below.

Material	Average Moisture Content (%)*
Cast Gypsum-Flyash	19.3 ± 2.3
Sedimented Gypsum-Flyash	
Split-Spoon Samples	23.0 ± 2.3
Undisturbed Samples	25.2 ± 3.1
*Average ±1 Standard Deviation	

As shown, the moisture content measured on undisturbed samples below the water table ranged from 20% to 32% with an average of 25.2 ± 3.1%. The split-spoon samples gave a slightly lower average moisture content of 23.0 ± 2.3%, probably due to the loss of some moisture during sampling and handling. Based upon the dry densities and moisture contents measured on the undisturbed samples, degrees of saturation of only 80 to 98% with an average of 90% (Table 3.1) were calculated, also indicating some loss of water during handling and extrusion of the samples. The calculated average saturated moisture content from the undisturbed samples, using the measured dry density and a specific gravity of 2.50, equalled 28.3%, about 3% greater than actually measured.

3.1.2 Dry Density and Total Unit Weight

The dry density measured on the undisturbed samples is tabulated in Table 3.1 and plotted versus elevation in Figure 3.2. In general, the density of the gypsum-flyash above an elevation of about 622 feet (MSL), which approximately corresponds to the top elevation of the earthen starter dike, is greater than the density of the underlying sedimented materials. Generally, the reverse trend is expected (i.e., increasing dry density with depth). This observed behavior may be due to the intermittent drying of the exposed surface of the pond above Elevation 622 feet (MSL) when the ponds were not maintained covered with water as observed during our site visits.

Measured dry densities below elevation 622 feet (MSL) were in the range of 86 to 93 pounds per cubic foot (pcf), with an average value of about 89 pcf. The density of the sedimented materials above elevation 622 feet (MSL) ranged from 85 to 98 pcf, with an average of 93.5 pcf. The average density measured on all of the sedimented samples is 91.5 pcf. This value is somewhat greater (by about 8%) than the predicted value of 85 pcf used in the original design calculations. The increased dry density, however, is beneficial in terms of storage volume and material strength and handling characteristics.

The corresponding overall average measured total unit weight of the gypsum-flyash for a dry density of 91.5 pcf equals 114.6 pcf, and the calculated saturated unit weight equals 117.4 pcf (Table 3.1).

3.2 Index Characteristics and Chemical Composition

3.2.1 Particle Size Distribution and Fines Content

The particle size distribution of eight gypsum-flyash samples recovered from the test borings were determined by sieve and hydrometer analyses performed in general accordance with ASTM Standards D 421 and D 422, except that gypsum saturated water was used to prevent dissolutioning of the gypsum.

The results of these tests are presented as individual grain size distribution curves in Appendix C and plotted collectively in Figure 3.3. As shown, the gypsum-flyash consists largely of silt-size particles with a small percentage of the particle sizes extending into the fine sand size fraction (5 to 10%), and clay size fraction (less than 1%). This range in grain size distribution is consistent with the particle sizes expected for gypsum-flyash.

The grain size distribution curves indicate that the gypsum-flyash recovered from borings TH-1 and TH-2 is generally coarser (i.e., larger particle sizes) than the materials recovered from test borings TH-4 and TH-7. This indicates that coarser particle sizes are sedimenting near the slurry discharge point, as expected, with a greater proportion of the finer particle sizes deposited at the remote, east end of Pond 1.

3.2.2 Specific Gravity

The specific gravity of the gypsum-flyash was determined on Shelby tube samples TH-2 US-4 and TH-7 US-3. The specific gravity of sample TH-2 US-4 equalled 2.48 and the specific gravity of sample TH-7 US-3 equalled 2.46. These values are within the range of specific gravity typically measured on gypsum-flyash.

3.2.3 Chemical Composition

The results of chemical analyses performed on six samples of gypsum-flyash are tabulated below.

Boring	Sample	Chemical Composition (% dry weight basis)			
		Acid Insoluble (Flyash)	Gypsum	Unreacted Limestone	Calcium Sulfite
TH-1	US-1	23	62	6	0.2
TH-2	US-4	44	27	17	7.0
TH-3	US-3	27	59	9	1.5
TH-4	US-3	49	37	8	0.2
TH-7	US-1	33	48	13	1.8
TH-7	US-3	33	46	12	3.6
Average		35	47	11	

As shown the gypsum-flyash was comprised of 27 to 62% gypsum with an average of 47% and 23 to 49% flyash with an average of 35%. Accordingly, on average, the gypsum content was slightly greater than the flyash content. Unreacted limestone comprised an average of 11% of the material. Calcium sulfite contents were generally less than 2%, but reached as high as 7.0% in one of the six samples. Calcium sulfite has a detrimental effect on the settling and stacking behavior of gypsum-flyash, and should preferably be less than 1 to 2% as observed in four out of six samples.

3.3 Strength Testing

3.3.1 Triaxial Shear Strength Tests

Consolidated undrained triaxial compression tests with pore pressure measurements ($\overline{\text{CIUC}}$ tests) were performed on six undisturbed samples of gypsum-flyash recovered from Pond 1. The tests were performed to obtain shear strength parameters for use in stability analyses, and to compare with the shear strength parameters previously reported by Garlanger & Ingra (1983). The results of the triaxial tests are summarized in Table 3.2. Individual stress-strain curves and effective stress paths are presented in Appendix D for each test, and the effective stress paths from all six tests are graphically summarized in Figure 3.4.

The measured effective angle of internal friction ($\overline{\phi}$), with cohesion equal to zero, varied from 39.2° to 44.3°. The two samples tested from the western, influent end of the stack (i.e., from test boring TH-2) displayed friction angles of 41.7° and 42.8°,while the two samples tested from test boring TH-7 on the remote, eastern end of the stack exhibited somewhat lower friction angles of 39.2° and 39.3°. This result indicates that the finer grained deposits at the eastern, remote end of the stack exhibit friction angles a few degrees (i.e., about 3°) lower than measured on the coarser materials at the western end of the stack.

The results of these strength tests and other more detailed testing performed on Widows Creek gypsum-flyash (Garlanger & Ingra, 1983) indicate measured effective friction angles equal to or greater than 39° with zero cohesion, with values typically in the range of 39° to 43°. Based on these results, the friction angle of 34° for sedimented gypsum-flyash recommended by TVA for use in stability analysis is somewhat conservative. Effective friction angles reported by TVA from three triaxial tests on sedimented gypsum equalled 31°, 39° and 40° with effective cohesion values of 2.4, 0 and 1.5 tons per square foot, respectively. Accordingly, the 34° effective friction angle selected by TVA was strongly biased by the one low reported strength of 31°.

3.3.2 Direct Shear Tests

Three direct shear tests were performed in accordance with ASTM standard D 3080 on a remolded light brownish-yellow slightly sandy plastic clay foundation soil using vertical consolidation stresses of 1000, 3000 and 6000 pounds per square foot (psf). The tests were performed to determine shear strength parameters for use in stability analyses of the gypsum-flyash stack. The test samples were comprised of a mixture of equal parts of split-spoon samples obtained from test borings TH-1, TH-3, TH-4 and TH-6. The plasticity index, liquid limit and fines content of the resulting composite sample were 46%, 64% and 80%, respectively. The remolded samples were statically compacted at an initial moisture content of 24.0% to a dry density of 93.0 pcf. Final consolidated moisture contents and dry densities varied from 26.3 to 30.4% and 93.4 to 95.6 pcf. As shown in Figure 3.5, the average effective friction angle of the remolded clay, with zero cohesion, equalled 20°. This value is lower than the friction angle of 25° reported by TVA based on the more extensive testing on the foundation soils. The measured friction angle, however, is within the range of measured values determined by the TVA.

3.4 Permeability Tests

Constant head permeability tests were performed on undisturbed samples of the gypsum-flyash for determining the *in situ* vertical coefficient of permeability. The permeability tests were performed in triaxial cells using confining pressures of 500 to 1500 psf and a back pressure of about 90 psi to achieve saturation. As shown in Table 3.3, the measured coefficients of permeability ranged from 2.3×10^{-6} cm/sec to 1.3×10^{-4} cm/sec. Figure 3.6 presents the results of the permeability tests with values obtained in previous studies on the Widows Creek gypsum-flyash. As shown, the values are generally in agreement with previous test data and within the anticipated range for gypsum-flyash for the void ratios of the test specimens.

Table 3.1

SUMMARY OF MOISTURE CONTENT, DENSITY AND INDEX PROPERTIES OF UNDISTURBED SAMPLES OF GYPSUM-FLYASH

Boring	Sample	Depth (feet)	Sample Center Elevation (MSL)	Fines Content -200 (%)	Natural Moisture Content Range (%)	Average Natural Moisture Content (%)	Dry Density γ_d (lb/ft^3)	Total Unit Weight γ_t (lb/ft^3)	Saturated Unit Weight γ_s (lb/ft^3)	Degree of Saturation S* (%)	Void Ratio e*	Porosity n	Saturated Moisture Content (%)	Solids Content (%)
• SEDIMENTED GYPSUM-FLYASH														
TH-1	US-1	4 - 6	638.4	99	23.3 - 27.8	25.9	88.9	111.9	115.8	85.7	0.75	0.43	30.2	76.8
TH-1	US-2	9 - 11	633.4		21.4 - 24.3	21.5	98.2	119.3	121.3	91.3	0.59	0.37	23.6	80.9
TH-1	US-3	14 - 16	628.4	93	20.0 - 24.3	22.1	98.1	119.8	121.2	93.6	0.59	0.37	23.6	80.9
TH-1	US-4	21 - 23	621.4		25.7 - 28.7	27.6	88.2	112.5	115.3	89.6	0.77	0.43	30.8	76.5
TH-2	US-3	33 - 34.25	616.9	84	22.8 - 28.4	25.0	87.5	109.3	114.9	79.6	0.78	0.44	31.3	76.1
TH-2	US-4	38 - 40	611.5	100	30.6 - 33.9	31.7	86.2	113.6	114.1	98.0	0.81	0.45	32.4	75.5
TH-2	US-5	43 - 45	606.5		27.1 - 32.6	29.2	87.7	113.3	115.0	93.8	0.78	0.44	31.1	76.3
TH-3	US-1	20 - 22	622.8		21.0 - 34.1	30.0	87.4	113.6	114.8	95.5	0.79	0.44	31.4	76.1
TH-3	US-2	24 - 26	618.6	85	22.4 - 28.5	26.1	90.6	114.2	116.7	90.4	0.72	0.42	28.9	77.6
TH-3	US-3	28 - 30	614.6		22.8 - 30.3	27.8	87.0	111.2	114.6	87.7	0.79	0.44	31.7	75.9
TH-4	US-1	6 - 8	633.4	98	26.5 - 29.6	27.7	85.3	108.9	113.6	83.5	0.83	0.45	33.2	75.1
TH-4	US-2	9 - 11	629.9		19.9 - 23.4	21.8	98.0	119.4	121.2	92.1	0.59	0.37	23.7	80.9
TH-4	US-3	14 - 16	624.9	99	20.7 - 26.3	22.9	95.8	117.7	119.9	91.2	0.63	0.39	25.2	79.9
TH-4	US-4	23 - 25	615.9		21.2 - 29.3	25.6	91.3	114.7	117.2	90.3	0.71	0.41	28.4	77.9
TH-6	US-1	10 - 12	637.9		21.7 - 23.3	22.4	92.9	113.6	118.1	82.2	0.68	0.40	27.2	78.6
TH-6	US-2	14 - 16	633.9	99	21.1 - 24.8	23.3	96.4	118.9	120.3	94.5	0.62	0.38	24.7	80.2
TH-7	US-1	10.5 - 12.5	627.1	99	18.9 - 22.4	21.4	93.9	114.1	118.8	81.1	0.66	0.40	26.4	79.1
TH-7	US-2	14.5 - 16.5	623.1		20.3 - 26.7	24.5	93.3	116.2	118.4	91.2	0.67	0.40	26.9	78.8
TH-7	US-3	18.5 - 20.5	619.1	97	20.0 - 25.1	23.2	93.4	115.1	118.5	86.6	0.67	0.40	26.8	78.9
Average						25.2	91.5	114.6	117.4	89.4	0.71	0.41	28.3	78.0
• CAST GYPSUM-FLYASH														
TH-2	US-1	12 - 14	637.5		20.9 - 24.3	22.5	94.6	115.9	119.2	86.9	0.65	0.39	26.0	79.4
TH-2	US-2	28 - 29.5	621.5		19.1 - 20.6	20.1	97.8	117.4	121.1	84.3	0.60	0.37	23.8	80.8

*Based on a specific gravity of 2.50 for gypsum-flyash.

Table 3.2

SUMMARY OF CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS ON UNDISTURBED GYPSUM-FLYASH SAMPLES

Boring	Sample	Depth (feet)	Sample Center Elevation (MSL)	Effective Confining Pressure $\bar{\sigma}_c$ (lb/ft^3)	Initial Conditions				Pre-shear Conditions				Effective Friction Angle $\bar{\phi}$ (degrees)	Effective Cohesion $\bar{c}$ (lb/ft^2)	Strain at Failure ϵ_f (%)
					Dry Density γ_d (lb/ft^3)	Moisture Content (%)	Void Ratio e*	Saturation S* (%)	Dry Density γ_d (lb/ft^3)	Moisture Content (%)	Void Ratio e*	Saturation S* (%)			
TH-2	US-2	28 - 29.5	621.5	4000	95.4	23.0	0.635	90.5	99.9	22.5	0.562	100.2	42.8	0	6.08
TH-2	US-4	38 - 40	611.5	1500	83.5	34.6	0.868	99.6	87.4	31.4	0.785	100.0	41.7	0	6.20
TH-4	US-2	9 - 11	629.9	1000	93.4	24.8	0.670	92.5	102.8	20.7	0.518	100.0	39.6	0	9.62
TH-4	US-4	23 - 25	615.9	5000	97.4	21.1	0.602	87.7	105.0	19.4	0.486	99.9	44.3	0	8.27
TH-7	US-1	10.5 - 12.5	627.1	3000	96.5	23.1	0.617	93.7	102.5	20.9	0.522	100.1	39.2	0	8.81
TH-7	US-3	18.5 - 20.5	619.1	1000	95.7	24.2	0.630	96.0	101.1	21.7	0.543	99.9	39.3	0	5.23
Average					93.7	25.1	0.670	93.3	99.8	22.8	0.569	100.0	41.2	0	7.37

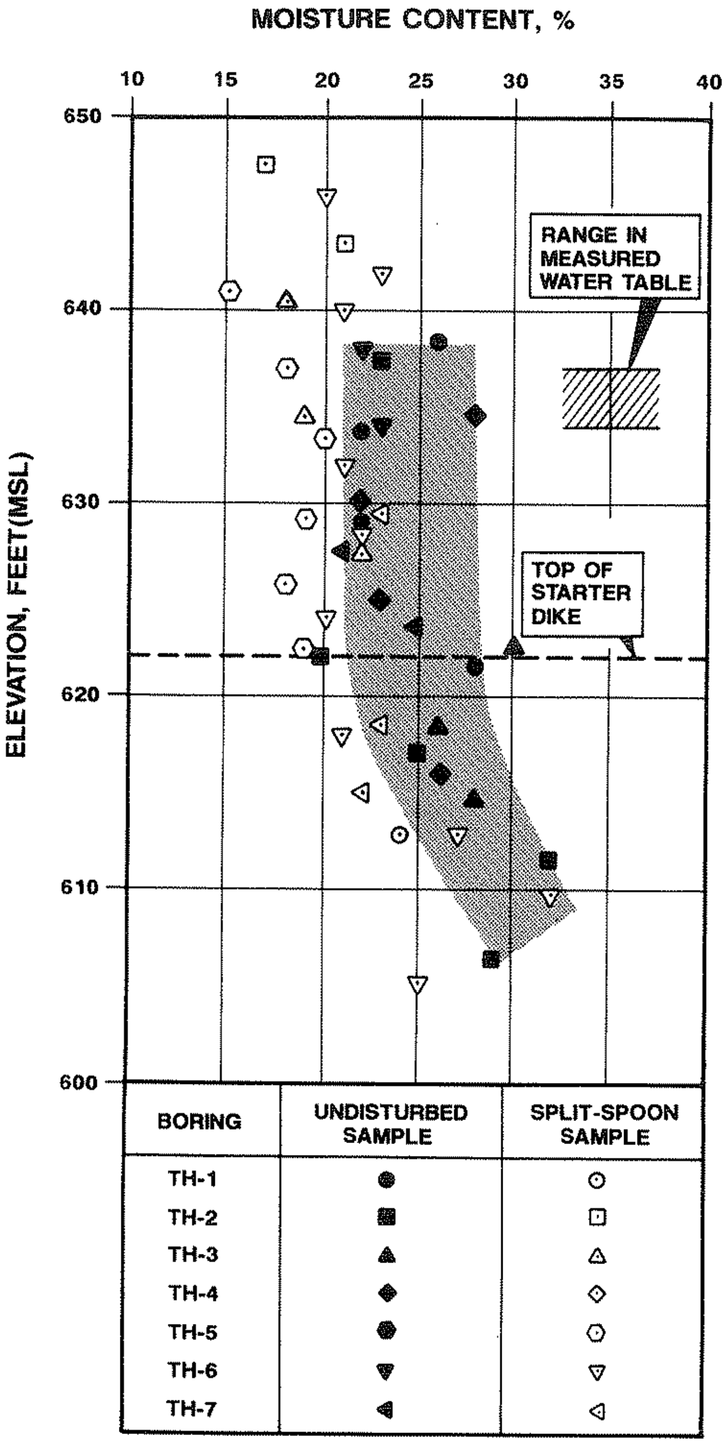
*Based on a specific gravity of 2.50 for gypsum-flyash.

Table 3.3

SUMMARY OF LABORATORY PERMEABILITY TEST RESULTS ON UNDISTURBED GYPSUM-FLYASH SAMPLES

Boring	Sample	Depth (feet)	Sample Center Elevation (MSL)	-200 (%)	Effective Confining Pressure $\bar{\sigma}_c$ (psf)	Initial Conditions				Final Conditions				Coefficient of Permeability k_v (cm/sec)
						Dry Density γ_d (lb/ft^3)	Moisture Content (%)	Void Ratio e*	Saturation S* (%)	Dry Density γ_d (lb/ft^3)	Moisture Content (%)	Void Ratio e*	Saturation S* (%)	
TH-1	US-1	4 - 6	638.4	99	500	90.8	25.4	0.72	88.4	95.8	25	0.63	99.5	$5.2x10^{-5}$
TH-1	US-3	14 - 16	628.4	93	500	95.4	23.1	0.64	90.9	98.6	22.8	0.58	97.9	$4.9x10^{-5}$
TH-2	US-3	33 - 34.25	616.9	84	1500	96.6	22.7	0.62	92.3	97.6	24	0.60	100.3	$1.9x10^{-5}$
TH-3	US-2	24 - 26	618.6	85	1000	94.9	26.1	0.64	101.3	94.9	24.5	0.64	95.1	$1.3x10^{-4}$
TH-4	US-1	6 - 8	633.4	98	500	93.8	23.9	0.66	90.1	104.1	20.3	0.50	101.9	$8.6x10^{-6}$
TH-4	US-3	14 - 16	624.9	99	1000	95.3	22.3	0.64	87.5	99.1	21.2	0.57	92.3	$1.4x10^{-5}$
TH-6	US-2	14 - 16	633.9	99	1000	96.3	23.5	0.62	94.8	99.2	21.7	0.57	94.7	$6.3x10^{-6}$
TH-7	US-1	10.5 - 12.5	627.1	99	500	98.0	19.5	0.59	82.4	105.2	20.5	0.48	106.1	$2.3x10^{-6}$
TH-7	US-3	18.5 - 20.5	619.1	97	1000	95.4	22.0	0.64	86.6	107.4	21	0.45	116.0	$1.6x10^{-5}$
Average				95		95.2	23.2	0.64	90.5	100.2	22.3	0.56	100.4	$3.3x10^{-5}$

* Based on a specific gravity of 2.50 for gypsum-flyash.



MOISTURE CONTENT
VS. ELEVATION

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FGD GYPSUM-FLYASH WASTE WET-
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WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

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FIGURE 3.1

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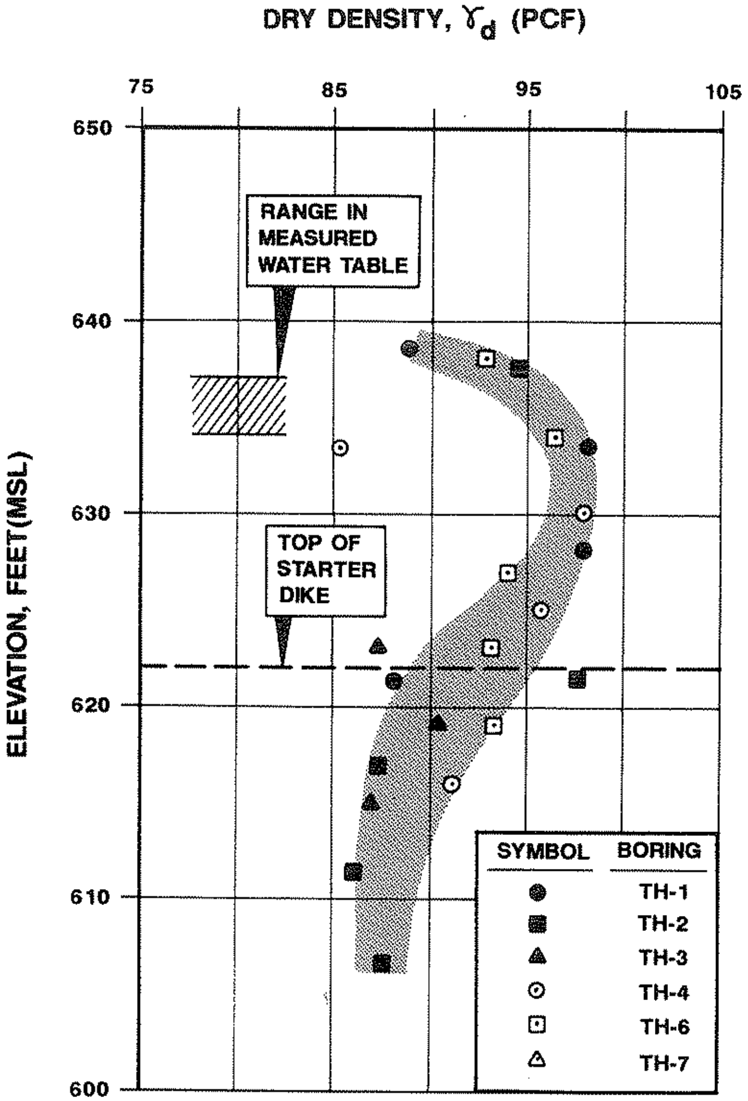

DRY DENSITY VS. ELEVATION

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WIDOWS CREEK STEAM PLANT
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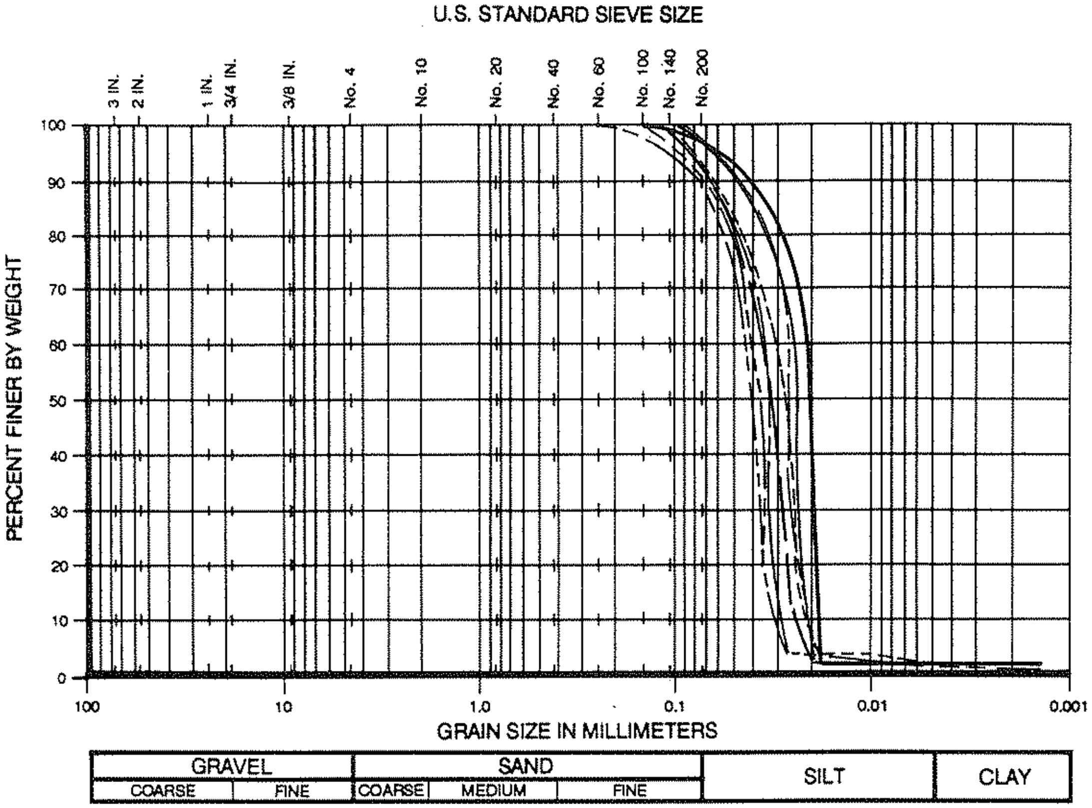
FIGURE 3.2



TEST HOLE No	SAMPLE No.	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS.
1	US-1	4.0'- 6.0'	— — —	GRAY GYPSUM -FLYASH	
1	US-3	14.0'-16.0'	---- ——	GRAY GYPSUM -FLYASH	
2	US-3	33.0'-34.25'	—— — —	DARK GRAY GYPSUM -FLYASH	
4	US-1	6.0'- 8.0'	------	DARK GRAY TO GRAYISH BROWN GYPSUM -FLYASH	
4	US-3	14.0'-16.0'	—— ——	DARK GRAY GYPSUM -FLYASH	
6	US-2	14.0'-16.0'	— —— -	DARK GRAY GYPSUM,-FLYASH	
7	US-1	10.5'-12.5'	━━━	DARK GRAY GYPSUM -FLYASH	
7	US-3	18.5'-20.5'	———	DARK GRAY GYPSUM -FLYASH	

GRAIN SIZE DISTRIBUTION

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STEVENSON, ALABAMA

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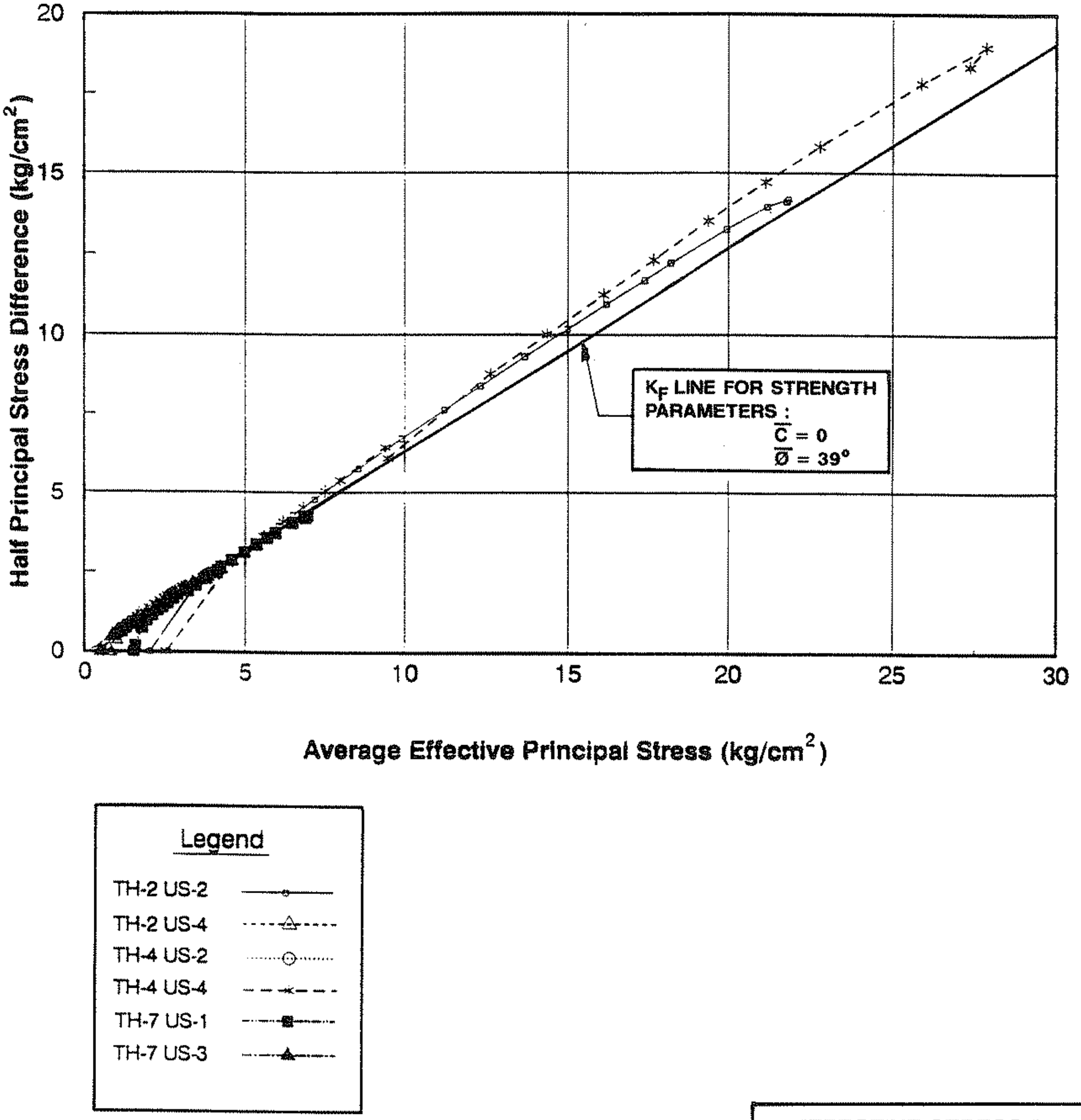
FIGURE 3.3



EFFECTIVE STRESS PATHS
FROM $\overline{\text{CIUC}}$ TESTS ON
SEDIMENTED
GYPSUM-FLYASH

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Consulting Engineers in Soil Mechanics, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
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STEVENSON, ALABAMA

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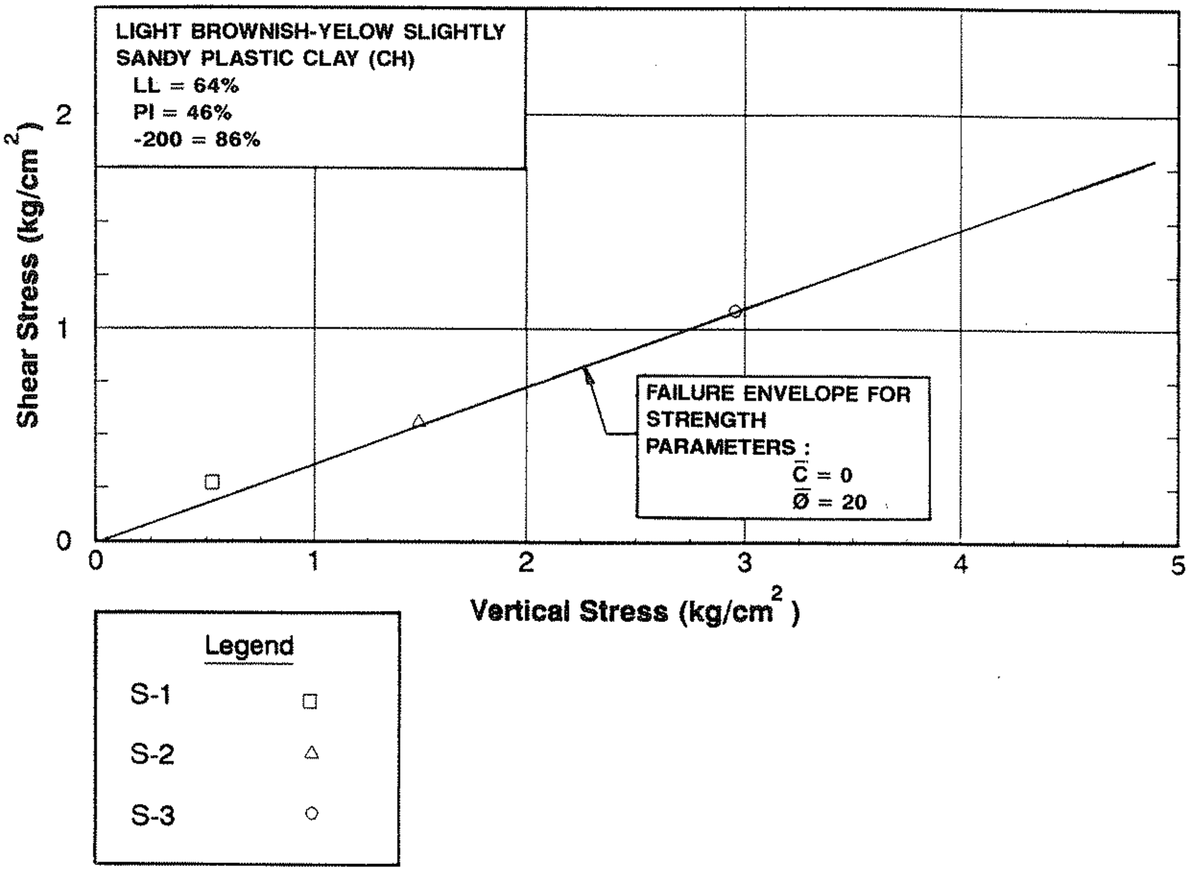
N39695

FIGURE 3.4



DIRECT SHEAR TESTS ON REMOLDED FOUNDATION SOILS

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Consulting Engineers in Soil Mechanics, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

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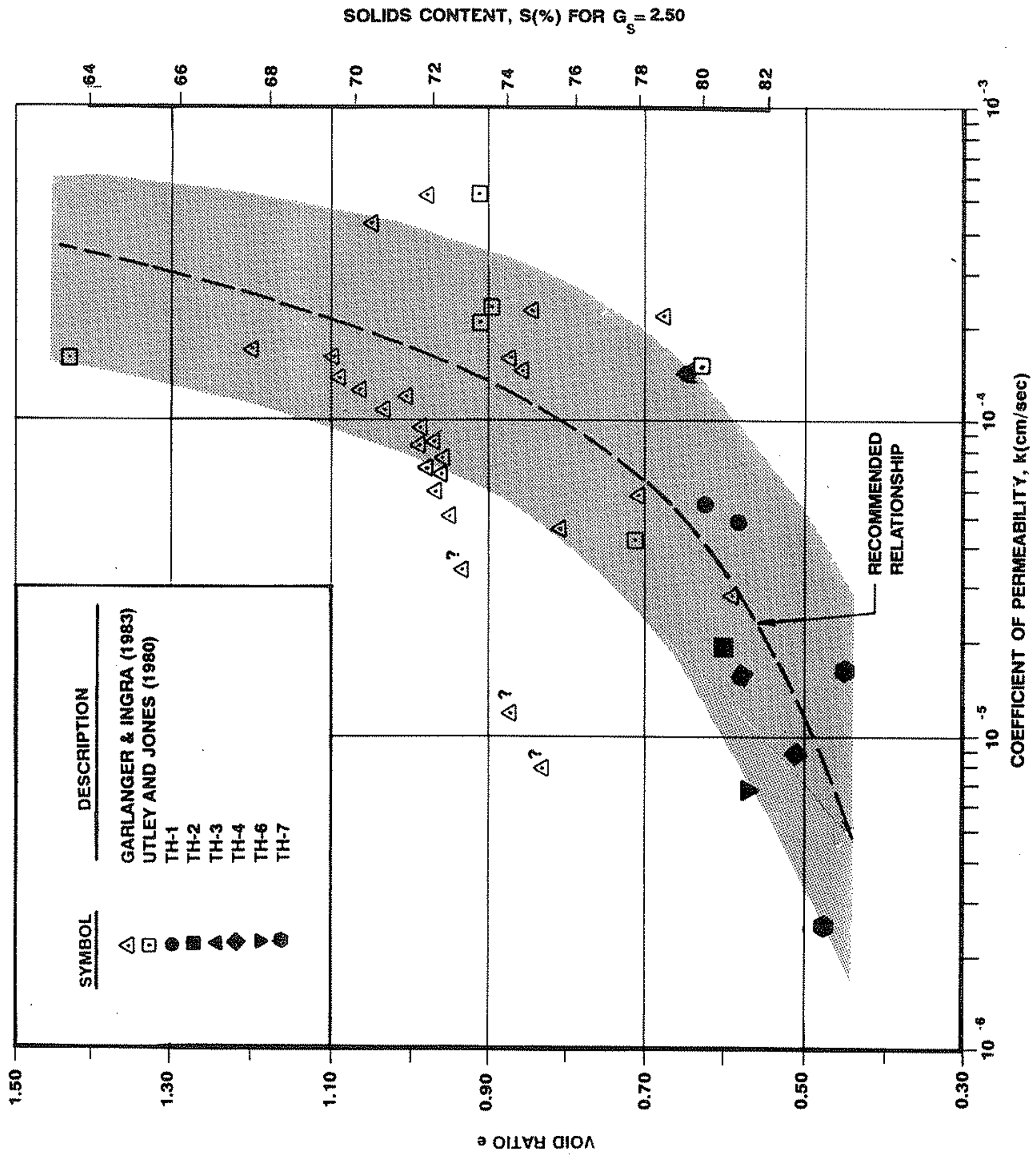
FIGURE 3.5



COEFFICIENT OF PERMEABILITY VS. VOID RATIO RELATIONSHIP FOR GYPSUM-FLYASH

Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Materials Testing

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FIGURE 3.6

Section 4

STACK SLOPE STABILITY ANALYSES, REMEDIAL ACTION PLANS, AND PHASE I STACK OPERATION/MANAGEMENT RECOMMENDATIONS

4.1 Evaluation of Stack Slope Stability

During our site visit of October 26, 1990 it was noted that the side slopes of the existing stack were relatively steep at some locations and were severely eroded by rainfall runoff and seepage related instability in the lower portion of the slope. It appears that the lower portion of the dike slope was originally cast too steeply and subsequently become unstable under seepage gradients that occurred as the water level in the pond was raised. The seepage gradients have caused the cast materials at the downstream toe of the dike to be eroded, thereby undermining the toe of the slope and causing the upper materials to progressively slough. This mechanism has resulted in an almost vertical scarp above the seepage spring line. This localized instability will require corrective action such as flattening the slope to a more stable configuration or installing drains to intercept and control seepage.

The overall stability of the gypsum stack slopes and foundation soils at the current stack height, however, appear adequate. No evidence of starter dike instability or instability of the foundation soils beyond the original earthen starter dike (i.e., an indication of deep seated failure of the gypsum stack through the foundation soils beneath the starter dike) were noted.

Stability analyses were performed on the gypsum-flyash stack to confirm that the stack will be stable when constructed to the proposed final geometry and stack height. The evaluation included analyses of the bearing capacity of the foundation soils, localized stability of the stack slope, and sliding stability at the interface between the natural ground soils and the gypsum-flyash.

The stability analyses were performed using either hand computations or computer solutions with search routines for circular and non-circular failure surfaces. Computer solutions were obtained by using Utexas2 (University of Texas Analysis of Slopes, Version 2) and the Spencer method of analysis. All analyses were performed using effective stress strength parameters and phreatic surfaces derived from graphical flow net analyses.

4.1.1 Strength Parameters for Gypsum-Flyash and Foundation Clays

As discussed in Section 3.3.1, six samples of the Widows Creek gypsum-flyash, representing the range of anticipated chemical composition and particle size, were selected for strength testing. The effective angle of internal friction ($\overline{\phi}$) determined from these tests varied from 39.2° to 44.3°, with values typically in the range of 40° to 43°. Based on these test results, the 34° effective friction angle for sedimented gypsum recommended by TVA (i.e., CEB 840620001) is somewhat conservative. For the current analyses, an effective friction angle of 39° with zero cohesion was used for the gypsum-flyash.

Based on a review of the data provided in TVA document CEB 840118003 we are in agreement with the strength parameters selected by TVA for the clay foundation soils. For our analyses, an effective friction angle of 25° with zero cohesion was selected for the remolded clays in the upper portion of the foundation soils (i.e., surface of the clay immediately beneath the gypsum-flyash), and an effective friction angle of 27° with zero cohesion was selected for deeper underlying *in situ* clays. For performing the stability analyses, it was assumed that a remolded clay liner is present above *in situ* clay deposits.

A series of direct shear tests performed on a remolded sample of the foundation clay indicated an effective friction angle of 20° with zero cohesion (Section 3.3.2). This value is within the range of values previously measured during the more extensive testing program performed by TVA, but is lower than the selected values used in the stability analyses. Due to the larger number of tests performed by TVA, it appears that the single soil tested in our laboratory may not be representative of the overall site conditions and utilization of this single lower value for design may be overconservative. The stability analyses, therefore, were performed using the selected effective friction angle of 25° with a target factor of safety of 1.5. The stability of the resulting slope geometry was then checked using the lower effective friction angle of 20° to confirm that the stack would still be stable for the lower friction angle.

The engineering properties used in our stability analyses are summarized below:

Engineering Property	Gypsum-Flyash	Remolded Foundation Soils	In Situ Foundation Soils
γ_t (lb/ft^3)	105	125	125
γ_{SAT} (lb/ft^3)	115	125	125
$\bar{\phi}$	39°	20° and 25°	27°
$\bar{c}$ (lb/ft^2)	0	0	0

Where: γ_t = total unit weight above the phreatic surface;
γ_{SAT} = saturated unit weight; $\bar{\phi}$ = effective friction angle;
and $\bar{c}$ = effective cohesion.

4.1.2 Stability Analysis of Existing Stack Slopes

Using the strength parameters listed above, the overall stability of the gypsum stack at the proposed final elevation of 750 feet (MSL) was analyzed by varying the average side slope until a minimum factor of safety of 1.5 was achieved. The results of these analyses indicate that the average slope of the gypsum-flyash stack should be no steeper than 5.0H:1.0V for a factor of safety of 1.5. This slope is consistent with the slope previously recommended by TVA on Drawing 10W215-34.

It is evident from these results that the controlling factor in the overall stability of the stack is the relatively low strength of the clay foundation soils. The strength of the gypsum-flyash is more than adequate for wet-stacking, and is not the limiting factor in the overall stability of the stack slopes.

Localized stability of the stack slope below the seepage spring line, however, is controlled by the strength properties of the gypsum-flyash. Based on an infinite slope analysis with seepage, the stack slope below the spring line should be no steeper than about 4.0H:1.0V for a factor of safety of 1.5.*

Based on the August 15, 1990 topographic map of the stack shown in Figure 4.1 and typical cross sections presented in Figure 4.2, the overall average slope of the existing cast perimeter dike determined at six locations ranges from 1.5H:1.0V to 2.7H:1.0V disregarding the steep erosion scarps. These slopes are much steeper than the TVA recommended slope of 5.0H:1.0V and are also steeper than the maximum 2.75H:1.0V slope required for localized stability below the spring line. Corrective action, therefore, will be required to stabilize the existing slopes the gypsum-flyash stack.

There are two approaches that can be used to stabilize the existing stack slopes. One approach is to provide underdrains to collect and control seepage on the face of the stack, thereby providing localized stability of the slopes and allowing the stack to be raised more steeply than the proposed 5.0H:1.0V slope. The second approach is to flatten the side slopes of the stack to such an extent that they will be stable under seepage conditions. Both approaches, however, additionally require management of rainfall runoff to minimize the effects of surface erosion. These concepts are discussed in greater detail below.

4.1.3 Stability Analysis of 3.0H:1.0V Stack Slope Geometry with Underdrains

During the two site visits it was noted that in some locations the slope was severely eroded by a combination of rainfall runoff and seepage. Erosion due to rainfall can be reduced by establishing vegetation on the slope and providing interceptor benches to reduce the length and catchment area of the slope. Seepage can be effectively controlled by utilizing a system of underdrains around the perimeter of the stack. Figures 4.3 through 4.6 depict a conceptual underdrain layout and stack geometry at several location around the stack that will reduce erosion of the slope due to rainfall and seepage, while increasing the overall stability and operational life of the stack (i.e., the underdrains will allow the side slopes of the stack to be raised more steeply with a resulting increase in stack storage volume).

In this remediation scenario the existing stack is reshaped and an underdrain system installed. The underdrain system consists of one underdrain near the toe of the slope and two inboard drains that are installed on top of the existing stack. Underdrains will be required only on the perimeter walls of the stack. The internal divider dike between Ponds 1 and 2 in Phase I, and the north dike separating Phase I and Phase II will not require underdrains.

For the conceptual design presented in Figures 4.3 through 4.6, the stack is provided with 20-foot wide benches at elevation intervals of 35 feet for surface erosion control. The side slopes of the stack between bench elevations will be no steeper than 2.5H:1.0V to provide an average slope of about 3.0H:1.0V. Ditches, or swales, will be provided on the inboard side of each bench to collect and convey rainfall runoff from each slope to outlet structures for piped discharge to the seepage collection ditch at the base of the stack.

Figure 4.7 presents the results of stability analyses for the benched slope configuration projected to a final top elevation of 750 feet (MSL). These analyses were performed using the phreatic

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* For a factor of safety of 1.0, the slope can be as steep as 2.75H:1.0V.

surface predicted from graphical flow net construction of anticipated drainage patterns in the stack at the proposed final height. As shown, the underdrains will depress the phreatic surface within the gypsum stack and minimize seepage on the face of the stack.

The stability analyses indicate that for a deep-seated circular arc failure through the foundation soils, the benched slope and underdrains provide a factor of safety of 1.6, while a sliding block failure at the interface between the gypsum-flyash and the remolded natural ground provides a factor of safety of 1.5 when the design friction angle of 25° is used. Using a more conservative friction angle of 20° (Section 4.1.1), the computed minimum factor of safety equals 1.3.

4.1.4 Stability Analysis of 5.0H:1.0V Stack

Figure 4.8 presents a conceptual remedial action design that incorporates a flatter side slope for seepage related stability and periodic benches to control surface runoff erosion. The average slope of the stack, as presented, is approximately 5.0H:1.0V with a top elevation of 720 feet (MSL). The top elevation of the stack will be limited if the flatter side slopes are used, due to the minimum requirements for ponded surface area on top of the stack. In general, the top of the combined Phase I and Phase II stacks should be not less than about 40 acres if two clarification ponds are to be utilized on top of the stack. For the proposed base area and a top area of 40 acres, the elevation of the stack will be limited to about 720 feet (MSL) if underdrains are not incorporated in the design of the stack.

With the indicated 4.0H:1.0V side slope, the slope will have a factor of safety of 1.5 against localized, seepage related instability. The overall deep-seated and sliding stability of the stack was computed for an average slope of 5.0H:1.0V. The minimum factors of safety and failure plane locations are shown on Figure 4.9. As shown, the minimum factor of safety for a deep-seated circular failure through the foundations soils is 1.7, while the minimum factor of safety computed for a sliding failure in the natural ground clays at the base of the stack is 1.6. Using a more conservative friction angle of 20° (Section 4.1.1), the computed minimum factor of safety equals 1.35.

4.2 Current TVA Stack Operation and Management Procedures

During our site visits in October of 1990 and March of 1991, the following observations were noted relative to current operation and management of the stack:

- The Phase I storage pond was divided into two long, narrow compartments divided by an earthen dike trending generally in an east-west direction. Only the southern compartment (i.e., Pond 1) was being used for slurry deposition at the time of our initial visit in October 1990. Pond 1 was further divided in about half by a north-south trending cast gypsum-flyash dike. During our second site visit in March 1991, the northern compartment was being used for waste disposal.

- During the second site visit it was noted that return water decanted from Pond 2 did not have the desired clarity (i.e., too much carryover of fine gypsum and flyash particles). It is our understanding that the desired return water clarity can be achieved, however, if the depth of the pond is increased by about one foot. The depth and volume of water in the clarification pond that is needed to provide the required retention time, however, has never been measured and is currently unknown.

- A one-point slurry discharge was being used instead of the proposed rim-ditch method of operation. Stack management can generally be improved by the use of a peripheral rim-ditch used in conjunction with the upstream method of construction. An elevated rim-ditch would improve the distribution and deposition of the gypsum-flyash in the stack, providing coarser materials around the perimeter of the stack. The coarser materials are generally more suitable for starter dike construction from strength, seepage and materials handling standpoints. Some ditching was noted adjacent to the starter dike, but the inboard side of the ditch did not have an "inner berm" or dike to contain and control the slurry flow.

- The slurry stream at some locations was meandering into the upstream slope of the perimeter starter dike and was causing erosion of the dike fill. The inside slope of the dike, however, was very steep and appeared to be near the angle of repose for the gypsum-flyash. Additionally, the fill at many locations appeared to be very loose and uncompacted, as though it was dozer placed or otherwise pushed into the edge of the pond from the top of the dike. Dozer-pushed, moist materials typically assume a "bulked" density (i.e., a density less than that achieved if the material was placed completely dry or completely saturated) and are subject to rapid changes in void ratio and collapse of the "bulked" structure when saturated.

- It is our understanding that the starter dike fill on the east end of Pond 1 is comprised almost entirely of material hauled from the west end of the stack. Attempts to dragline excavate and cast the sedimented materials at the east end of Pond 1 for construction of the perimeter dike have, for the most part, been unsuccessful because the deposits are too soft and wet to handle.

4.3 Recommended Stack Management Procedures

Based on the above observations and the results of our field exploration and testing programs, we recommend the following items be taken into consideration and incorporated into the stack management procedures.

4.3.1 Storage Volume and Life

Using an average 5.0H:1.0V side slope on the gypsum-flyash stack will reduce the final height of the stack compared to that preliminarily estimated in our conceptual management plan prepared in 1983 when the anticipated side slope of the stack was 3.0 horizontal to 1.0 vertical. To maintain a combined minimum top area of 40 acres on top of the stack at the end of the Phase II operations, we estimate that the elevation of the stack will not be able to exceed about Elevation 720 feet (MSL), instead of 750 feet (MSL) as used in the preliminary storage volume calculations. From the provided topographic map, we estimate that the total storage volume of the stack at the original design elevation and geometry will be approximately 13,300 acre-feet. The available storage volume at the lower elevation and flatter slope, however, will be reduced to approximately 9,500 acre-feet, indicating a reduction in storage volume of approximately 3,800 acre-feet.

At the revised (i.e., reduced) gypsum-flyash production rate of 2,886 tons per day provided by TVA and assuming an average material dry density of 92 pounds per cubic foot established from the recent testing, the total storage volume of 9,500 acre-feet should be sufficient for a total storage life of 18 years, which is consistent with the original design objectives. The required flatter side slopes of the stack, therefore, does not limit the useful life of the storage facility in light of the reduced gypsum-flyash production rate.

Utilization of underdrains, however, will permit the side slopes of the stack to be raised at an average slope of 3.0H:1.0V, making available the total storage volume of 13,300 acre-feet. The additional 3,800 acre-feet of storage at the above production rates results in an increased facility life of approximately 7.2 years, for a total facility life of approximately 25 years.

4.3.2 Upstream Method of Construction

The upstream method of construction using wet cast gypsum-flyash excavated from the pond with a dragline is apparently working well on the west end of the pond near the slurry input point. It is our understanding, however, that TVA has generally been unable to effectively handle the soft and wet sedimented materials at the remote, east end of Pond 1. With the single-point slurry discharge procedures currently being used, the sedimented deposits at this end of the stack are comprised of the finer grained materials that are inherently less pervious (i.e., take longer to drain), lower in strength, and generally more difficult to handle. If conventional upstream methods of construction are to be used (i.e., wet casting with either a dragline or backhoe excavator) it will be necessary to deposit coarser materials at the remote end of the stack. The rim-ditch method of operation is one way to achieve this end.

If TVA is unable to effectively implement the rim-ditch method of operation, it will be necessary to continuously haul materials to raise the dike at the remote end of the stack or provide extended periods of dewatering and drying for the fine-grained materials to achieve a manageable moisture content. Alternatively, a piped slurry distribution system with multiple discharge points around the complete perimeter of the stack will be required to give a more uniform distribution of the coarser sediments. Piped distribution systems are easy to operate once in place but must be raised with each lift of the dike. Other disadvantages include initial costs for the additional pipe and control valves and additional pumping cost when discharging at remote locations in the pond.

Wet cast materials are inherently more stable than dozer pushed or loosely placed moist materials that can become "bulked" and are subject to collapse upon wetting. Every effort, therefore, should be made to construct the perimeter and rim-ditch dikes of wet, cast materials.

If continued raising of the dike on the east end of the site with hauled fill is required, however, we recommend that the hauled materials be wetted and compacted sufficiently to preclude collapse or large changes in void ratio when the material is inundated. As it is difficult to place and compact material at the very edge of the pond, we recommend that the inside slope of the dike be constructed wider than required and the loose materials on the face of the inside slope be dressed back to the compacted materials. The dressed, inside slope of the dike should be no steeper than about 3.0H:1.0V.

4.3.3 Rim-Ditching

In the rim-ditch method of operation, the gypsum-flyash slurry is made to flow in an elevated ditch around the inside of the stack perimeter. The coarser particles tend to settle in the rim-ditch while the finer fraction of the gypsum-flyash is directed to the center of the pond through sluices cut through the inside bank (berm) of the rim-ditch. The rim-ditch concept of operation will be fully successful only if the rim-ditch is elevated above the ponded water level in the interior of the pond. Elevating the ditch accelerates dewatering of the deposits in the rim-ditch (i.e., the coarser particle sizes) and facilitates more rapid excavation and construction of each new lift of the starter dike.

The Widows Creek gypsum-flyash, however, appears to be more erodible than FGD gypsums without flyash or phosphogypsums, and additional water level control structures may be required to prevent the rim-ditch from being eroded down to the pond elevation through the sluice cuts. We, therefore, recommend that a temporary decant structure be provided at each discharge point from the rim-ditch into the pond to minimize the effects of erosion and to maintain the desired elevation differential. With a control structure in place, for example, the base elevation for erosion in the rim-ditch will be the control elevation of the structure (i.e., weir elevation). Without a control structure, the elevation of the water in the pond will become the control elevation for erosion in the rim-ditch.

We further recommend that the rim-ditch be set inboard as much as possible to facilitate flattening the inside slope of the perimeter dike and both slopes of the rim-ditch inner berm. The flatter slopes should make the rim-ditch more stable and easier to maintain. If the inner berm of the rim-ditch is elevated much more than about 5 feet, the inboard slope of the berm should be no steeper than about 3.5 horizontal to 1.0 vertical to prevent seepage related erosion and instability.

According to the August 15, 1990 topographic map provided by TVA, the average flow slope of the sedimented gypsum-flyash in the easternmost compartment of the Pond 1 portion of the Phase I stack is approximately 4.5 feet vertical per 1000 feet horizontal, whereas the average slope of the dike crest road from the influent end to the remote, eastern end of the stack is approximately 6.5 feet per 1000 feet. Similar or slightly steeper slopes should be anticipated within the rim-ditch as the stack is raised.

We strongly recommend that TVA attempt to refine and utilize the rim-ditch method of operation. This effort will probably require more frequent monitoring of stack operations and daily construction and maintenance of the rim-ditch and starter dikes.

4.3.4 Continued Phase I Stack Operations

The available storage space in the Phase I disposal area is presently limited due to the limited top area and subsequent size of the return water clarification pond. We recommend, therefore, that construction of the perimeter dikes of Phase II begin immediately. In the interim, continued operation of the Phase I gypsum-flyash stack will be required.

As discussed above, continued operation of the existing stack is possible if the existing side slopes are stabilized by flattening and benching or by providing underdrains in conjunction with benching. In terms of daily stack operations, aesthetics, safety and erosion control, the underdrain option is the more attractive of the two and will be presented below.

Figures 4.10 through 4.14 illustrate our recommendations for continued operation of the Phase I gypsum stack using an underdrain option similar to that discussed in Section 4.1.3. The key steps illustrated in these figures include the following:

Step 1:

- Construct a north-south cross dike near the middle of Pond 2 and use the western end of Pond 2 as a permanent clarification pond until the Phase II dikes are constructed. The volume of water required for adequate retention time and clarification of the return water can be field calibrated by determining the volume of water within the western one-half of Pond 2 from the original topographic map and raising the water level until the desired clarification is achieved. It is our understanding that raising the current level by about one foot will provide adequate clarification. The required size of the clarification pond can be determined and the cross dike located accordingly (i.e., make the clarification pond no larger than necessary to maximize the available gypsum-flyash storage area on the eastern end of the pond).
- Construct a rim-ditch along the north side of Pond 1 and install a temporary decant spillway at the east end of the ditch.
- Install a second temporary decant near the north end of the new cross dike and maintain a small clarification pond on the east side of the dike to facilitate deposition of the slurry materials.
- Direct gypsum-flyash slurry via the new rim-ditch to the east end of Pond 2. If the rim-ditch is not sloped correctly, reexcavation and adjustment of the rim-ditch slope may be required.

Step 2

- While the gypsum-flyash slurry is being routed across the north side of Pond 1, reshape the outside slopes of the existing stack on the south end of the west wall and the south and east walls in accordance with the design figures.
- The underdrains along these same walls can be installed in conjunction with the shaping operations.
- Upon completion of the underdrain installation, a new rim-ditch will be constructed around the south side of Pond 1 to the northeast corner of the pond, adjacent to the temporary decant installed as part of Step 1.

Step 3

- Gypsum-flyash slurry can then be routed to Pond 2 via the new rim-ditch constructed around the south side of Pond 1. Here again, reexcavation and adjustment of the rim-ditch slope may be required.

- The remainder of the underdrain system across the west end of Pond 1 can be installed while slurry is routed around the south side of the pond.

- Locate a temporary decant spillway discharging from Pond 1 to the clarification pond in anticipation of Step 4 slurry operations and start raising the containment dike across the north side of Pond 1.

Step 4

- Discharge slurry into Pond 1 and decant directly into the clarification pond. The north-south divider dike may be allowed to overtop and be eventually eliminated.

- After adequate drying time, install the required underdrains across the east end of Pond 2 and commence raising the perimeter dikes and construction of a rim-ditch around the east end of Pond 2.

Step 5

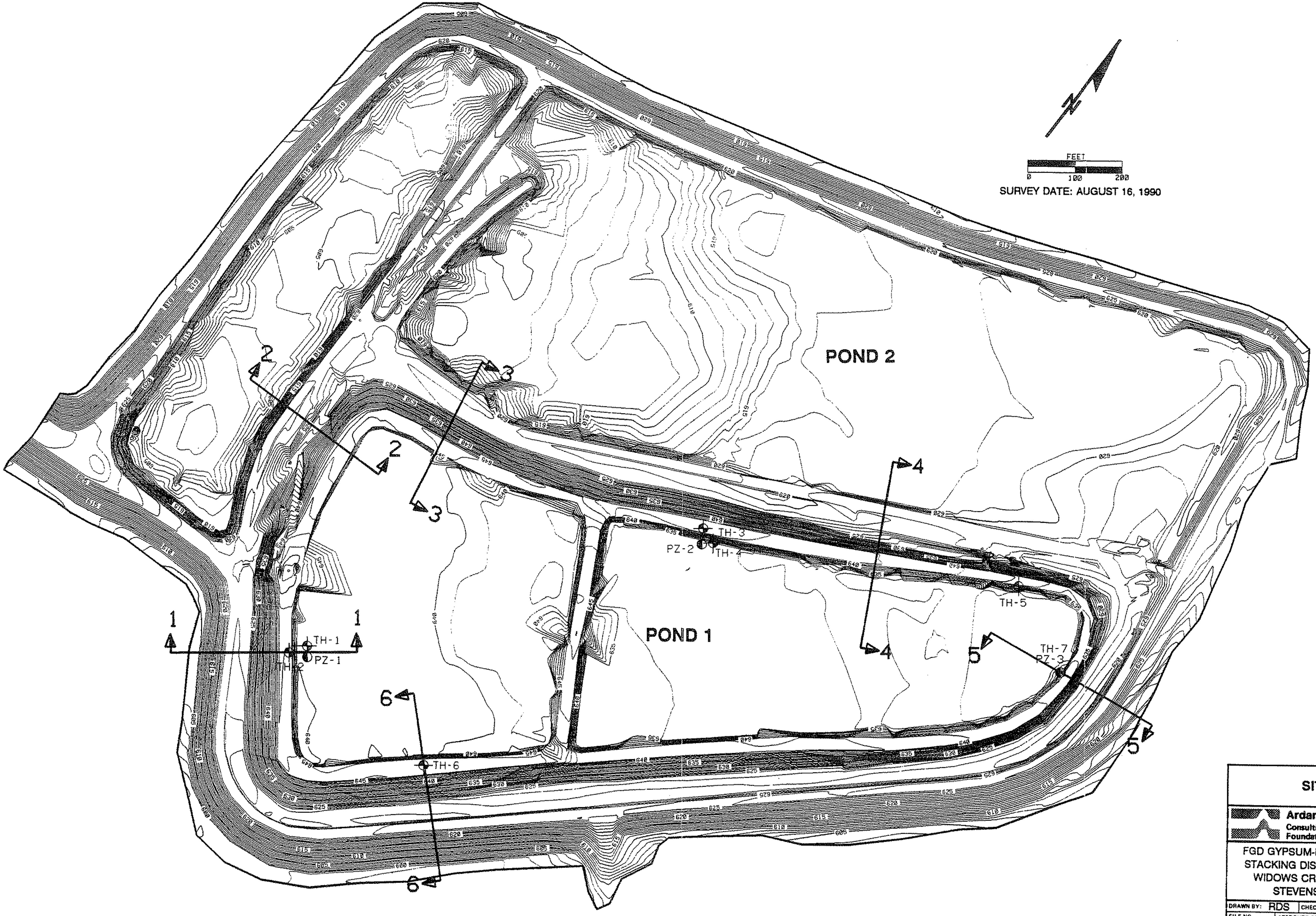
- Alternate slurry deposition between Pond 1 and Pond 2 until the Phase II expansion is complete. At that time, a decant can be provided from the clarification pond into the Phase II expansion and slurry can be placed directly into the clarification pond, which will eventually be raised to an elevation consistent with the remainder of the Phase I ponds.

4.3.5 Erosion Control

The outside slopes of the gypsum-flyash stack need to be stabilized against erosion from rainfall runoff. There are a variety of methods available for slope surface stabilization but it is anticipated that conventional seeding and mulching techniques, if effective, will prove to be the most economical. We recommend, therefore, that two test sections be constructed immediately on the existing slopes to verify performance. One test section should consist of 6 inches of topsoil obtained from the Pond 2 excavation, seeded and mulched in accordance with requirements of TVA agronomists. The second test section should be placed directly on the gypsum-flyash, without the topsoil cover. This section will be seeded and mulched, only, in accordance with requirements of TVA agronomists.

Prior to installation of the proposed underdrain system, the lower portion of the slope below the seepage spring line will remain saturated and will not support conventional vegetation. Both test sections, therefore, should be constructed above the seepage spring line if underdrains are to installed at a later date. If underdrains are not to be used, the test section should extend below the spring line and vegetation selected accordingly.

To facilitate inspection and maintenance of the stack, vegetation on the side slopes of the stack will need to be mowed periodically.



SITE PLAN

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FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
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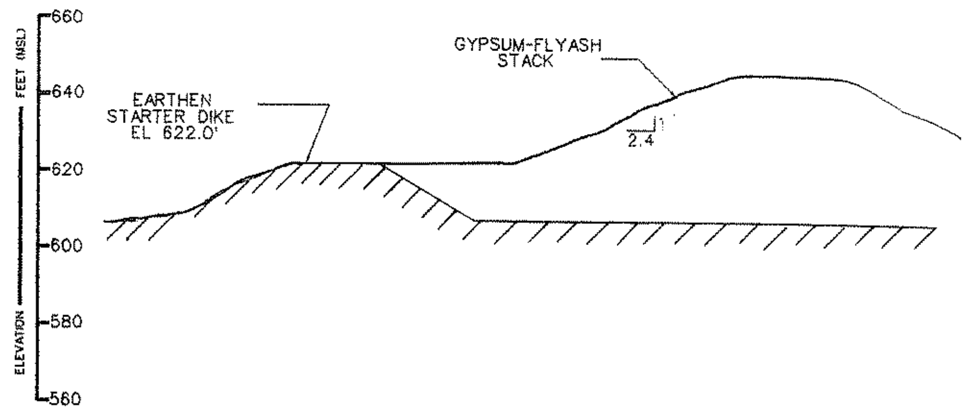
FIGURE 4.1



SECTION 3-3

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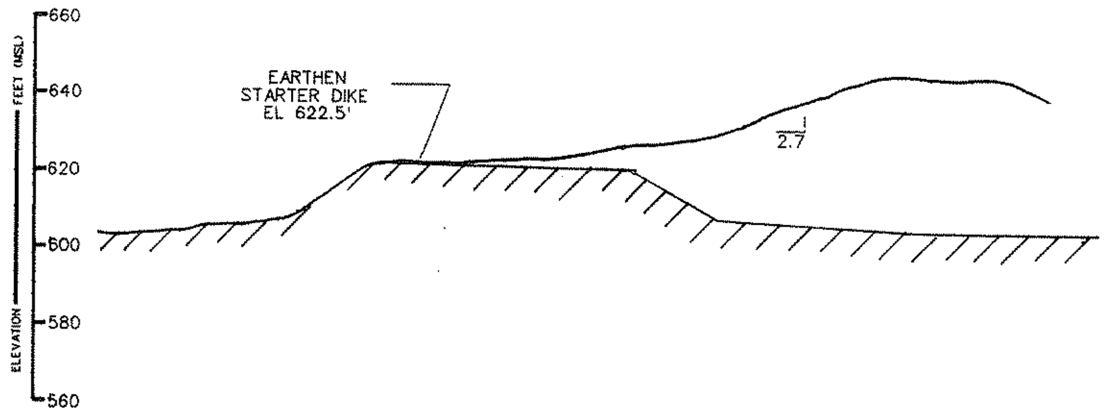

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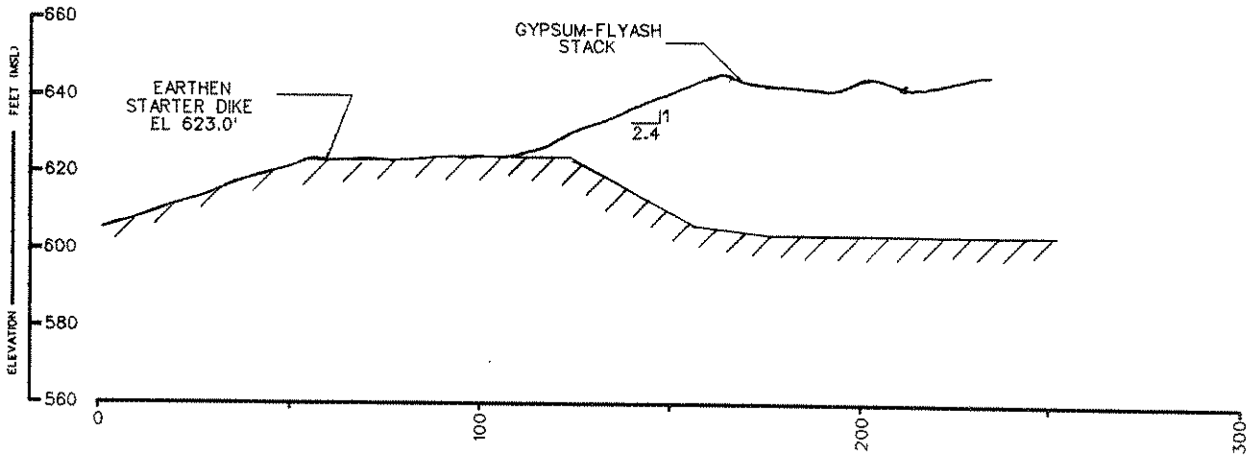

SECTION 1-1

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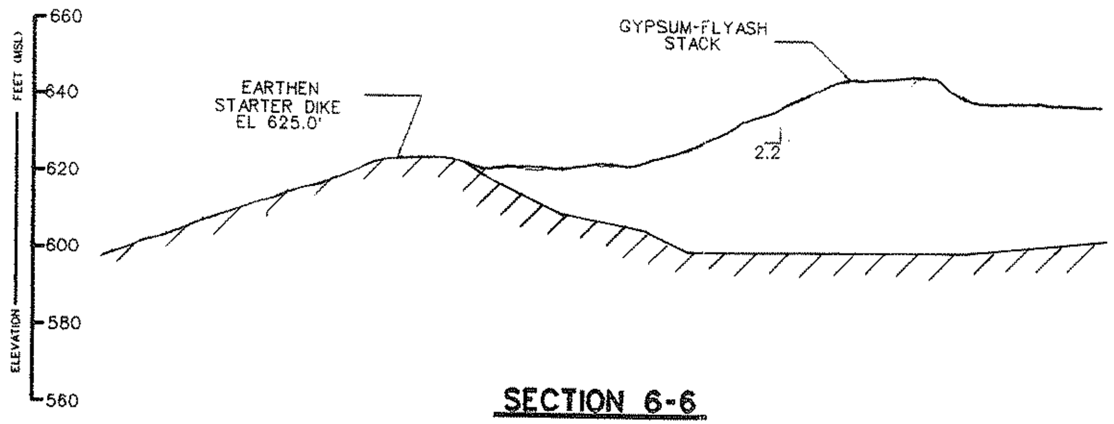

SECTION 6-6

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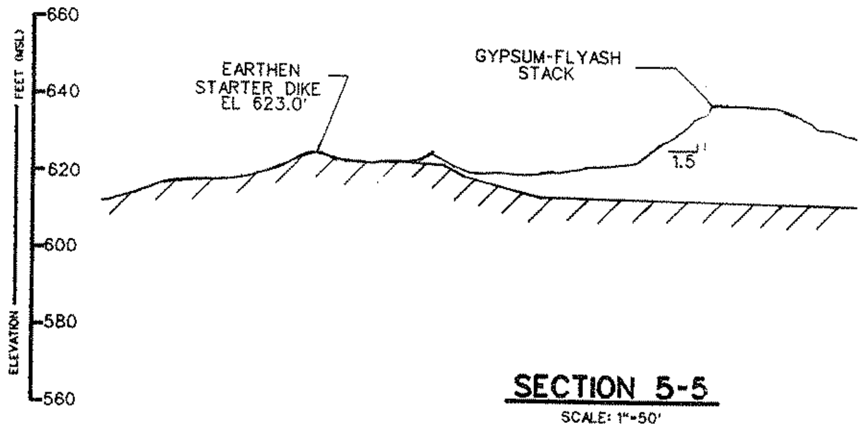

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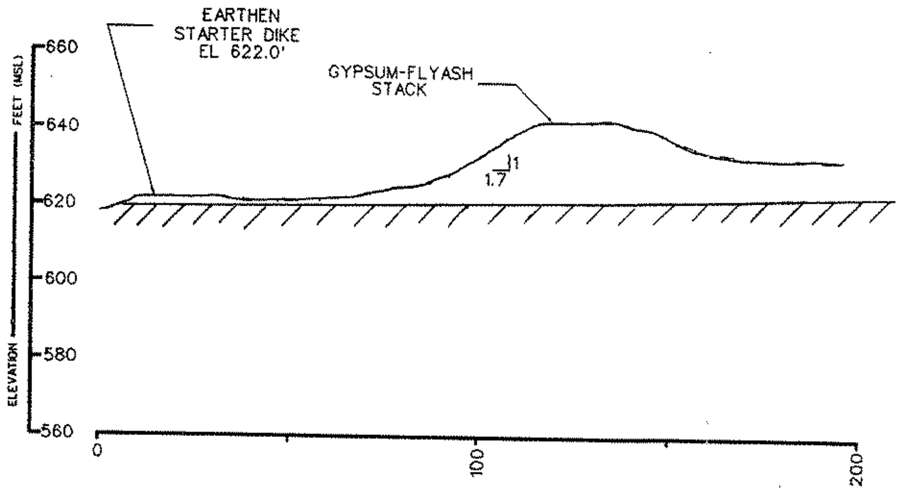

SECTION 4-4

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EXISTING GEOMETRY OF STARTER DIKE AND GYPSUM-FLYASH STACK

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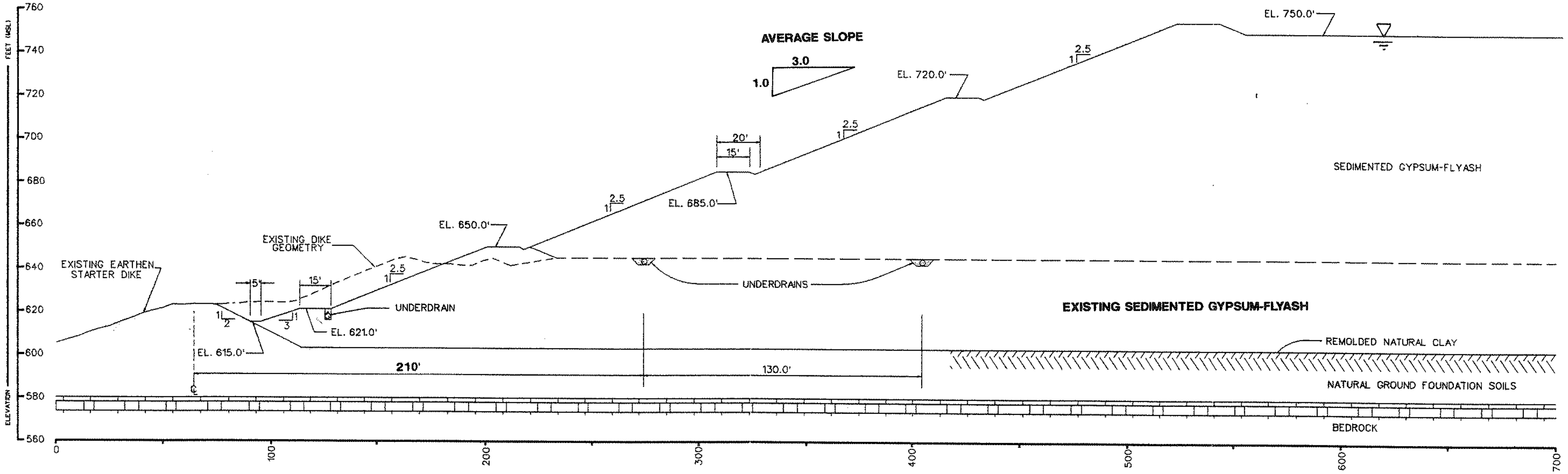
FIGURE 4.2



SECTION 1-1

SCALE: 1"=50'

CROSS SECTION 1-1 FOR CONCEPTUAL REMEDIAL PLAN FOR GYPSUM-FLYASH STACK

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FIGURE 4.3

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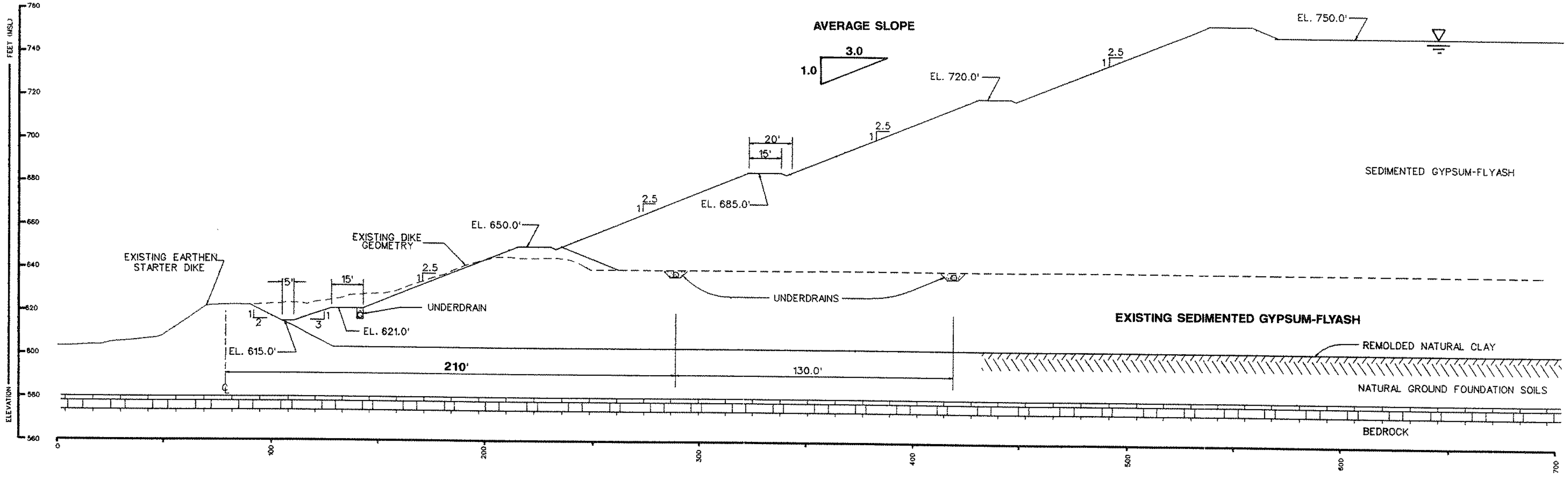


SECTION 2-2

SCALE: 1"=50'

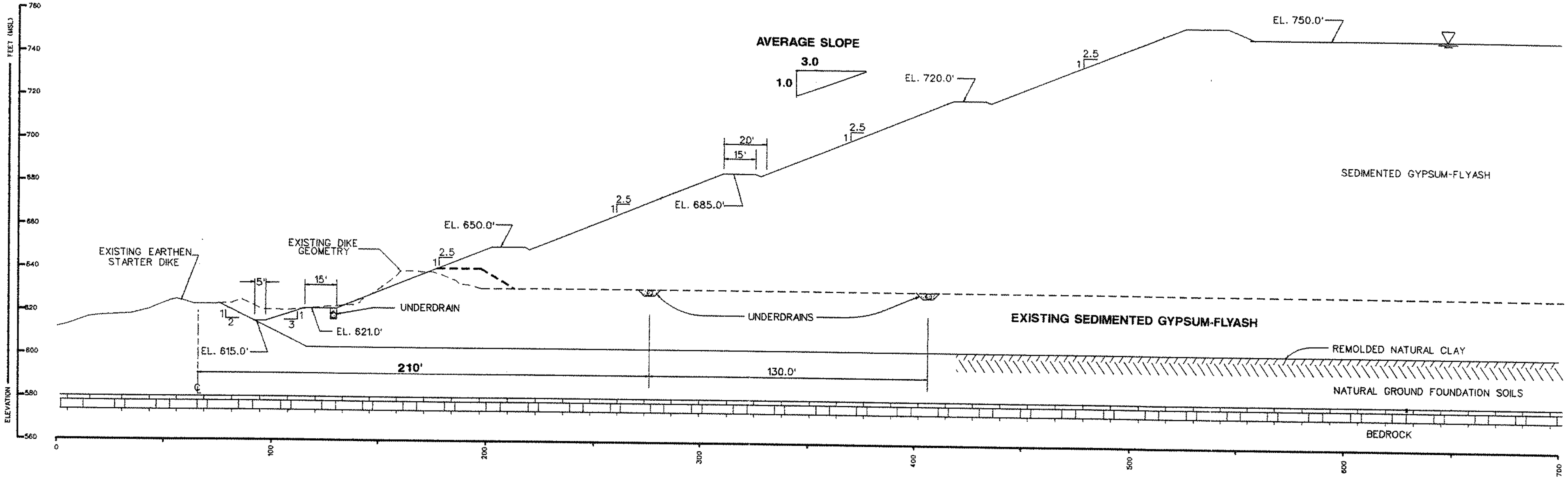
CROSS SECTION 2-2 FOR CONCEPTUAL REMEDIAL PLAN FOR GYPSUM-FLYASH STACK

Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics,
Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY: RDS
CHECKED BY: EJW
DATE: 4/11/91
FILE NO. 90-059
APPROVED BY: John E. Garlanger

FIGURE 4.4



SECTION 5-5

SCALE: 1"=50'

CROSS SECTION 5-5 FOR CONCEPTUAL REMEDIAL PLAN FOR GYPSUM-FLYASH STACK

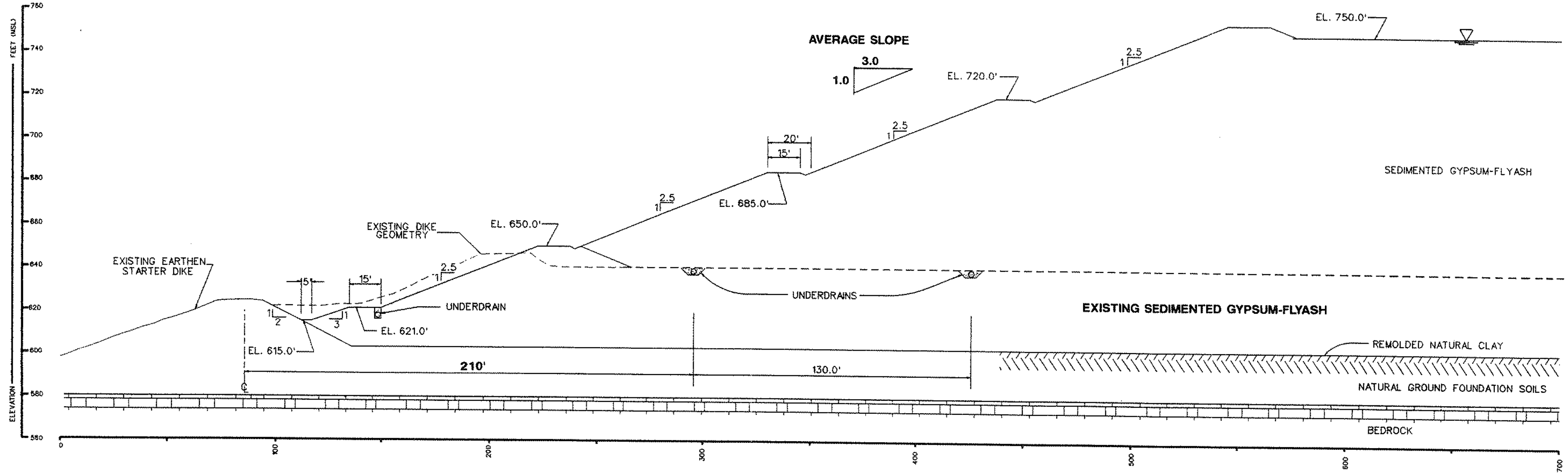
Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY:	RDS	CHECKED BY:	EJW	DATE:	4/11/91
FILE NO. 90-059	APPROVED BY:				

N39695

FIGURE 4.5



SECTION 6-6

SCALE: 1"=50'

CROSS SECTION 6-6 FOR CONCEPTUAL REMEDIAL PLAN FOR GYPSUM-FLYASH STACK

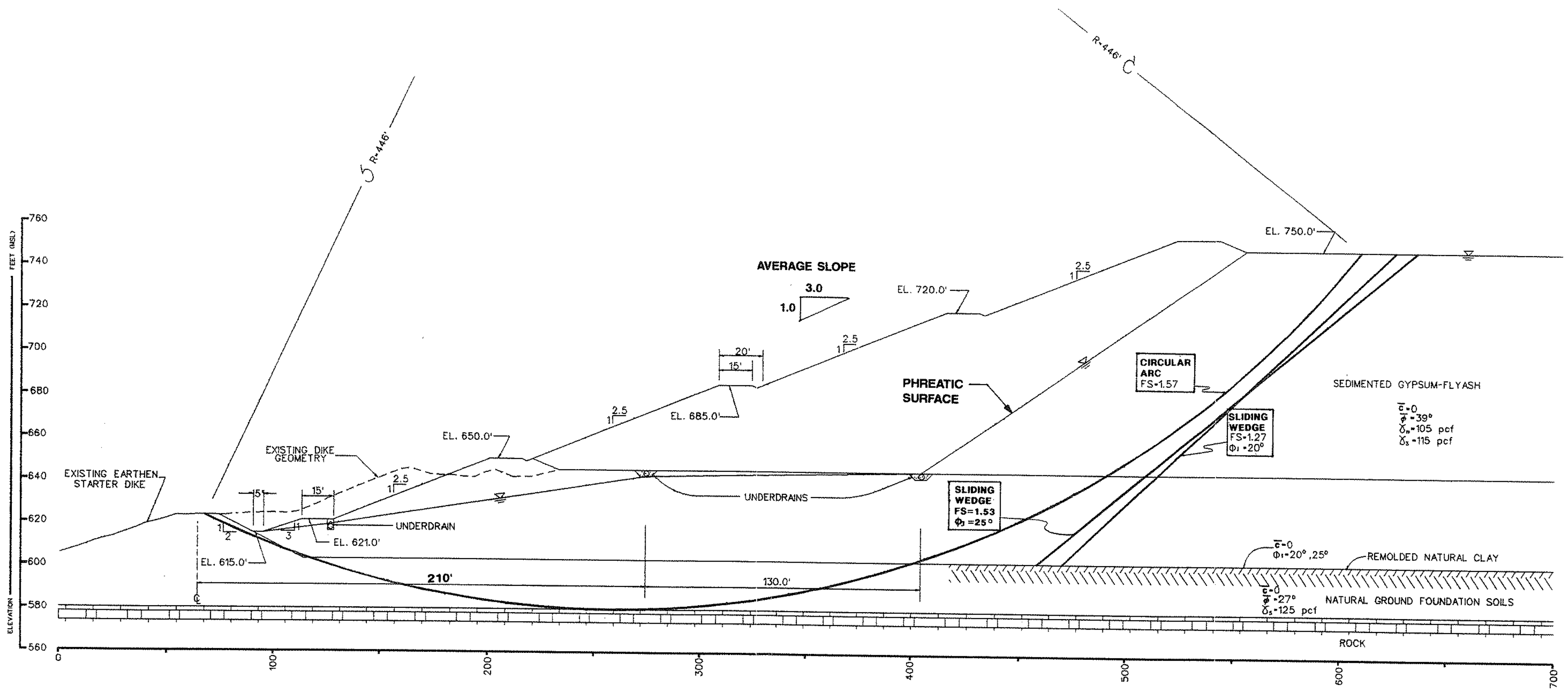
Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY: RDS	CHECKED BY: EJW	DATE: 4/11/91
FILE NO. 90-059	APPROVED BY: John E. Garlanger	

N39695

FIGURE 4.6



SCALE: 1"=50'

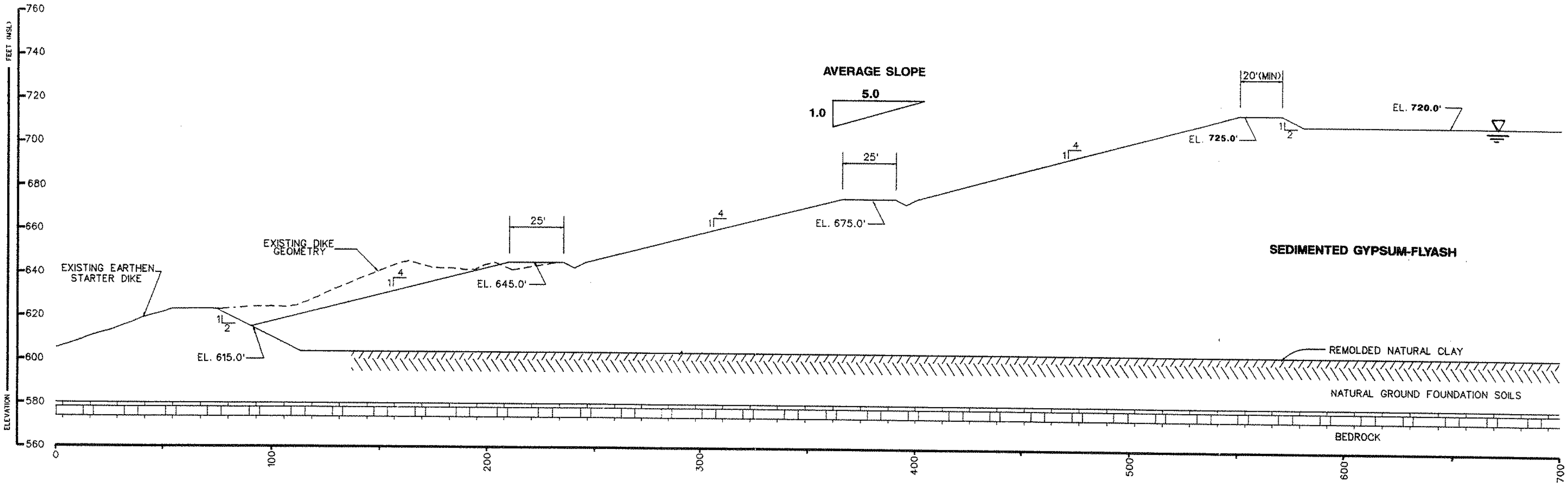
STABILITY ANALYSIS FOR CONCEPTUAL REMEDIAL PLAN WITH UNDERDRAINS

Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY:	RDS	CHECKED BY:	EJW	DATE:	4/11/91
FILE NO. 90-059	APPROVED BY: John E. Garlanger				

FIGURE 4.7



SECTION 1-1

SCALE: 1"-50'

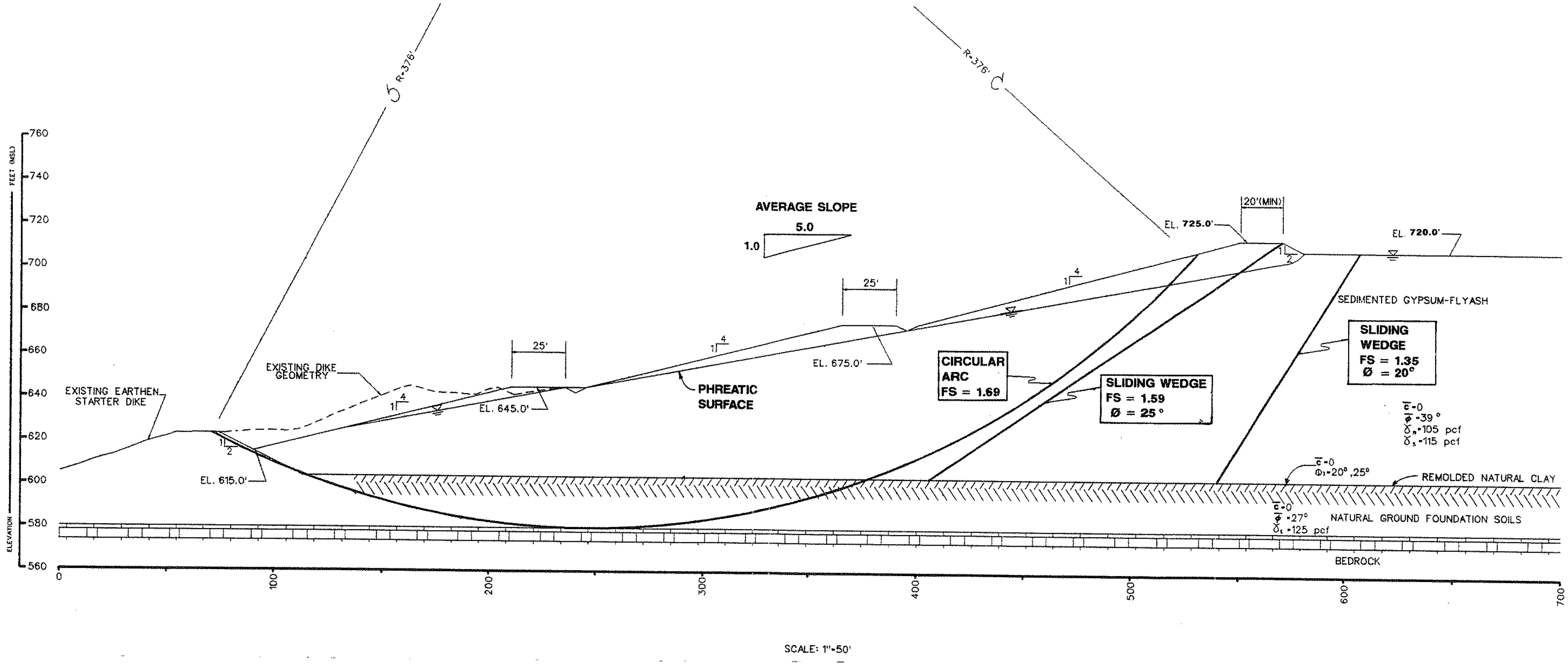
CONCEPTUAL REMEDIAL PLAN FOR GYPSUM-FLYASH STACK WITHOUT UNDERDRAINS

Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY:	RDS	CHECKED BY:	EJW	DATE:	4/11/91
FILE NO. 90-059	APPROVED BY: John E. Garlanger				

FIGURE 4.8



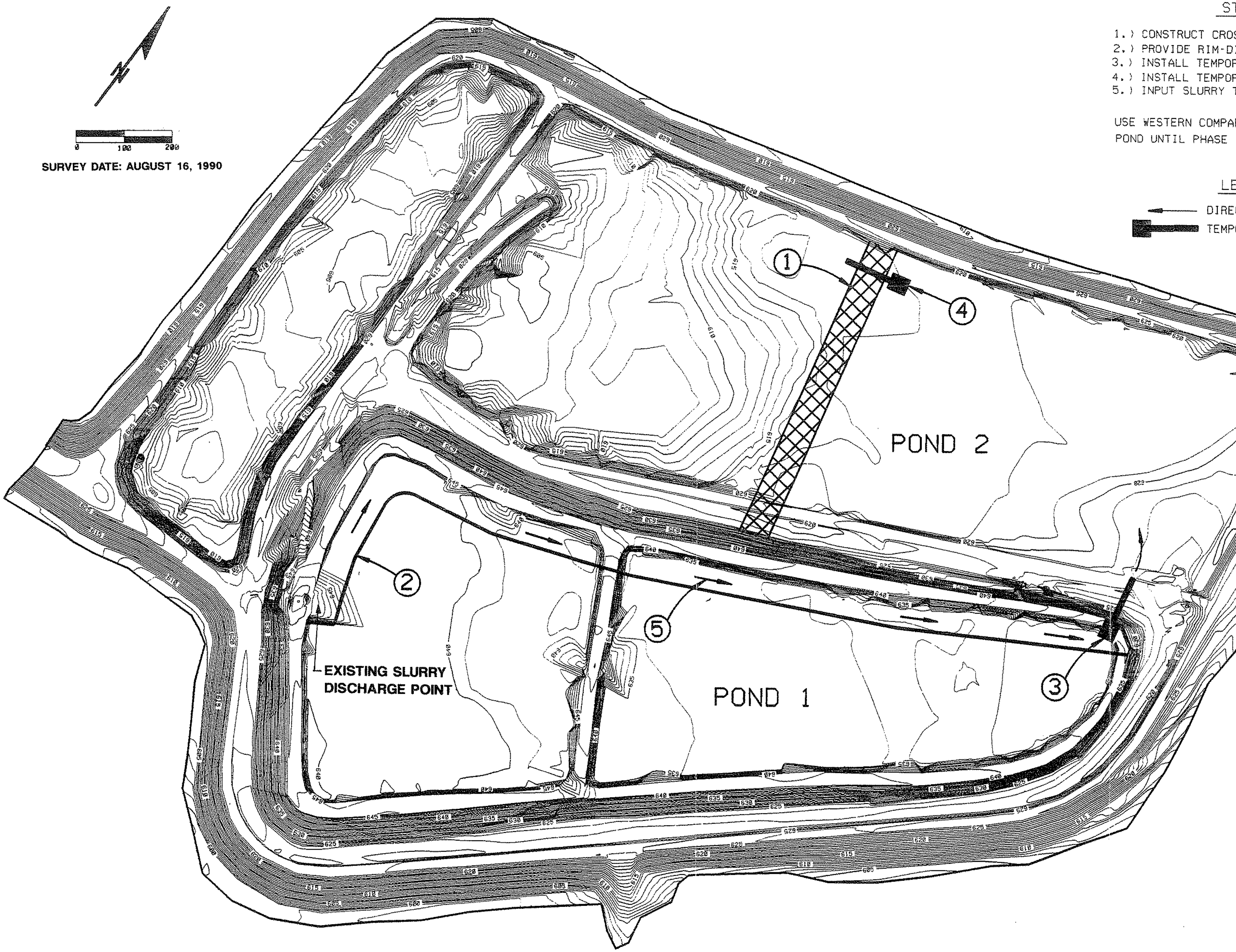
STABILITY ANALYSIS FOR CONCEPTUAL REMEDIAL PLAN WITHOUT UNDERDRAINS

Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY:	RDS	CHECKED BY:	EJW	DATE:	4/11/91
FILE NO.	90-059	APPROVED BY:	John E. Garlanger		

FIGURE 4.9



STEPS

1.) CONSTRUCT CROSS DIKE IN POND 2
2.) PROVIDE RIM-DITCH ALONG NORTH SIDE OF POND 1
3.) INSTALL TEMPORARY DECANT AND DISCHARGE PIPE
4.) INSTALL TEMPORARY DECANT TO CLARIFICATION POND
5.) INPUT SLURRY TO EASTERN COMPARTMENT OF POND 2

USE WESTERN COMPARTMENT OF POND 2 AS CLARIFICATION POND UNTIL PHASE II IS COMPLETE

LEGEND

← DIRECTION OF SLURRY FLOW
▬ TEMPORARY DECANT SPILLWAY LOCATION

RECOMMENDED OPERATION OF PHASE I STACK - STEP 1

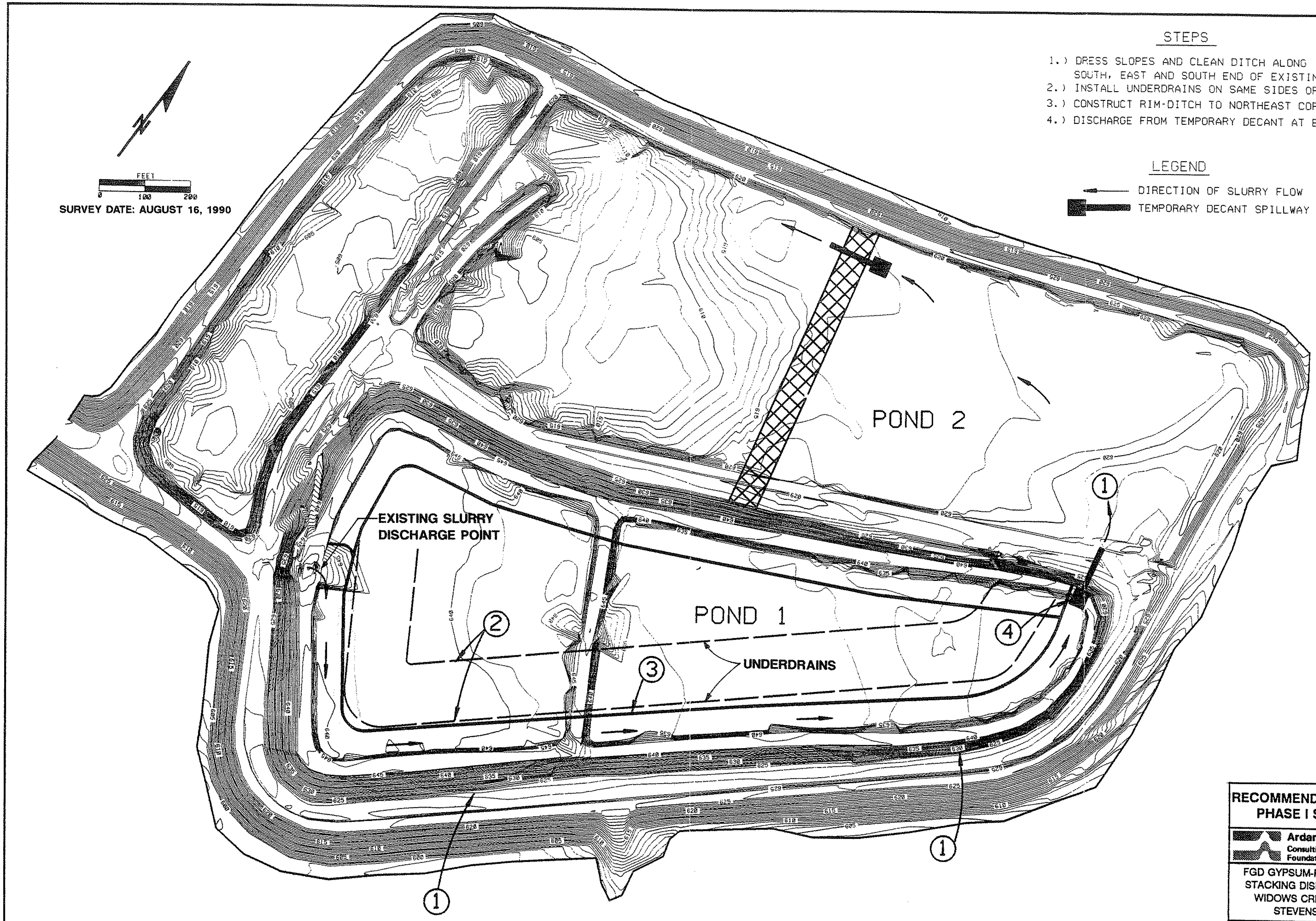
Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY: RDS	CHECKED BY: EJW	DATE: 4/11/91
FILE NO. 90-059	APPROVED BY:	

N39695

FIGURE 4.10



STEPS

1.) DRESS SLOPES AND CLEAN DITCH ALONG SOUTH, EAST AND SOUTH END OF EXISTING STACK
2.) INSTALL UNDERDRAINS ON SAME SIDES OF STACK
3.) CONSTRUCT RIM-DITCH TO NORTHEAST CORNER
4.) DISCHARGE FROM TEMPORARY DECANT AT END OF RIM-DITCH

LEGEND

← DIRECTION OF SLURRY FLOW
■ TEMPORARY DECANT SPILLWAY LOCATION

RECOMMENDED OPERATION OF PHASE I STACK - STEP 2

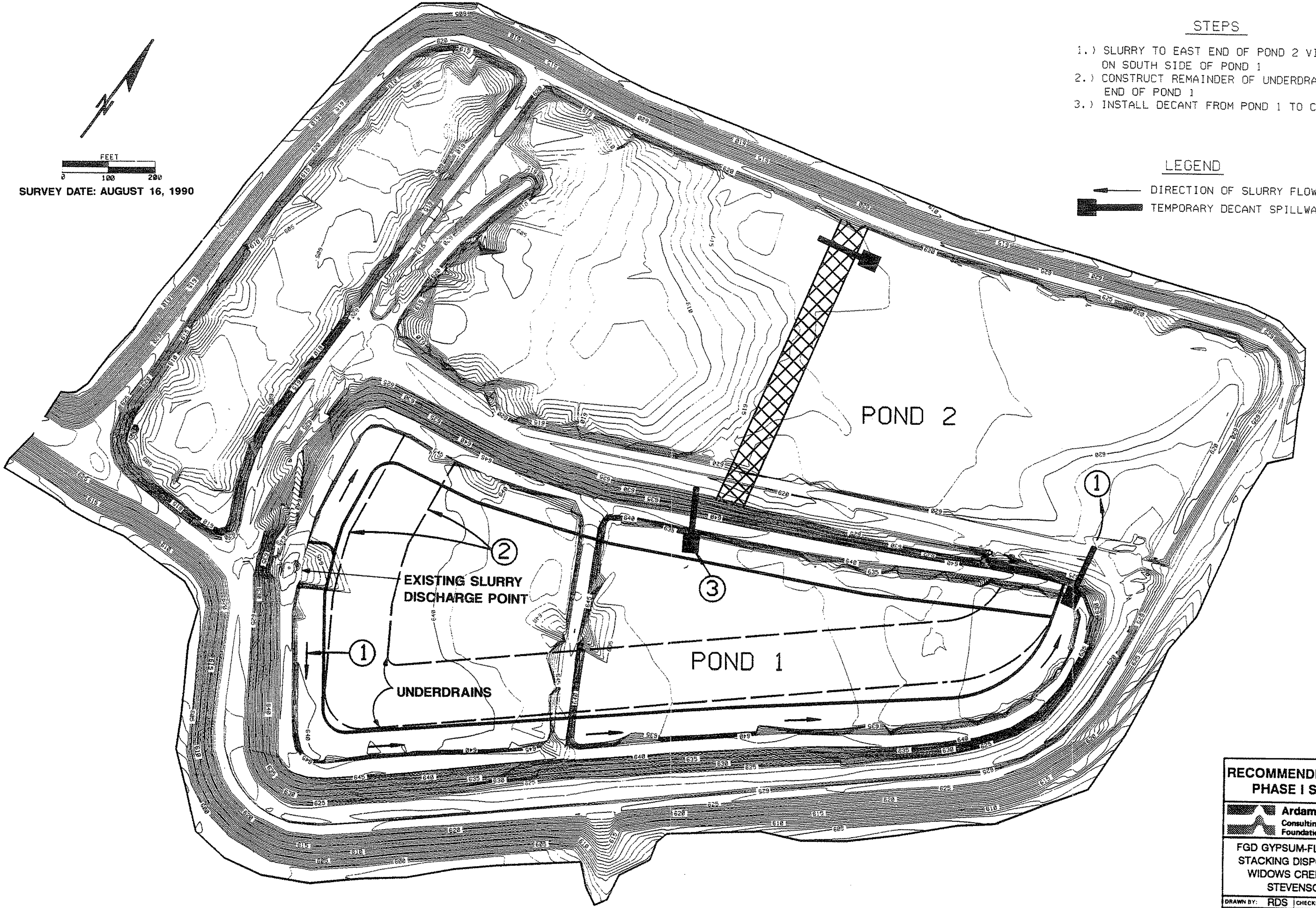
Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY:	RDS	CHECKED BY:	EJW	DATE:	4/11/91
FILE NO. 90-059	APPROVED BY:				

N39695

FIGURE 4.11



STEPS

1.) SLURRY TO EAST END OF POND 2 VIA RIM-DITCH ON SOUTH SIDE OF POND 1
2.) CONSTRUCT REMAINDER OF UNDERDRAIN ON WEST END OF POND 1
3.) INSTALL DECANT FROM POND 1 TO CLARIFICATION POND

LEGEND

←	DIRECTION OF SLURRY FLOW
▬	TEMPORARY DECANT SPILLWAY LOCATION

RECOMMENDED OPERATION OF PHASE I STACK - STEP 3

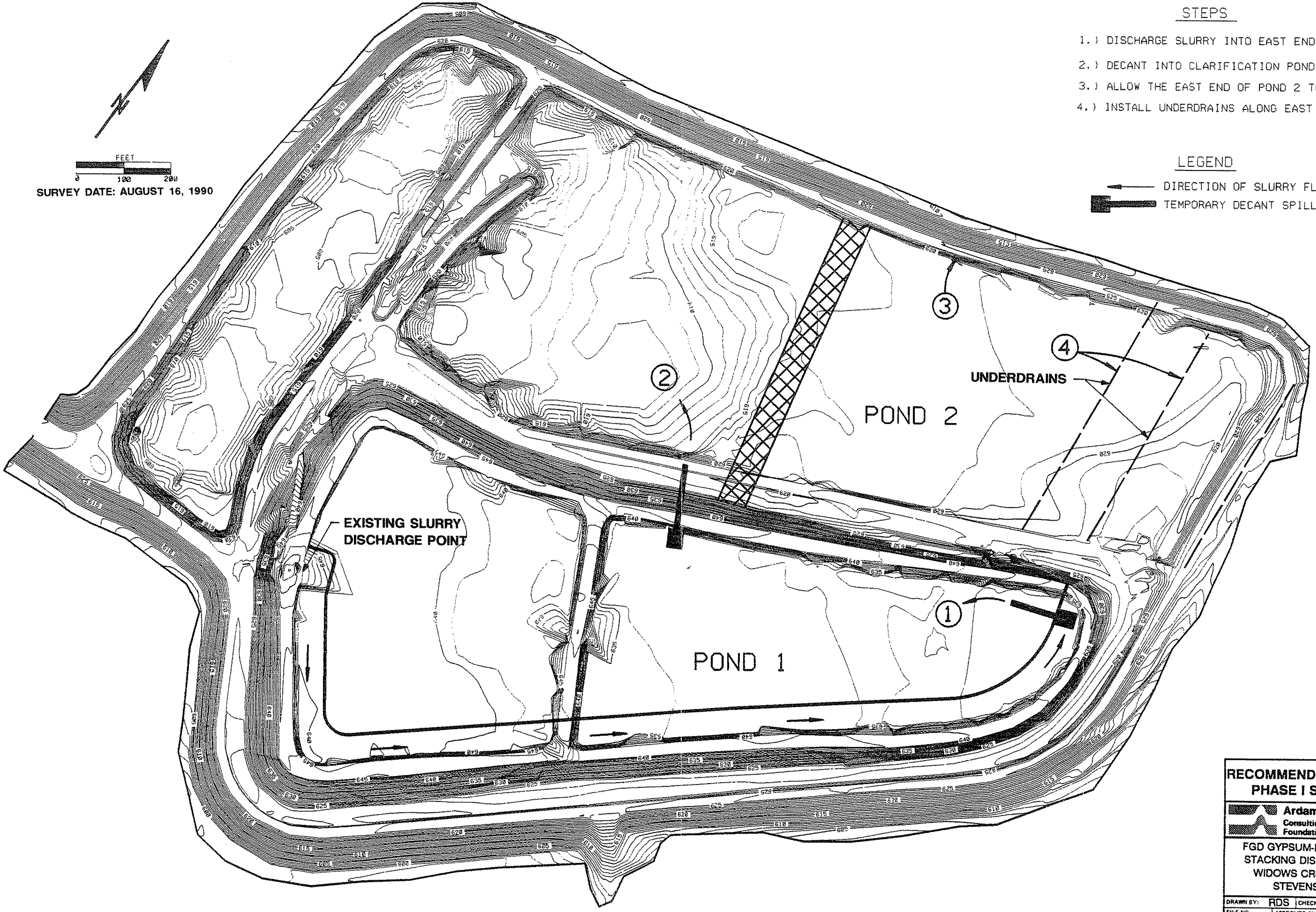
Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY: RDS CHECKED BY: EJW DATE: 4/11/91
FILE NO. 90-059 APPROVED BY:

N39695

FIGURE 4.12



STEPS

1.) DISCHARGE SLURRY INTO EAST END OF POND 1
2.) DECANT INTO CLARIFICATION POND
3.) ALLOW THE EAST END OF POND 2 TO DRY
4.) INSTALL UNDERDRAINS ALONG EAST SIDE OF POND 2

LEGEND

← DIRECTION OF SLURRY FLOW
▬ TEMPORARY DECANT SPILLWAY LOCATION

RECOMMENDED OPERATION OF PHASE I STACK - STEP 4

Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY: RDS
CHECKED BY: EJW
DATE: 4/11/91
FILE NO. 90-059
APPROVED BY:

N39695

FIGURE 4.13

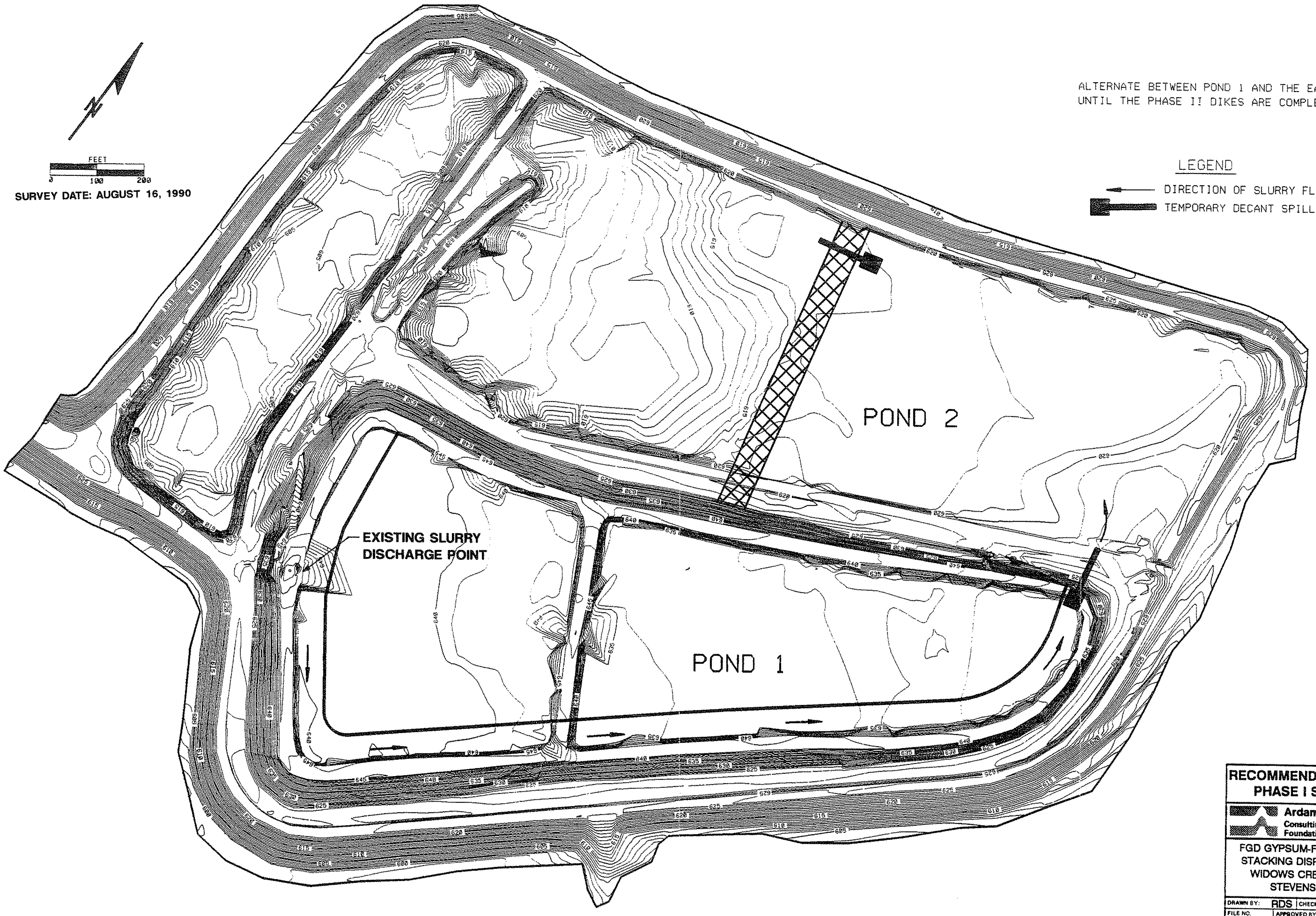
SURVEY DATE: AUGUST 16, 1990

ALTERNATE BETWEEN POND 1 AND THE EAST END OF POND 2
UNTIL THE PHASE II DIKES ARE COMPLETED

LEGEND

← DIRECTION OF SLURRY FLOW

▬ TEMPORARY DECANT SPILLWAY LOCATION



RECOMMENDED OPERATION OF PHASE I STACK - STEP 5

Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-
STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY: RDS	CHECKED BY: EJW	DATE: 4/11/91
FILE NO. 90-059	APPROVED BY: John E. Garlanger	

N39695

FIGURE 4.14

Section 5

SUMMARY AND CONCLUSIONS

The results of our engineering evaluations indicate that the existing gypsum-flyash stack is being raised too steeply. At the present relatively low height, localized seepage and erosion related instability of the stack slopes is occurring, and if the height of the stack is raised significantly, overall instability of the stack foundation soils may become a problem. Corrective action, therefore, is required to stabilize the slopes of the gypsum-flyash stack for continued use of the facility.

Two approaches have been recommended to stabilize the existing stack slopes. One approach provides underdrains to collect and control seepage in the stack, thereby providing localized stability of the slopes and allowing the stack to be raised more steeply than the proposed design slope of 5.0H:1.0V slope. The second approach is not to use underdrains and flatten the side slopes of the stack such that they will be stable with seepage, but resulting in less storage volume. Both approaches also require management of rainfall runoff to minimize the effects of surface erosion.

Figures 4.10 through 4.14 present a conceptual design for raising the stack using the underdrain option while Figure 4.8 presents a design for raising the stack using flatter side slopes without underdrains. Either option will provide overall stability to the stack. The underdrain option is preferred, however, and has the following advantages:

- Positive seepage control is provided by the underdrains and no seepage exists on the face of the slope. This will result in relatively dry slopes which improves localized slope stability and facilitates placing and maintaining a vegetative cover on the slopes for surface erosion protection.

- The underdrains will depress the phreatic surface within the stack and improve overall stack stability relative to circular arc and sliding wedge failure modes through the foundation soils. The underdrains will allow the stack to be raised more steeply with a resulting increase in storage life. Based on the preliminary design presented herein, an additional 7 years of storage life may be available if the steeper side slopes are used.

Continued operation of the Phase I stack is possible if the existing side slopes are stabilized by flattening and benching or by providing underdrains in conjunction with benching. The available storage volume in the Phase I disposal area is presently limited, however, due to the limited top area and subsequent size of the return water clarification pond. We recommend, therefore, that construction of the perimeter dikes of the Phase II area begins immediately. In the interim, continued operation of the Phase I gypsum-flyash stack will be required.

The overall stability of the stack can be maintained by using the average side slopes shown on the preliminary design figures contained herein. These figures, however, are conceptual in nature and do not represent final design recommendations relative to the details of the underdrain system, management of surface water runoff, and location of control structures. Detailed engineering evaluations and design of these features will be required before incorporation of these features into the Phase I and Phase II stacks.

Appendix A

SOIL BORING LOGS

BORING LOG

ARDAMAN & ASSOCIATES, INC.

BORING NO: TH-1
TOTAL DEPTH: 42.0ft.
SHEET 1 OF 2

PROJECT WIDOWS CREEK FGD GYPSUM - FLYASH STACK EVALUATION
FILE NO. 90-059
CLIENT Tennessee Valley Authority
ELEVATION 643.4' (MSL)
BORING LOCATION N 1,600,610.00 ; E 527,279.29 (plant coordinates)
BORING TYPE SPT
COUNTY Jackson
STATE Alabama
CASING TYPE None
DATE STARTED 10-31-90
COMPLETED 10-31-90
DRILLER/RIG P.Boney / CME 45
WATER TABLE: 1st depth 6.87'
DATE 11-03-90
TIME --
WATER TABLE: 2nd depth --
DATE --
TIME --
REMARKS Field Inspector: H.Ellingsworth

Elevation	Depth (ft)	Standard Pen. Test ASTM D-1586			Lab Data					Soils Description and Remarks	Depth (ft)	Graphic Log
		Blows/ 6 in	N Value	Sample Number	NM (%)	-200 (%)	LL (%)	PI (%)	Dry Den (pcf)			
		1-1-2-3	3	1						Gypsum - flyash (fill)		
		3-3-4-5	7	2								
638.4	5			US-1 R=75%	26	99			88.9			
		4-8-9-12	17	3							▽	
633.4	10			US-2 R=100%	22				98.2	Gypsum - flyash, sedimented		
		12-23 25-22	48	4								
628.4	15			US-3 R=100%	22	93			98.1			
		10-14 18-17	32	5								
623.4	20	4-3-4-4	7	6								
				US-4 R=100%	28				88.2	Gypsum - flyash ,sedimented, more sandy		
618.4	25	8-10 12-16	22	7								
		5-11 11-12	22	8								
613.4	30											
		9-13 24-24	37	9	24							
608.4	35											
		4-1/12" 4	1	10						Very fine and soft sedimented gypsum - flyash		
603.4	40											

BORING LOG

ARDAMAN & ASSOCIATES, INC.

BORING NO: TH-1
TOTAL DEPTH: 42.0ft.
SHEET 2 OF 2

PROJECT WIDOWS CREEK FGD GYPSUM - FLYASH STACK EVALUATION
CLIENT Tennessee Valley Authority
BORING LOCATION N 1,600,610.00 ; E 527,279.29 (plant coordinates)

FILE NO. 90-059
ELEVATION 643.4' (MSL)
BORING TYPE SPT

		Standard Pen. Test ASTM D-1586			Lab Data							
Elevation	Depth (ft)	Blows/ 6 in	N Value	Sample Number	NM (%)	-200 (%)	LL (%)	PI (%)	Dry Den (pcf)	Soils Description and Remarks	Depth (ft)	Graphic Log
		5-7 11-12	18	11 12						Yellowish brown slightly sandy clay with rock fragments (CL)		▨
										Boring terminated at 42.0 feet		
598.4	45											
593.4	50											
588.4	55											
583.4	60											
578.4	65											
573.4	70											
568.4	75											
563.4	80											

BORING LOG
ARDAMAN & ASSOCIATES, INC.

BORING NO: TH-2
TOTAL DEPTH: 50.0ft.
SHEET 1 OF 2

PROJECT WIDOWS CREEK FGD GYPSUM - FLYASH STACK EVALUATION
FILE NO. 90-059
CLIENT Tennessee Valley Authority
ELEVATION 650.5' (MSL)
BORING LOCATION N 1,600,584.38 ; E 527,242.99 (plant coordinates)
BORING TYPE SPT
COUNTY Jackson
STATE Alabama
CASING TYPE None
DATE STARTED 10-30-90
COMPLETED 10-30-90
DRILLER/RIG P.Boney / CME 45
WATER TABLE: 1st depth 9.0'
DATE 10-30-90
TIME --
WATER TABLE: 2nd depth --
DATE --
TIME --
REMARKS Field Inspector: H.Ellingsworth

		Standard Pen. Test ASTM D-1586			Lab Data							
Elevation	Depth (ft)	Blows/ 6 in	N Value	Sample Number	NM (%)	-200 (%)	LL (%)	PI (%)	Dry Den (pcf)	Soils Description and Remarks	Depth (ft)	Graphic Log
		5-10 12-10	22	1						Gypsum - flyash, cast		
		10-16 22-26	38	2	17							
645.5	5	16-16 14-11	30	3								
		6-5-5-4	10	4	21							
		5-5-6-8	11	5							▽	
640.5	10	3-5-8-11	13	6								
				US-1 R=75%	23				94.6			
635.5	15	7-9 11-15	20	7								
630.5	20	9-11 23-31	34	8								
		10-13 20-24	33	9								
625.5	25											
		13-12 17-20	29	10								
				US-2 R=100%	20				97.8			
620.5	30	9-18 20-22	38	11								
				US-3 R=100%	25	90 84			87.5	Gypsum - flyash, sedimented		
615.5	35	15-14 18-17	32	12								
610.5	40			US-4 R=100%	32	100			86.2			

BORING LOG

ARDAMAN & ASSOCIATES, INC.

BORING NO: TH-2
TOTAL DEPTH: 50.0ft.
SHEET 2 OF 2

PROJECT WIDOWS CREEK FGD GYPSUM - FLYASH STACK EVALUATION
FILE NO. 90-059
CLIENT Tennessee Valley Authority
ELEVATION 650.5' (MSL)
BORING LOCATION N 1,600,584.38 ; E 527,242.99 (plant coordinates)
BORING TYPE SPT

Elevation	Depth (ft)	Standard Pen. Test ASTM D-1586			Lab Data					Soils Description and Remarks	Depth (ft)	Graphic Log
		Blows/ 6 in	N Value	Sample Number	NM (%)	-200 (%)	LL (%)	PI (%)	Dry Den (pcf)			
		4-4-7-10	11	13								
				US-5 R=100%	29				82.7	Gypsum - flyash, sedimented		
605.5	45											
		WOR		14								
		4-5-7-10	12	15						Yellowish brown slightly sandy clay with rock fragments (CL)		
600.5	50											
										Boring terminated at 50.0 feet		
595.5	55											
590.5	60											
585.5	65											
580.5	70											
575.5	75											
570.5	80											

BORING LOG

ARDAMAN & ASSOCIATES, INC.

BORING NO: TH-3
TOTAL DEPTH: 32.0ft.
SHEET 1 OF 1

PROJECT WIDOWS CREEK FGD GYPSUM - FLYASH STACK EVALUATION
FILE NO. 90-059
CLIENT Tennessee Valley Authority
ELEVATION 643.6' (MSL)
BORING LOCATION N 1,601,332.12 ; E 527,292.93 (plant coordinates)
BORING TYPE SPT
COUNTY Jackson
STATE Alabama
CASING TYPE None
DATE STARTED 10-31-90
COMPLETED 10-31-90
DRILLER/RIG P.Boney / CME 45
WATER TABLE: 1st depth 3.0'
DATE --
TIME --
WATER TABLE: 2nd depth --
DATE --
TIME --
REMARKS Field Inspector: H.Ellingsworth

Elevation	Depth (ft)	Standard Pen. Test ASTM D-1586 Blows/ 6 in	N Value	Sample Number	Lab Data NM (%)	-200 (%)	LL (%)	PI (%)	Dry Den (pcf)	Soils Description and Remarks	Depth (ft)	Graphic Log
		3-3-6-15	9	1						Gypsum - flyash, cast		
		10-10 10-21	20	2	18						▽	
638.6	5	20-21 25-40	46	3								
633.6	10	16-16 14-13	30	4	19							
		13-15 16-17	31	5						Gypsum - flyash, sedimented		
628.6	15											
		14-15 14-14	29	6	22							
623.6	20	2-1-3-4	4	7								
				US-1 R=75%	30				87.4	Gypsum - flyash, sedimented, more flyash than above		
		2-6-7-9	13	8								
618.6	25			US-2 R=100%	26	85			90.6			
		6-8 21-21	29	9								
613.6	30			US-3 R=100%	28				87.1	Mostly flyash		
		5-7 10-13	17	10 11						Yellowish brown slightly sandy clay with rock fragments (CL)		
										Boring terminated at 32.0 feet		
608.6	35											
603.6	40											

BORING LOG

ARDAMAN & ASSOCIATES, INC.

BORING NO: TH-4
TOTAL DEPTH: 27.0ft.
SHEET 1 OF 1

PROJECT WIDOWS CREEK FGD GYPSUM - FLYASH STACK EVALUATION
FILE NO. 90-059
CLIENT Tennessee Valley Authority
ELEVATION 639.9' (MSL)
BORING LOCATION N 1,601,303.20 ; E 527,810.52 (plant coordinates)
BORING TYPE SPT
COUNTY Jackson
STATE Alabama
CASING TYPE None
DATE STARTED 10-31-90
COMPLETED 10-31-90
DRILLER/RIG P.Boney / CME 45
WATER TABLE: 1st depth 4.79'
DATE 11-03-90
TIME --
WATER TABLE: 2nd depth --
DATE --
TIME --
REMARKS Field Inspector: H.Ellingsworth

Elevation	Depth (ft)	Standard Pen. Test ASTM D-1586 Blows/ 6 in	N Value	Sample Number	Lab Data NM (%)	-200 (%)	LL (%)	PI (%)	Dry Den (pcf)	Soils Description and Remarks	Depth (ft)	Graphic Log
		1-1-2-1	3	1						Gypsum - flyash (fill)		
		1-1/24"		2						Gypsum - flyash, sedimented		
634.9	5										▽	
				US-1 R=50%	28	98			85.3			
		2-3-4-4	7	3								
629.9	10			US-2 R=100%	22				98.0			
		7-7-7-7	14	4								
624.9	15			US-3 R=100%	23	99 98			95.8			
		4-5-7-7	12	5								
619.9	20	7-6 17-20	23	6								
614.9	25			US-4 R=100%	26				91.3			
		3-3-3-3	6	7 8								
										Yellowish brown slightly sandy clay with rock fragments (CL)		
609.9	30									Boring terminated at 27.0 feet		
604.9	35											
599.9	40											

BORING LOG

ARDAMAN & ASSOCIATES, INC.

BORING NO: TH-5
TOTAL DEPTH: 25.0ft.
SHEET 1 OF 1

PROJECT WIDOWS CREEK FGD GYPSUM - FLYASH STACK EVALUATION
FILE NO. 90-059
CLIENT Tennessee Valley Authority
ELEVATION 642.1' (MSL)
BORING LOCATION N 1,601,646.08 ; E 528,409.30 (plant coordinates)
BORING TYPE SPT
COUNTY Jackson
STATE Alabama
CASING TYPE None
DATE STARTED 11-01-90
COMPLETED 11-01-90
DRILLER/RIG P.Boney / CME 45
WATER TABLE: 1st depth 8.5'
DATE 11-01-90
TIME --
WATER TABLE: 2nd depth --
DATE --
TIME --
REMARKS Field Inspector: H.Ellingsworth

Elevation	Depth (ft)	Standard Pen. Test ASTM D-1586 Blows/ 6 in	N Value	Sample Number	Lab Data NM (%)	-200 (%)	LL (%)	PI (%)	Dry Den (pcf)	Soils Description and Remarks	Depth (ft)	Graphic Log
		5-8 10-15	18	1	15							
		15-12 12-15	24	2								
637.1	5	8-8 12-21	20	3	18							
		12-10 8-6	18	4								
632.1	10	10-18 18-18	36	5	20						∇	
		12-15 23-22	38	6						Gypsum - flyash, cast		
		10-15 16-22	31	7	19							
627.1	15	12-13 14-19	27	8								
		15-50	65	9	18							
		22-30-40	70	10								
622.1	20	24-25 26-27	51	11	19							
		13-12 6-7	18	12								
		4-5-7 50/5"	12	13						Gypsum - flyash, sedimented		
617.1	25				26					Yellowish brown slightly sandy clay with rock fragments (CL)		
										Boring terminated at 25.0 feet		
612.1	30											
607.1	35											
602.1	40											

BORING LOG

ARDAMAN & ASSOCIATES, INC.

BORING NO: TH-6
TOTAL DEPTH: 49.0ft.
SHEET 1 OF 2

PROJECT WIDOWS CREEK FGD GYPSUM - FLYASH STACK EVALUATION
FILE NO. 90-059
CLIENT Tennessee Valley Authority
ELEVATION 648.9' (MSL)
BORING LOCATION N 1,600,568.35 ; E 527,615.08 (plant coordinates)
BORING TYPE SPT
COUNTY Jackson
STATE Alabama
CASING TYPE None
DATE STARTED 11-01-90
COMPLETED 11-01-90
DRILLER/RIG P.Boney / CME 45
WATER TABLE: 1st depth --'
DATE --
TIME --
WATER TABLE: 2nd depth --
DATE --
TIME --
REMARKS Field Inspector: H.Ellingsworth

Elevation	Depth (ft)	Standard Pen. Test ASTM D-1586			Lab Data					Soils Description and Remarks	Depth (ft)	Graphic Log
		Blows/ 6 in	N Value	Sample Number	NM (%)	-200 (%)	LL (%)	PI (%)	Dry Den (pcf)			
		3-6 10-14	16	1						Gypsum - flyash, cast		
		12-12 12-14	24	2	20							
643.9	5	7-12 14-13	26	3								
		3-4-4-4	8	4	23							
638.9	10	2-4-5-8	9	5	21					Gypsum - flyash, sedimented		
				US-1 R=100%	22				92.9			
		5-5-3-5	8	6								
633.9	15			US-2 R=100%	23	100 99			96.4			
		7-9 15-14	24	7	21							
628.9	20											
		5-8-8-7	16	8	22							
623.9	25											
		5-15 21-21	36	9	20							
618.9	30											
		18-18 20-20	38	10	21							
613.9	35											
		11-20 20-25	40	11	27							
		18-35 31-31	66	12								
608.9	40	5-21	57	13	32							

BORING LOG
ARDAMAN & ASSOCIATES, INC.

BORING NO: TH-6
TOTAL DEPTH: 49.0ft.
SHEET 2 OF 2

PROJECT WIDOWS CREEK FGD GYPSUM - FLYASH STACK EVALUATION
CLIENT Tennessee Valley Authority
BORING LOCATION N 1,600,568.35 ; E 527,615.08 (plant coordinates)
FILE NO. 90-059
ELEVATION 648.9' (MSL)
BORING TYPE SPT

Elevation	Depth (ft)	Standard Pen. Test ASTM D-1586			Lab Data					Soils Description and Remarks	Depth (ft)	Graphic Log
		Blows/ 6 in	N Value	Sample Number	NM (%)	-200 (%)	LL (%)	PI (%)	Dry Den (pcf)			
		36-45	57	14	32							▤
		15-23 25-28	48	15								▤
603.9	45	14-12 14-14	26	16	25					Gypsum - flyash, sedimented		▤
		8-5-4-8	9	17								▤
		1-1-1-2	2	18 19 20	85					Light gray plastic gypsum		▨
598.9	50									Yellowish brown slightly sandy clay with rock fragments (CL)		
										Boring terminated at 49.0 feet		
593.9	55											
588.9	60											
583.9	65											
578.9	70											
573.9	75											
568.9	80											

BORING LOG

ARDAMAN & ASSOCIATES, INC.

BORING NO: TH-7
TOTAL DEPTH: 26.5ft.
SHEET 1 OF 1

PROJECT WIDOWS CREEK FGD GYPSUM - FLYASH STACK EVALUATION
FILE NO. 90-059
CLIENT Tennessee Valley Authority
ELEVATION 638.6' (MSL)
BORING LOCATION N 1,601,553.50 ; E 528,589.86 (plant coordinates)
BORING TYPE SPT
COUNTY Jackson
STATE Alabama
CASING TYPE None
DATE STARTED 11-02-90
COMPLETED 11-02-90
DRILLER/RIG P.Boney / CME 45
WATER TABLE: 1st depth 1.7'
DATE 11-03-90
TIME --
WATER TABLE: 2nd depth --
DATE --
TIME --
REMARKS Field Inspector: H.Ellingsworth

Elevation	Depth (ft)	Standard Pen. Test ASTM D-1586			Lab Data					Soils Description and Remarks	Depth (ft)	Graphic Log
		Blows/ 6 in	N Value	Sample Number	NM (%)	-200 (%)	LL (%)	PI (%)	Dry Den (pcf)			
		1/3'									▽	▤
633.6	5									Rotary wash to 8.0 feet		▤
628.6	10	1-1-2-3	3	1	23							▤
				US-1 R=100%	21	99 99			93.9			▤
		1/24"		2								▤
623.6	15			US-2 R=100%	25				93.3			▤
		1-1-1-6	2	3 4						Gypsum - flyash, sedimented		▤
618.6	20			US-3 R=100%	23	99 97			93.4			▤
		4-5-8-9	13	5								▤
		4-3-2-2	5	6	22							▤
613.6	25	10-12 12-13	24							Yellowish brown slightly sandy clay with rock fragments (CL)		▨
										Boring terminated at 26.5 feet		
608.6	30											
603.6	35											
598.6	40											

Appendix B

PIEZOMETER INSTALLATION LOGS

PIEZOMETER INSTALLATION RECORD

CLIENT: TVA **PROJECT:** WIDOWS CREEK FOSSIL PLANT

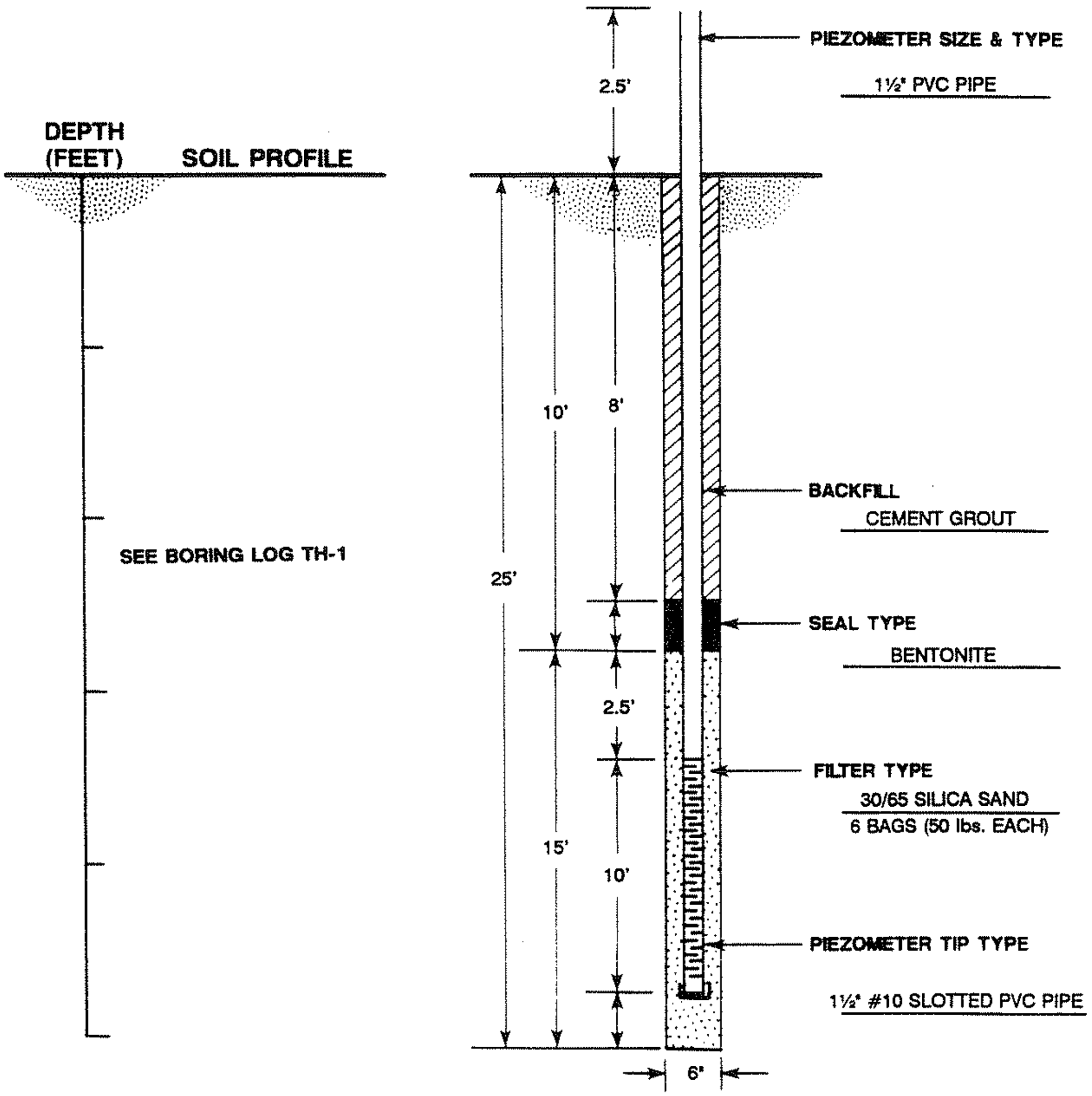
STATION NO: TH-1 **PIEZOMETER NO:** PZ-1 **FILE NO:** 90-13-059

CREW SUPERVISOR: H. ELLINGSWORTH **DATE INSTALLED:** OCT. 31, 1990

PIEZOMETER LOCATION: ADJACENT TO BORING TH-1

GROUND ELEVATION: 643.4'± **PIEZOMETER TOP ELEV.:** 645.9'±

REMARKS: HOLE DRILLED WITH REVERT AND FLUSHED OUT WITH CLEAN WATER BEFORE INSTALLATION OF PIEZOMETER



PIEZOMETER SIZE & TYPE: 1½" PVC PIPE

BACKFILL: CEMENT GROUT

SEAL TYPE: BENTONITE

FILTER TYPE: 30/65 SILICA SAND
6 BAGS (50 lbs. EACH)

PIEZOMETER TIP TYPE: 1½" #10 SLOTTED PVC PIPE

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Consulting Engineers in Soil Mechanics, Foundations, and Materials Testing

PIEZOMETER INSTALLATION RECORD

CLIENT: TVA **PROJECT:** WIDOWS CREEK FOSSIL PLANT

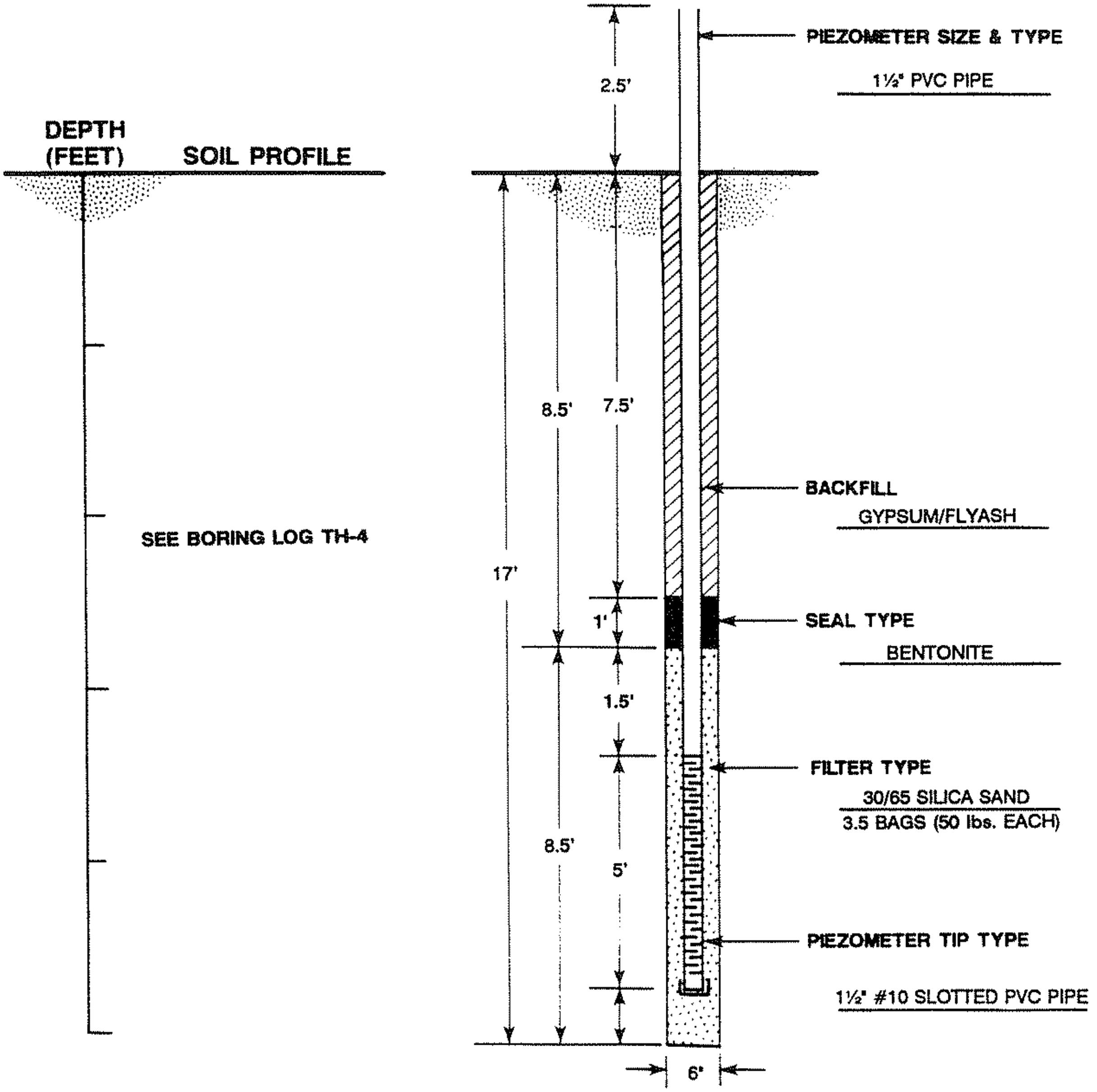
STATION NO: TH-4 **PIEZOMETER NO:** PZ-2 **FILE NO:** 90-13-059

CREW SUPERVISOR: H. ELLINGSWORTH **DATE INSTALLED:** NOV. 1, 1990

PIEZOMETER LOCATION: ADJACENT TO BORING TH-4

GROUND ELEVATION: 639.9'± **PIEZOMETER TOP ELEV.:** 642.4'±

REMARKS: HOLE DRILLED WITH CLEAN WATER



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Consulting Engineers in Soil Mechanics, Foundations, and Materials Testing

PIEZOMETER INSTALLATION RECORD

CLIENT: TVA PROJECT: WIDOWS CREEK FOSSIL PLANT

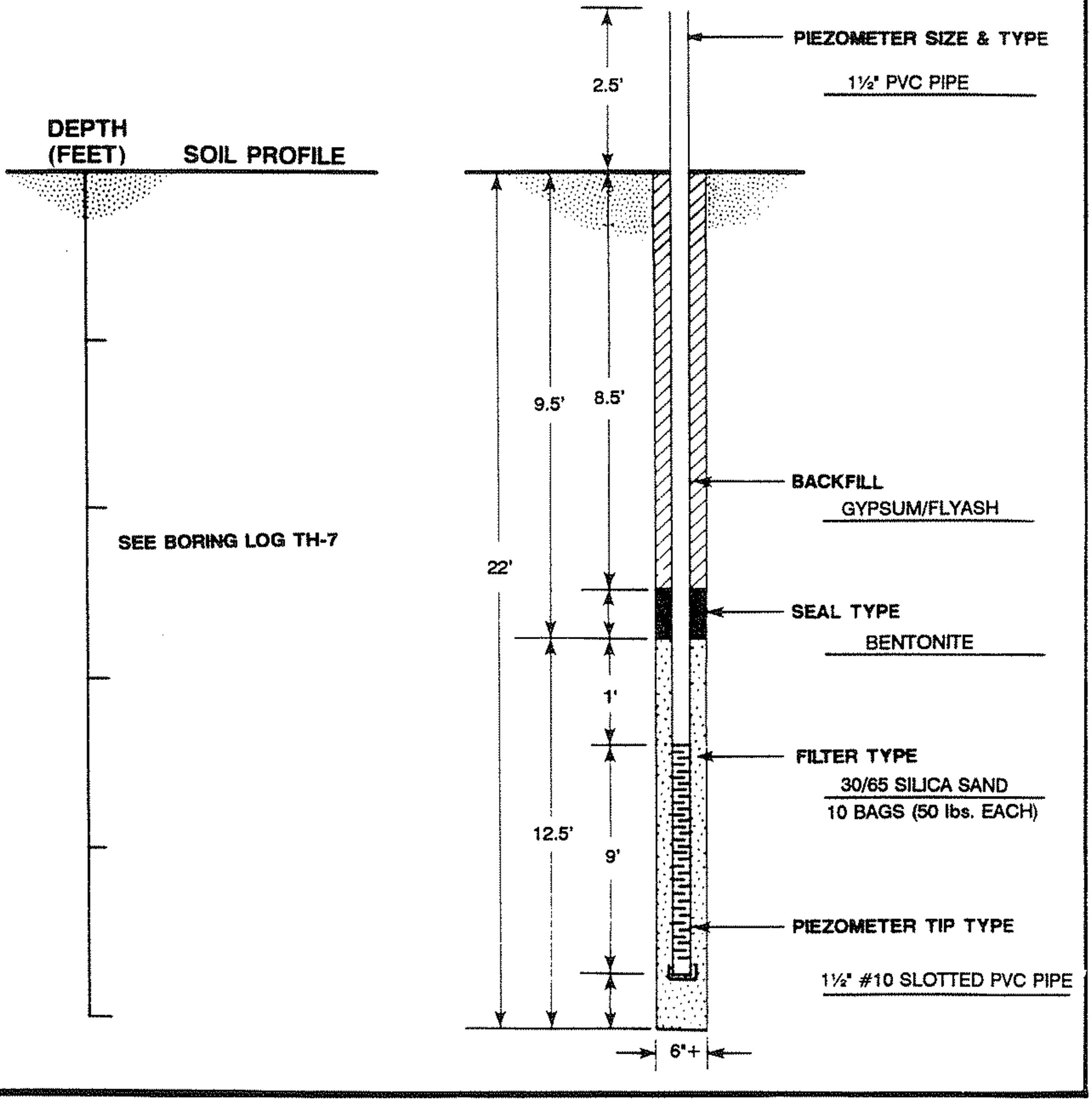
STATION NO: TH-7 PIEZOMETER NO: PZ-3 FILE NO: 90-13-059

CREW SUPERVISOR: H. ELLINGSWORTH DATE INSTALLED: NOV. 2, 1990

PIEZOMETER LOCATION: ADJACENT TO BORING TH-7

GROUND ELEVATION: 638.6'± PIEZOMETER TOP ELEV.: 641.1'±

REMARKS: HOLE DRILLED WITH POND WATER



PIEZOMETER SIZE & TYPE: 1½" PVC PIPE

BACKFILL: GYPSUM/FLYASH

SEAL TYPE: BENTONITE

FILTER TYPE: 30/65 SILICA SAND 10 BAGS (50 lbs. EACH)

PIEZOMETER TIP TYPE: 1½" #10 SLOTTED PVC PIPE

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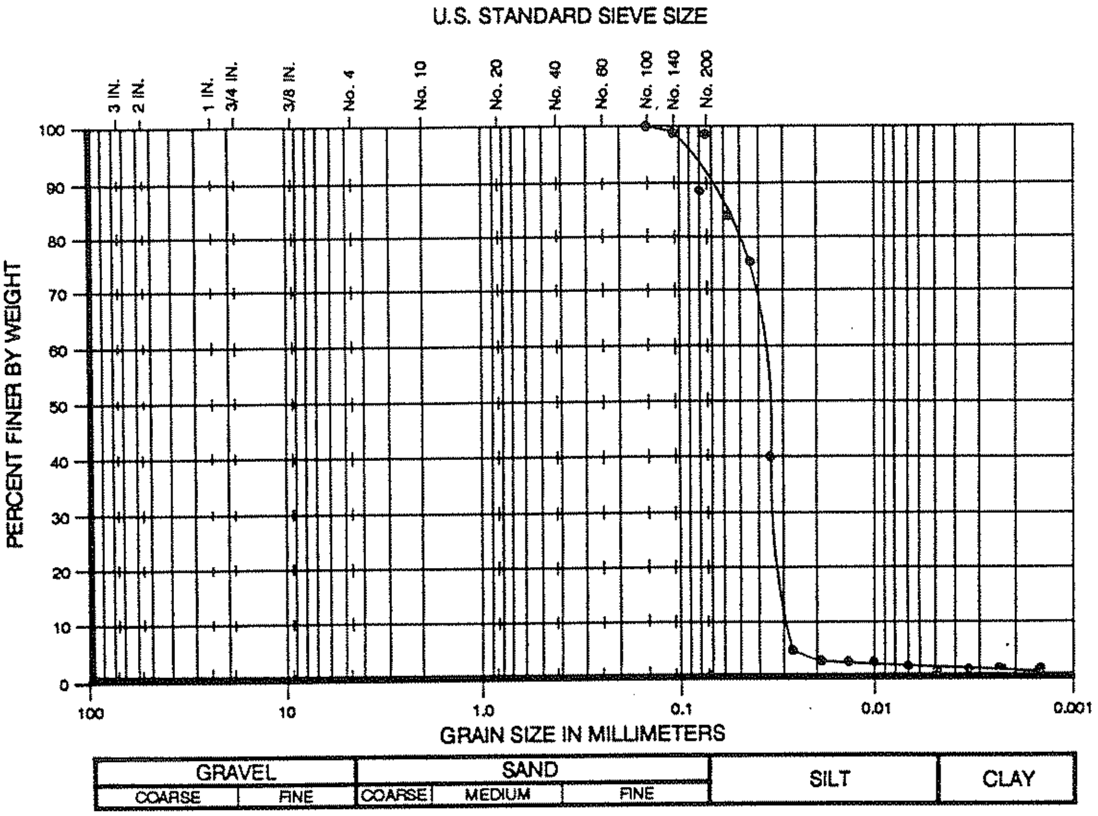
Appendix C

GRAIN SIZE DISTRIBUTION CURVES



TEST HOLE No	SAMPLE No.	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS.
TH-1	US-1	4.0'- 6.0'	●	GRAY GYPSUM-FLYASH	—

GRAIN SIZE DISTRIBUTION

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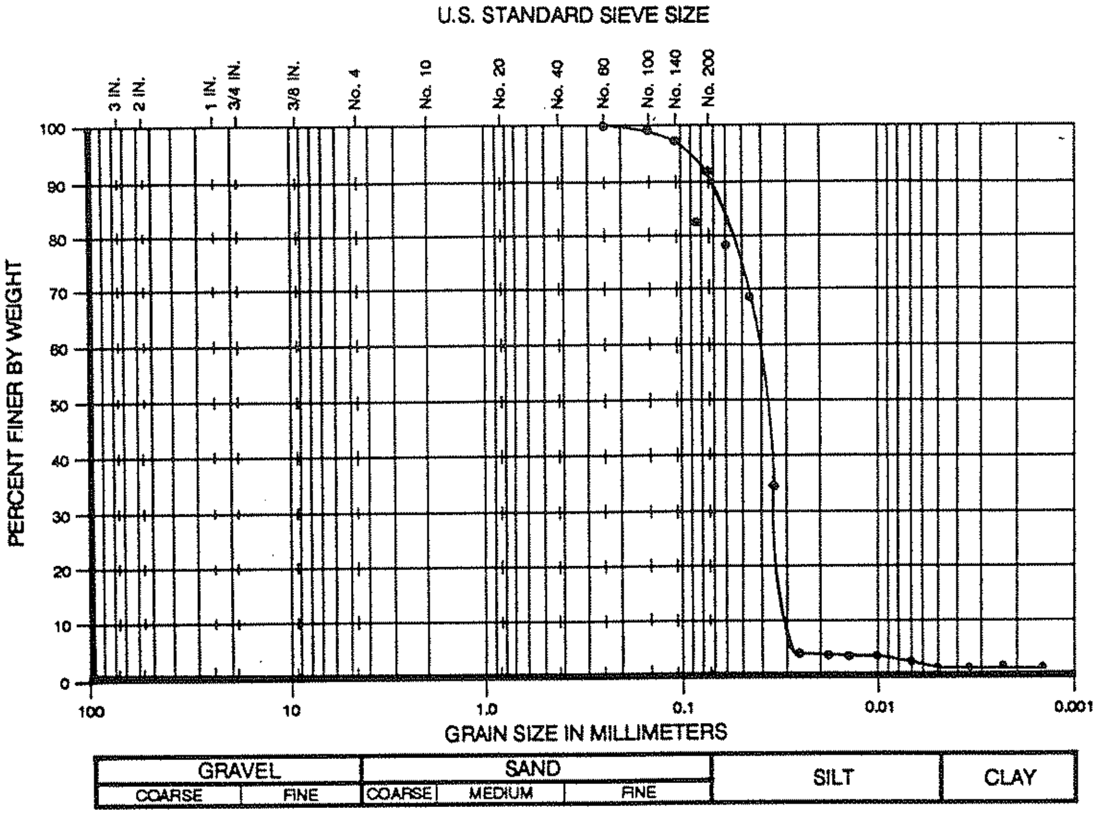
Consulting Engineers in Soil Mechanics,
Foundations and Material Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY: GRW	CHECKED BY: EJW	DATE: 4/18/91
FILE No.: 90-059	APPROVED BY:	

AO117 (1/90)

FIGURE C.1



TEST HOLE No	SAMPLE No.	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS.
TH-1	US-3	14.0'- 16.0'	●	**GRAY GYPSUM-FLYASH**	—

GRAIN SIZE DISTRIBUTION

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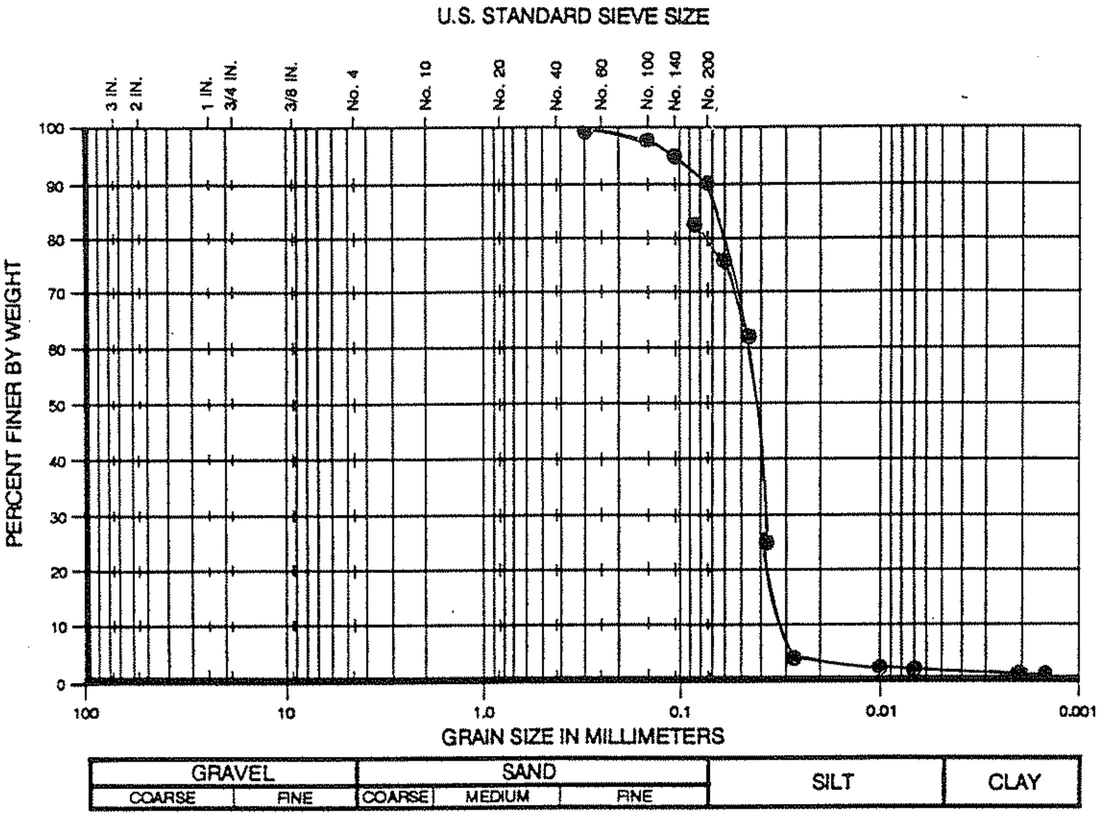
Consulting Engineers in Soil Mechanics,
Foundations and Material Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY: **GRW**	CHECKED BY: **EJW**	DATE: **4/18/91**
FILE No.: **90-059**	APPROVED BY: John E. Garlanger	

AO117 (1/90)

FIGURE C.2



TEST HOLE No	SAMPLE No.	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS.
TH-2	US-3	33.0'- 34.25'	●	DARK GRAY GYPSUM-FLYASH	—

GRAIN SIZE DISTRIBUTION

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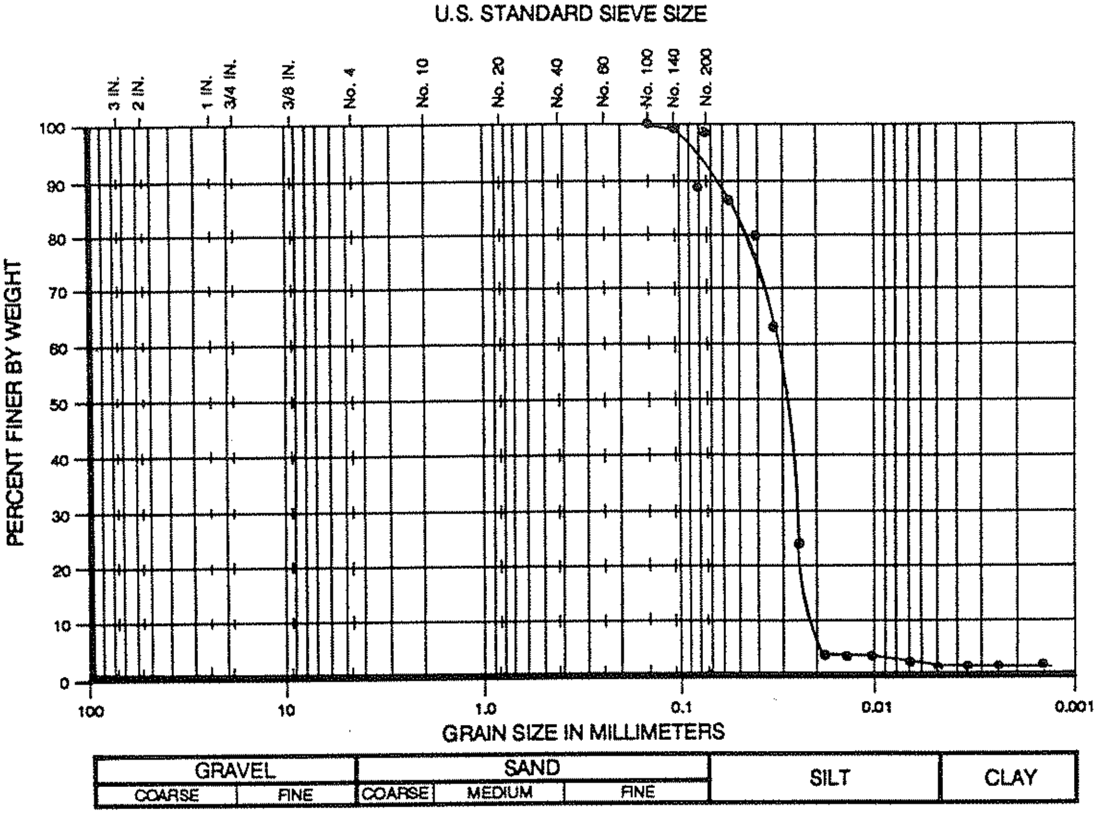
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY: GRW CHECKED BY EJW DATE: 4/18/91
FILE No.: 90-059 APPROVED BY:

AO117 (1/90)

FIGURE C.3



TEST HOLE No	SAMPLE No.	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS.
TH-4	US-1	6'-8'	●	DARK GRAY TO GRAYISH BROWN GYPSUM-FLYASH	—

GRAIN SIZE DISTRIBUTION

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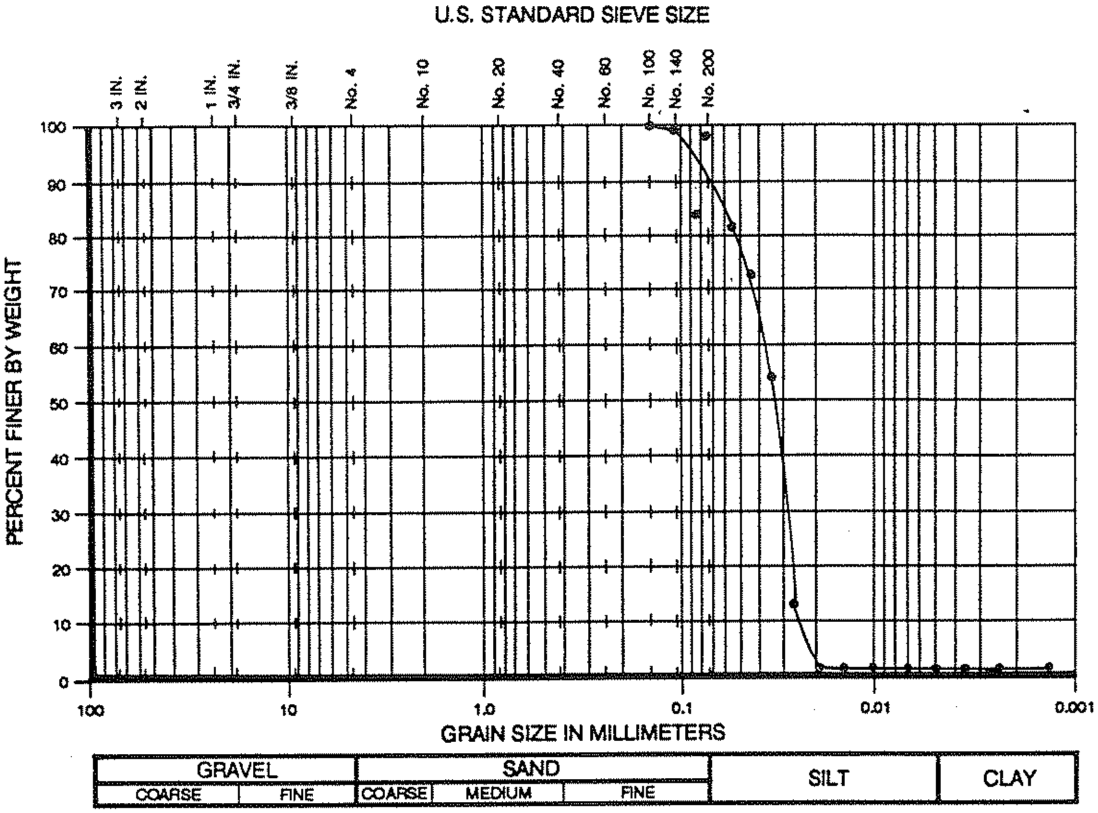
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY: **GRW** CHECKED BY: **EJW** DATE: **4/18/91**
FILE No.: **90-059** APPROVED BY:

AO117 (1/90)

FIGURE C.4



TEST HOLE No	SAMPLE No.	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS.
TH-4	**US-3**	14.0'- 16.0'	●	**DARK GRAY GYPSUM-FLYASH**	—

GRAIN SIZE DISTRIBUTION

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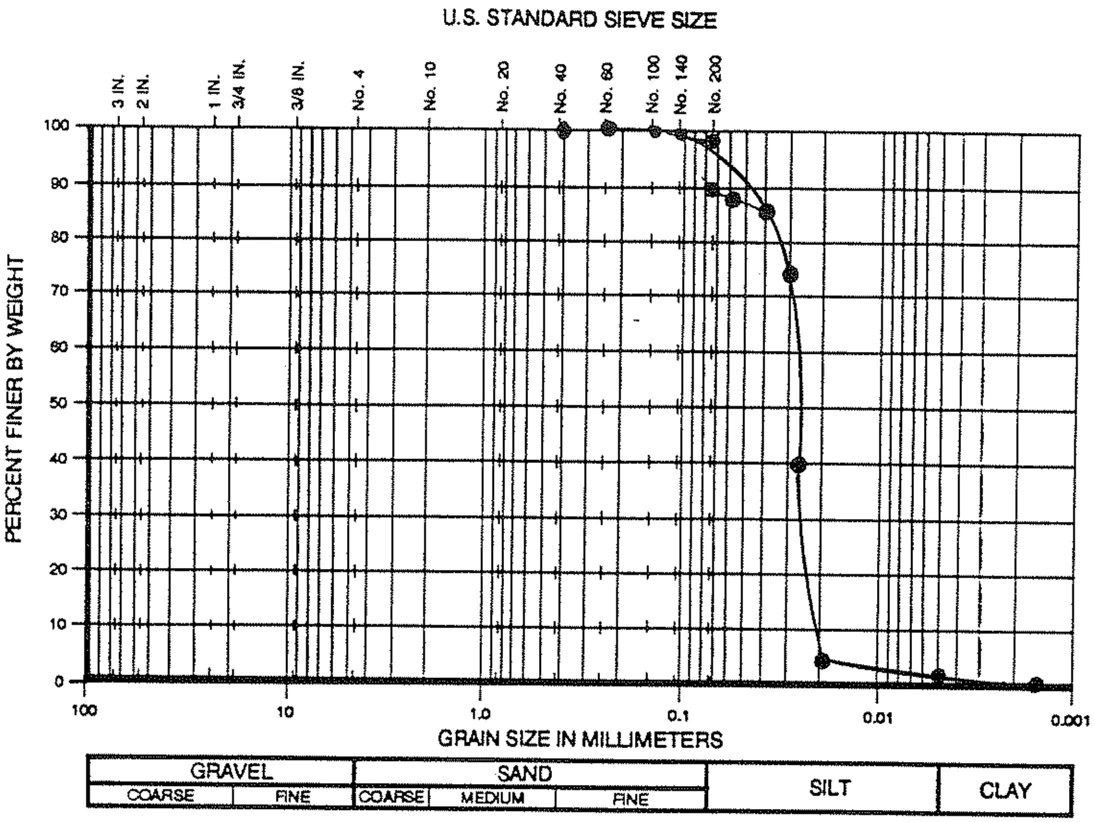
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY: **GRW**	CHECKED BY: **EJW**	DATE: **4/18/91**
FILE No.: **90-059**	APPROVED BY:	

FIGURE C.5



TEST HOLE No	SAMPLE No.	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS.
TH-6	US-2	14.0'- 16.0'	●	DARK GRAY GYPSUM-FLYASH	—

GRAIN SIZE DISTRIBUTION

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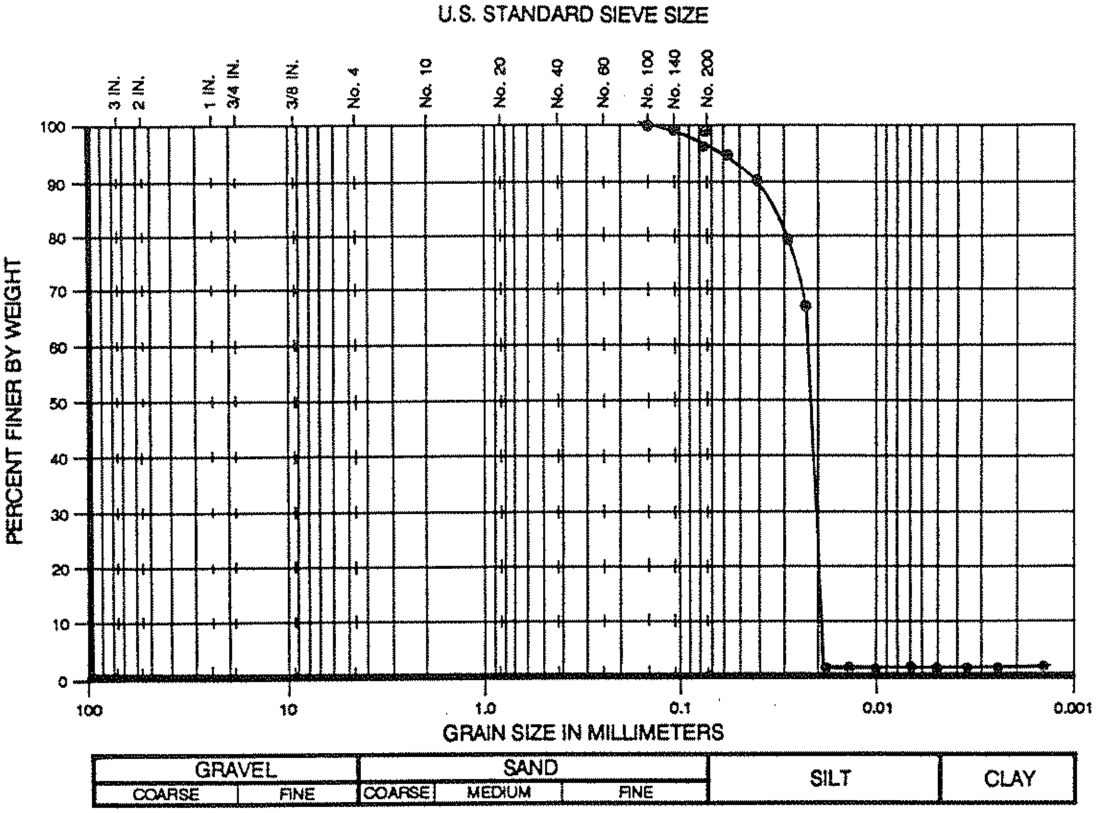
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY: GRW CHECKED BY: EJW DATE: 4/18/91
FILE No.: 90-059 APPROVED BY:

117 (1/90)

FIGURE C.6



TEST HOLE No	SAMPLE No.	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS.
TH-7	US-1	10.5'- 12.5'	●	**DARK GRAY GYPSUM-FLYASH**	———

GRAIN SIZE DISTRIBUTION

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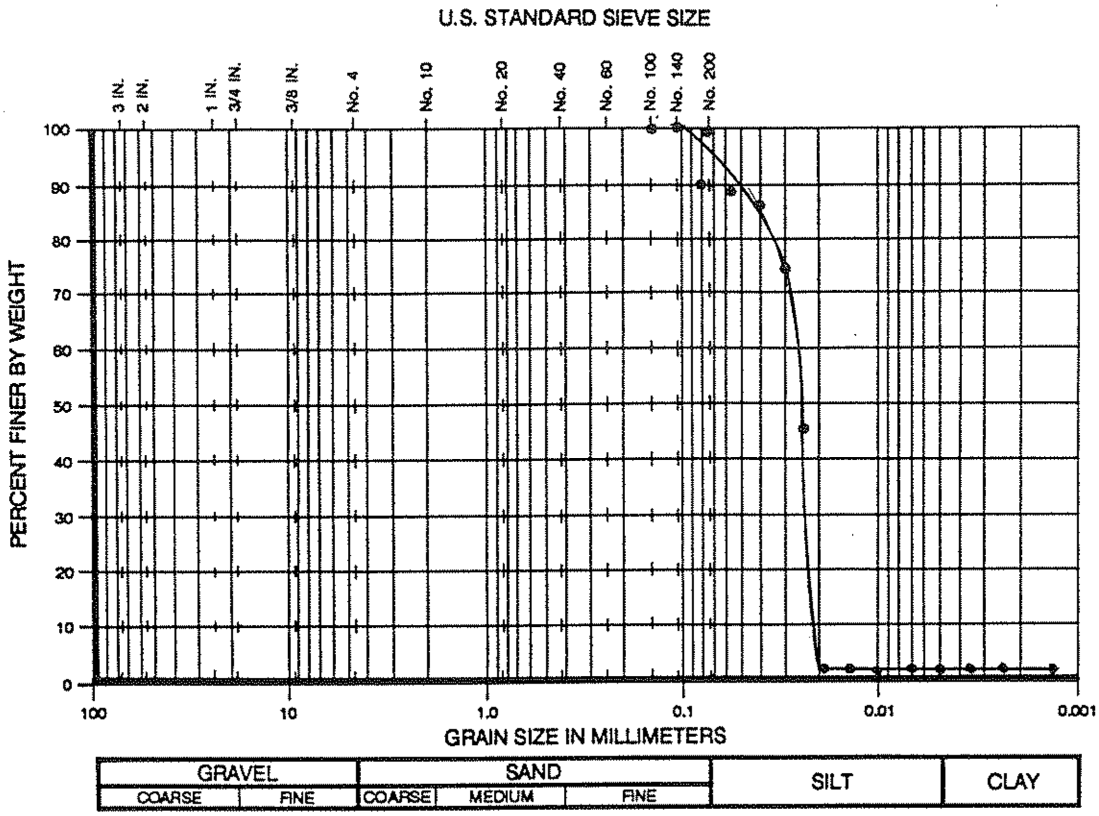
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY: **GRW**	CHECKED BY: **EJW**	DATE: **4/18/91**
FILE No.: **90-059**	APPROVED BY:	

AO117 (1/90)

FIGURE C.7



TEST HOLE No	SAMPLE No.	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS.
TH-7	US-3	18.5'- 20.0'	●	**DARK GRAY GYPSUM-FLYASH**	—

GRAIN SIZE DISTRIBUTION

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Consulting Engineers in Soil Mechanics, Foundations and Material Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY: **GRW**	CHECKED BY **EJW**	DATE: **4/18/91**
FILE No.: **90-059**	APPROVED BY:	

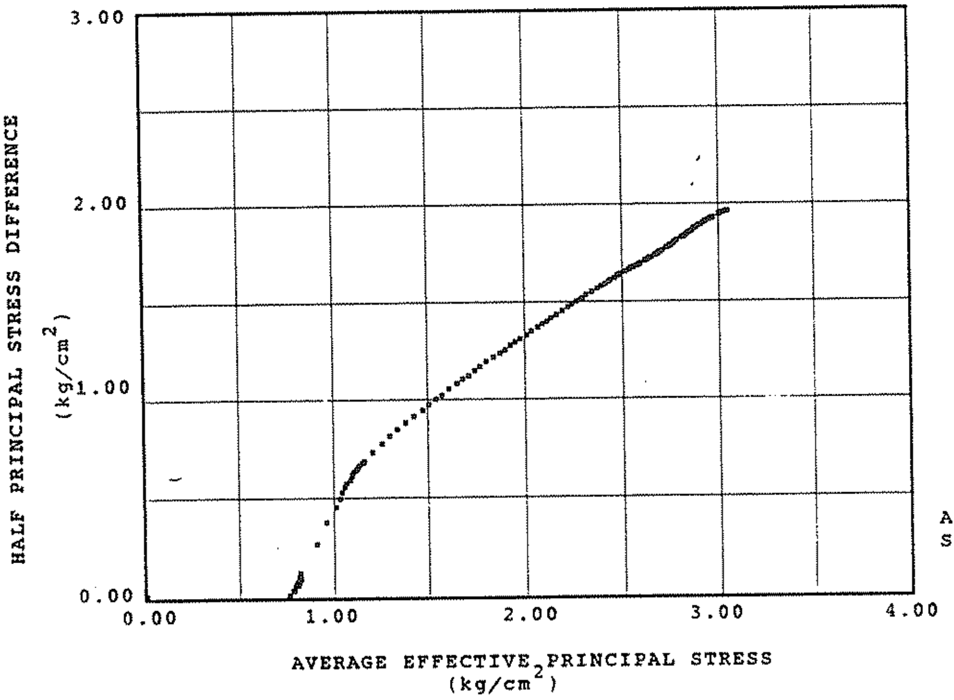
AO117 (1/90)

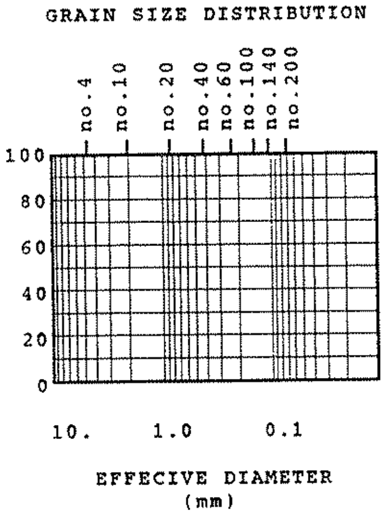
FIGURE C.8

Appendix D

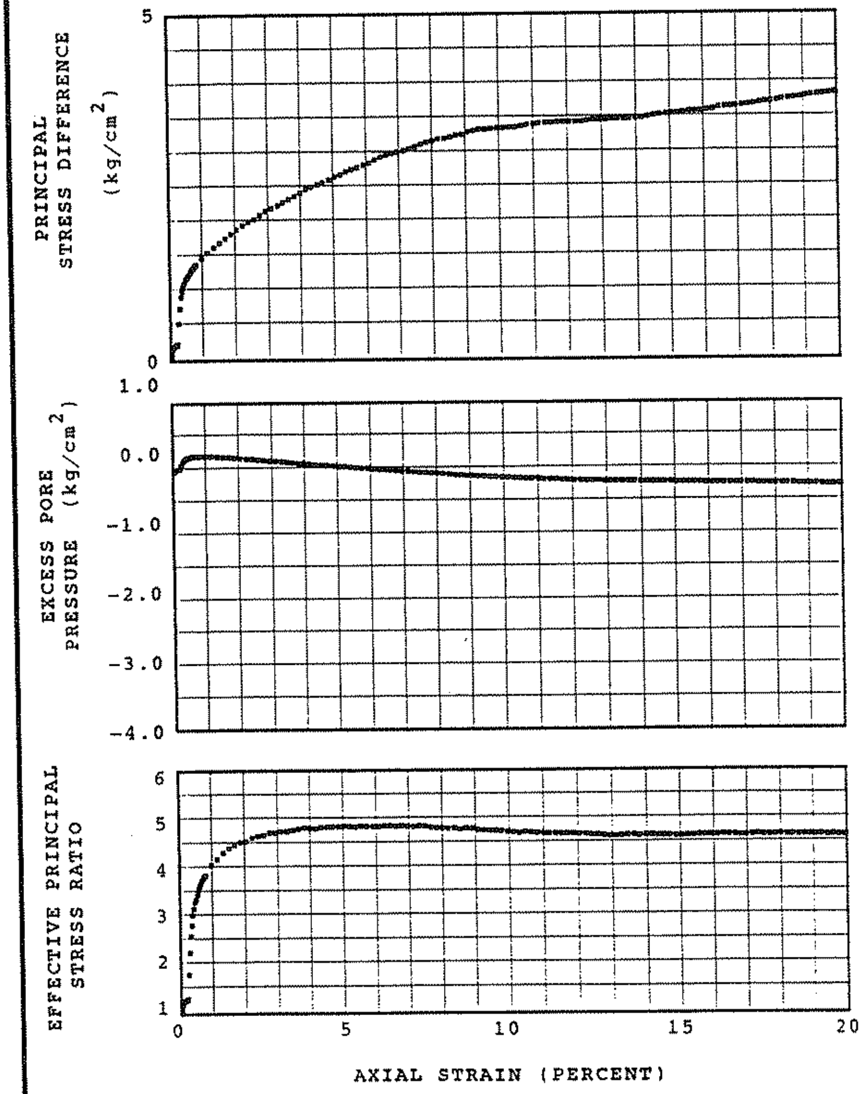
TRIAXIAL SHEAR TEST RESULTS

CONSOLIDATED - UNDRAINED TRIAXIAL COMPRESSION TEST





ASSUMED SPECIFIC GRAVITY 2.50
SAMPLE DESCRIPTION
Gypsum and flyash



SAMPLE ID
Th-2, US-4,
38-40'

TYPE OF SPECIMEN	Undisturbed
STRAIN RATE	1.10%/hr
EFFECTIVE CONSOLIDATION PRESSURE	0.7 kg/cm^2
BACK PRESSURE	12.0 kg/cm^2
INTIAL CONDITIONS	
WATER CONTENT	34.6%
DRY DENSITY	83.5 pcf
VOID RATIO	0.868
SATURATION	99.6%
PRE-SHEAR CONDITIONS	
WATER CONTENT	31.4%
DRY DENSITY	87.4 pcf
VOID RATIO	0.785
SATURATION	100.0%
B - FACTOR	99.3%
MAXIMUM STRESS RATIO	
AXIAL STRAIN	6.20%
σ'_1	3.63 kg/cm^2
σ'_3	0.73 kg/cm^2
A - FACTOR	0.01
MAXIMUM STRESS DIFFERENCE	
AXIAL STRAIN	21.60%
σ'_1	5.00 kg/cm^2
σ'_3	1.07 kg/cm^2
A - FACTOR	-.08

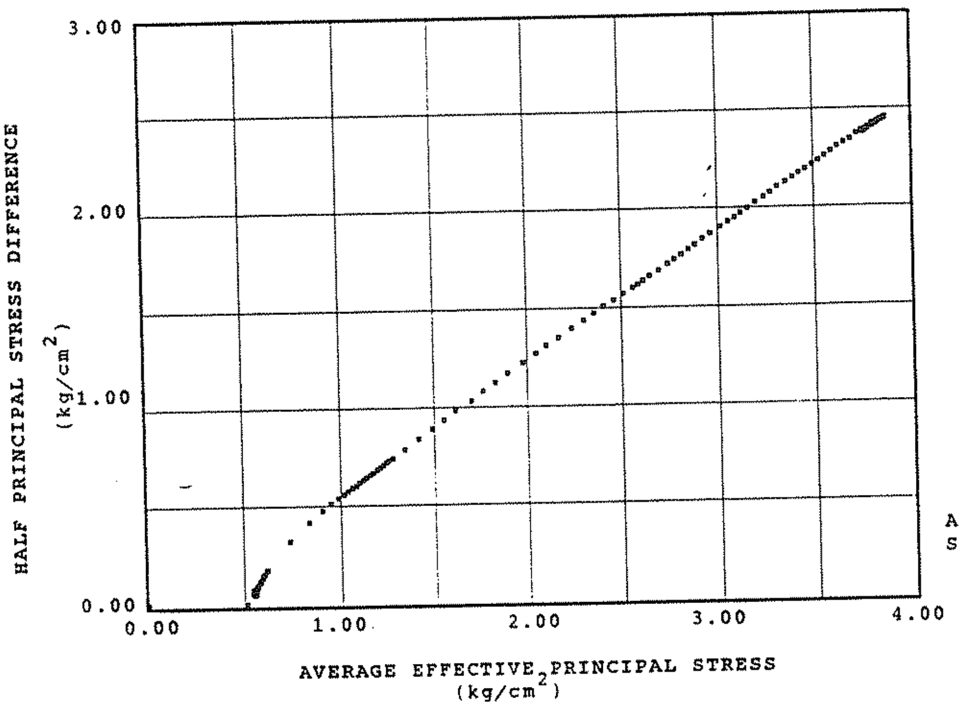
Ardaman & Associates Inc.
Consulting Engineers

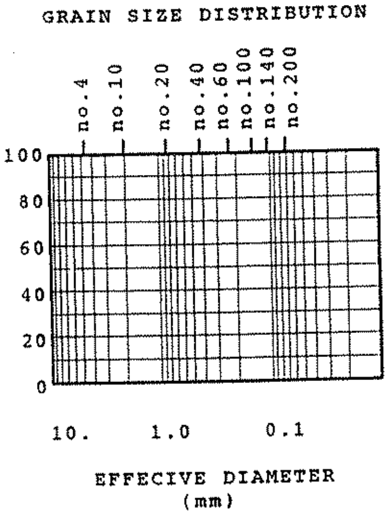
FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

CHECKED BY: EJW
DATE: 4/11/91
FILE NO. 90-059
APPROVED BY:

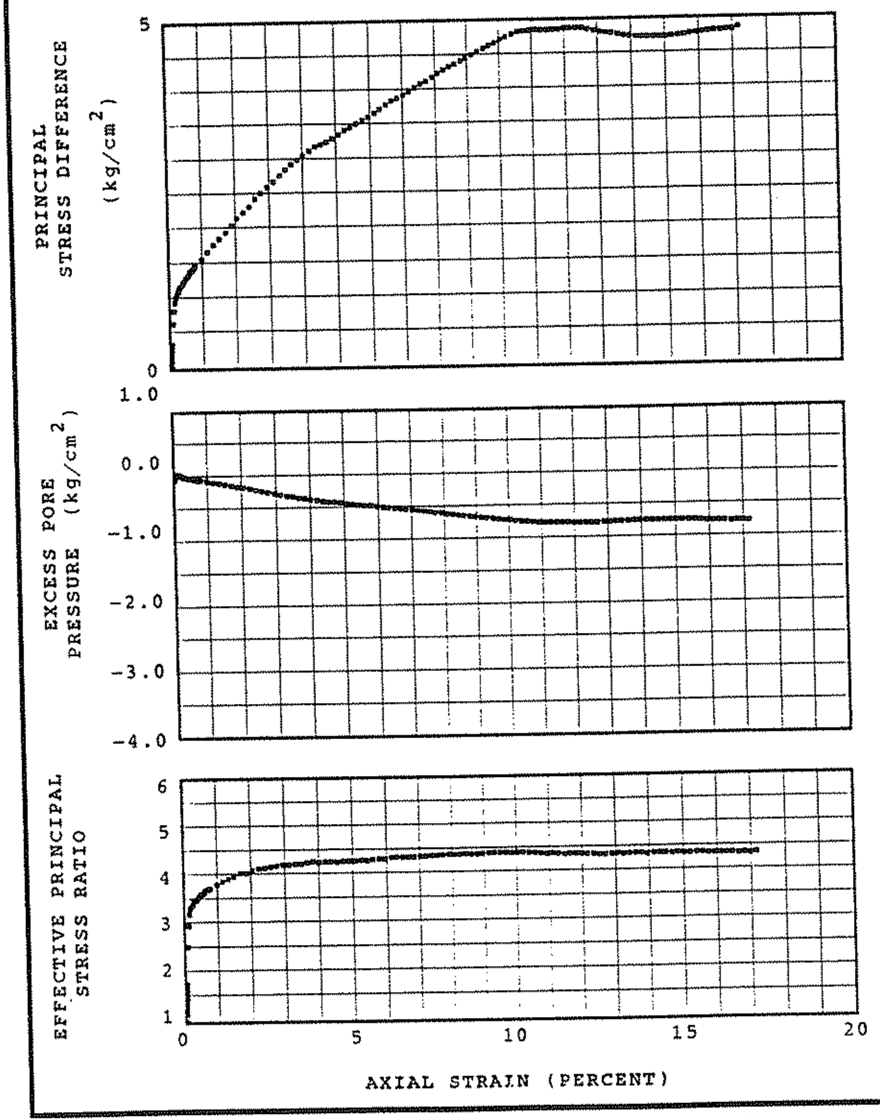
FIGURE D.2

CONSOLIDATED - UNDRAINED TRIAXIAL COMPRESSION TEST





ASSUMED SPECIFIC GRAVITY 2.50
SAMPLE DESCRIPTION
Gypsum and flyash



SAMPLE ID
Th-4, US-2,
ss#1, 9-11'

TYPE OF SPECIMEN	Undisturbed
STRAIN RATE	1.05%/hr
EFFECTIVE CONSOLIDATION PRESSURE	0.5 kg/cm^2
BACK PRESSURE	12.0 kg/cm^2
INTIAL CONDITIONS	
WATER CONTENT	24.8%
DRY DENSITY	93.4 pcf
VOID RATIO	0.670
SATURATION	92.5%
PRE-SHEAR CONDITIONS	
WATER CONTENT	20.7%
DRY DENSITY	102.8 pcf
VOID RATIO	0.518
SATURATION	100.0%
B - FACTOR	99.6%
MAXIMUM STRESS RATIO	
AXIAL STRAIN	9.62%
σ'_1	5.97 kg/cm^2
σ'_3	1.32 kg/cm^2
A - FACTOR	-.17
MAXIMUM STRESS DIFFERENCE	
AXIAL STRAIN	12.11%
σ'_1	6.31 kg/cm^2
σ'_3	1.41 kg/cm^2
A - FACTOR	-.18

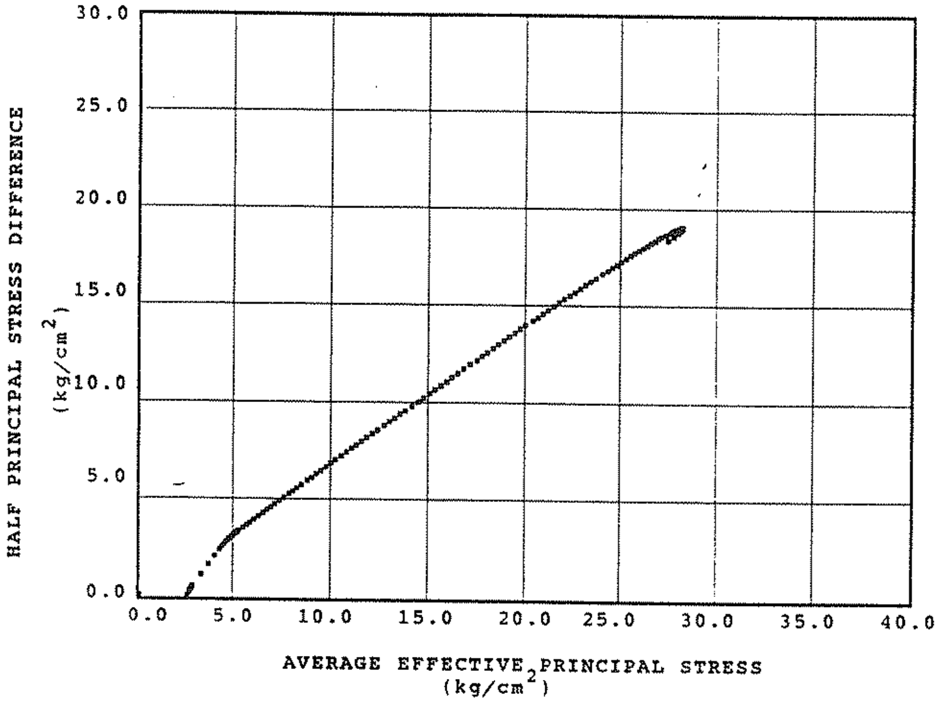
Ardaman & Associates Inc.
Consulting Engineers

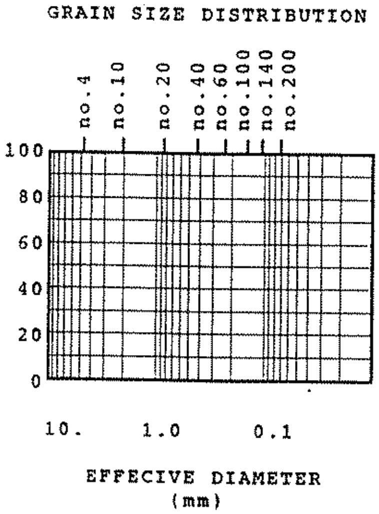
FGD GYPSUM-FLYASH WASTE WET-
STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

CHECKED BY: EJW DATE: 4/11/91
FILE NO. 90-059 APPROVED BY:

FIGURE D.3

CONSOLIDATED - UNDRAINED TRIAXIAL COMPRESSION TEST

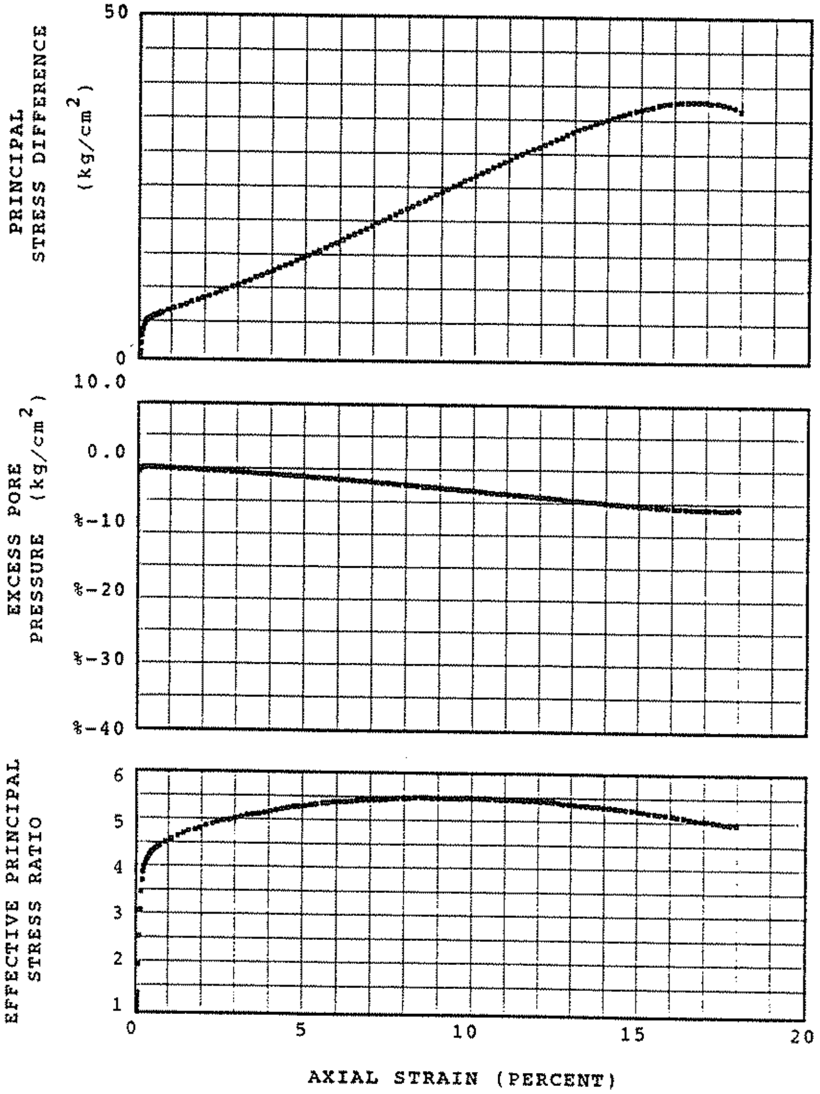




ASSUMED SPECIFIC GRAVITY 2.50

SAMPLE DESCRIPTION

Gypsum and flyash



SAMPLE ID

TH-4, us-4,
ss#1, 23-25'

TYPE OF SPECIMEN	Undisturbed
STRAIN RATE	0.92%/hr
EFFECTIVE CONSOLIDATION PRESSURE	2.5 kg/cm^2
BACK PRESSURE	11.5 kg/cm^2
INTIAL CONDITIONS	
WATER CONTENT	21.1%
DRY DENSITY	97.4 pcf
VOID RATIO	0.602
SATURATION	87.7%
PRE-SHEAR CONDITIONS	
WATER CONTENT	19.4%
DRY DENSITY	105.0 pcf
VOID RATIO	0.486
SATURATION	99.9%
B - FACTOR	99.1%
MAXIMUM STRESS RATIO	
AXIAL STRAIN	8.27%
σ'_1	27.85 kg/cm^2
σ'_3	4.95 kg/cm^2
A - FACTOR	-.11
MAXIMUM STRESS DIFFERENCE	
AXIAL STRAIN	16.49%
σ'_1	47.08 kg/cm^2
σ'_3	9.04 kg/cm^2
A - FACTOR	-.17

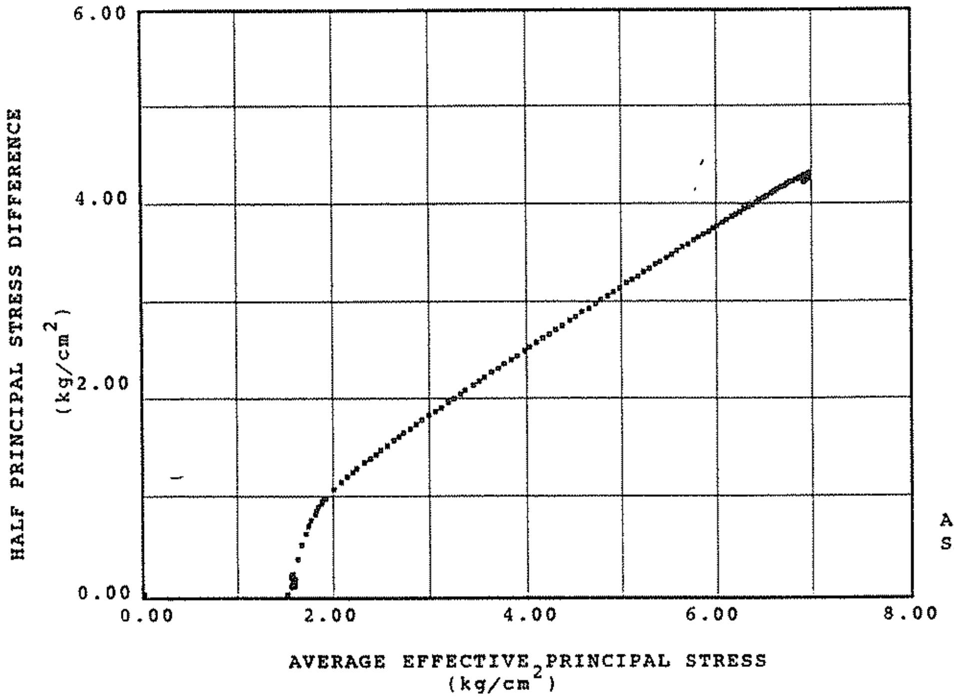
Ardaman & Associates Inc.
Consulting Engineers

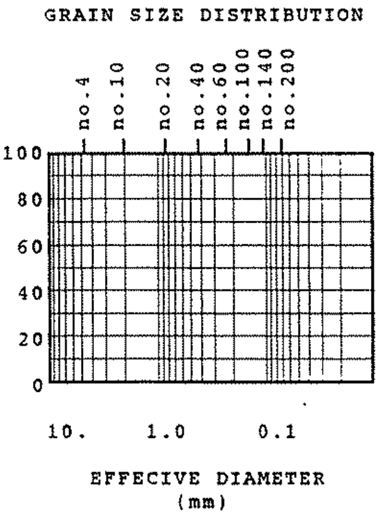
FGD GYPSUM-FLYASH WASTE WET-
STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

CHECKED BY: EJW
DATE: 4/11/91
FILE NO. 90-059
APPROVED BY: BJ

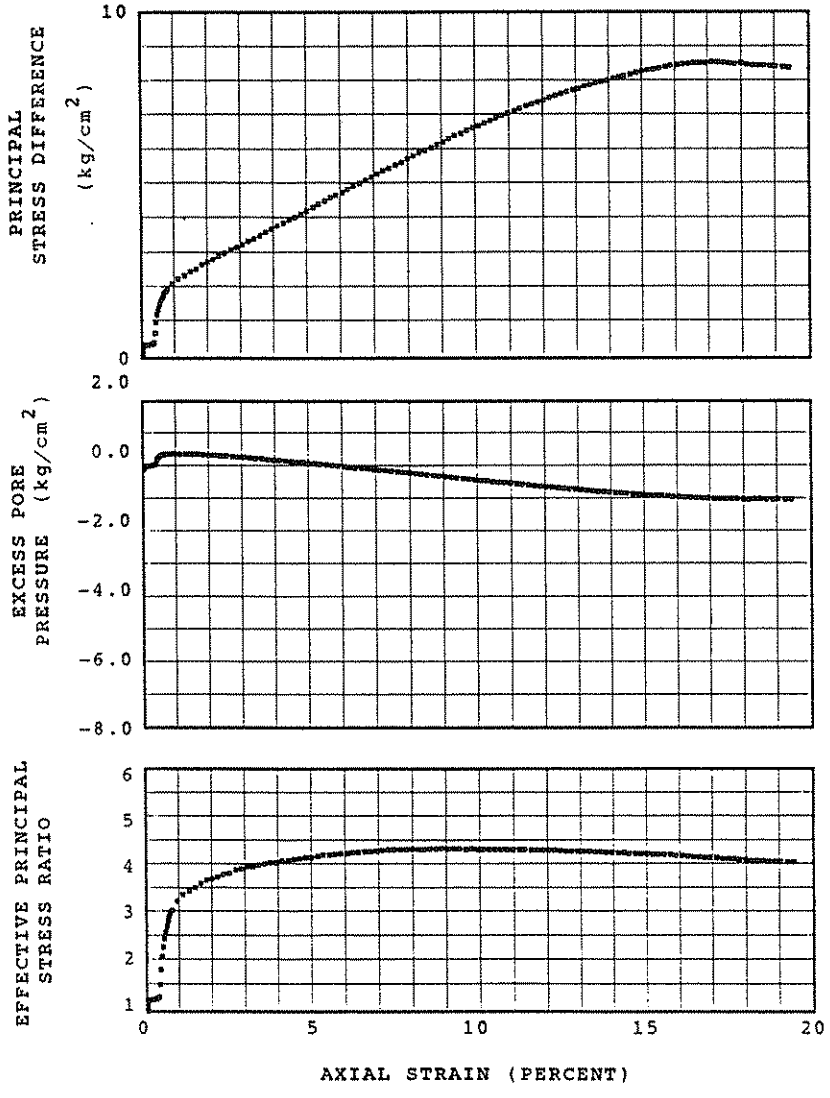
FIGURE D.4

CONSOLIDATED - UNDRAINED TRIAXIAL COMPRESSION TEST





ASSUMED SPECIFIC GRAVITY 2.50
SAMPLE DESCRIPTION
Gypsum and flyash



SAMPLE ID
Th-7, US-1,
10.5-12.5'

TYPE OF SPECIMEN	Undisturbed
STRAIN RATE	1.05%/hr
EFFECTIVE CONSOLIDATION PRESSURE	1.5 kg/cm^2
BACK PRESSURE	12.0 kg/cm^2
INTIAL CONDITIONS	
WATER CONTENT	23.1%
DRY DENSITY	96.5 pcf
VOID RATIO	0.617
SATURATION	93.7%
PRE-SHEAR CONDITIONS	
WATER CONTENT	20.9%
DRY DENSITY	102.5 pcf
VOID RATIO	0.522
SATURATION	100.0%
B - FACTOR	99.8%
MAXIMUM STRESS RATIO	
AXIAL STRAIN	8.81%
σ'_1	7.98 kg/cm^2
σ'_3	1.80 kg/cm^2
A - FACTOR	-.04
MAXIMUM STRESS DIFFERENCE	
AXIAL STRAIN	17.04%
σ'_1	11.25 kg/cm^2
σ'_3	2.65 kg/cm^2
A - FACTOR	-.13

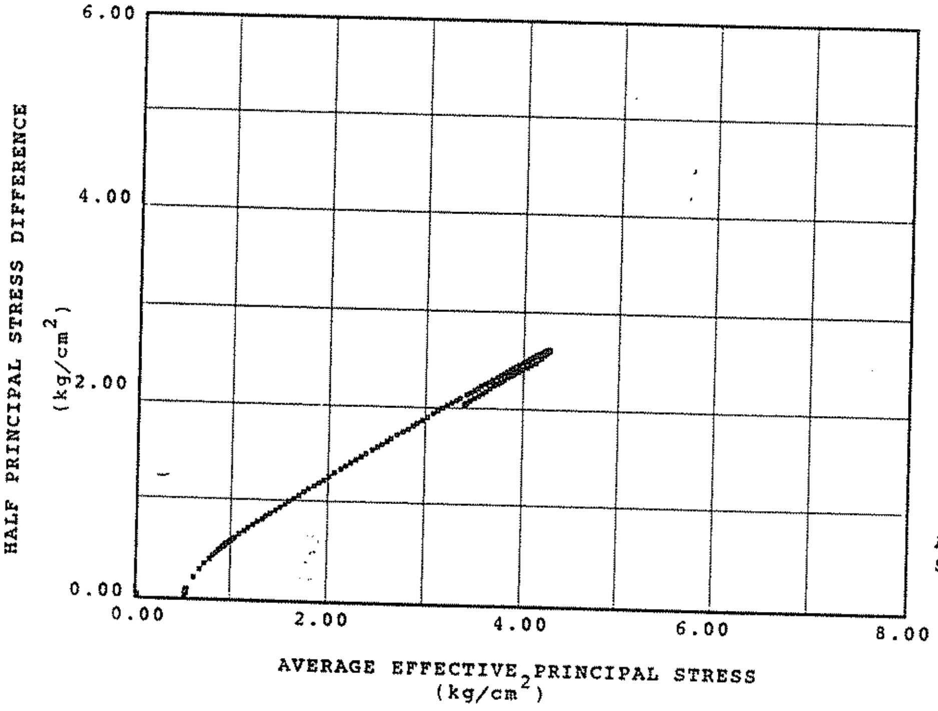
Ardaman & Associates Inc.
Consulting Engineers

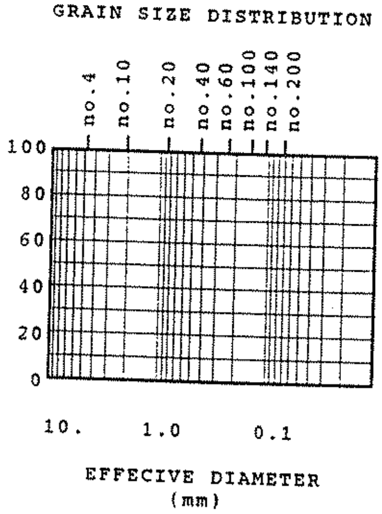
FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

CHECKED BY: EJW DATE: 4/11/91
FILE NO. 90-059 APPROVED BY:

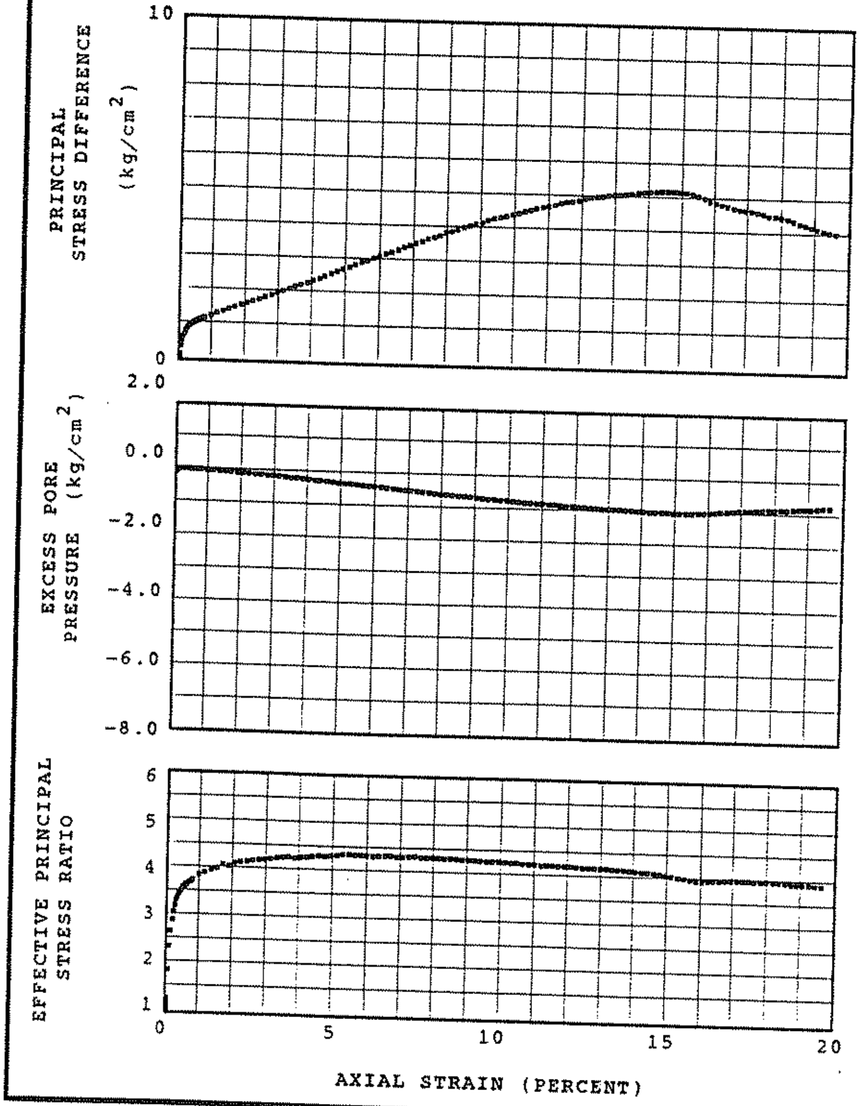
FIGURE D.5

CONSOLIDATED - UNDRAINED TRIAXIAL COMPRESSION TEST





ASSUMED SPECIFIC GRAVITY 2.50
SAMPLE DESCRIPTION
Gypsum and flyash



SAMPLE ID
Th-7, US-3,
18.5-20.5'

TYPE OF SPECIMEN	Undisturbed
STRAIN RATE	1.07%/hr
EFFECTIVE CONSOLIDATION PRESSURE	0.5 kg/cm^2
BACK PRESSURE	12.0 kg/cm^2
INTIAL CONDITIONS	
WATER CONTENT	24.2%
DRY DENSITY	95.7 pcf
VOID RATIO	0.630
SATURATION	96.0%
PRE-SHEAR CONDITIONS	
WATER CONTENT	21.7%
DRY DENSITY	101.1 pcf
VOID RATIO	0.543
SATURATION	99.9%
B - FACTOR	98.6%
MAXIMUM STRESS RATIO	
AXIAL STRAIN	5.23%
σ'_1	3.69 kg/cm^2
σ'_3	0.83 kg/cm^2
A - FACTOR	-.11
MAXIMUM STRESS DIFFERENCE	
AXIAL STRAIN	14.35%
σ'_1	6.84 kg/cm^2
σ'_3	1.62 kg/cm^2
A - FACTOR	-.21

Ardaman & Associates Inc.
Consulting Engineers

FGD GYPSUM-FLYASH WASTE WET-
STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

CHECKED BY:	EJW	DATE:	4/11/91
FILE NO. 90-059		APPROVED BY:	

FIGURE D.6

Proposed Management Plan
Widows Creek Gypsum-Flyash Storage Facility
Stevenson, Alabama
Contract No. 90PKA-89214B

Ardaman & Associates, Inc.

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Ardaman & Associates, Inc.

Consultants in Soils, Hydrogeology,
Foundations and Materials Testing

June 18, 1991
File No. 90-059

Tennessee Valley Authority
2 North 83A Blue Ridge Place
Chattanooga, Tennessee 37402-2801

Attention: Mr. J. S. Baugh

Subject: Proposed Management Plan for the Widows Creek Gypsum-Flyash Storage Facility, Stevenson, Alabama, Contract No. 90PKA-89214B

Gentlemen:

This report contains recommendations for design and operation of the 80-acre, Phase II gypsum-flyash disposal area, as outlined in "Task C" of our proposal dated April 12, 1990, and authorized by your Contract No. 90PKA-89214B. As it is our understanding that Pond 1 of the Phase I stack is not currently being used for slurry disposal, the management plan for continued use of the Phase I gypsum-flyash disposal area previously presented in our report of April 22, 1991 has been modified slightly and is also presented herein. In particular, the initial rim-ditch constructed across the north side of Pond 1 will not be required and can be eliminated.

The attached drawings and descriptions illustrate the proposed management plan for the continued use of the Phase I stack and the transition into the Phase II compartment, using the proposed underdrain option and 3.0 horizontal to 1.0 vertical side slopes. A current topographic map of the existing area was not available and some of the stack elevations presented herein may be assumed and approximate only. The management figures are conceptual in nature and some of the illustrated features are not necessarily to scale.

This report has been prepared for the exclusive us of TVA in accordance with generally accepted geotechnical engineering practices for specific application to the above referenced project. No other warranty, expressed or implied, is made.

If you have any questions or require additional information, please contact the undersigned or Mr. Thomas S. Ingra, P.E.

Very truly yours,
ARDAMAN & ASSOCIATES, INC.

Bill E Jackson

Bill E. Jackson, P.E.
Senior Project Engineer

John E. Garlanger

John E. Garlanger, Ph.D., P.E.
Principal

BEJ/bj:cc

3B-90059.BEJ

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Introduction

Under the proposed "Task C", TVA will be provided with the required slope at which the Phase II stack should be constructed to attain a top elevation of 750 feet (MSL), an operation plan including the use of compartments and rim-ditches necessary to fill the Phase II area and the expected life of the proposed Phase II area based upon TVA projected plant utilization factors and corresponding waste generation rates. If necessary, revisions to the layout/height of the Phase II area earthen starter dikes were to be addressed to optimize operation/filling of the area.

Based on the results of the engineering evaluation of the Phase I gypsum-flyash disposal facility presented in our report of April 22, 1991, the existing stack is being raised too steeply (see topographic map presented as Figure 1) to realize overall stability at the proposed final height (i.e., elevation 750 feet) and localized seepage and erosion related instability of the stack side slopes is also occurring at the current, lower elevations. The two primary controlling factors in the overall stability of the stack are the relatively low strength of the clay foundation soils and the high phreatic surface and seepage gradients within the saturated gypsum-flyash mass. The strength of the sedimented, gypsum-flyash materials is not a limiting factor in the overall stability of the stack.

To achieve the desired final top-of-stack elevation of 750 feet (MSL), while staying within the proposed lateral limits of the stack, will require that the stack be raised with an average side slope of approximately 3.0 horizontal to 1.0 vertical. The stability analyses performed and documented in our report of 22 April indicate that positive seepage control will be required at this slope to maintain a factor of safety equal to or greater than 1.5.

A conceptual design modification to the stack geometry to achieve this end is presented in the 22 April report. In general, this design calls for the use of underdrains to lower the phreatic surface within the stack and to control seepage from the side slopes. The average side slope of 3.0 horizontal to 1.0 vertical is achieved by using a series of steeper slopes with intervening setbacks and benches for control of surface runoff and erosion. Figure 2 presents a typical cross section of the stack showing the proposed conceptual plan. This geometry is used in the stack management plan presented herein.

Proposed Management Plan

Figures 3 through 17 illustrate our recommendations for operating Phases I and II of the Widows Creek gypsum-flyash stack using the underdrain option discussed above. Key elements illustrated in these figures and general operating considerations are discussed below.

Upstream Method of Construction and Rim-Ditch Operations

The upstream method of construction using wet cast gypsum-flyash excavated from the pond with a dragline is apparently working well near the slurry input point on the west end of Pond No. 1 of the Phase I storage area. It is our understanding, however, that TVA has generally been unable to effectively handle the soft and wet sedimented materials at the remote, east end of the stack.

With the single-point slurry discharge procedures currently being used, the sedimented deposits at the remote end of the stack are generally comprised of the finer grained materials which are inherently less pervious (i.e., take longer to drain), lower in strength and generally more difficult to handle than the coarser materials that settle more rapidly near the slurry input point. If conventional, upstream methods of construction are to be used (i.e., wet casting with either a dragline or backhoe excavator) it will be necessary to deposit coarser materials at the remote end of the stack. The rim-ditch mode of operation is one way to achieve this end.

In the rim-ditch mode of operation, the gypsum-flyash slurry is made to flow in an elevated ditch around the inside of the stack perimeter. The coarser particles tend to settle in the rim-ditch while the finer fraction of the gypsum-flyash slurry is directed to the center of the pond through sluices cut in the inside bank (berm) of the rim-ditch. The rim-ditch concept of operation will be fully successful only if the rim-ditch is elevated above the ponded water level in the interior of the pond. Elevating the ditch accelerates dewatering of the deposits in the rim-ditch (i.e., the coarser particle sizes) and facilitates more rapid excavation and construction of each new lift of the starter dike.

The TVA gypsum-flyash mixture may be more erodible than conventional gypsums without flyash, and additional water level control structures will probably be required to prevent the inner berm of the rim-ditch from being eroded down to the pond elevation when discharging through the sluice cuts. We, therefore, recommend that a temporary decant structure be provided at each discharge point from the rim-ditch into the pond to minimize the effects of erosion and to maintain the desired elevation differential. With a control structure in place, for example, the base elevation for erosion in the rim-ditch will be the control elevation of the structure (i.e., weir elevation). Without a control structure, the elevation of the pond will become the control elevation for erosion in the rim-ditch.

If TVA is unable to effectively implement the rim-ditch mode of operation, an alternate slurry distribution system will be required to distribute the coarser materials to the remote end of the stack. Without an adequate slurry distribution system, it will be necessary to either provide extended periods for dewatering and drying of the fine-grained materials at the remote, low end of the stack or to continuously haul materials to raise these portions of the dike.

Wet cast materials are inherently more stable than dozer pushed or loosely placed and uncompacted moist materials that can become "bulked" and are subject to collapse upon wetting. We recommend that every effort be made to construct the perimeter and rim-ditch dikes with wet cast materials. If continued raising of the dike at the remote end of the site with hauled fill, however, is required, we recommend that the hauled materials be wetted and compacted sufficiently to preclude sudden collapse or large settlements when the material is inundated.

A piped slurry distribution system with multiple discharge points around the perimeter of the stack may be used as an alternative to the rim-ditch method of distribution. Piped distribution systems are easy to operate once in place but must be raised with each lift of the dike. Disadvantages include initial equipment costs (i.e., pipes and control valves) and additional pumping costs when discharging at remote locations in the pond.

We strongly recommend that TVA attempt to refine and utilize the rim-ditch mode of operation. This effort will probably require more frequent monitoring of stack operations and daily construction and maintenance of the rim-ditch and starter dikes. The stack management plan presented herein assumes a rim-ditch mode of operation.

Design Criteria

According to the August 1990 topographic map provided by TVA, the average flow slope of the sedimented gypsum-flyash in the easternmost compartment of Pond 1 of the Phase I stack is approximately 4.5 feet vertical per 1000 feet horizontal. An average slope of 5.0 feet vertical per 1000 feet horizontal was assumed for the model presented in this report. Slopes in the immediate vicinity of the slurry input, however, are typically slightly steeper, with slopes at the remote end of the stack being slightly flatter. Actual deposition slopes will vary from those shown and field adjustments of the rim-ditch and starter dike grade may be required.

A gypsum-flyash production rate of 2886 tons per day was provided by TVA. Dry densities of the inplace deposits in Pond 1 of the Phase I compartment were measured and reported in our report of April 22, 1991. The average density of all the sedimented gypsum-flyash samples measured during that study was 91.5 pounds per cubic foot (pcf). The density of the sedimented materials will not be a constant but will vary as the height of the stack increases (i.e., as the height of the stack increases, the sedimented materials at the base of the stack will be compressed by the weight of the overlying deposits, thereby increasing the average density of the mass). An initial average density of 90.0 pcf and a final, end-of-life average density of 92 pcf was assumed and used for the volume computations presented in this report.

Staged Construction Techniques

Figures 3 through 17 illustrate our recommendations for continued operation of the Phase I storage compartment and transition into and operation of the Phase II compartment. The model assumes that underdrains are used to lower the phreatic surface within the stack and to provide positive seepage control for the side slopes of the stack. An average stack side slope of 3.0 horizontal to 1.0 vertical, similar to that discussed above, is also assumed. Key steps illustrated in these figures include the following:

Stage No. 1

1. Install underdrains on top of the existing stack. Installation of the outfall pipes will be coordinated with regrading and shaping of the stack side slopes.

2. Clean the perimeter ditch and flatten side slopes of the stack to the geometry proposed in Figures 4.3 through 4.6 of the preliminary design report. Spoil from this operation will be used to construct the new starter dike and rim-ditch for the stack. The slopes on the north side of Pond 1 do not need to be flattened (i.e., only the perimeter slopes that will form the outside of the final stack geometry will be flattened). Vegetation used for slope erosion control should be placed as soon as possible after the slopes are shaped to the final grade.

3. A working bench not less than 15 feet wide will be provided at the toe of the stack for installation of the toe drain. Toe drain installation techniques will depend on the seepage conditions existing at the toe at the time of construction. If the toe is very wet, a continuous trencher which will support the sides of the trench and allow continuous feed of the drain

pipe and filter gravel will probably be required. Utilization of a filter fabric around this type of drain is generally not feasible and a special, graded filter gravel will be required. If the slope is dry enough to support an open excavation, we recommend that a filter fabric be used around the filter gravel.

4. The cross dike in Pond 2 should be constructed at some time during this stage of operation. The crest elevation of the cross dike should be consistent with that of the existing divider dike and the new dike should tie into the toe of the north wall slope of the existing gypsum-flyash stack.

Stage No. 1a

1. A new starter dike and rim-ditch will be constructed of the spoil removed during reshaping the side slope of the stack. Wet cast materials are generally preferred for construction of the starter dike and rim-ditch to minimize "bulking" that can contribute to collapse and rapid erosion during initial wetting and slurry flow in the ditch. As wet materials will most likely not be available, it is anticipated that the first new starter dike and rim-ditch will have to be wetted and compacted as necessary to achieve the desired minimum density (will need to be determined).

   The side slopes of the rim-ditch below the anticipated water line should be no steeper than 3.0 horizontal to 1.0 vertical. The initial slope of the rim-ditch should be similar to the existing top slope of the stack but in no case should the initial trial slope be less than 5 feet vertical to 1000 feet horizontal.

2. Temporary decants will be installed at the approximate locations shown. These decants should have adjustable weir boards, similar to that conceptually shown on the attached Figure 9 from one of our previous reports, or some other mechanism to control or completely block flow through the structure.

3. The dikes on the north side of Pond 1 should be raised by three to five feet using material excavated from within the existing pond with a hydraulic excavator or backhoe. Here again, wetting and compaction of this material may be required if the excavated materials are not sufficiently wet to prevent bulking.

4. Flow slurry in the new rim-ditch constructed on the south side of Pond 1, discharging into Pond 2a (i.e., east end of Pond 2), and observe performance of the ditch and slurry flow. Excavate and adjust the slope of the ditch as necessary to maintain the desired flow without producing excessive scour in the ditch. This will be a trial and error operation and the results of this testing will determine the feasibility of using the rim-ditch method of slurry distribution for the remainder of the stack operations.

Stage No. 2

1. When the east end of Pond 2a is based out in gypsum to an elevation near that of the perimeter earthen starter dike, direct slurry discharge back into Pond 1 from the west end of the new rim-ditch. Pull all of the boards from the decant from Pond 2a and allow the pond to dry sufficiently to install the underdrains across the east end of the pond. These

drains can alternately be installed initially at a lower elevation during the Stage No. 1 construction phase using a design similar to that proposed for the Phase II compartment.

2. The perimeter ditch at the toe of the Pond 2a stack should be cleaned and made continuous with the ditch on the east end of Pond 1.

3. The active decant will be near the center of the north wall of Pond 1 and will discharge directly into the new Clarification Pond (i.e., the west end of Pond 2, designated as Pond 2b). The new pond should be used, primarily, for final clarification. An effort, therefore, should be made to keep sufficient water in Pond 1 to provide primary clarification and deposition of the majority of the solids in Pond 1 to prevent Pond 2b from being filled too rapidly with solids.

4. The rim-ditch on the south side of Pond 1 should be cleaned and raised. Reslurry and discharge from various locations around the south wall rim-ditch may be required to raise the base elevation of the stack if the rim-ditch needs to be raised more than about three to five feet. (Note the maximum height of the inner berm of the rim-ditch will be a function of the berm width and seepage/erosion characteristics of the TVA gypsum-flyash and will need to be determined by trial and error.)

Stage No. 3

1. Direct slurry through the south wall rim-ditch to the east end of Pond 2a and start raising the rim-ditch across the east end of area 2a. Temporary slurry discharges back into Pond 1 may be required to facilitate initial construction of the rim-ditch.

2. The addition of a second decant in the southwest corner of Pond 2a will help distribute sedimented materials more uniformly across the pond and will facilitate construction of the rim-ditch across the north side to the northwest corner (i.e., when discharging from the rim-ditch at the northwest corner of the pond, decant from the southwest corner).

3. Raise the dikes on the north wall of Pond 1 as necessary while discharging through the rim-ditch on the south wall.

Stage No. 4

1. Continue alternating slurry discharges between Ponds 1 and 2a until the Phase II stack is ready for use. The stack geometry illustrated on the attached figure for Stage No.4 is the anticipated geometry after about 8 months of slurry operations. As illustrated, the average stack elevation in Pond 1 is near 660 feet (MSL) and in Pond 2a it is near 640 feet (MSL). The actual elevations will vary, depending on the sequence of operations used, and may differ significantly from those illustrated.

2. The preliminary underdrain layout for Phase II is also shown on this figure. For ease of construction, the underdrains for Phase II can be installed in conjunction with the perimeter dike construction and be placed in the natural ground foundation soils instead of in the gypsum, as was done in Phase I. The Phase II drains, if constructed in this manner, will not

function initially but will only flow when the gypsum elevation is raised above the elevation of a relief ditch constructed around the perimeter of the area.

3. Figure 7 illustrates the conceptual underdrain relief detail. In general, the proposed underdrain outfall pipes will be buried in the foundation soils and the earthen perimeter dike to minimize the risk of damage during slurry distribution and during excavation and construction of the new starter dike with sedimented materials. Outfalls from the underdrains will be non-slotted pipes laid in such a manner as to form a continuous loop between underdrain sections to facilitate clean out and maintenance of the drains, if required.

4. As an alternative to the proposed underdrain system (i.e., drain placed in foundation soils at base of stack), the underdrains may be placed at a later date in the surface of the sedimented gypsum-flyash materials using a procedure similar to that used in the Phase I compartment. An advantage of this alternative is a reduction in the initial capital expenditures associated with the Phase II construction.

5. Detailed design of the underdrains is still required. The drawings and locations presented herein are conceptual and are intended for preliminary cost estimating purposes only.

Stage No. 5

1. A second slurry discharge line will be added to initially introduce gypsum-flyash slurry into the southwest corner of the Phase II pond (hereafter referred to as Pond 3).

2. Prior to slurring into Pond 3, the west end of the toe ditch on the north side of Pond 2a will be cleaned and improved and cut into the clarification pond (i.e., Pond 2b) and a temporary decant installed near the center of the Pond 3 south wall. The east end of the toe ditch may be filled or blocked as necessary to prevent flow in that direction. We understand that the normal operating elevation of the return water stilling basin and the clarification pond are near elevation 613 feet (MSL). The decant, therefore, will need to be set at a location that can accommodate water elevations from approximately 612 feet (MSL) upward.

3. It should be noted that, initially, there will be no return water flow from slurry input into Pond 3, unless the area is initially charged with clear water. Without internal divider dikes, we estimate that initially charging Pond 3 to elevation 613 feet (MSL) could require as much as 300 acre-feet of water. If this water can not be consumed within the system or otherwise used, it will have to be discharged at a later date as the area is filled with sedimented gypsum-flyash and the water is displaced. If the operating level in the stilling basin can be lowered, the operating level of the Pond 3 decant can also be lowered and the volume of water required to initially charge the area can be reduced.

4. During operation of Pond 3, the rim-ditch along the south and east sides of Ponds 1 and 2a should be cleaned and the dikes raised as necessary.

Stage No. 6

1. When the sedimented gypsum deposits at the west end of Pond 3 approach the crest elevation of the earthen starter dike, slurry discharge should be routed through the rim-ditch

on the south side of Pond 1 and into the southeast corner of Pond 3. Decant will still be through the south wall of Pond 3 into the clarification pond, 2b.

2. While discharging slurry from the southeast corner of Pond 3, a ditch should be excavated in the sedimented deposits on the west side of the site. This ditch will initially be used as a rim-ditch for routing slurry across the north side of the pond but will later be converted to the permanent return water and underdrain seepage collection ditch. Material excavated from the ditch will be cast inboard and will be used to form the new gypsum-flyash starter dike for the stack.

Stage No. 7

1. After the ditch on the west side of Pond 3 has been excavated, slurry will again be discharged into the southwest corner of the area and will be directed along the north wall by the new ditch.

2. As the ditch fills; additional increases in elevation near the slurry input end will be required to move the discharge point from west to east along the north wall. For elevation increases above the original earthen starter dike, a new gypsum-flyash starter dike and elevated rim-ditch will be required. Alternately, the elevation of the original starter dike can be raised by stacking gypsum-flyash against the upstream face of the dike. This material, however, will need to be removed at a later date when the permanent return water ditch is constructed.

Stage No. 7a

1. The base elevation of the sedimented deposits on the west side of the site can be raised by installing weir boards in the decant spillway and allowing the water level in the area to rise. The boards can be raised gradually (i.e., maintain only enough water in the area to provide the desired clarification) to minimize the quantity of water required to achieve the desired higher elevation. If necessary, the decant can be moved farther to the east to improve water clarity.

Stage No. 8

1. Slurry into Ponds 1 and 2a and decant into the clarification pond.

2. Continue to clean and raise the starter dike and rim ditch along the west end of Pond 3. If the height of the rim-ditch or inner berm fill becomes to high and difficult to construct or maintain, it may be necessary to periodically discharge into the center of the pond from the west end of the stack to build up the base elevation of the sedimented material supporting the rim-ditch.

Stage No. 9

1. Return slurry discharge point to the west end of Pond 3 and continue to extend deposits along the north wall.

2. Alternate slurry discharge points between Ponds until the rim-ditch on the north side of Pond 3 is beyond the mid point of the wall.

Stage No. 10

1. Slurry into Ponds 1 and 2a.

2. Clean and excavate a permanent return water ditch on north side of Pond 3.

3. Install a decant that will discharge water from the new return water and underdrain relief ditch into the stilling basin.

4. Install a temporary decant into the return water ditch on the north side of Pond 3.

Stage No. 11

1. Slurry directly into Pond 2b (i.e., the old clarification pond) with the decant backflowing through the control structure on the north wall of Pond 2a, into Pond 3. Water displaced from pond 2b will be discharged into Pond 3 and can either be stored there (i.e., by adjusting weir board height on the north wall decant structure) or allowed to flow through to the stilling basin.

2. The ultimate goal at this point is to fill Pond 2b to an elevation similar to that of Ponds 1 and 2a and convert these three small areas into one large area. Two ponds consisting of the Phase I and Phase II areas would then be available for alternating use.

3. The central decant on the south wall of Pond 3 would continue to be used by maintaining an elevated ditch that would discharge through another control structure into the stilling basin. The two phases would physically abut with a small divider dike being maintained at about the location of the existing earthen starter dike. No attempt should be made to operate the areas as two separate stacks, as this method is highly inefficient and greatly reduces the available storage volume.

4. When discharging from the rim-ditch on the north side of Pond 3, the decant on this wall can be temporarily removed and the decant on the south wall of Pond 3 will be the active decant. When discharging from the east end of Pond 3, either decant location could be used.

Stage No. 12

1. This stage conceptually illustrates the stack configuration when Pond 2b is filled to approximately Elevation 620 feet (MSL). An elevated decant ditch will be maintained on the north side of Pond 2b as the stack rises.

2. After Pond 2b has dried sufficiently to afford access, shape the toe ditch to the desired geometry and install underdrains across the west side of the pond in a manner similar to that previously used for Pond 1.

3. Pond 2b will be raised at approximately the same rate as Pond 3 until the elevation reaches that of Pond 2a. This operation will require intermittent discharges into Ponds 2b and 3. The divider dike between the two ponds should align with the original earthen starter dike separating the Phase I and Phase II compartments. The area north of Pond 2a will be raised in conjunction with Pond 2b by maintaining a berm on the east end of the toe ditch and periodically discharging slurry into the area. A temporary decant or cut in the dike near the east end of Pond 2a may be required to facilitate this operation.

Final

1. The geometry illustrated in this figure represents the approximate geometry of the stack at the average final design elevation of 750 feet (MSL), as conceptually illustrated in Figures 4.3 through 4.6 of our interim report dated 22 April, 1991. Although not shown, the top of the stack will, in fact, slope from west to east, away from the slurry input points.

Storage Volumes and Life

From the original, natural ground topographic map provided by TVA and the proposed final stack geometry presented in Figure 17, we estimate that the total storage volume of the stack will be approximately 13,300 acre-feet. At the current design gypsum-flyash production rate of 2,886 tons per day provided by TVA and assuming an average material dry density of 92 pounds per cubic foot established from the recent testing, the computed storage volume of 13,300 acre-feet should be sufficient for a total storage life of approximately 25 years.

The following table lists the approximate operating time periods for each of the stages presented in the proposed management plan. These times are approximate only and may differ from that shown due to variations in the slope of the sedimented deposits, natural ground elevations, perimeter dike heights, actual patterns of distribution, plant operating periods and other factors. Operating times were estimated using an annual gypsum-flyash production rate of 2886 tons per year with an average production volume of 1.5 acre-feet per day.

STAGE	TIME	TOTAL TIME
4	8 Mon.	8 Mon.
5	5 Mon.	13 Mon.
6	2 Wks.	13.5 Mon.
7	2 Wks.	14 Mon.
7a	2 Mon.	16 Mon.
8	3 Wks.	
9	2 Wks.	
10	3 Wks.	18 Mon.
11 (El 620)	3 Mon.	21 Mon.

Closure

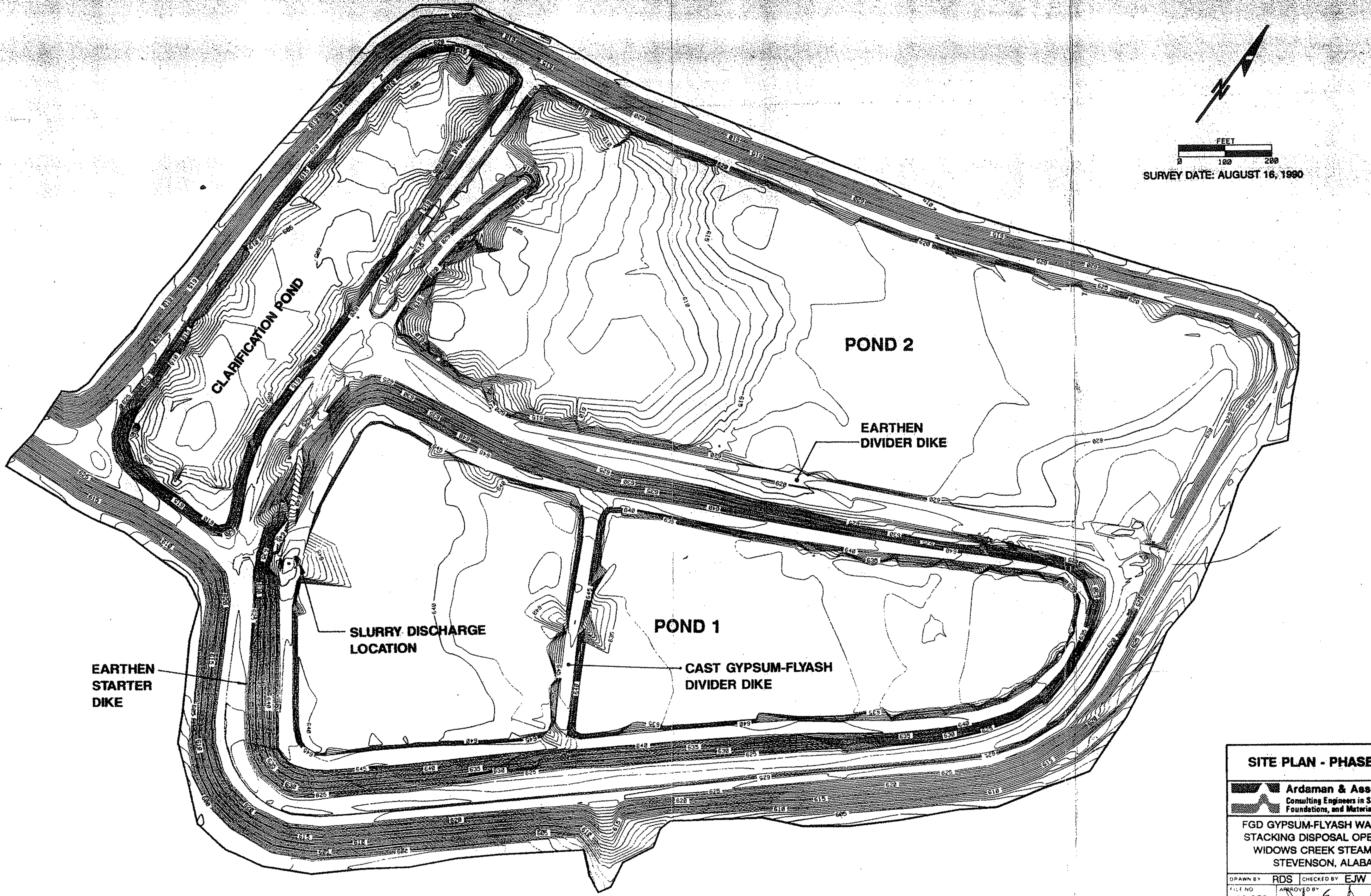
Rim-ditching is a proven technology in the phosphate industry (i.e., phospogypsum) but little experience, other than pilot plant studies, is available on the use of the rim-ditch method in gypsum-flyash ponds. Based on our visual inspection and testing of the TVA gypsum-flyash, however, we see no reason why rim-ditching at your facility will not be effective, if properly implemented.

It takes a concerted effort to initially establish the proper slopes and elevations on the rim-ditch and, once established, the ditch must be continuously maintained and the slope adjusted as necessary to achieve the desired flow distances. It is our opinion that the rim-ditch method offers a economical method of slurry distribution and that TVA should make a concerted effort to properly implement the method prior to going to alternative methods of distribution.

An alternative to the rim-ditch is a piped slurry distribution system. This method is also used in the phosphate industry, primarily in cold weather areas where maintenance of the rim-ditch during the colder winter months is not feasible. An advantage of the piped distribution system is that routine maintenance of the rim-ditch is eliminated. The perimeter dike, however, must be raised just as frequently and the piped distribution system must also be raised in conjunction with the dike. Initial cost of the pipe and control valves and additional pumping costs associated with head loss in the pipes is another consideration.

The cross sections and conceptual design figures presented in our report April 22, 1991 are not intended to be a final design and are conceptual only. The illustrated phreatic surface is that required to achieve a stability factor of safety equal to or greater than 1.5. To achieve the desired factor of safety, the drains will have to be designed to produce a similar phreatic surface. Drain design was outside Ardaman's original scope of services and has not been completed to date.

The number and offset distances of the drains and the drain construction details will need to be determined by detailed design. The drain designs and details presented herein are conceptual only and are presented only for purposes of establishing preliminary cost estimates. To effectively predict the phreatic surface, the detailed drain design should include graphical flow net analyses of the stack at the proposed geometry, considering permeability and anisotropic variations in the gypsum-flyash deposits at various stack heights.



SITE PLAN - PHASE I AREA

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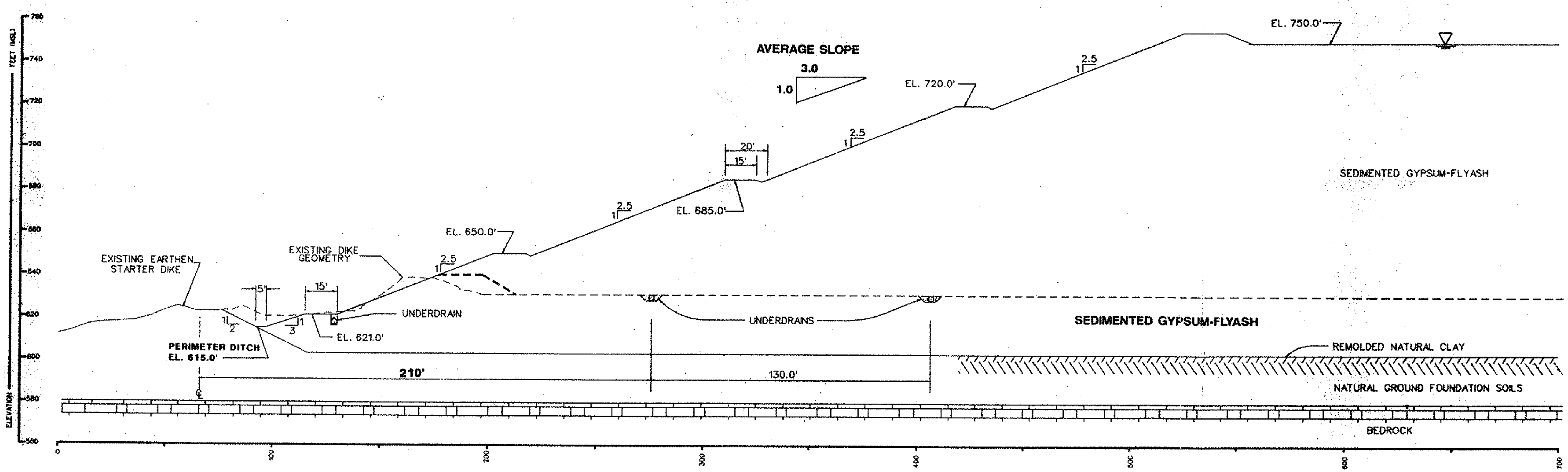
FGD GYPSUM-FLYASH WASTE WET-
STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY RDS
CHECKED BY EJW
DATE 4/11/91
FILE NO 90-059
APPROVED BY John E.

FIGURE 1



TYPICAL CROSS SECTION

SCALE: 1"=50'

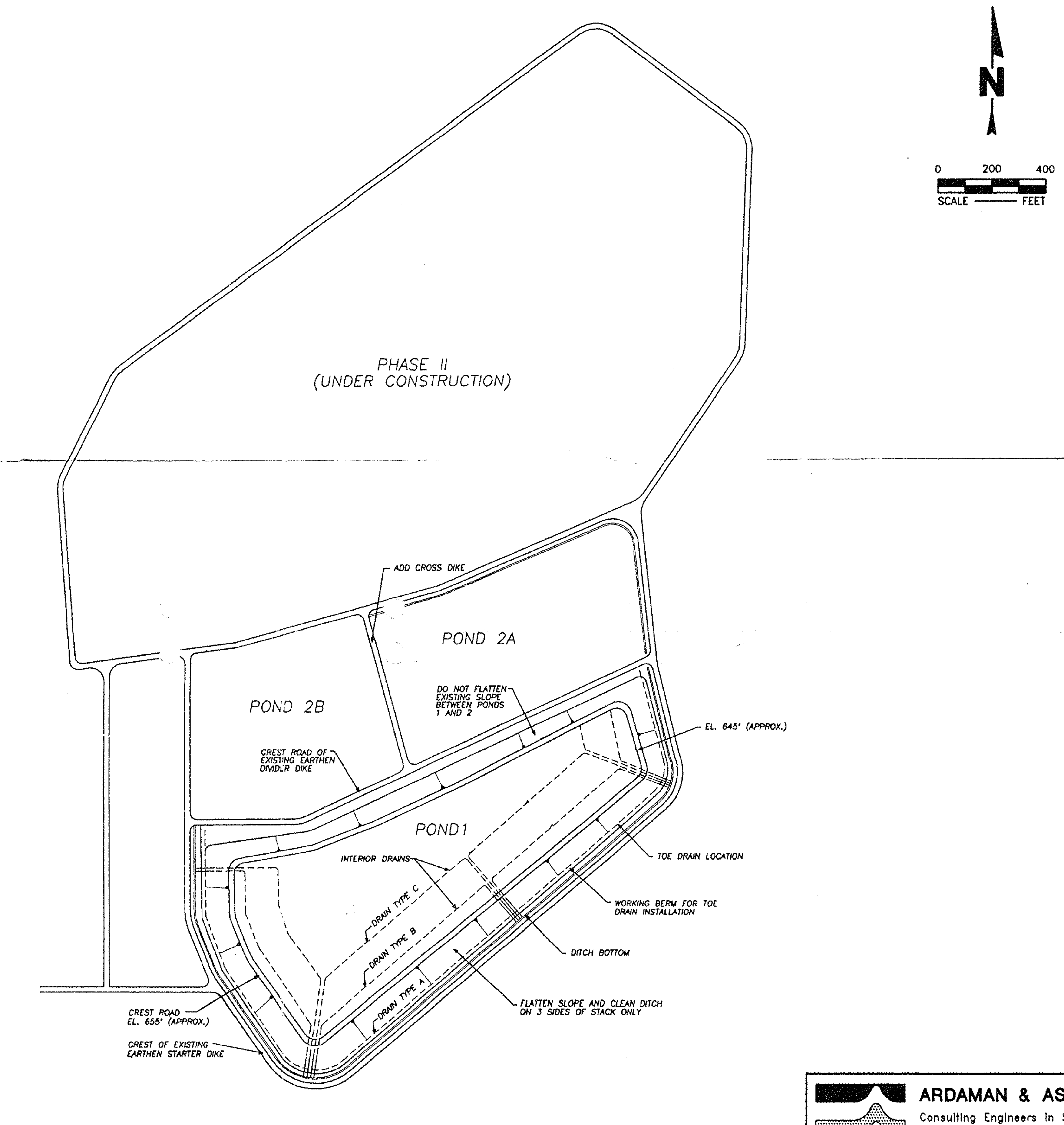
CROSS SECTION 5-5 FOR CONCEPTUAL REMEDIAL PLAN FOR GYPSUM-FLYASH STACK

Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics
Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-
STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY	RDS	CHECKED BY	EJW	DATE	4/11/91
FILE NO 90-059	APPROVED BY				

FIGURE 2



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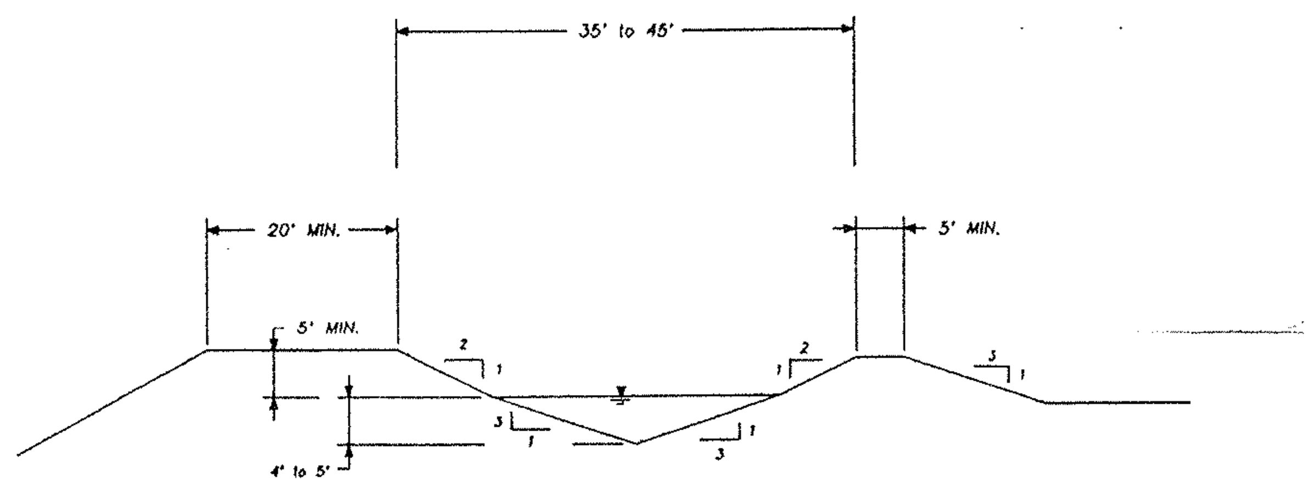
Consulting Engineers in Soils, Hydrogeology,
Foundations, Materials Testing, & Environmental

STAGE 1
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK GYPSUM–FLYASH
DISPOSAL FACILITY
STEVENSON, ALABAMA

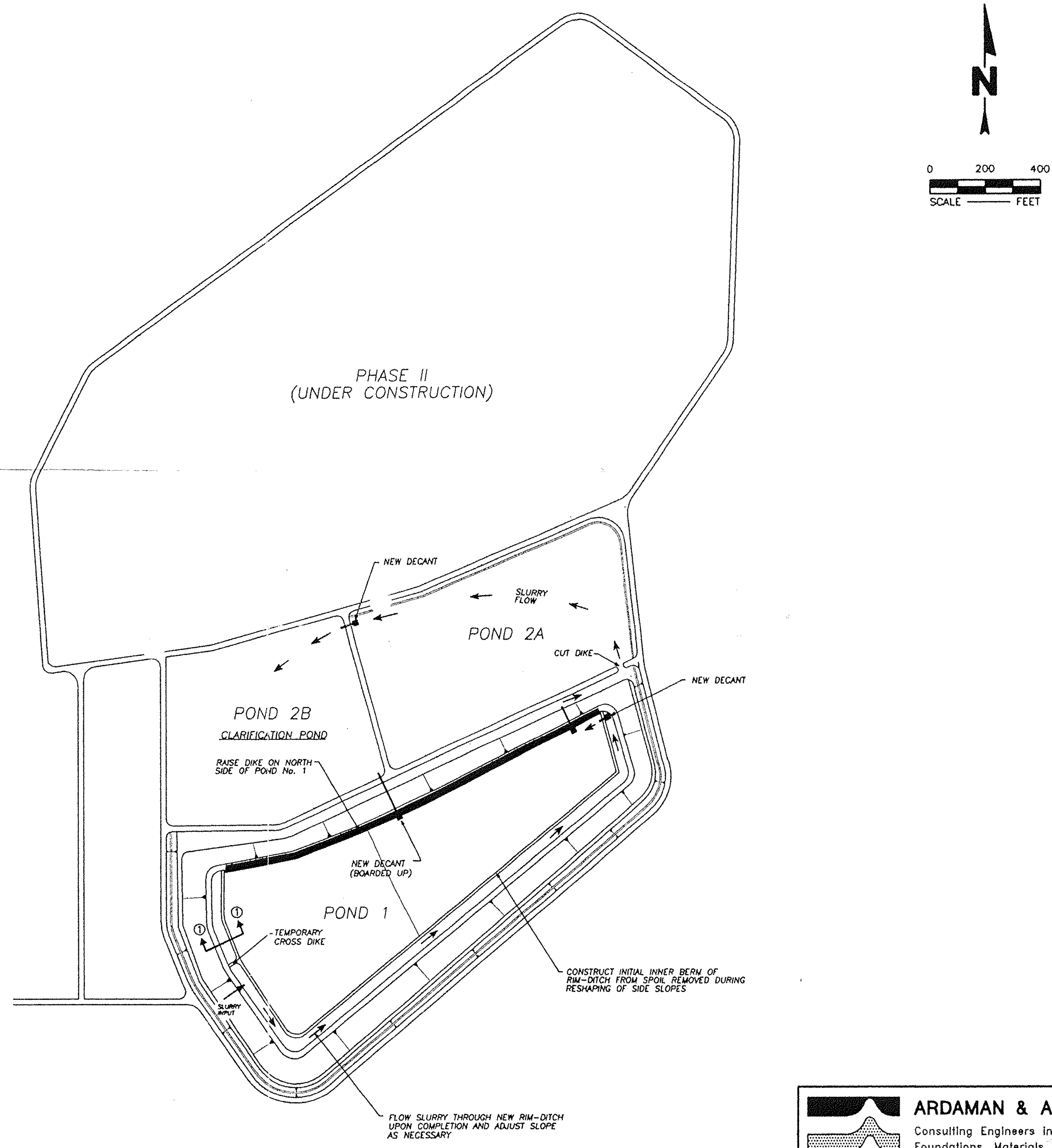
DRAWN BY: R.B.E.	CHECKED BY: RJS	DATE: 6/4/91
FILE NO. 90–059	APPROVED BY:	**FIGURE 3**



SECTION ① – ①

INITIAL RIM–DITCH

NOT TO SCALE



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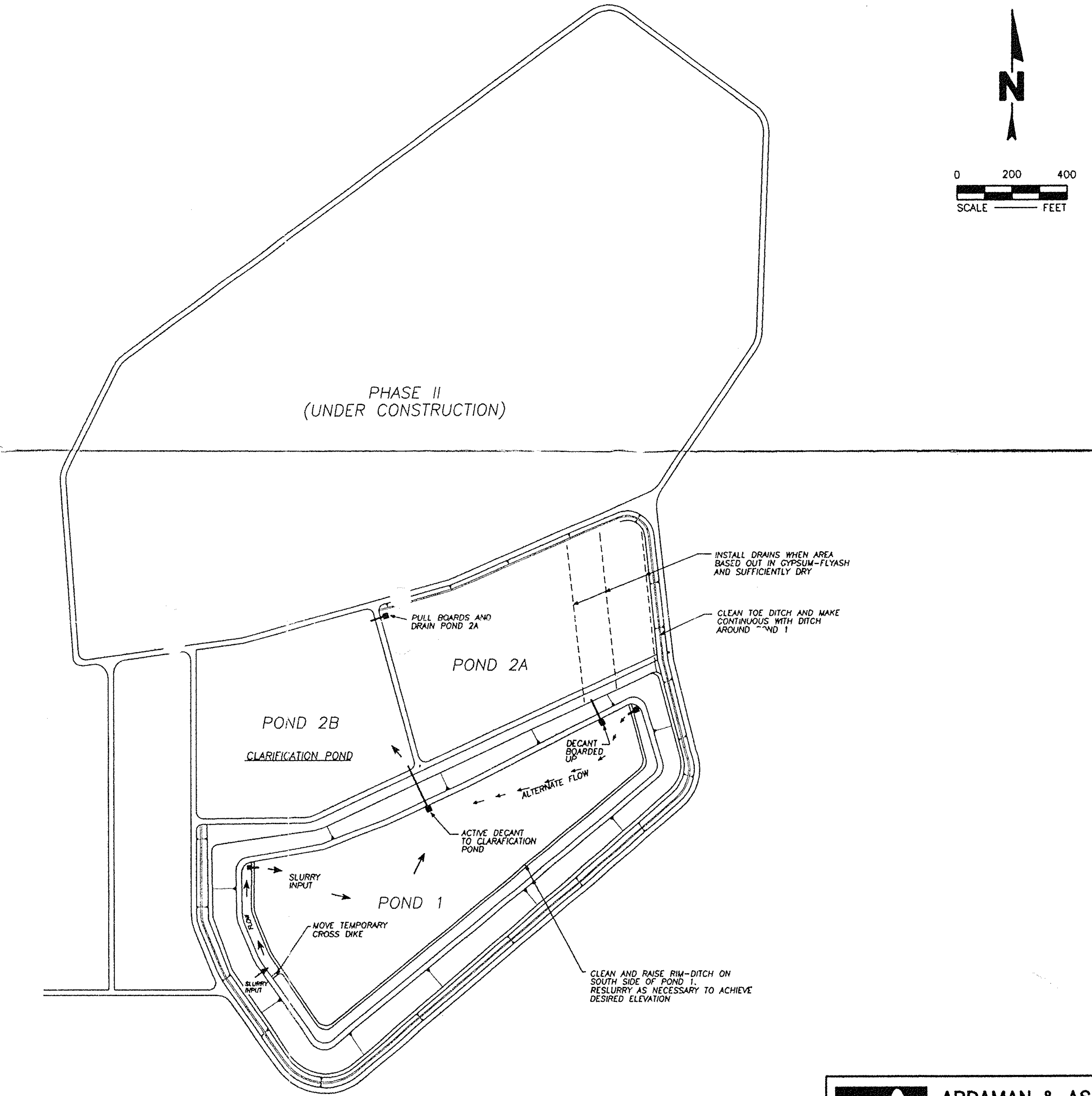
Foundations, Materials Testing, & Environmental

STAGE 1A
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK GYPSUM–FLYASH
DISPOSAL FACILITY
STEVENSON, ALABAMA

DRAWN BY: R.B.E.
CHECKED BY: TJS
DATE: 6/4/91
FILE NO. 90–059
APPROVED BY:
FIGURE 4



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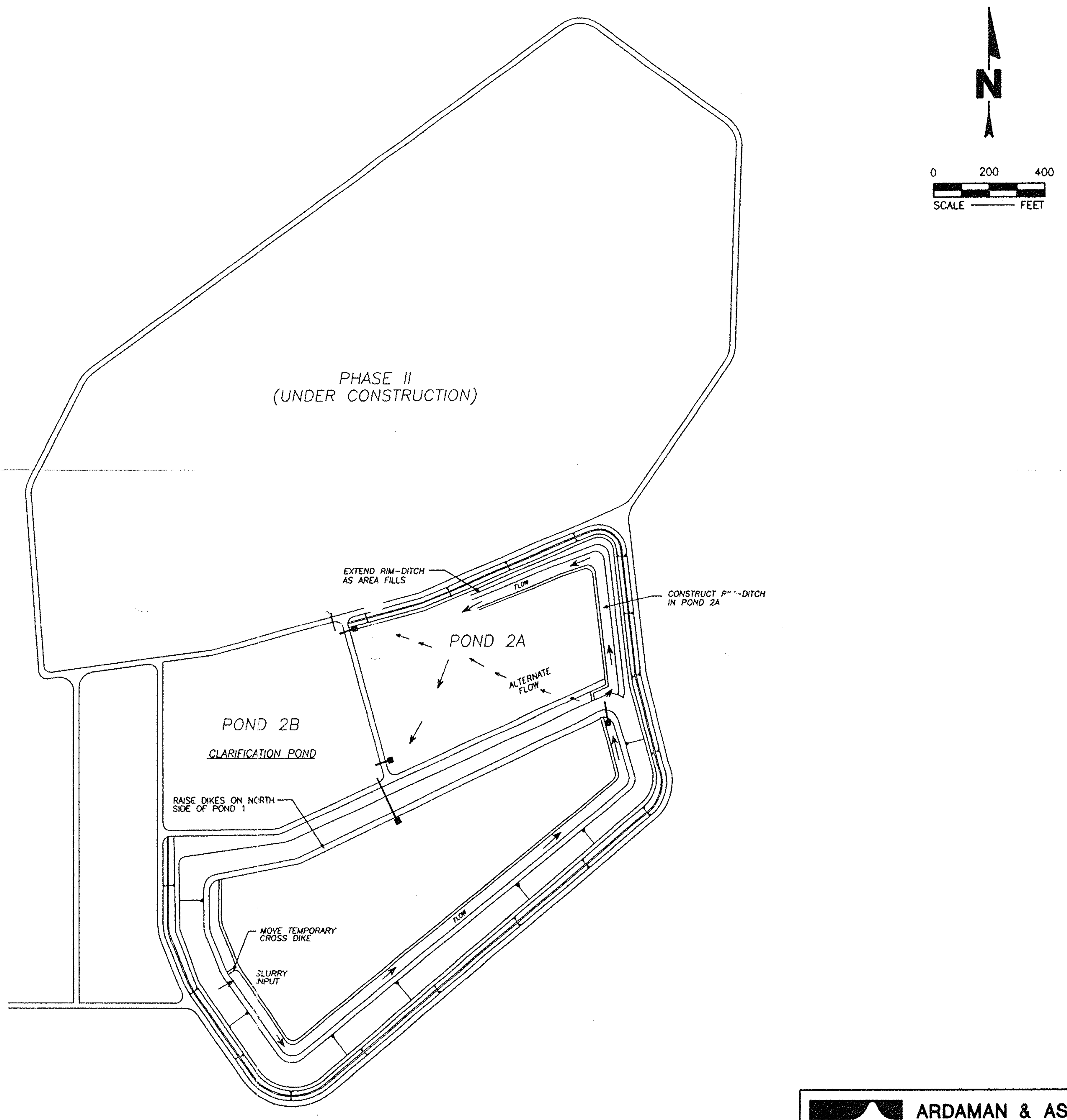
STAGE 2
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK GYPSUM–FLYASH
DISPOSAL FACILITY
STEVENSON, ALABAMA

DRAWN BY: R.B.E.	CHECKED BY: RJS	DATE: 6/4/91
FILE NO. 90–059	APPROVED BY:	**FIGURE 5**



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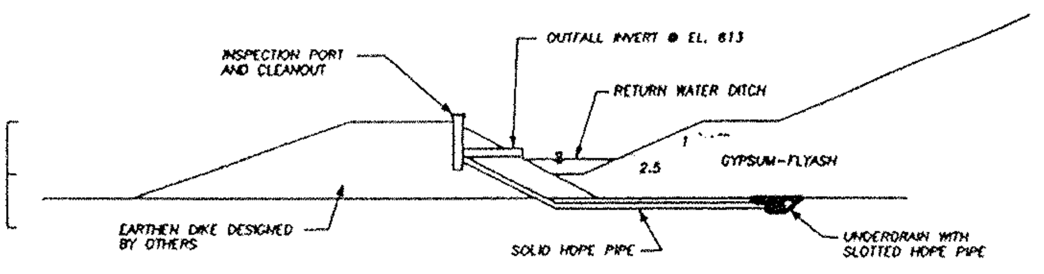
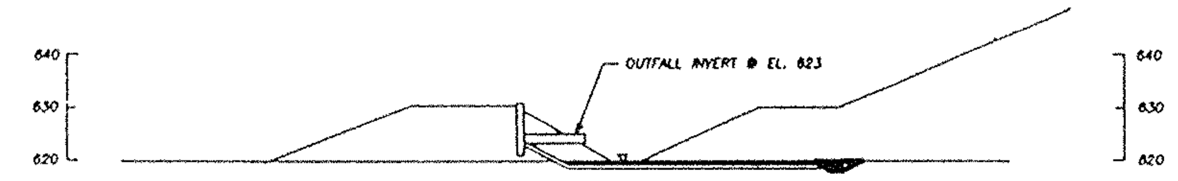
STAGE 3
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK GYPSUM–FLYASH
DISPOSAL FACILITY
STEVENSON, ALABAMA

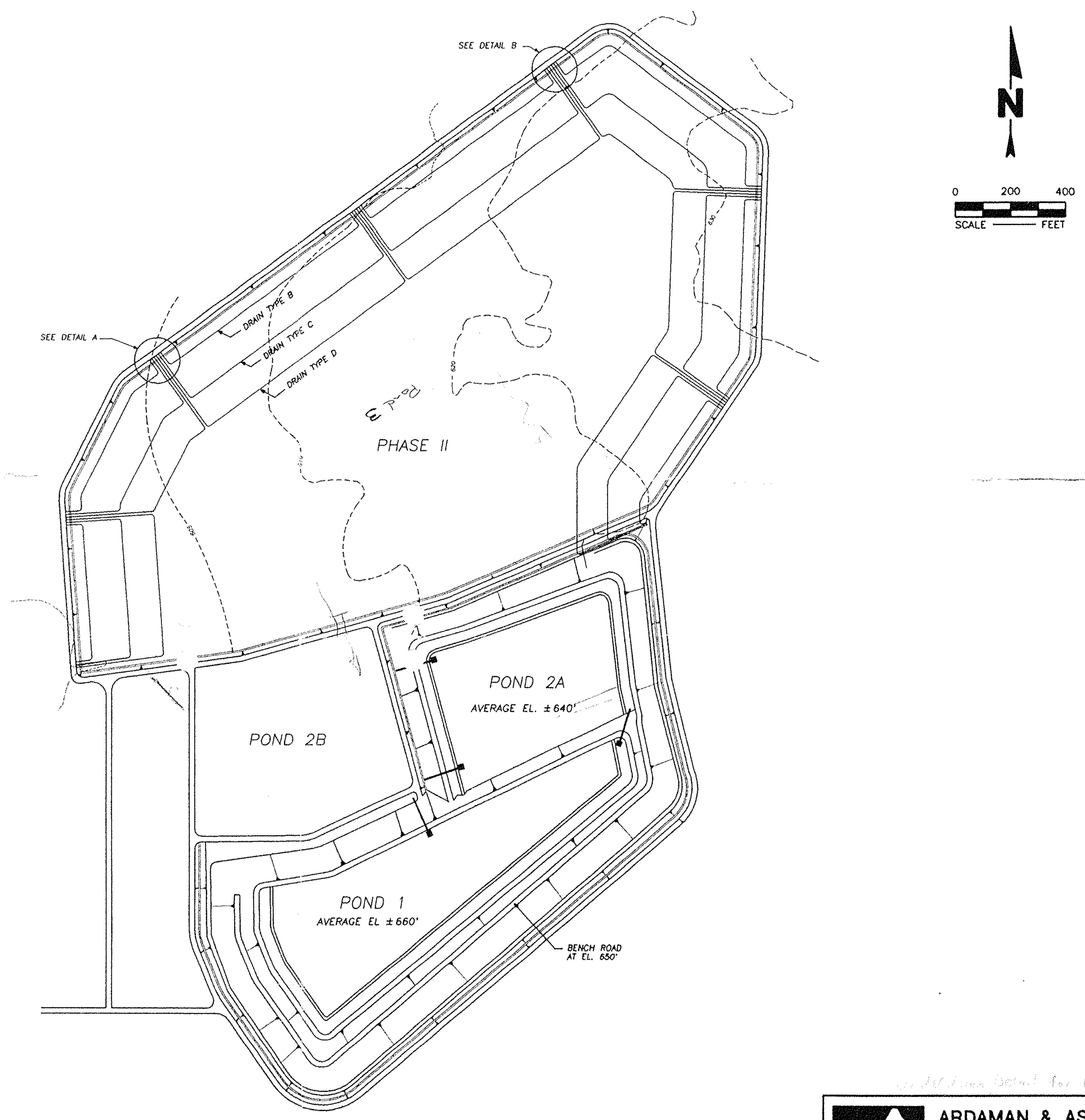
DRAWN BY: R.B.E.
CHECKED BY: KJS
DATE: 6/4/91
FILE NO. 90–059
APPROVED BY:
FIGURE 6



DETAIL A



DETAIL B



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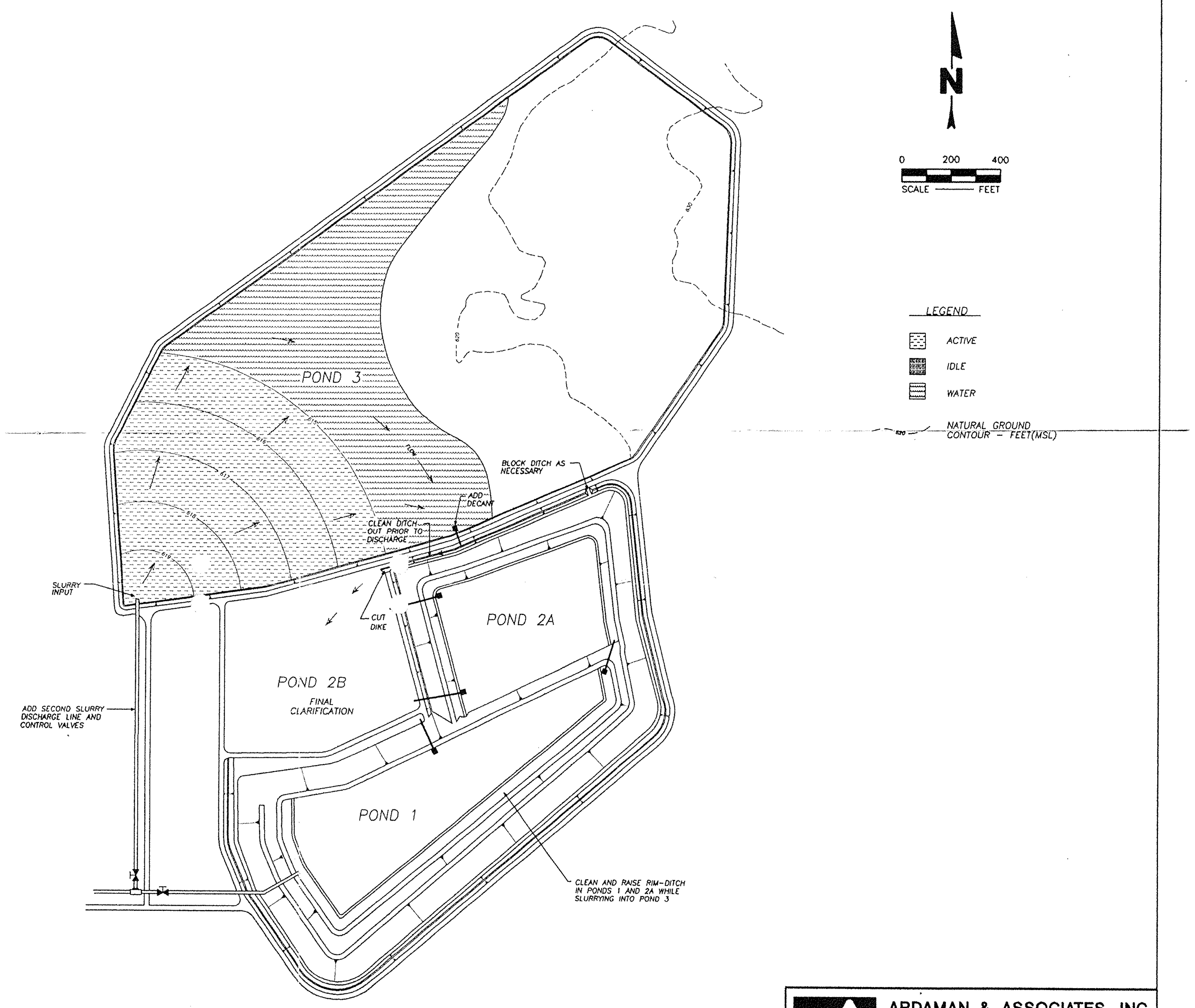
STAGE 4
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK GYPSUM–FLYASH
DISPOSAL FACILITY
STEVENSON, ALABAMA

DRAWN BY: R.B.E.	CHECKED BY: TJS	DATE: 6/4/91
FILE NO. 90–059	APPROVED BY:	**FIGURE 7**



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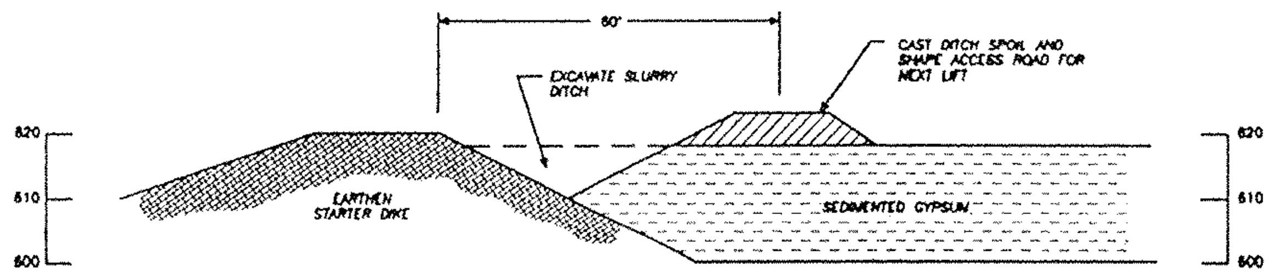
STAGE 5

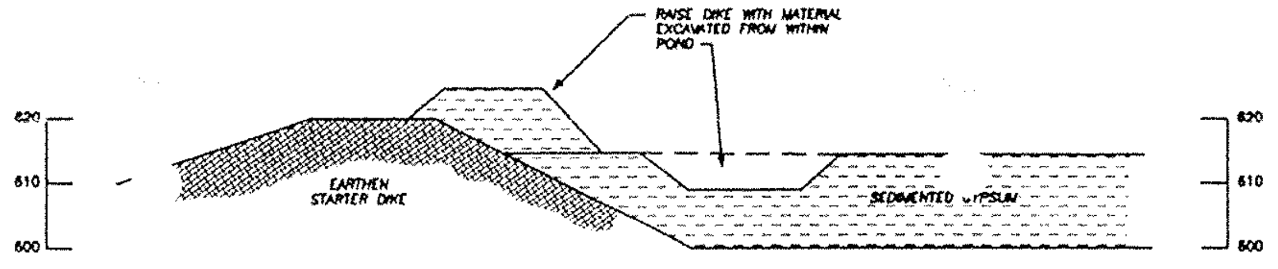
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK GYPSUM–FLYASH
DISPOSAL FACILITY
STEVENSON, ALABAMA

DRAWN BY: R.B.E.	CHECKED BY: KJS	DATE: 6/4/91
FILE NO. 90–059	APPROVED BY:	**FIGURE 8**



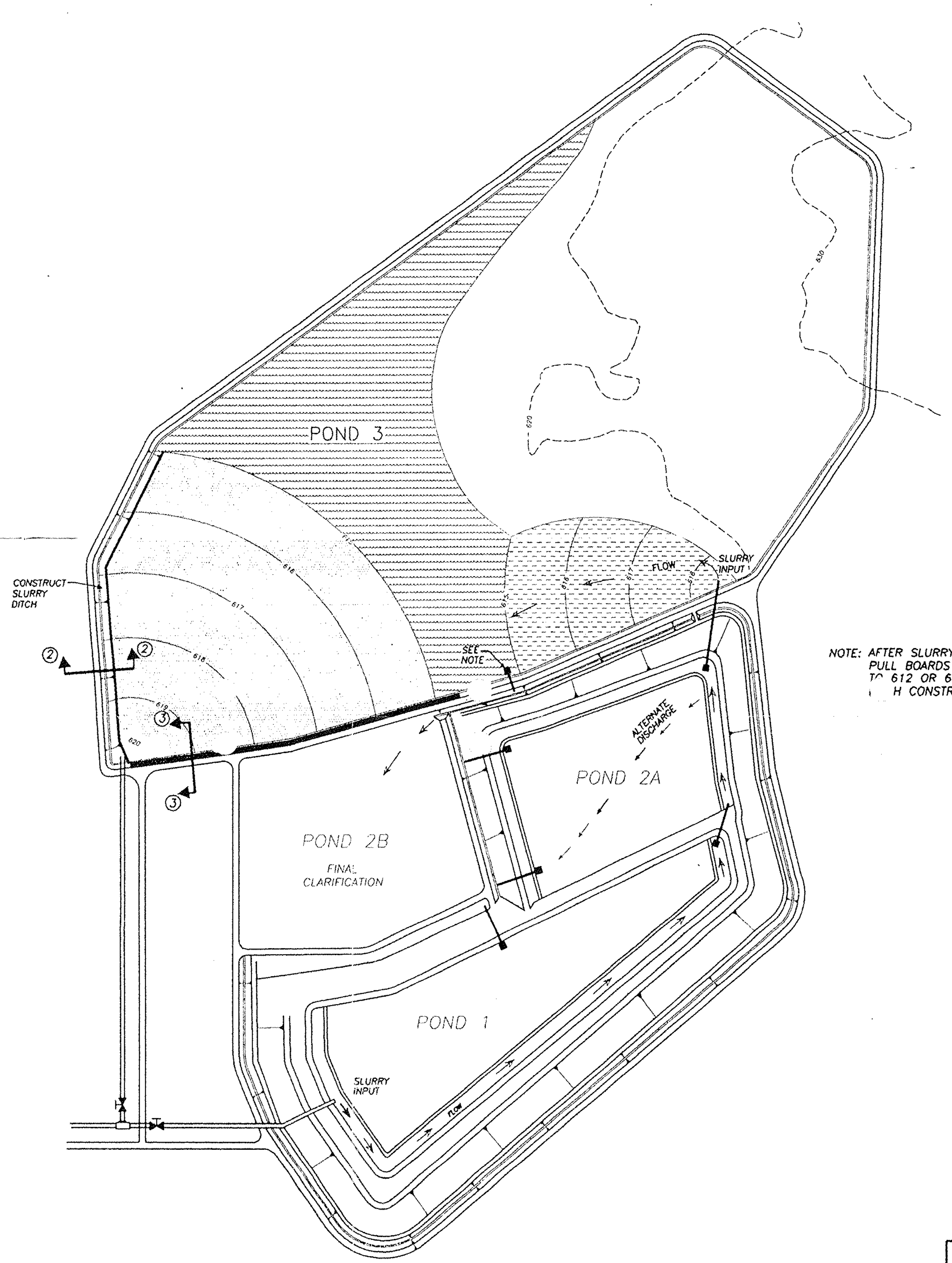
CROSS SECTION ② – ②

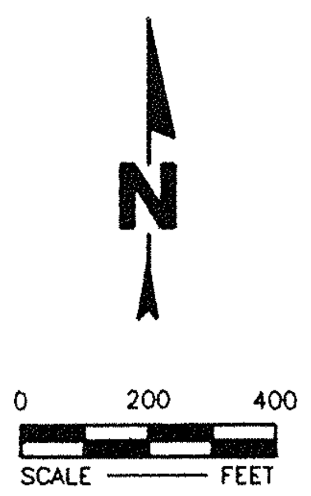
CONCEPTUAL PLAN FOR CONSTRUCTING
INITIAL SLURRY DITCH



CROSS SECTION ③ – ③

CONCEPTUAL PLAN FOR INITIALLY RAISING
SOUTH WALL DIKE





LEGEND

▤	ACTIVE
▩	IDLE
☰	WATER
— 620 —	NATURAL GROUND CONTOUR – FEET(MSL)

NOTE: AFTER SLURRY DISCHARGE INTO POND 3, AS SHOWN,
PULL BOARDS ON SPILLWAY AND LOWER POND LEVEL
TO 612 OR 613 FEET(MSL) TO FACILITATE SLURRY
H CONSTRUCTION ON THE WEST SIDE OF POND 3

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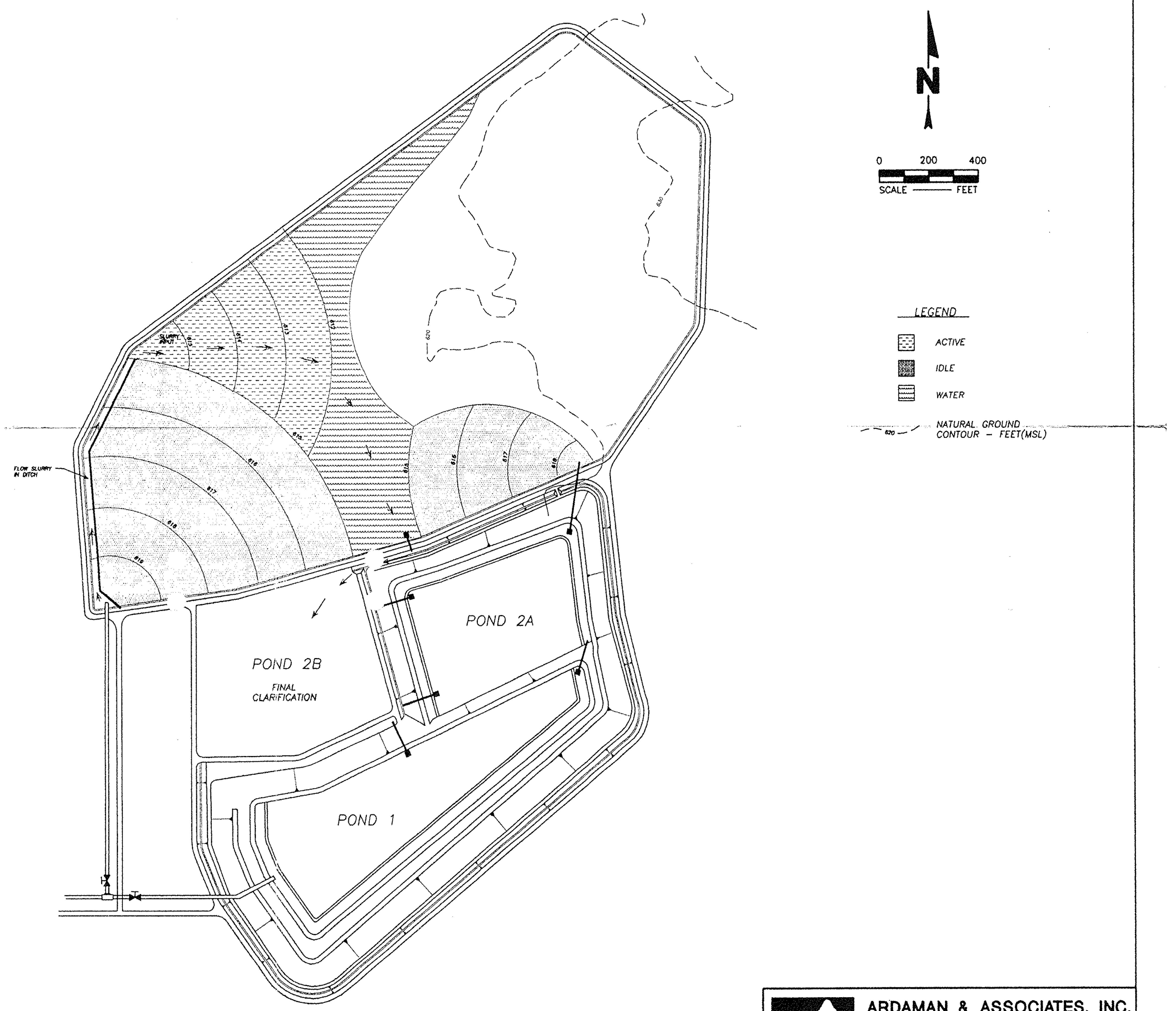
STAGE 6
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK GYPSUM–FLYASH
DISPOSAL FACILITY
STEVENSON, ALABAMA

DRAWN BY: R.B.E.	CHECKED BY: TJS	DATE: 6/4/91
FILE NO. 90-059	APPROVED BY:	**FIGURE 9**



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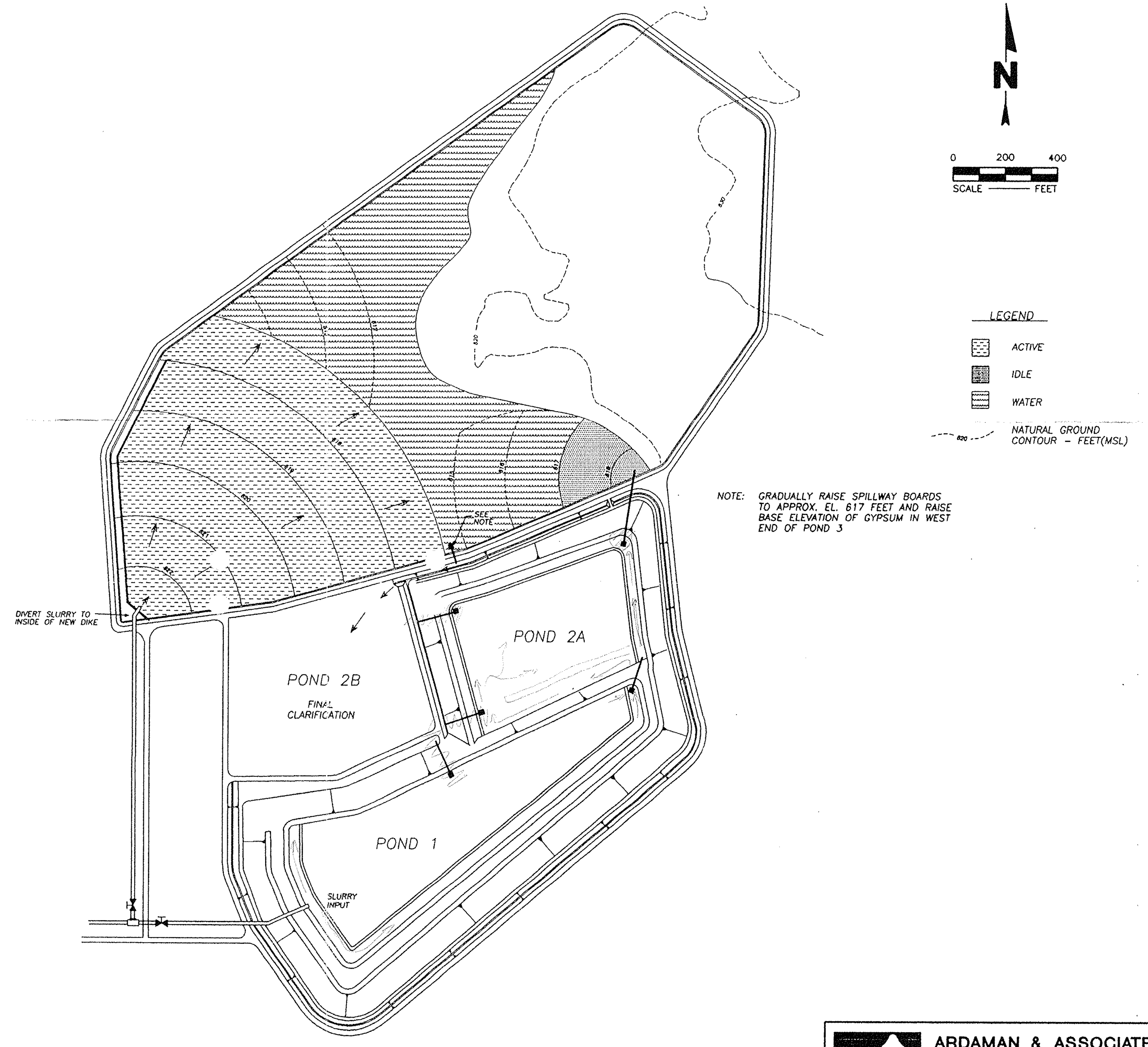
STAGE 7
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK GYPSUM–FLYASH
DISPOSAL FACILITY
STEVENSON, ALABAMA

DRAWN BY: R.B.E.	CHECKED BY: TJS	DATE: 6/4/91
FILE NO. 90–059	APPROVED BY:	**FIGURE 10**



LEGEND

▤	ACTIVE
▩	IDLE
☰	WATER
620	NATURAL GROUND CONTOUR – FEET(MSL)

NOTE: GRADUALLY RAISE SPILLWAY BOARDS TO APPROX. EL. 617 FEET AND RAISE BASE ELEVATION OF GYPSUM IN WEST END OF POND 3

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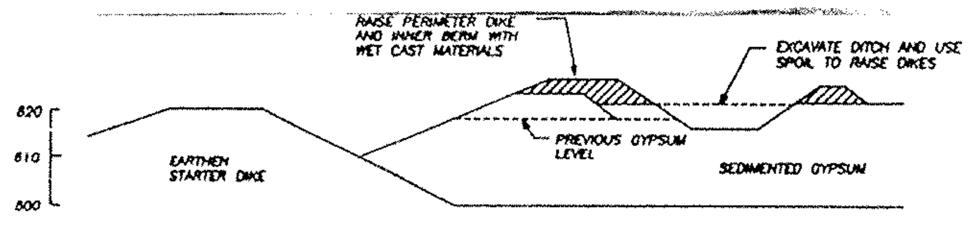
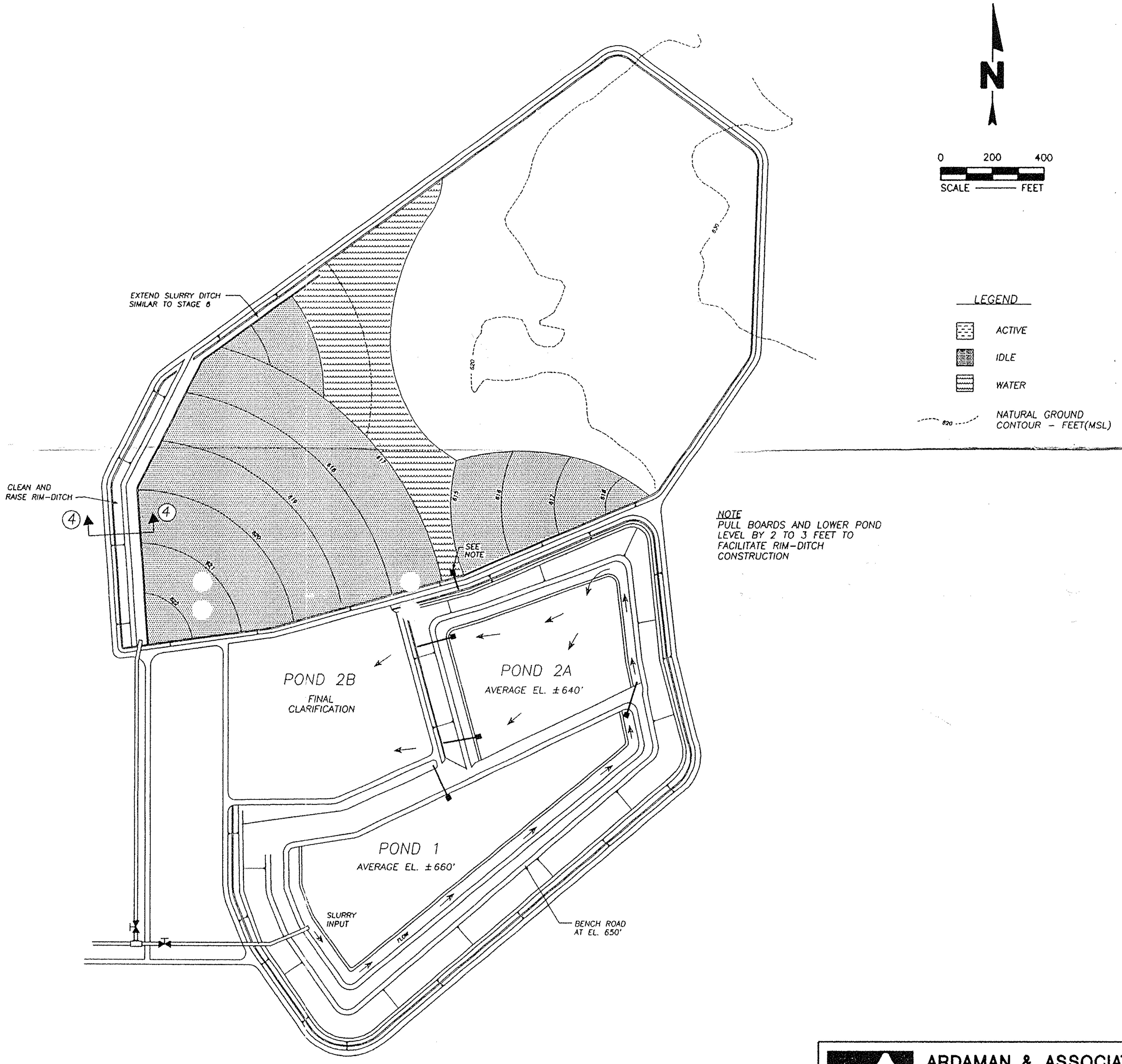
STAGE 7A
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK GYPSUM–FLYASH
DISPOSAL FACILITY
STEVENSON, ALABAMA

DRAWN BY: R.B.E.	CHECKED BY: TJS	DATE: 6/4/91
FILE NO. 90–059	APPROVED BY:	**FIGURE 11**



SECTION ④ – ④

CONCEPTUAL DESIGN FOR RAISING DIKES DURING STAGE 8



NOTE
PULL BOARDS AND LOWER POND LEVEL BY 2 TO 3 FEET TO FACILITATE RIM-DITCH CONSTRUCTION

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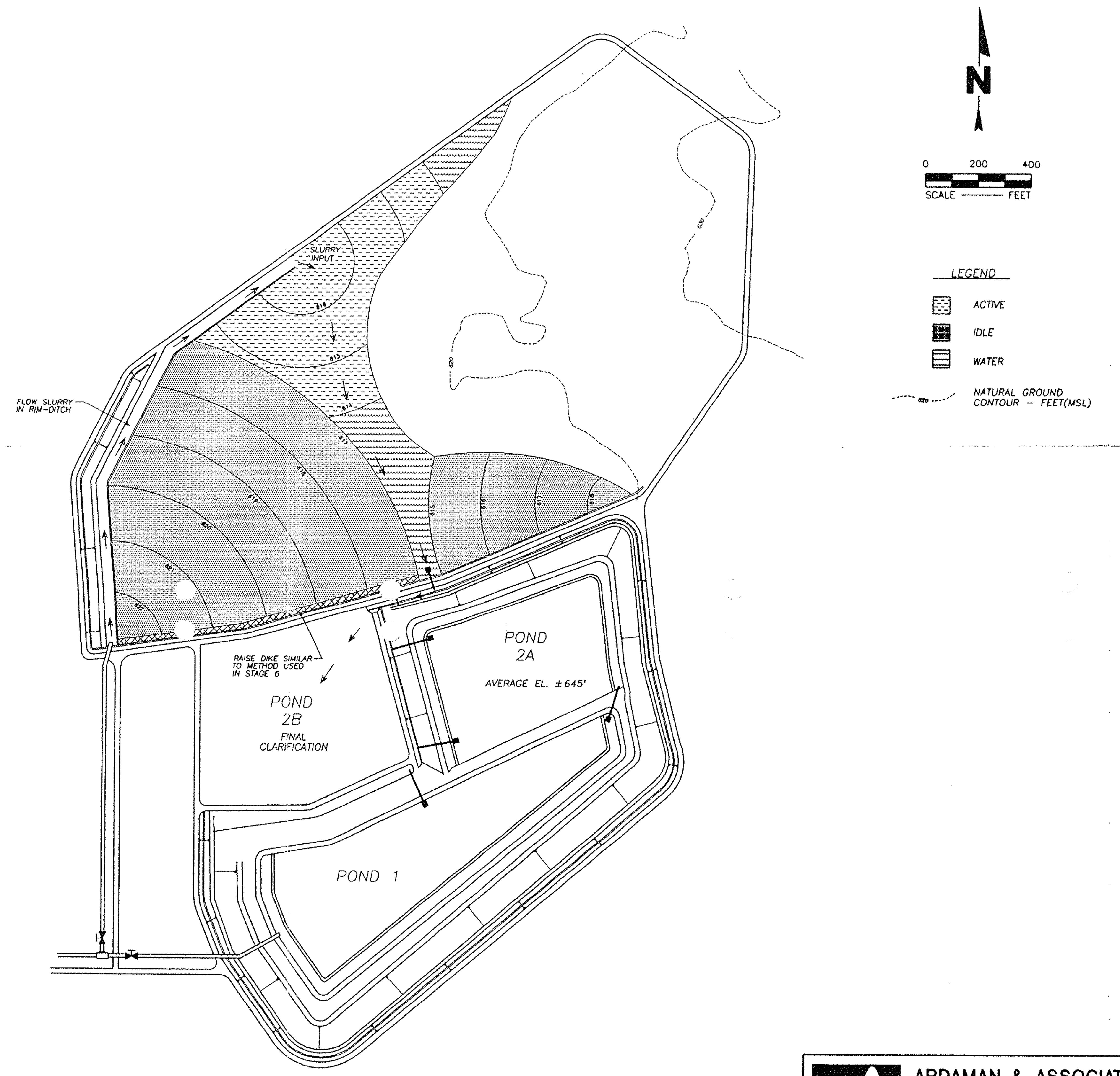
STAGE 8
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK GYPSUM-FLYASH
DISPOSAL FACILITY
STEVENSON, ALABAMA

DRAWN BY: R.B.E.	CHECKED BY: KJS	DATE: 6/4/91
FILE NO. 90-059	APPROVED BY:	**FIGURE 12**



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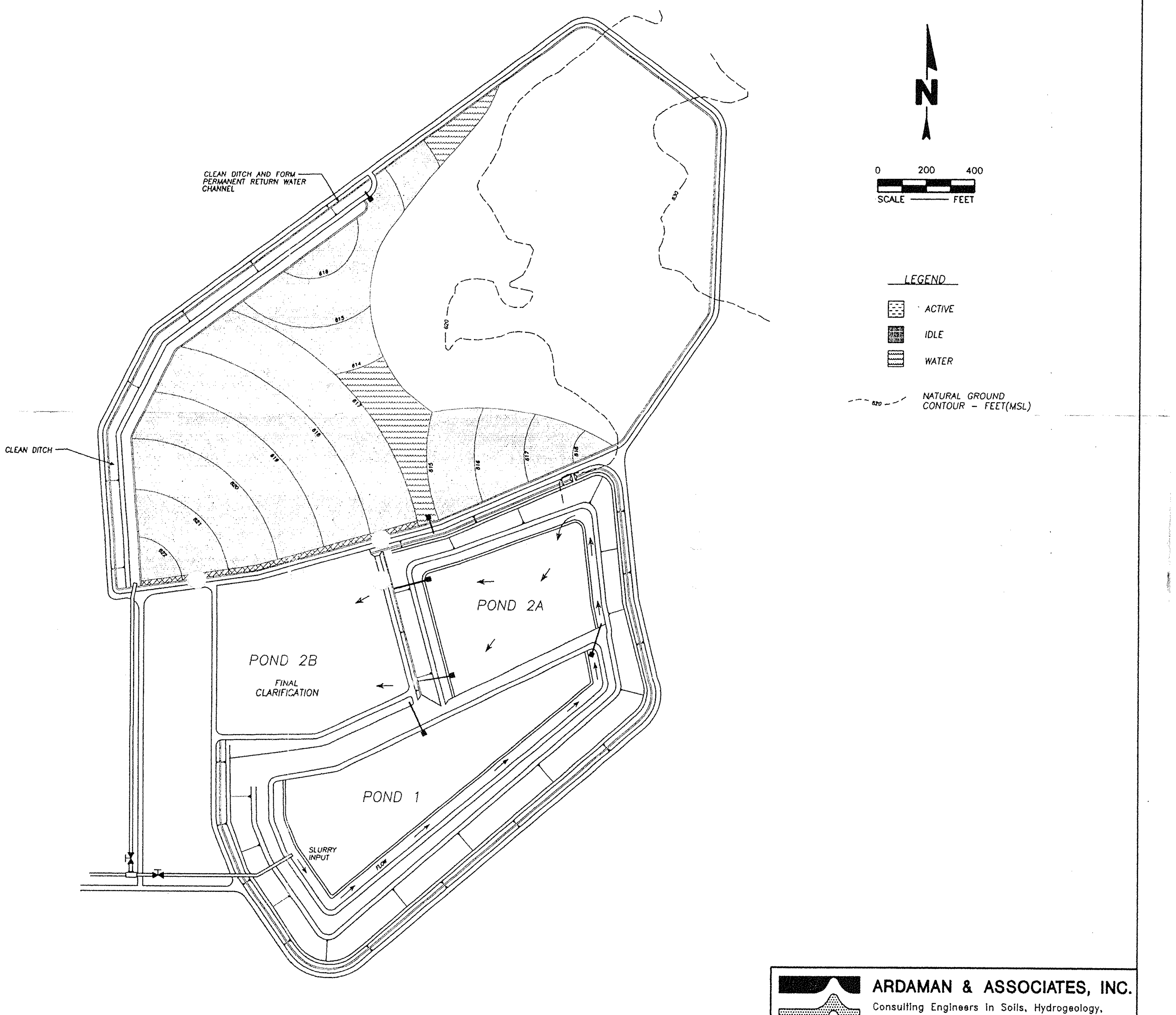
STAGE 9
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK GYPSUM–FLYASH
DISPOSAL FACILITY
STEVENSON, ALABAMA

DRAWN BY: R.B.E.	CHECKED BY: TJS	DATE: 6/4/91
FILE NO. 90–059	APPROVED BY:	**FIGURE 13**



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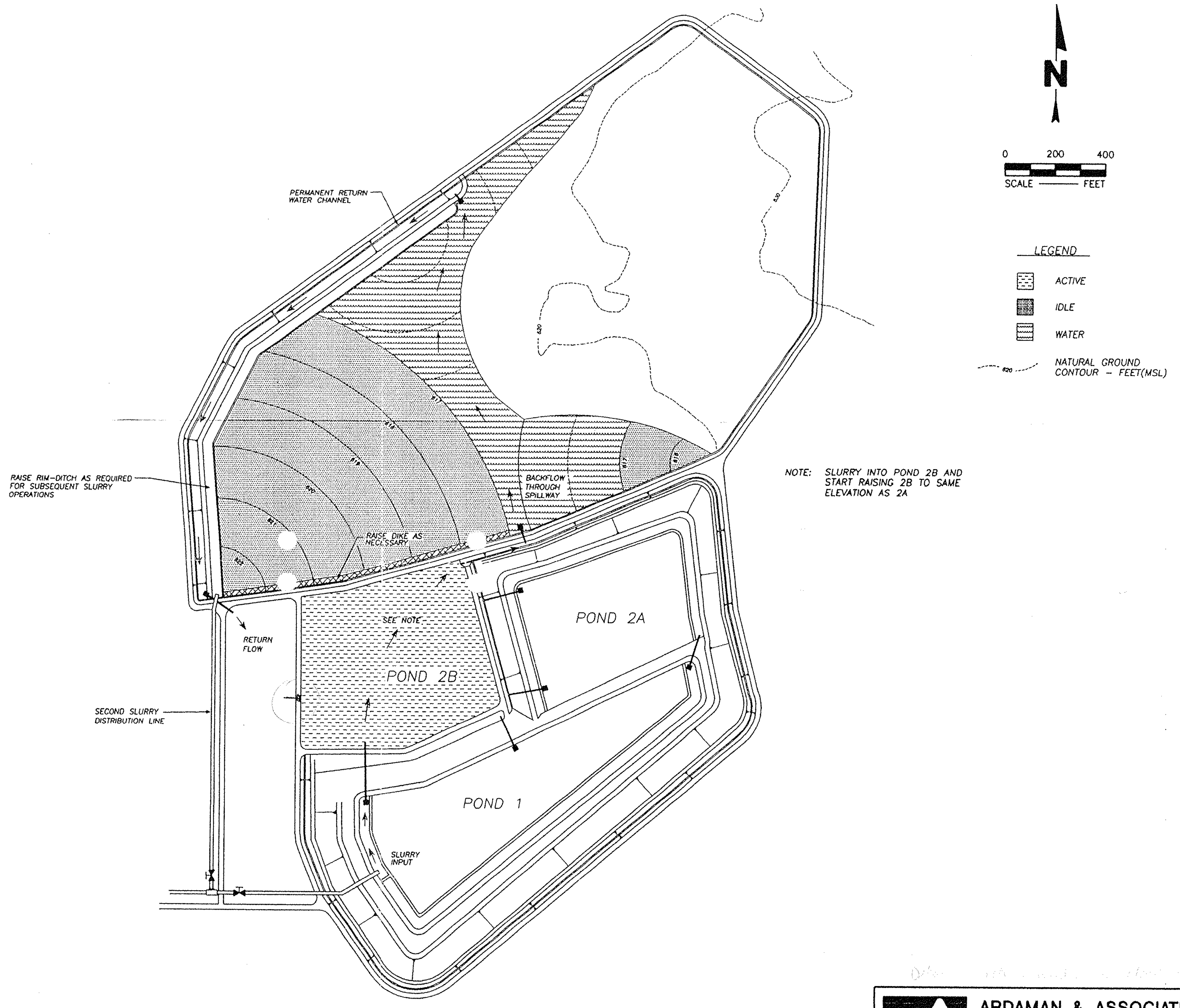
STAGE 10
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK GYPSUM–FLYASH
DISPOSAL FACILITY
STEVENSON, ALABAMA

DRAWN BY: R.B.E.	CHECKED BY: TJS	DATE: 6/4/91
FILE NO. 90–059	APPROVED BY:	**FIGURE 14**



NOTE: SLURRY INTO POND 2B AND START RAISING 2B TO SAME ELEVATION AS 2A

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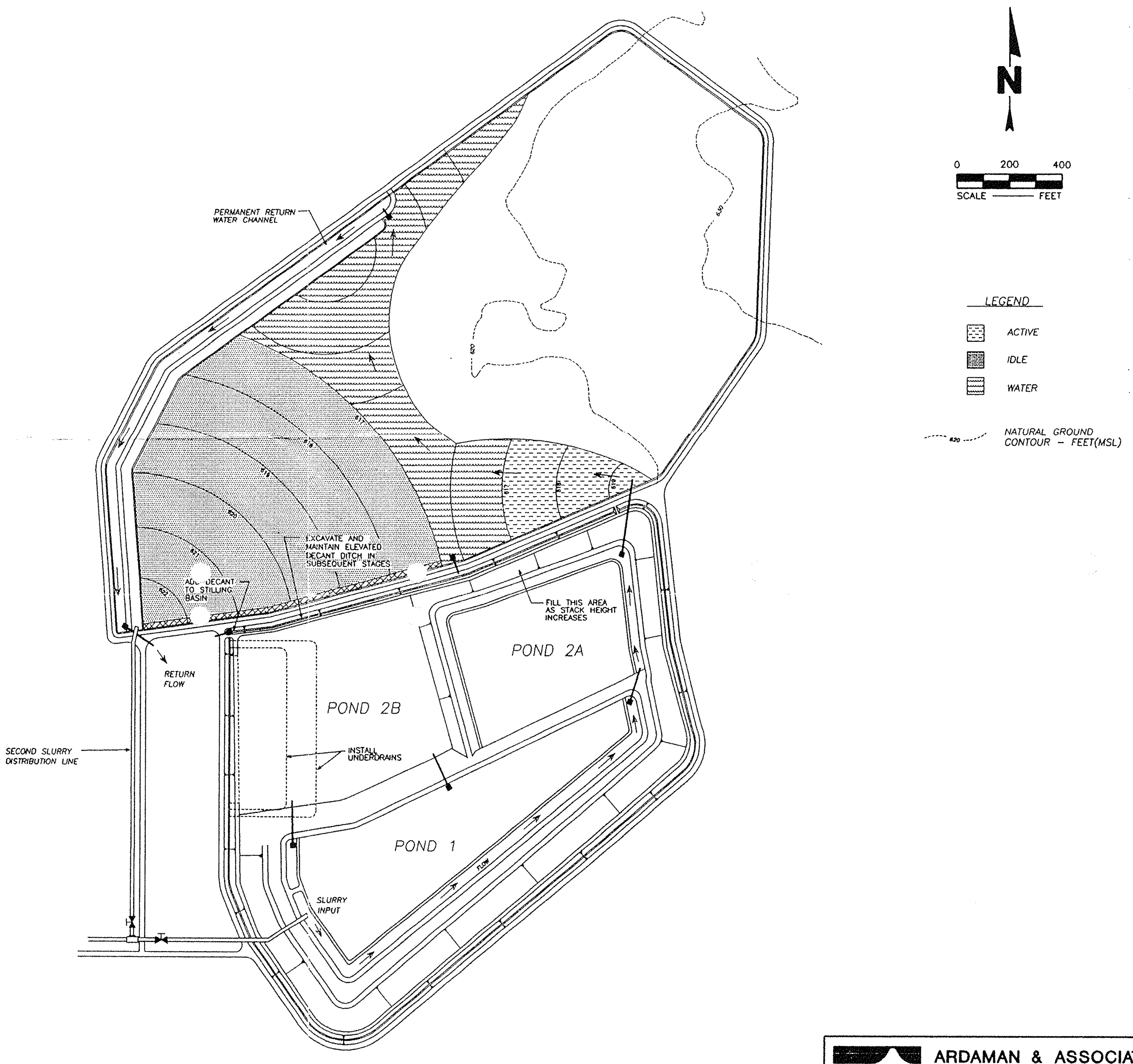
STAGE 11
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK GYPSUM–FLYASH
DISPOSAL FACILITY
STEVENSON, ALABAMA

DRAWN BY: R.B.E.	CHECKED BY: KJS	DATE: 6/4/91
FILE NO. 90–059	APPROVED BY:	**FIGURE 15**



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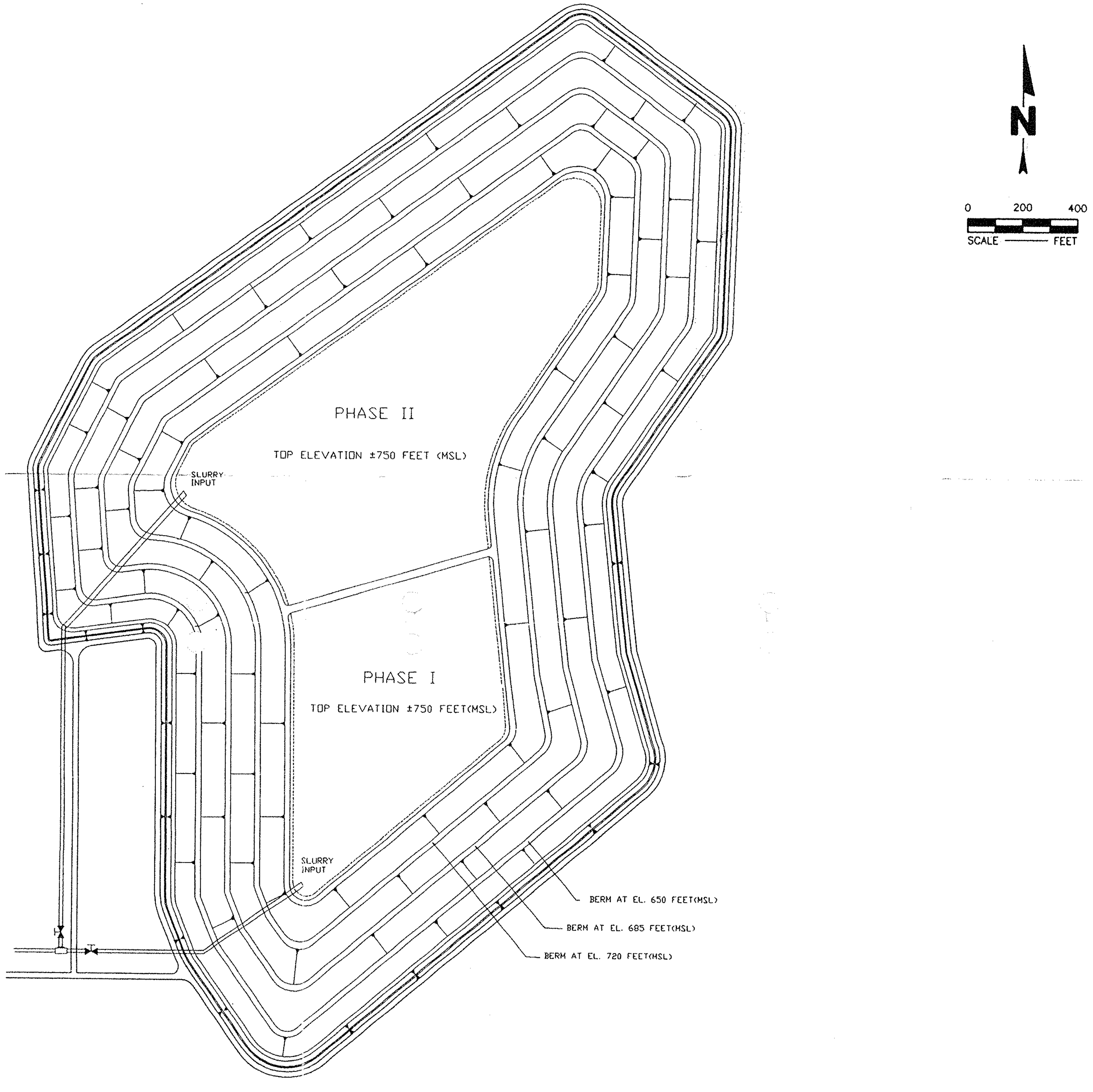
STAGE 12
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK GYPSUM-FLYASH
DISPOSAL FACILITY
STEVENSON, ALABAMA

DRAWN BY: R.B.E.	CHECKED BY: TJS	DATE: 6/4/91
FILE NO. 90-059	APPROVED BY:	**FIGURE 16**



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FINAL STAGE
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK GYPSUM-FLYASH
DISPOSAL FACILITY
STEVENSON, ALABAMA

DRAWN BY: R.B.E.	CHECKED BY:	DATE: 6/4/91
FILE NO. 90-059	APPROVED BY:	**FIGURE 17**

Preliminary Evaluation
Proposed Underdrain System
Widows Creek Gypsum-Flyash Storage Facility
Stevenson, Alabama
Contract No. 90PKA-89214B

Ardaman & Associates, Inc.

Preliminary Evaluation
Proposed Underdrain System
Widows Creek Gypsum-Flyash Storage Facility
Stevenson, Alabama
Contract No. 90PKA-89214B

Ardaman & Associates, Inc.

OFFICES

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Cocoa, 1300 N. Cocoa Blvd., Cocoa, Florida 32924, Phone (407) 632-2503
Fort Myers, 2508 Rockfill Road, Fort Myers, Florida 33916, Phone (813) 337-1288
Miami, 2608 W. 84th Street, Hialeah, Florida 33016, Phone (305) 825-2683
Port St. Lucie, 1017 S.E. Holbrook Ct., Port St. Lucie, Florida 34985, Phone (407) 337-1200
Sarasota, 2500 Bee Ridge Road, Sarasota, Florida 34277, Phone (813) 922-3526
Tallahassee, 3175 West Tharpe Street, Tallahassee, Florida 32303, Phone (904) 576-6131
Tampa, 105 N. Faulkenburg Road, Suite D, Brandon, Florida 34299-1506, Phone (813) 654-2336
West Palm Beach, 2511 Westgate Avenue, Suite 10, West Palm Beach, Florida 33409, Phone (407) 687-8200

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Ardaman & Associates, Inc.

Consultants in Soils, Hydrogeology,
Foundations and Materials Testing

August 2, 1991
File No. 90-059

Tennessee Valley Authority
2 North 83A Blue Ridge Place
Chattanooga, Tennessee 37402-2801

Attention: Mr. J. S. Baugh

Subject: Preliminary Evaluation of the Proposed Underdrain System for the Widows Creek Gypsum-Flyash Storage Facility, Stevenson, Alabama, Contract No. 90PKA-89214B

Gentlemen:

This report documents the results of engineering services performed relative to your Contract No. 90PKA-89214B for a preliminary evaluation of underdrains at the Widows Creek Steam Plant, FGD gypsum-flyash disposal facility, Stevenson, Alabama. Included in this report are the results of graphical, anisotropic flow net analyses of the gypsum-flyash stack for three heights of a typical cross-sectional geometry, with the resulting requirements for drain sizes and locations. Additional stability analyses have also been performed at the three stack heights using the predicted phreatic surfaces from the flow net analyses to confirm that the desired factor of safety is achieved.

The results of this preliminary evaluation indicate that the underdrains will perform adequately within the FGD gypsum-flyash, if properly sized and located. Additional field and laboratory testing of the TVA gypsum-flyash materials is still recommended to confirm the assumptions used in this report and to better define variations in the material properties as a function of stack height and location relative to the slurry discharge point. Engineering evaluation of the underdrains considering variations in the perimeter dike and natural ground geometries and elevations should also be performed prior to final drain design and construction.

This report has been prepared for the exclusive us of TVA in accordance with generally accepted geotechnical engineering practices for specific application to the above referenced project. No other warranty, expressed or implied, is made.

It has been a pleasure assisting you with this project. If you have any questions or need additional information or assistance, please do not hesitate to contact the undersigned or our Mr. Thomas S. Ingra, P.E.

Very truly yours,
ARDAMAN & ASSOCIATES, INC.

Bill E. Jackson, P.E.
Senior Project Engineer

John E. Garlanger, Ph.D., P.E.
Principal

3D-90059.BEJ/ew:cc

8008 S. Orange Avenue (32809), Post Office Box 593003, Orlando, Florida 32859-3003 Phone (407) 855-3860 FAX (407) 859-8121
Offices in: Avon Park, Bartow, Bradenton, Cocoa, Fort Myers, Miami, Orlando, Port Charlotte, Port St. Lucie, Sarasota, Tallahassee, Tampa, W. Palm Beach

Introduction

Based on the results of previous engineering evaluations of the Phase I gypsum-flyash disposal facility presented in our report of April 22, 1991, the existing gypsum-flyash stack is being raised too steeply to realize overall stability at the proposed final height (i.e., elevation 750 feet). Localized seepage and erosion of the stack side slopes is occurring at the lower elevations and is contributing to the current stack instability. The two primary controlling factors in the overall stability of the stack are the relatively low strength (friction angle) of the clay foundation soils and the high phreatic surface and seepage gradients within the saturated gypsum-flyash mass. The strength of the sedimented, gypsum-flyash materials is adequate and is not a limiting factor in the overall stability of the stack.

To achieve the desired final top elevation of 750 feet (MSL), while staying within the proposed lateral limits of the stack, will necessitate that the stack be raised with an average side slope of approximately 3.0 horizontal to 1.0 vertical. Stability analyses performed and documented in our report of 22 April indicate that positive seepage control will be required to maintain a factor of safety equal to or greater than 1.5 if this slope is to be achieved.

A conceptual design modification to the stack geometry to achieve this end is presented in the 22 April report. In general, this preliminary design calls for the use of underdrains to lower the phreatic surface within the stack and to control seepage from the side slopes. The average side slope of 3.0 horizontal to 1.0 vertical is achieved by using a series of steeper slopes with intervening setbacks and benches for control of surface runoff and erosion.

The preliminary stack geometry, drain location and phreatic surface used in the stability analyses presented in the 22 April report represent a combination of conditions required to achieve a computed factor of safety equal to or greater than 1.5 and do not constitute design recommendations. A detailed evaluation and design of the underdrains to handle the flow required to produce an actual phreatic surface similar to that used in the stability analyses, therefore, is still required.

Scope of Services

A detailed scope of work required to finalize the underdrain design was outlined and recommended in our letter of May 16, 1991. The current, preliminary evaluation of the underdrain system represents a reduced scope of services, as outlined in our letter of June 17, 1991, to assess, in general, if the proposed underdrains will function as intended in the TVA gypsum-flyash deposits. No additional field or laboratory materials testing of the gypsum-flyash deposits was performed in conjunction with this evaluation and all calculations are based on previously reported test data.

The scope of services proposed in our letter of June 17, 1991 is reproduced as follows:

1) No additional field or laboratory testing of the TVA gypsum-flyash will be performed. Permeability and anisotropic behavior of the TVA gypsum-flyash deposits, therefore, will be determined or assumed from the existing test data.

2) Anisotropic flow nets will be constructed for three stack heights considering the proposed stack geometry (i.e., average slope of 3.0 horizontal to 1.0 vertical with benches) with an initial gypsum-flyash elevation approximately equal to that of the original earthen starter dike. The flow nets will be based on permeability test data presented in our report of 22 April, 1991. As it is our understanding that TVA would prefer to construct the drains in the Phase II compartment within the gypsum-flyash instead of in the foundation soils as originally proposed. Analysis of the drains installed in the foundation soils prior to slurry deposition, therefore, will not be performed.

3) Cross sectional design requirements (i.e., size and geometry of the gravel collection zone around the drain pipe) for each drain and the number and location of drains will be determined from the flow net analyses. Flows per unit length of pipe will be determined for each drain for the stack heights analyzed and a plot of flow versus stack height will be generated. Variations in permeability due to self-weight consolidation and other factors will be considered in the computations. The computed flow rates can be used at a later date, if required, to determine drain design details, such as pipe sizes and lengths between outfalls, required for detailed design and preparation of construction drawings.

Material Properties

Material properties of the Widows Creek FGD gypsum-flyash were estimated from existing data* and no additional field or laboratory testing was performed for the engineering analyses presented in this report.

Density

The in-place dry density of the Widows Creek gypsum-flyash was determined from undisturbed samples obtained from test borings performed on top of the stack during the time frame of October 30 through November 3, 1990. The results of these tests are summarized in Table 1 and are also presented relative to sample elevation in Figure 1. A copy of the test boring location plan and simplified boring log profiles are also presented in Appendix A for reference.

These tests, in general, indicated that the density of the gypsum-flyash above an elevation of about 622 feet (MSL), which approximately corresponds to the top elevation of the earthen starter dike, is greater than the density of the underlying sedimented materials. A reverse trend of increasing density with depth is generally expected for this type of sedimented deposit. This observed condition is probably the result of surface drying and desiccation during periods when the pond is not fully covered with water, as observed during our site visits. Measured dry densities below elevation 622 feet (MSL) were in the range of 86 to 93 pounds per cubic foot (pcf), with an average value of about 89 pcf. The density of the sedimented materials above

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* Garlanger, J.E. and Ingra, T.S. (1983). "Evaluation of Engineering Properties and Wet Stacking Disposal of Widows Creek FGD Gypsum - Fly Ash Waste". Tennessee Valley Authority, Office of Power, Division of Energy Demonstration and Technology.

Ardaman & Associates, Inc., April 22, 1991. "Interim Report on Evaluation of FGD Gypsum-Flyash Wet-Stacking Disposal Facility, Widows Creek Steam Plant, Stevenson, Alabama".

elevation 622 feet (MSL) ranged from 85 to 98 pcf, with an average of 93.5 pcf. The average dry density of all the sedimented samples was 91.5 pcf.

Also shown on Figure 1 is the theoretical dry density for a normally consolidated and saturated gypsum-flyash deposit, as determined from the consolidation curve (i.e., void ratio versus effective vertical consolidation stress) presented as Figure 2. This curve was previously developed from slurry-consolidation and settling tests performed as part of the 1983 study and characterization of the Widows Creek gypsum-flyash engineering properties. The tested sample used to develop this curve was comprised of 33.3% gypsum, 35.9% acid insoluble material (flyash), 27.4% limestone, and 0.3% sulfite.

The results of chemical analyses performed on six samples of gypsum-flyash obtained from the test borings performed in the Widows Creek stack in 1990 are tabulated below.

Boring	Sample	Chemical Composition (% dry weight basis)			
		Acid Insoluble (Flyash)	Gypsum	Unreacted Limestone	Calcium Sulfite
TH-1	US-1	23	62	6	0.2
TH-2	US-4	44	27	17	7.0
TH-3	US-3	27	59	9	1.5
TH-4	US-3	49	37	8	0.2
TH-7	US-1	33	48	13	1.8
TH-7	US-3	33	46	12	3.6
Average		35	47	11	

As shown the existing gypsum-flyash deposit is comprised of 27 to 62% gypsum with an average of 47% and 23 to 49% flyash with an average of 35%. Accordingly, on average, the gypsum content was slightly greater than the flyash content. Unreacted limestone comprised an average of 11% of the material. Calcium sulfite contents were generally less than 2%, but reached as high as 7.0% in one of the six samples.

As can be seen from Figure 1, the measured, in-place density of the existing gypsum-flyash deposit is generally greater than the theoretical density. In particular, the deposits above elevation 622 feet (MSL) are overconsolidated and significantly more dense than anticipated for a normally consolidated deposit. The chemical composition of the existing gypsum-flyash deposit varies slightly from the material tested and used to develop the consolidation curve presented in Figure 2. This variation in composition may account for some of the differences in the predicted and measured material densities.

If we assume that the gypsum-flyash near the base elevation of the existing pond is normally consolidated and that the differences in density are the result of slight variations in material composition and secondary compression, then an approximation of dry density versus depth for the stack at the final design height can be made by shifting the theoretical density curve to coincide with the lowest densities measured in the field (i.e., assumed to be normally consolidated), as shown on Figure 3. This figure indicates that the density of the existing, overconsolidated gypsum-flyash in the elevation range of 615 to 640 feet is still greater than the density that would result from theoretical, self-weight consolidation under the full weight of the stack at the final design top elevation of 750 feet (MSL).

It appears, therefore, that the maximum dry density of the inplace materials may be controlled by factors other than self-weight consolidation. In particular, surface drying and desiccation may generate densities that are greater than would be anticipated by self-weight consolidation alone. Continued surface drying and desiccation could result in a stack that has a relatively uniform dry density versus depth relationship instead of a linearly increasing relationship.

Permeability

Figure 4 presents and summarizes the results of vertical permeability tests obtained from previous studies on the Widows Creek gypsum-flyash, including the results of the most recent (i.e., April 22, 1991) work completed by Ardaman & Associates, Inc. The recommended relationship of void ratio versus coefficient of permeability presented in this figure is used as the basis of all assumptions of vertical permeability (k_v) presented in this report.

Falling head permeability tests were performed in three piezometers installed in Pond 1 of the existing stack, adjacent to borings TH-1, TH-4, and TH-7, to determine the *in situ* horizontal coefficient of permeability (k_h) of the gypsum-flyash. The measured horizontal coefficient of permeability of the sedimented gypsum-flyash on the western, influent end of the Pond 1, as determined in piezometer PZ-1, equalled 1.7×10^{-4} cm/sec. The measured coefficients of permeability at the remaining two piezometers (i.e., PZ-2 and PZ-3), located near the middle and east end of Pond 1, were slightly lower, and equalled 5.2×10^{-5} and 8.0×10^{-5} cm/sec, respectively.

The anisotropic behavior of the TVA gypsum-flyash was estimated by comparing the field measured horizontal coefficient of permeability (k_h) to the vertical coefficient of permeability (k_v) obtained from a correlation of measured field density at the piezometer site with Figure 4, as tabulated below.

Location	Depth of Collection Zone (feet)	Ground Elevation Feet (MSL)	Measured k_h (cm/sec)	Average Dry Density* (pcf)	Void Ratio e	Computed k_v** (cm/sec)	Ratio k_h/k_v
TH-1, PZ-1	10 - 25	643.4	1.7×10^{-4}	91.8	0.68	6.0×10^{-5}	2.83
TH-4, PZ-2	8.5 - 17	639.9	5.2×10^{-5}	96.9	0.59	3.0×10^{-5}	1.73
TH-7, PZ-3	9.5 - 22	638.6	8.0×10^{-5}	93.5	0.65	5.0×10^{-5}	1.60

* Average dry density over depth of piezometer collection zone, obtained from Table 1.
** Correlation of average void ratio with Figure 4.

Based on the above results, a gypsum-flyash ratio of horizontal to vertical coefficient of permeability (i.e., k_h/k_v) of 3.0 was conservatively selected for use in the flow net analyses and underdrain design.

The absolute value of the vertical coefficient of permeability will be primarily a function of the gypsum-flyash dry density (i.e., void ratio) using the relationship of void ratio to permeability presented in Figure 4. If the gypsum-flyash density is controlled by the effects of surface drying and desiccation (as appears to be the case for the existing stack), then the density and permeability may be fairly uniform throughout the full depth of the deposit. If the density of the deposit, on the other hand, were to follow a normally consolidated, theoretical relationship of increasing density with depth, then the coefficient of permeability would decrease with depth.

The lowest dry density measured for the existing stack (see Table 1) was 85.3 pcf and the highest value was 98.2 pcf. The average dry density below elevation 622 feet was about 89.0 pcf while the average above that elevation was 93.5 pcf. The average dry density of all the sedimented samples was 91.5 pcf. Considering a typical minimum dry density of 86.0 pcf, a maximum of 98.0 pcf and an average specific gravity of 2.47, correlations with Figure 4 (i.e., for void ratios of 0.79 and 0.57, respectively) indicate that the vertical coefficient of permeability of the existing deposit should be in the range of $9x10^{-5}$ to $2.5x10^{-5}$ cm/sec. For the average dry density of 91.5 pcf, the indicated vertical coefficient of permeability is approximately $6x10^{-5}$ cm/sec.

The effective coefficient of permeability used in flow computations is a function of the horizontal and vertical coefficients of permeability. Using a ratio of horizontal to vertical coefficient of permeability of 3, the effective coefficient of permeability is equal to $\sqrt{3}k_v$. The effective coefficient of permeability for gypsum-flyash at the measured average dry density of 91.5 pcf, therefore, is $1.04x10^{-4}$ cm/sec. The range of effective values, based on the typical minimum and maximum dry densities discussed above (i.e., 86.0 and 98.0 pcf), therefore, will be from $1.56x10^{-4}$ to $4.33x10^{-4}$ cm/sec.

Engineering Evaluation

Flow Nets

Graphical, anisotropic flow nets were constructed for three heights of a typical cross-sectional geometry of the Widows Creek gypsum-flyash stack. The three stack heights correspond to top of stack elevations of 645, 680, and 750 feet (MSL). The location and size of the proposed underdrains were altered, as necessary, to produce a phreatic surface that was depressed sufficiently to achieve an overall stability factor of safety equal to or greater than 1.5.

The typical cross section used in the flow net analyses is shown on Figure 5. This section (i.e., Section 5-5 from the April 22, 1991 report) assumes that the elevation of the existing gypsum-flyash fill is near the crest elevation of the perimeter starter dike and that the average side slope of the stack is 3.0 horizontal to 1.0 vertical. The assumed elevation of the natural clay liner at the base of the stack was taken as 603 feet (MSL).

Figures 6, 7 and 8 show the resulting flow nets and required drain locations for an anisotropic soil with a ratio of horizontal to vertical permeability (i.e., k_h/k_v) equal to 3.0 overlying an impervious layer of soil. The insert in the upper, left hand corner of each figure shows the transformed section used to develop the actual flow net (i.e., drawn to actual scale) presented on the larger scale drawing. An innermost drain width of 18 feet and a middle drain width of 12 feet at the indicated offset distances was required to generate the flow patterns illustrated.

Stability Analyses

Stability analyses were performed for each of the three stack heights evaluated to confirm that the stack will be stable at the proposed intermediate and final heights and geometries. These analyses were performed using the computer program Utexas2 (University of Texas Analysis of Slopes, Version 2) with the Spencer method of analysis and search routines for circular and non-circular failure surfaces. The stability analyses included a check of the bearing capacity of the foundation soils and sliding stability at the interface between the natural ground clayey soils and the gypsum-flyash. All analyses were performed using effective stress strength parameters and phreatic surfaces derived from the graphical flow net analyses.

Strength parameters used in the stability analyses were consistent with the values used and discussed in our previous report of April 22, 1991. In particular an effective friction angle of 39° with zero cohesion was used for the sedimented gypsum-flyash and an effective friction angle of 25° with zero cohesion was selected for the remolded clays in the upper portion of the foundation soils (i.e., surface of the clay immediately beneath the gypsum-flyash). An effective friction angle of 27° with zero cohesion was selected for the deeper, natural deposits underlying the clay liner.

The unit weights of the materials used in the analyses were unchanged from those presented in the report of 22 April. Gypsum-flyash was assumed to have a moist unit weight of 105 pounds per cubic foot (pcf) above the phreatic surface and a saturated unit weight of 115 pcf below it. The natural ground foundation soils were assumed to be saturated with a unit weight of 125 pcf.

The results of stability analyses performed at the three stack heights evaluated are presented in Figures 9, 10 and 11 and are summarized in the table below. As can be seen from these figures, the computed factor of safety in all cases is greater than 1.5. The computed values for the two intermediate height cases are slightly greater than the computed values at the final stack elevation of 750 feet (MSL). The minimum factor of safety for overall foundation bearing capacity failure and gypsum-flyash stack failure modes is 1.58 for a sliding wedge along the gypsum-flyash and natural ground interface.

Layered System

Based on the measured performance of the existing stack, it appears that the density and, subsequently, the permeability of the Widows Creek gypsum-flyash does not follow theoretical trends of self-weight consolidation but is controlled more by other factors, such as surface drying and desiccation. It is possible and anticipated, therefore, that the density of the gypsum-flyash may be fairly uniform over the full height of the stack, resulting in a relatively uniform permeability.

As a worst case example, however, the lower one-third of the stack was assumed to be more highly consolidated (i.e., with a dry density of 98 pcf), while the upper two-thirds was assumed to be more normally consolidated with an average dry density of 87.0 pcf. A flow net was then drawn considering an anisotropic ratio of 3.0, a vertical coefficient of permeability of 2.5×10^{-5} cm/sec in the lower deposit and a vertical coefficient of 8.5×10^{-5} cm/sec in the upper materials. This flow net is presented as Figure 12, which, in turn, was used to generate the phreatic surface used in the stability analysis presented in Figure 13. As documented by Figure 13, the overall stability of the stack considering the above scenario is still greater than 1.35.

Elevation of Top of Stack (feet, MSL)	Factor of Safety	
	Bearing Capacity Type Foundation Failure	Sliding Wedge at Interface of Gypsum-Flyash and Natural Ground
645	1.64	1.66
680	1.71	1.71
750	1.62	1.58
750 (layered)	1.38	1.36

Drain Designs and Flow Quantities

To generate the desired flow patterns presented in Figures 6 through 8, the underdrain locations and sizes were modified slightly from that presented in our conceptual design of April 22, 1991. In particular, the innermost drain required a top collection zone width of 18 feet and the drain was moved inboard an additional 50 feet. The middle drain location was unchanged but the drain width increased from 10 to 12 feet. The toe drain location was also unchanged but the vertical thickness of the graded gravel collection was increased to 5 feet. A sketch of the preliminary drain designs are presented on Figure 14.

Using the flow nets presented in Figures 6 through 8, the unit flow (i.e., flow per unit length of drain pipe) relative to effective coefficient of permeability was determined for each drain for the stack heights analyzed. Presented in Figure 15 is a plot of unit flow (i.e., relative to effective coefficient of permeability of the gypsum-flyash) versus stack height/elevation for each drain. Flow rates per foot of drain can be computed by multiplying the unit flow values obtained from Figure 15 by the effective coefficient of permeability for the gypsum-flyash. The effective coefficient of permeability for the measured average dry density of 91.5 pcf is 0.30 ft/day (1.04×10^{-4} cm/sec). For the lowest measured dry density (86.0 pcf) and highest vertical coefficient of permeability, the effective coefficient of permeability is 0.44 ft/day (1.56×10^{-4} cm/sec).

Closure

Based on the preliminary engineering analyses presented and discussed above, an underdrain system, if properly designed and constructed, can be effectively used to lower the phreatic surface within the proposed Widows Creek gypsum-flyash disposal facility. Anisotropic flow nets and computer stability analyses performed considering the measured material properties of the Widows Creek gypsum-flyash indicate that the underdrains can be used to enhance the overall stability of the stack and also to control seepage from the stack face. These benefits will permit the stack to be raised more steeply than the originally proposed 5.0 horizontal to 1.0 vertical slope and to permit erosion control measures to be implemented on the side slopes of the stack.

The analyses presented herein represent a preliminary evaluation of the underdrain system to assess, in general, if the proposed underdrains will function as intended in the TVA gypsum-flyash deposits. No additional field or laboratory materials testing of the gypsum-flyash deposits was performed in conjunction with this evaluation and all calculations are based on previously reported test data. The computed factors of safety against slope stability failure are applicable only for the particular geometries and conditions evaluated and presented herein. Variations in the height of the perimeter dike, natural ground elevation, elevation of the underdrains relative to the perimeter dike and other factors can significantly alter the results of these analyses and change the conclusions presented in this report.

Additional field and laboratory testing of the TVA gypsum-flyash materials is still recommended to confirm the assumptions used in this report and to better define variations in the material properties as a function of stack height and location relative to the slurry discharge point. Engineering evaluation of the underdrains considering variations in the perimeter dike and natural ground geometries and elevations should also be performed prior to final drain design and construction.

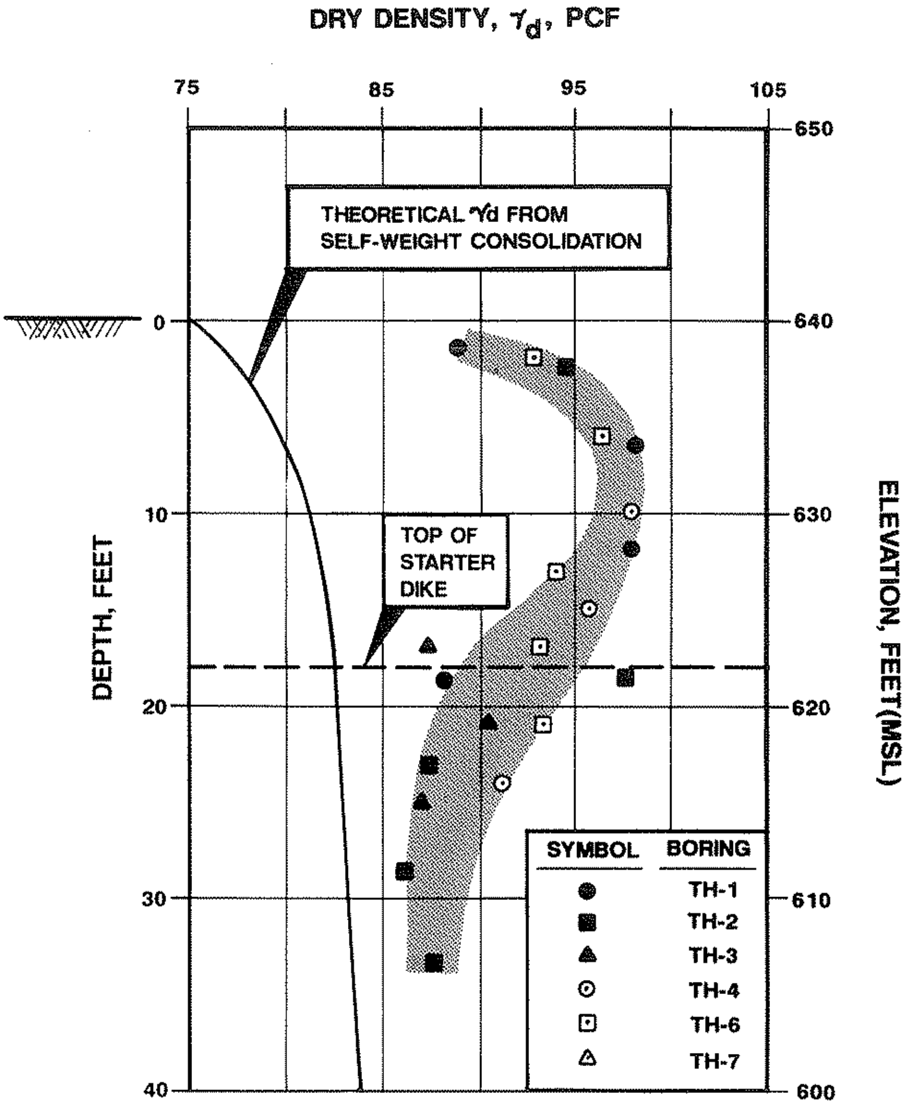
A detailed design of the underdrain system is still required. The various elements of the underdrain should also be laboratory tested to confirm mechanical and chemical compatibility with the Widows Creek gypsum-flyash and process waters.

Table 1

SUMMARY OF MOISTURE CONTENT, DENSITY AND INDEX PROPERTIES OF UNDISTURBED SAMPLES OF GYPSUM-FLYASH

Boring	Sample	Depth (feet)	Sample Center Elevation (MSL)	Fines Content -200 (%)	Natural Moisture Content Range (%)	Average Natural Moisture Content (%)	Dry Density γ_d (lb/ft^3)	Total Unit Weight γ_t (lb/ft^3)	Saturated Unit Weight γ_s (lb/ft^3)	Degree of Saturation S* (%)	Void Ratio e*	Porosity n	Saturated Moisture Content (%)	Solids Content (%)
• SEDIMENTED GYPSUM-FLYASH														
TH-1	US-1	4 - 6	638.4	99	23.3 - 27.8	25.9	88.9	111.9	115.8	85.7	0.75	0.43	30.2	76.8
TH-1	US-2	9 - 11	633.4		21.4 - 24.3	21.5	98.2	119.3	121.3	91.3	0.59	0.37	23.6	80.9
TH-1	US-3	14 - 16	628.4	93	20.0 - 24.3	22.1	98.1	119.8	121.2	93.6	0.59	0.37	23.6	80.9
TH-1	US-4	21 - 23	621.4		25.7 - 28.7	27.6	88.2	112.5	115.3	89.6	0.77	0.43	30.8	76.5
TH-2	US-3	33 - 34.25	616.9	84	22.8 - 28.4	25.0	87.5	109.3	114.9	79.6	0.78	0.44	31.3	76.1
TH-2	US-4	38 - 40	611.5	100	30.6 - 33.9	31.7	86.2	113.6	114.1	98.0	0.81	0.45	32.4	75.5
TH-2	US-5	43 - 45	606.5		27.1 - 32.6	29.2	87.7	113.3	115.0	93.8	0.78	0.44	31.1	76.3
TH-3	US-1	20 - 22	622.8		21.0 - 34.1	30.0	87.4	113.6	114.8	95.5	0.79	0.44	31.4	76.1
TH-3	US-2	24 - 26	618.6	85	22.4 - 28.5	26.1	90.6	114.2	116.7	90.4	0.72	0.42	28.9	77.6
TH-3	US-3	28 - 30	614.6		22.8 - 30.3	27.8	87.0	111.2	114.6	87.7	0.79	0.44	31.7	75.9
TH-4	US-1	6 - 8	633.4	98	26.5 - 29.6	27.7	85.3	108.9	113.6	83.5	0.83	0.45	33.2	75.1
TH-4	US-2	9 - 11	629.9		19.9 - 23.4	21.8	98.0	119.4	121.2	92.1	0.59	0.37	23.7	80.9
TH-4	US-3	14 - 16	624.9	99	20.7 - 26.3	22.9	95.8	117.7	119.9	91.2	0.63	0.39	25.2	79.9
TH-4	US-4	23 - 25	615.9		21.2 - 29.3	25.6	91.3	114.7	117.2	90.3	0.71	0.41	28.4	77.9
TH-6	US-1	10 - 12	637.9		21.7 - 23.3	22.4	92.9	113.6	118.1	82.2	0.68	0.40	27.2	78.6
TH-6	US-2	14 - 16	633.9	99	21.1 - 24.8	23.3	96.4	118.9	120.3	94.5	0.62	0.38	24.7	80.2
TH-7	US-1	10.5 - 12.5	627.1	99	18.9 - 22.4	21.4	93.9	114.1	118.8	81.1	0.66	0.40	26.4	79.1
TH-7	US-2	14.5 - 16.5	623.1		20.3 - 26.7	24.5	93.3	116.2	118.4	91.2	0.67	0.40	26.9	78.8
TH-7	US-3	18.5 - 20.5	619.1	97	20.0 - 25.1	23.2	93.4	115.1	118.5	86.6	0.67	0.40	26.8	78.9
Average						25.2	91.5	114.6	117.4	89.4	0.71	0.41	28.3	78.0
• CAST GYPSUM-FLYASH														
TH-2	US-1	12 - 14	637.5		20.9 - 24.3	22.5	94.6	115.9	119.2	86.9	0.65	0.39	26.0	79.4
TH-2	US-2	28 - 29.5	621.5		19.1 - 20.6	20.1	97.8	117.4	121.1	84.3	0.60	0.37	23.8	80.8

*Based on a specific gravity of 2.50 for gypsum-flyash.



MEASURED DRY DENSITY VERSUS DEPTH

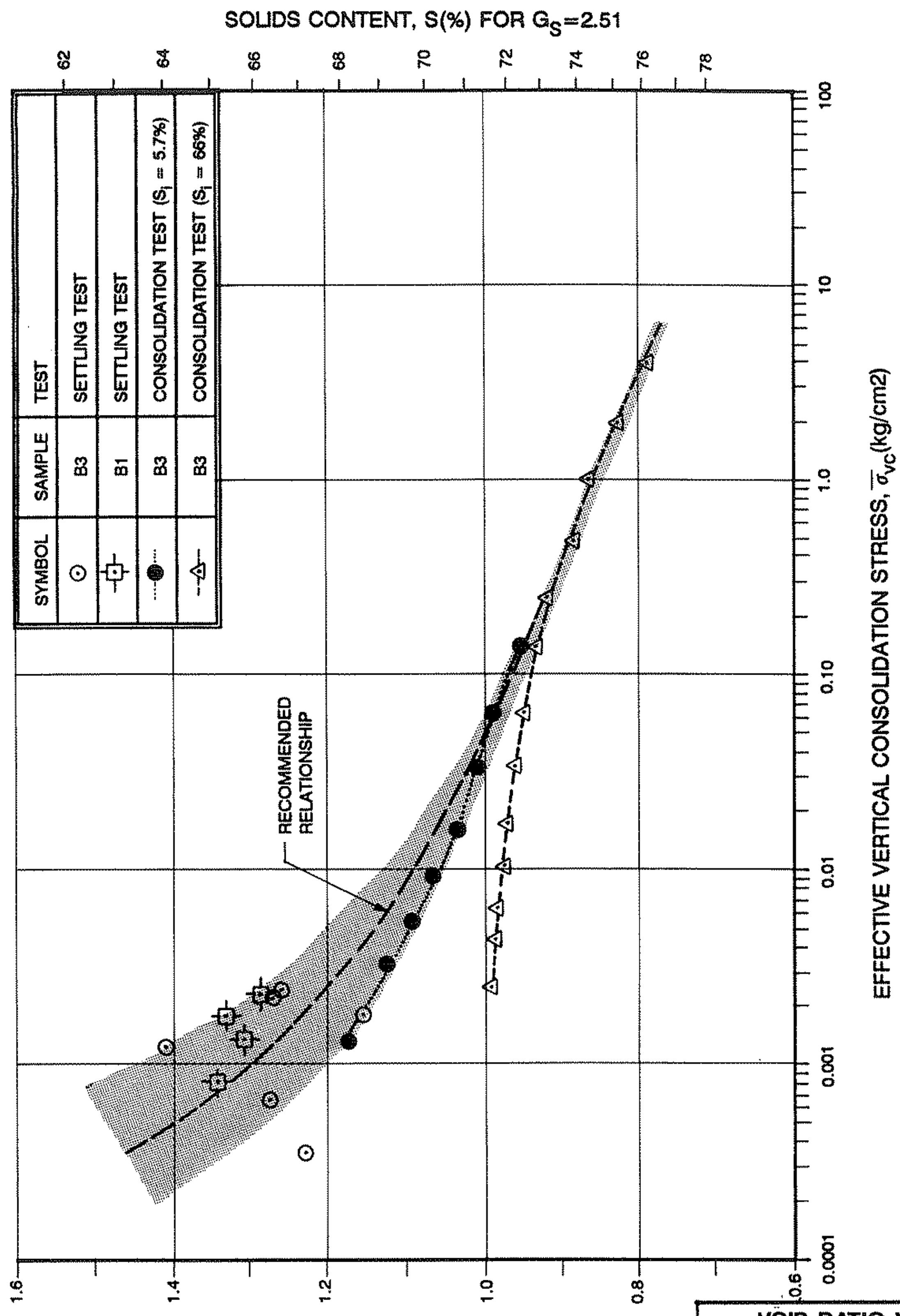
Ardaman & Associates, Inc.
Consulting Engineers in Soils, Hydrogeology, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY: RBE
CHECKED BY: PR
DATE: 8/1/91
FILE NO. 90-059
APPROVED BY: Thomas L. Ingra

N39695

FIGURE 1



VOID RATIO VERSUS EFFECTIVE STRESS

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FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY: KAG	CHECKED BY: EJW	DATE: 8/1/91
FILE NO. 90-059	APPROVED BY: John E. Garlanger	

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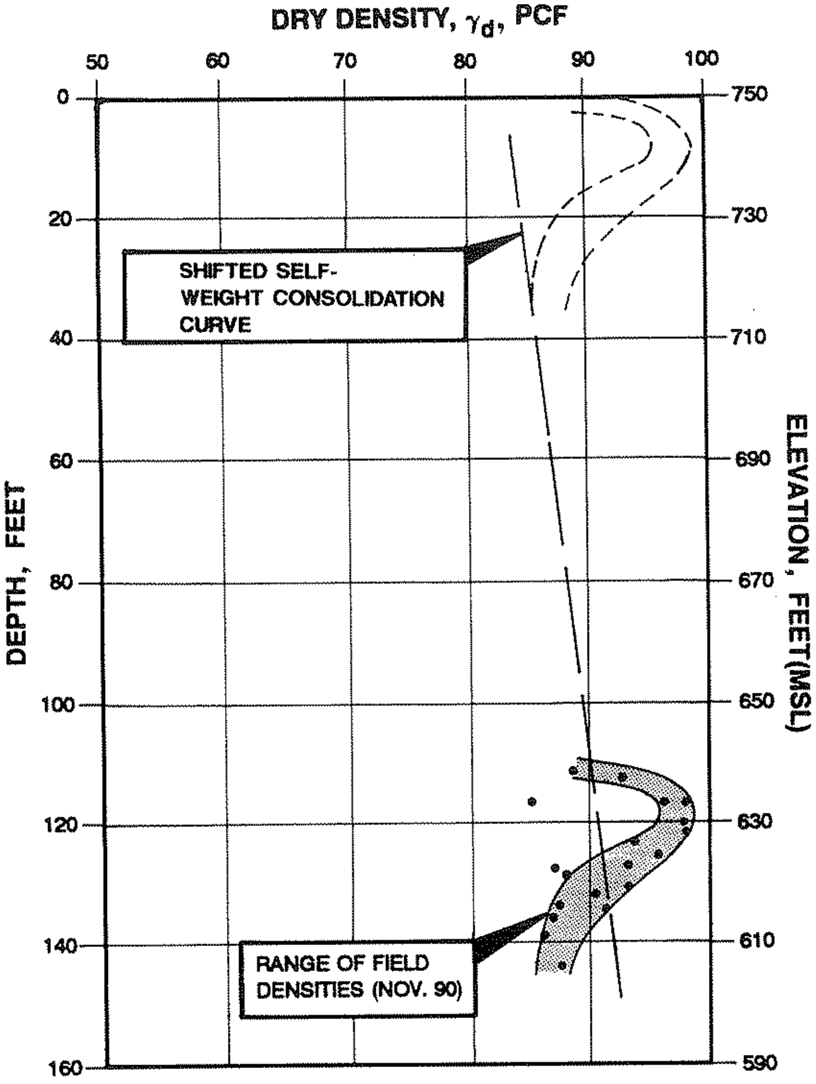
FIGURE 2



SHIFTED SELF-WEIGHT CONSOLIDATION CURVE

RANGE OF FIELD DENSITIES (NOV. 90)

DRY DENSITY VERSUS DEPTH

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FGD GYPSUM-FLYASH WASTE WET-
STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

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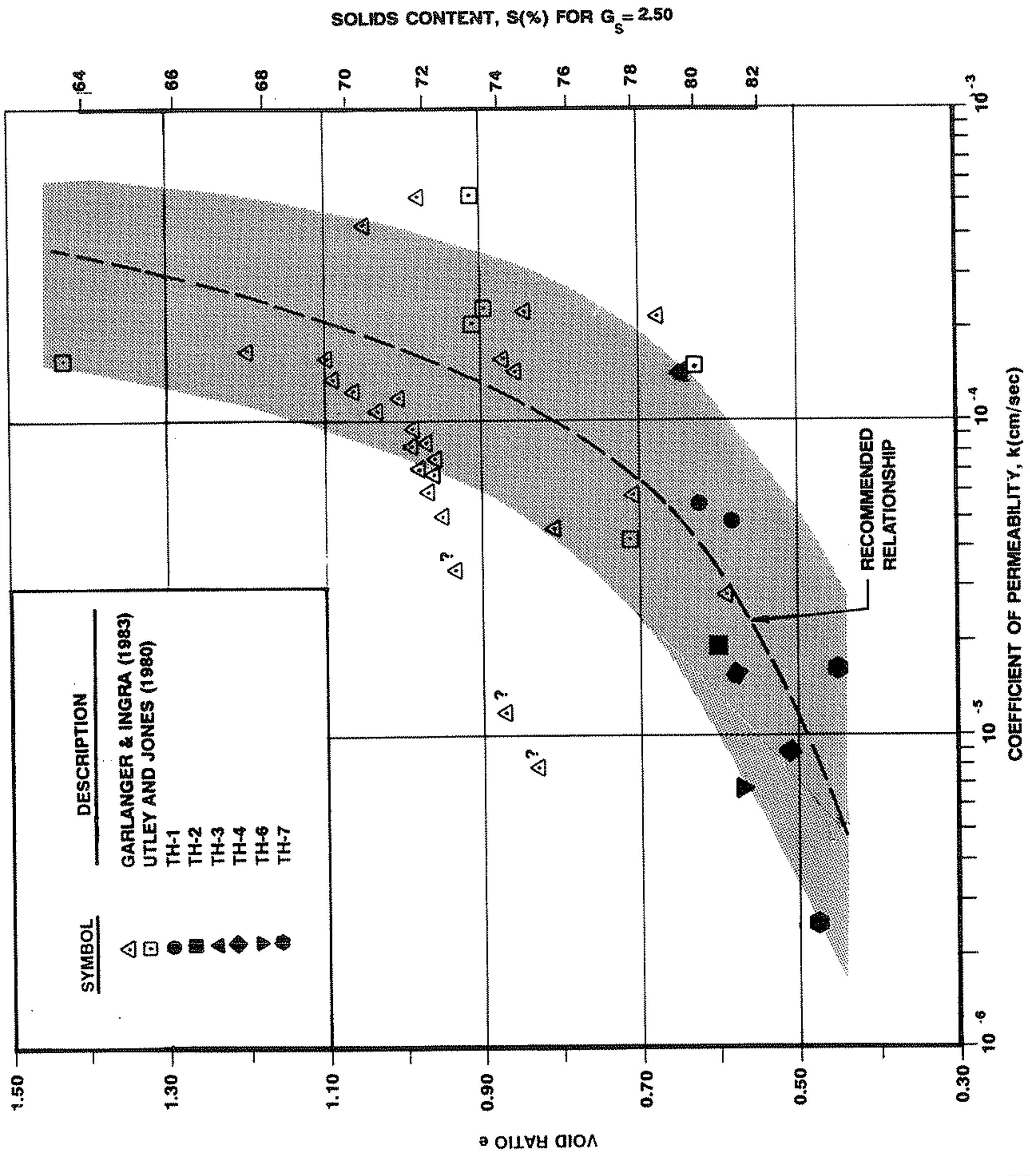
FIGURE 3



COEFFICIENT OF PERMEABILITY VS. VOID RATIO RELATIONSHIP FOR GYPSUM-FLYASH

Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

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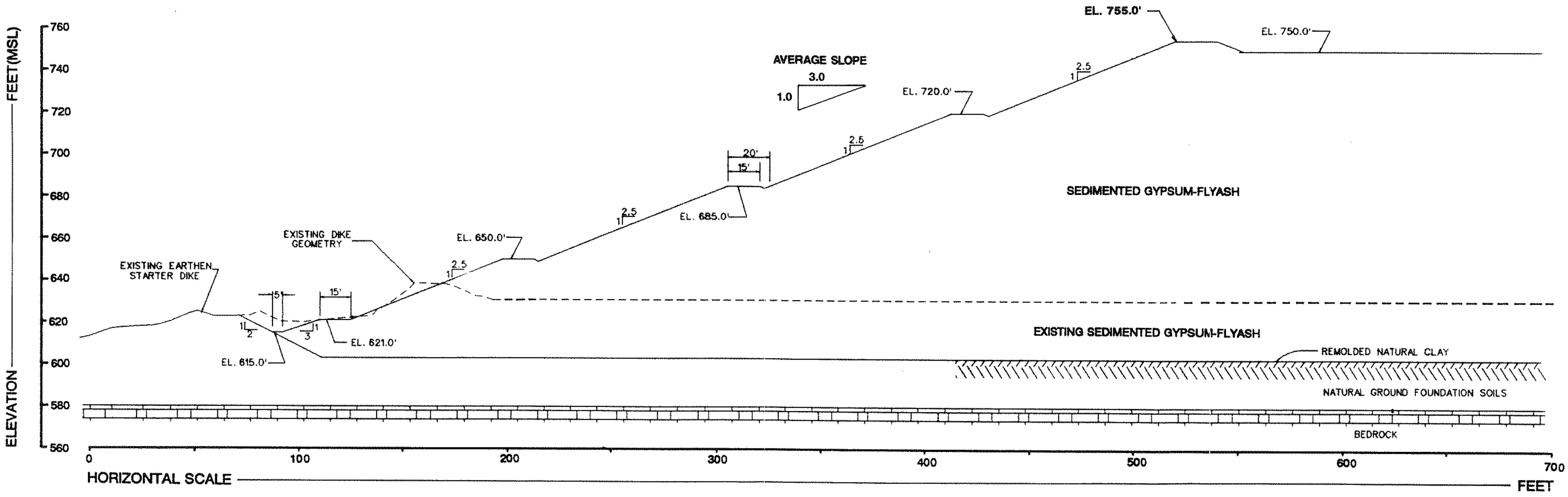
FIGURE 4



SECTION 5-5

SCALE: 1"=50'

TYPICAL CROSS-SECTION FOR CONCEPTUAL REMEDIAL PLAN FOR GYPSUM-FLYASH STACK

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FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

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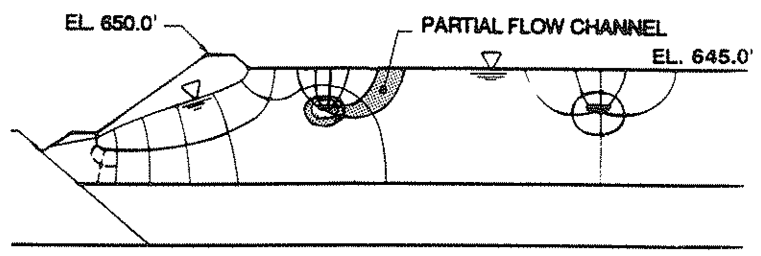
FILE NO. 90-059	APPROVED BY: John E. Garlanger	

N36488

FIGURE 5

TRANSFORMED FLOW NET, $\frac{k_h}{k_v} = 3$



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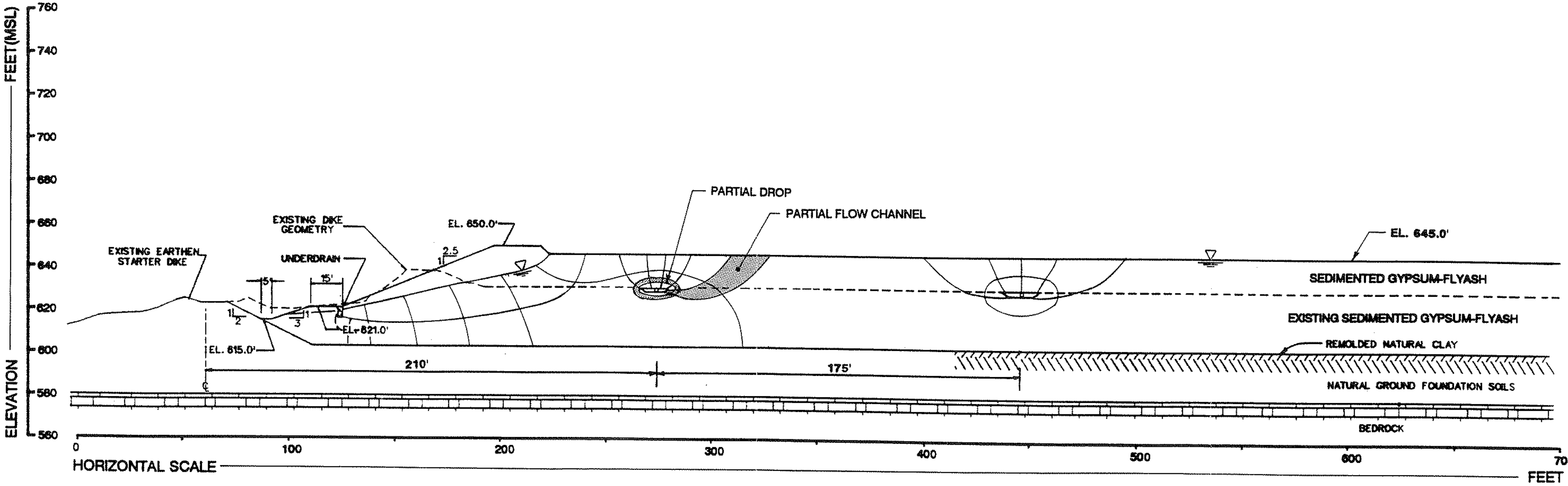

SECTION 5-5
SCALE: 1"=50'

ANISOTROPIC FLOW NET FOR GYPSUM-FLYASH STACK WITH TOP ELEVATION 645 FEET

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Consulting Engineers in Soils, Hydrogeology, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

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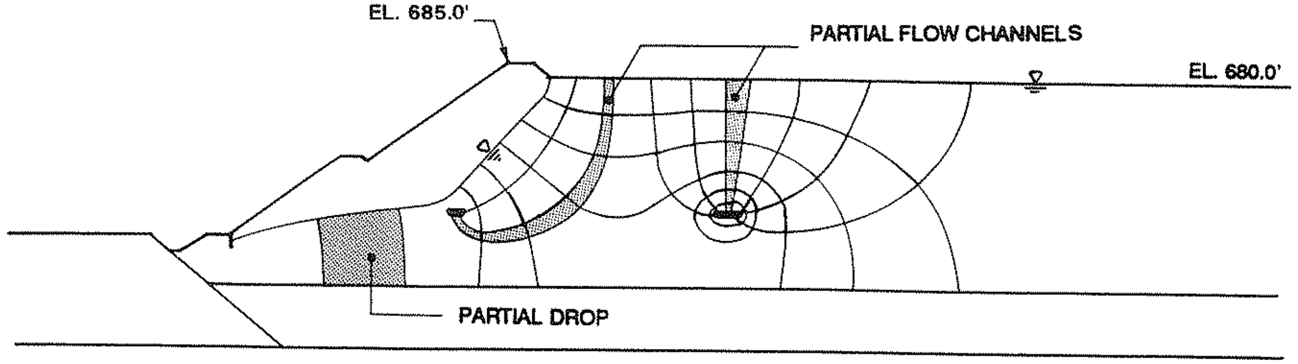
FILE NO. 90-059	APPROVED BY:	

N36488

FIGURE 6

TRANSFORMED FLOW NET, $\frac{k_h}{k_v}=3$



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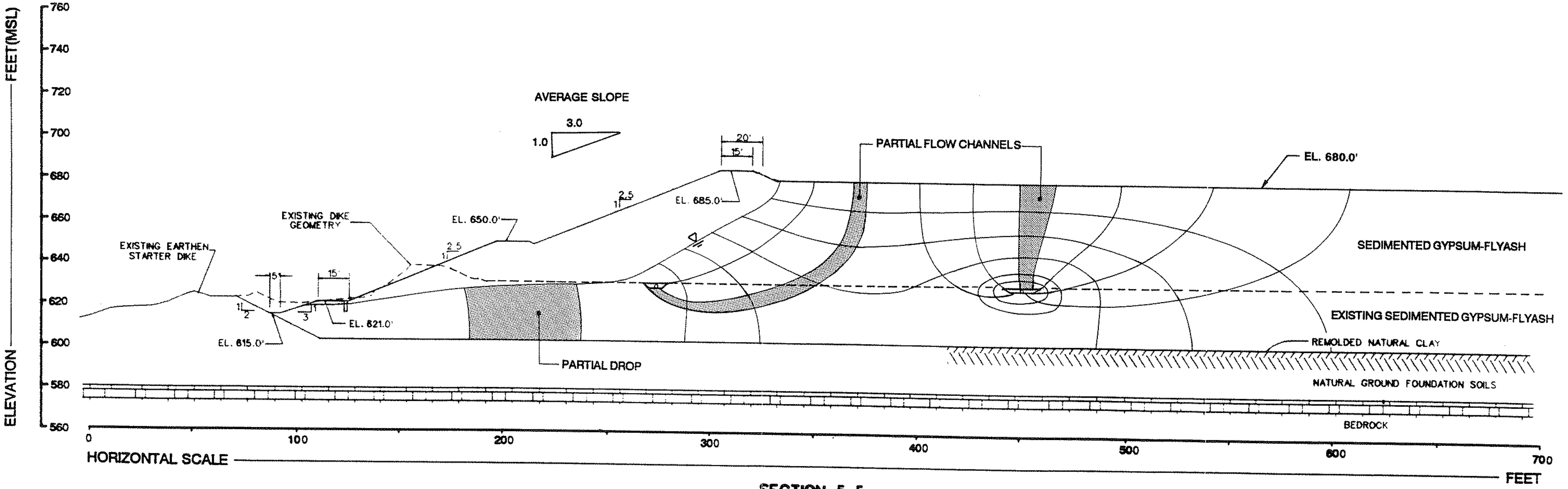

SECTION 5-5

SCALE: 1"=50'

ANISOTROPIC FLOW NET FOR GYPSUM-FLYASH STACK WITH TOP ELEVATION OF 680 FEET

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FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

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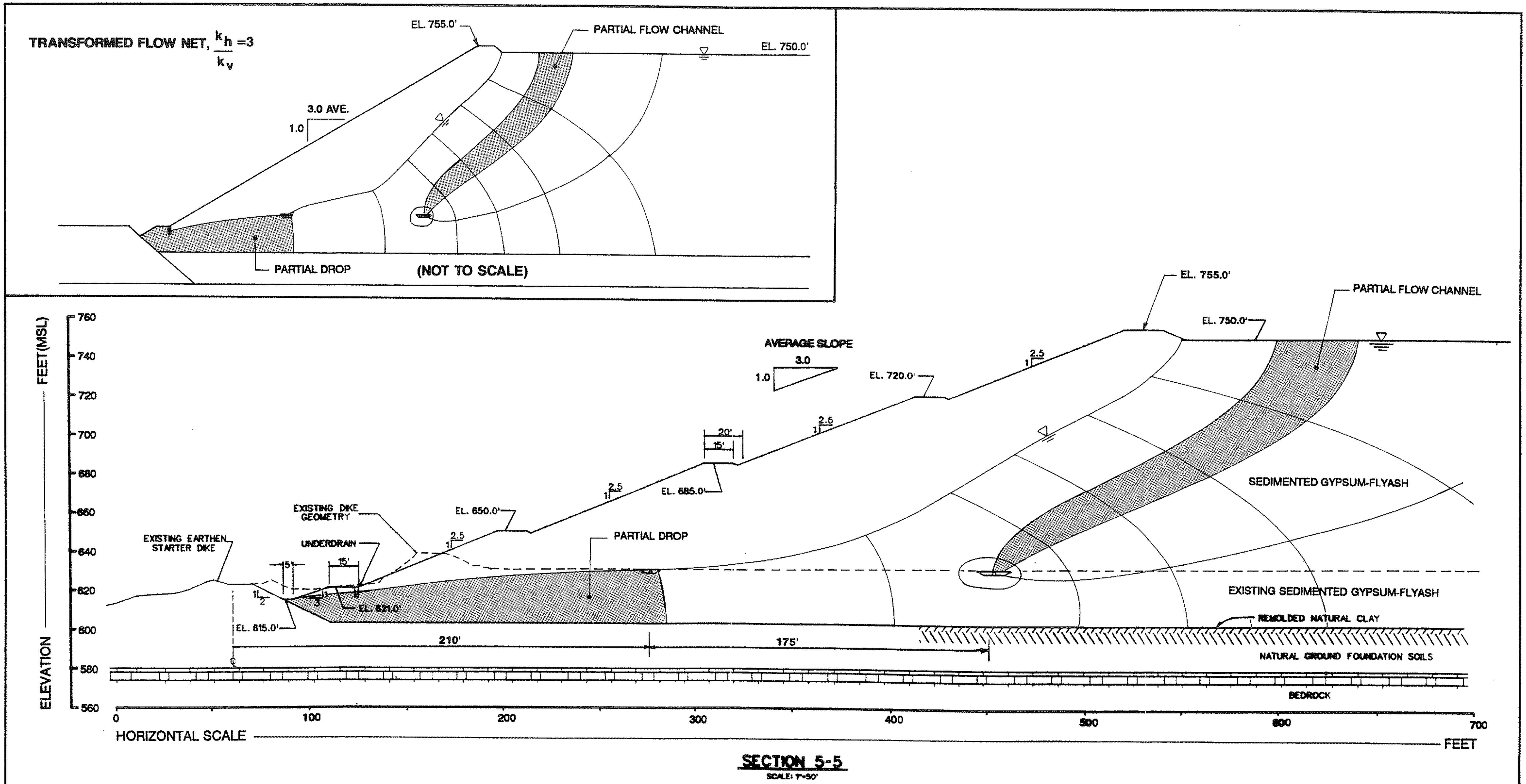
FILE NO. 90-059	APPROVED BY: John E. Garlanger	

FIGURE 7

N36488



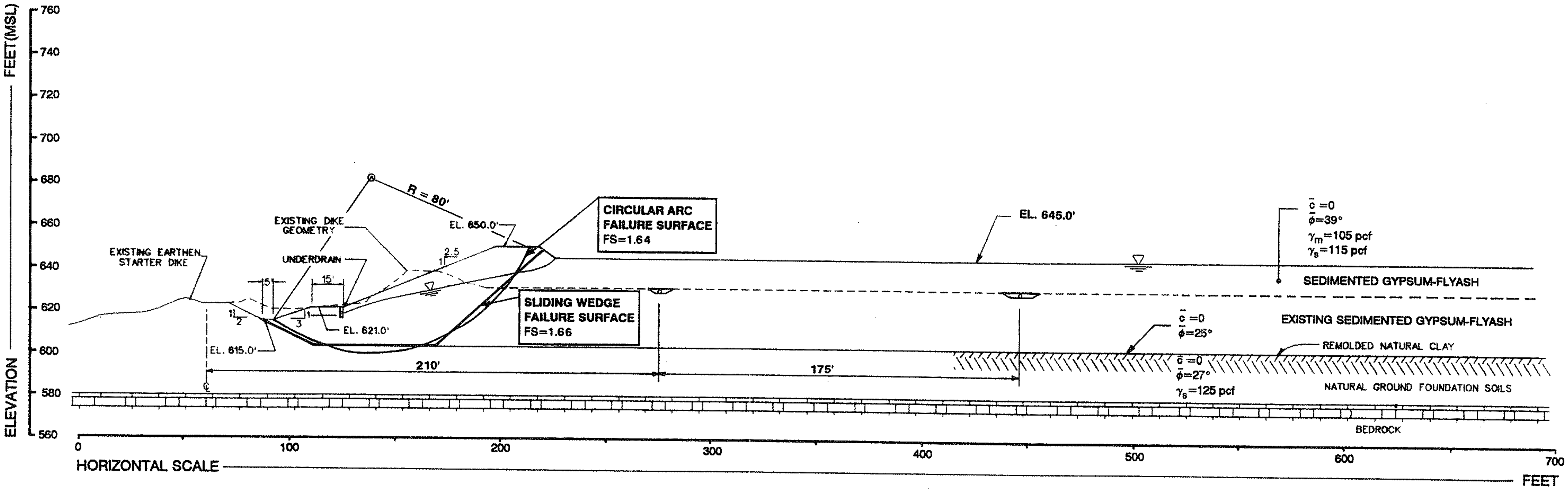
ANISOTROPIC FLOW NET FOR GYPSUM-FLYASH STACK WITH TOP ELEVATION OF 750 FEET

Ardaman & Associates, Inc.
Consulting Engineers in Soils, Hydrogeology, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY: SEF
CHECKED BY: EJW
DATE: 8/1/91
FILE NO. 90-059
APPROVED BY: John E. Garlanger

FIGURE 8



SECTION 5-5

SCALE: 1"=50'

STABILITY ANALYSIS FOR GYPSUM-FLYASH STACK WITH TOP ELEVATION OF 645 FEET

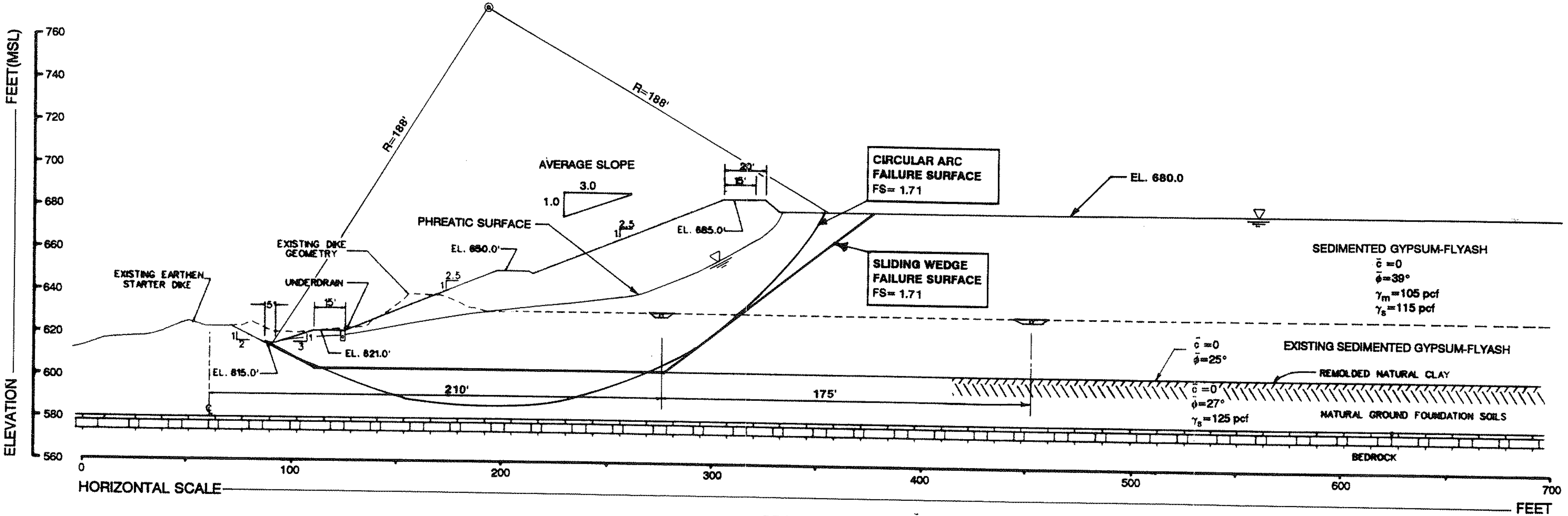
Ardaman & Associates, Inc.
Consulting Engineers in Soils, Hydrogeology, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY: SEF	CHECKED BY: EJW	DATE: 8/1/91
FILE NO. 90-059	APPROVED BY: John E. Garlanger	

N36488

FIGURE 9



SECTION 5-5

SCALE: [illegible]

STABILITY ANALYSIS FOR GYPSUM-FLYASH STACK WITH TOP ELEVATION OF 680 FEET

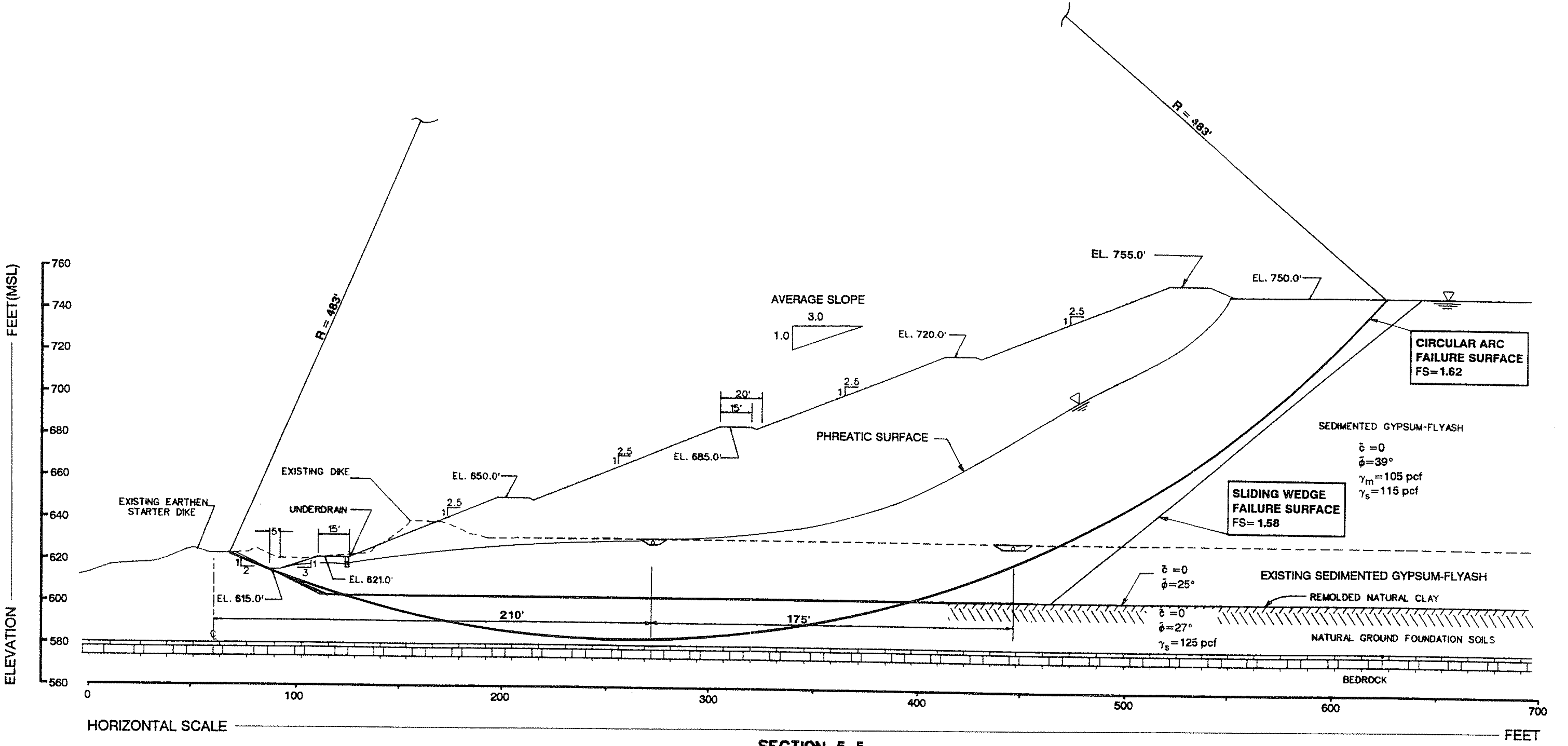
Ardaman & Associates, Inc.
Consulting Engineers in Soils, Hydrogeology, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY SEF	CHECKED BY EJW	DATE 8/1/91
FILE NO. 90-059	APPROVED BY John E. Garlanger	

N36488

FIGURE 10



SECTION 5-5

SCALE: 1"=50'

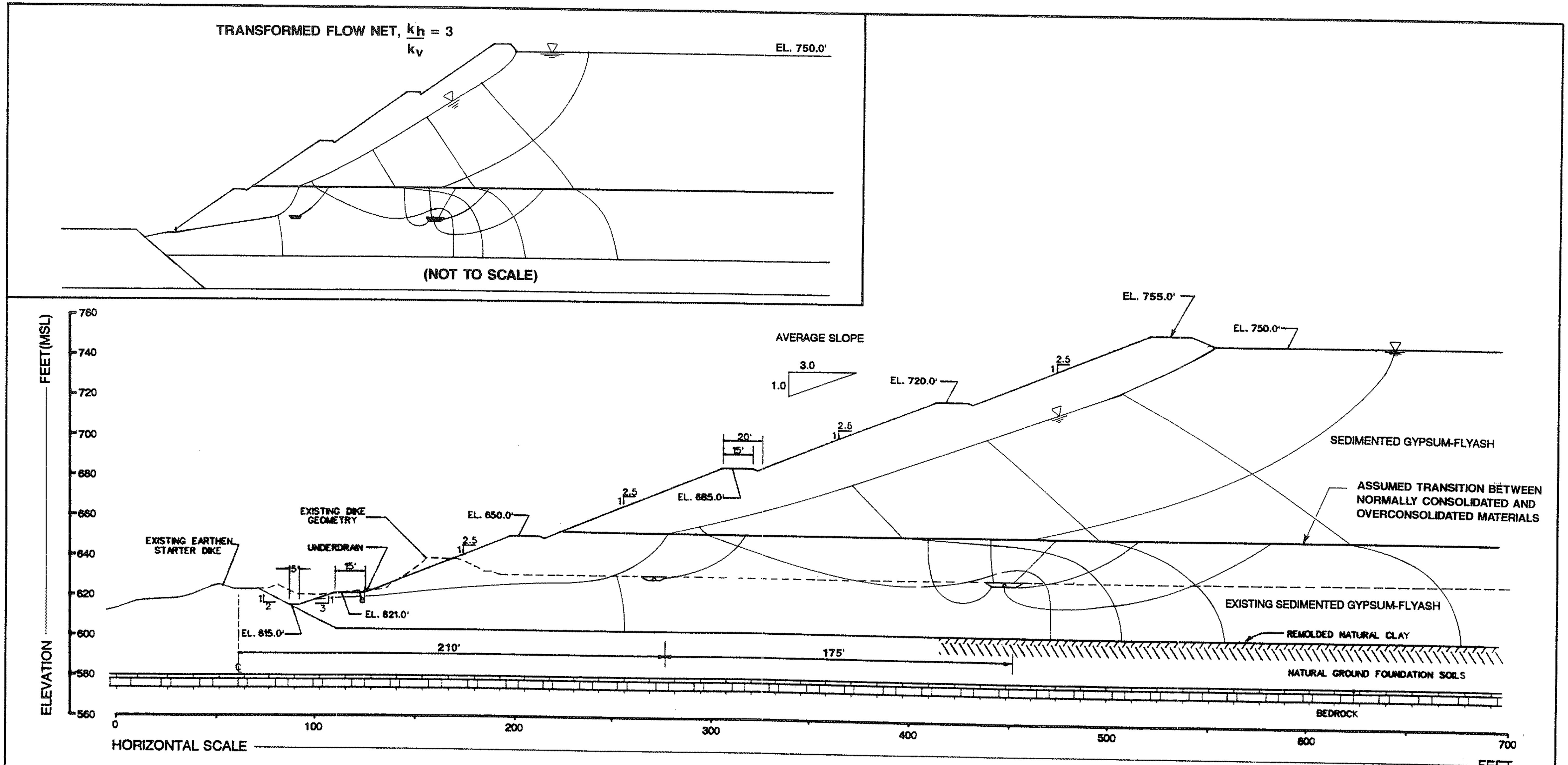
STABILITY ANALYSIS FOR GYPSUM-FLYASH STACK WITH TOP ELEVATION OF 750 FEET

Ardaman & Associates, Inc.
Consulting Engineers in Soils, Hydrogeology,
Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-
STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY SEF
CHECKED BY EJW
DATE 8/1/91
FILE NO. 90-059
APPROVED BY John E. Garlanger

FIGURE 11



SECTION 5-5

SCALE: 1"=50'

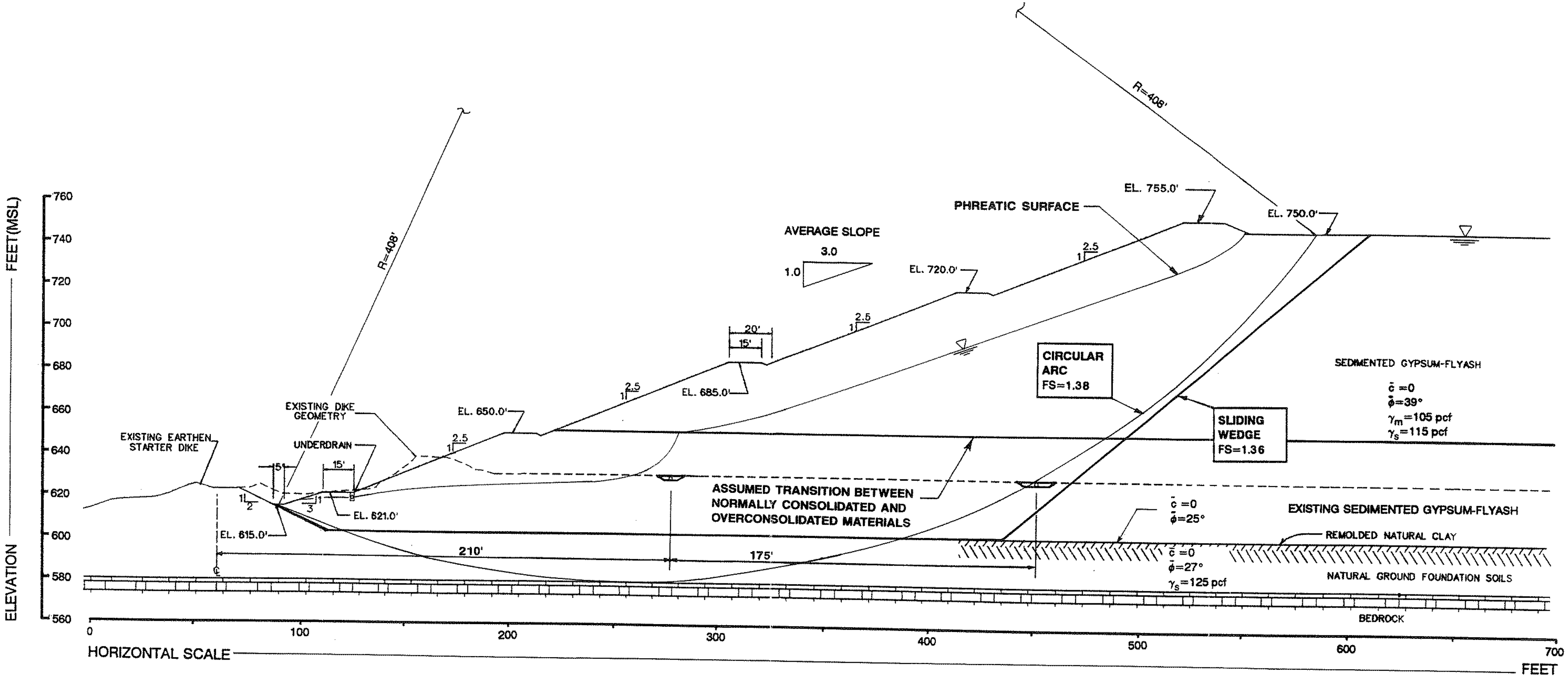
ANISOTROPIC FLOW NET FOR 2-LAYERED GYPSUM-FLYASH STACK

Ardaman & Associates, Inc.
Consulting Engineers in Soils, Hydrogeology, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-
STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY: SEF	CHECKED BY: EATW	DATE: 8/1/91
FILE NO. 90-059	APPROVED BY: John E. Garlanger	

FIGURE 12



SECTION 5-5

SCALE: 1"=50'

STABILITY ANALYSIS FOR 2-LAYERED GYPSUM-FLYASH STACK

Ardaman & Associates, Inc.
Consulting Engineers in Soils, Hydrogeology, Foundations, and Materials Testing

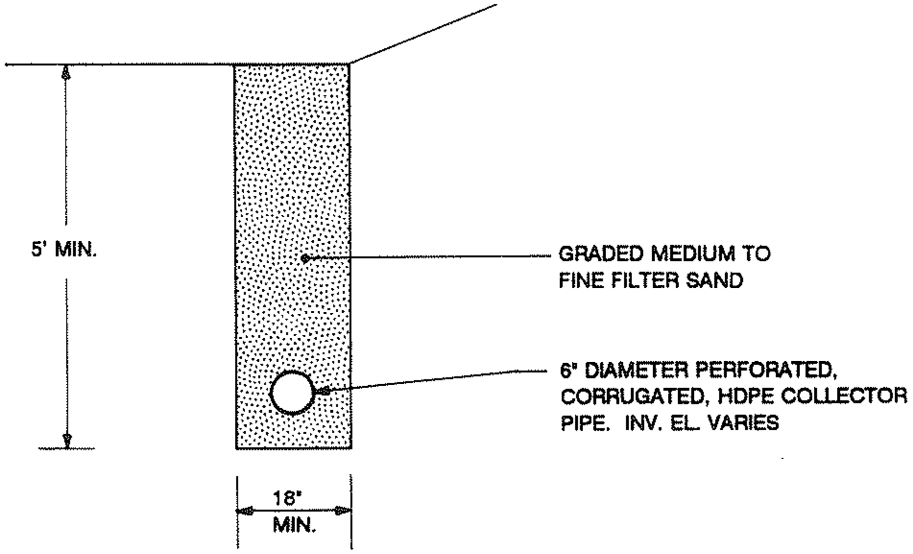
FGD GYPSUM-FLYASH WASTE WET-
STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY: SEF	CHECKED BY: EJW	DATE: 8/1/91
FILE NO. 90-059	APPROVED BY: John E Garlanger	

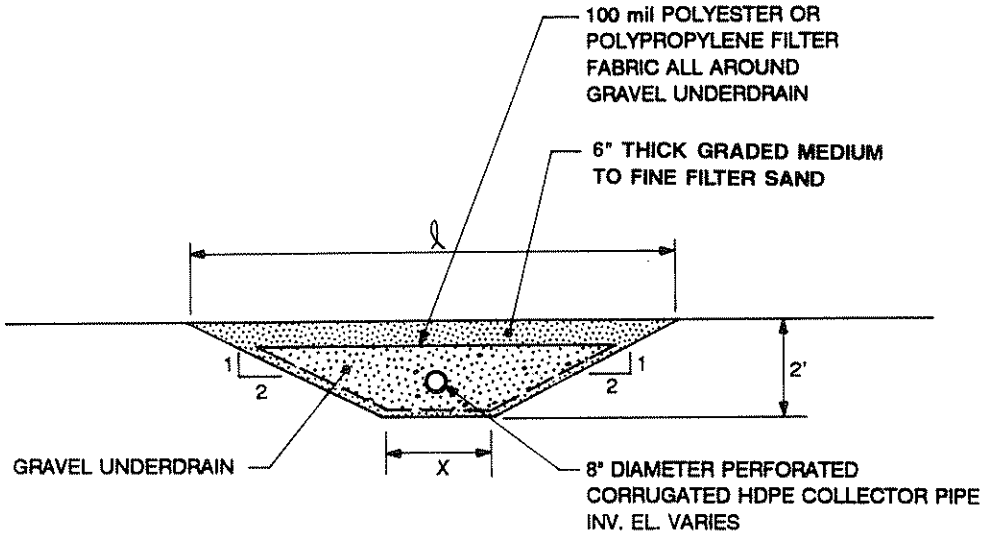
FIGURE 13

DRAIN TYPE "A"

NOT TO SCALE



DRAIN TYPES "B" AND "C"



DRAIN TYPE	ℓ(FEET)	X (FEET)
B	12	4
C	18	10

PRELIMINARY DRAIN DESIGN DETAILS

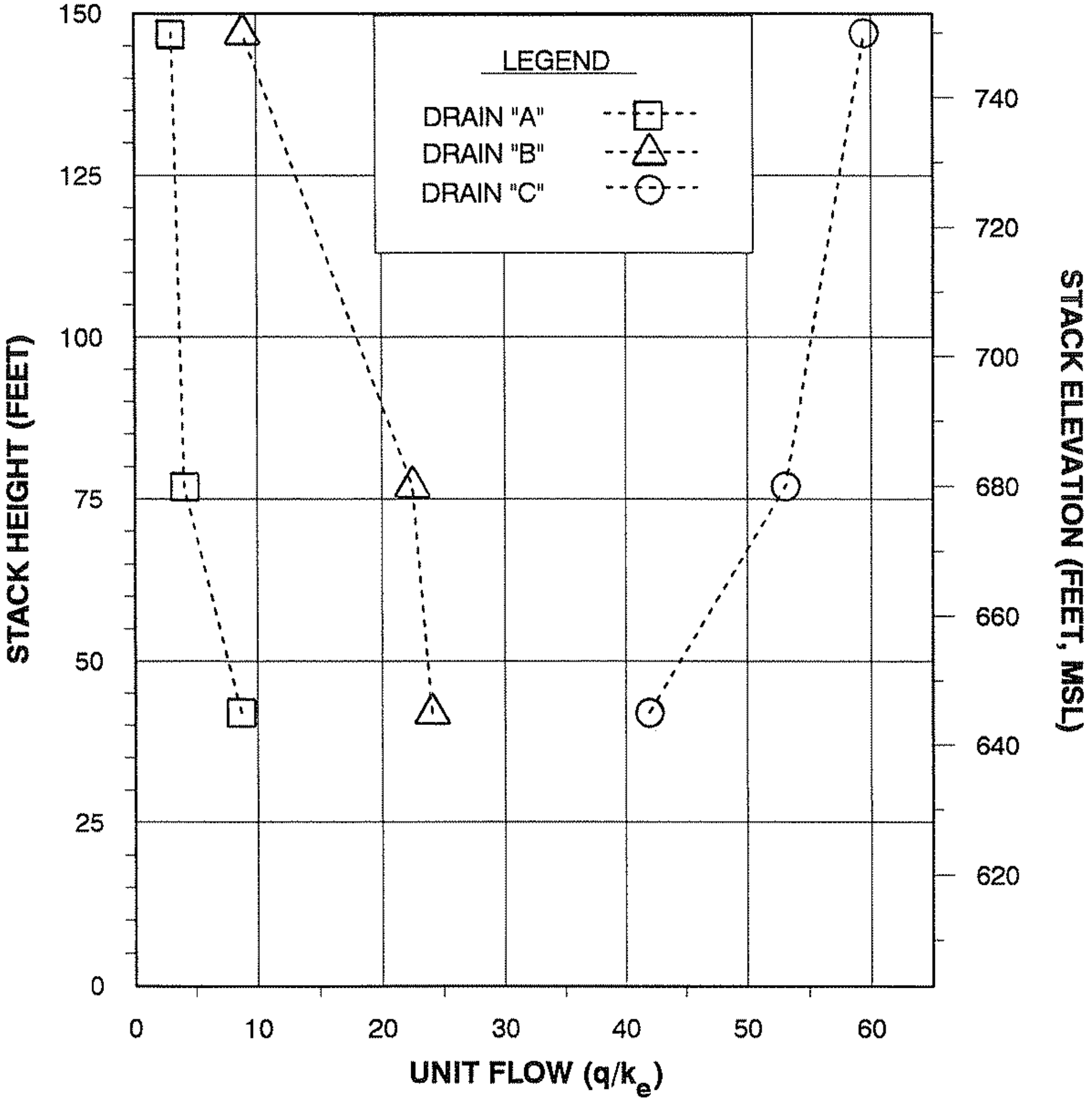
Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY: KAG	CHECKED BY: EJW	DATE: 8/1/91
FILE NO. 90-059	APPROVED BY: John E Garlanger	

N54105

FIGURE 14



NOTE: q = UNIT FLOW (CUBIC FEET PER DAY PER LINEAR FOOT OF DRAIN)

k_e = EFFECTIVE COEFFICIENT OF PERMEABILITY = $\sqrt{3}\,k_v$ IN FEET PER DAY

UNIT FLOW VERSUS
STACK HEIGHT/ELEVATION

Ardaman & Associates, Inc.
Consulting Engineers in Soils, Hydrology, Foundations and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

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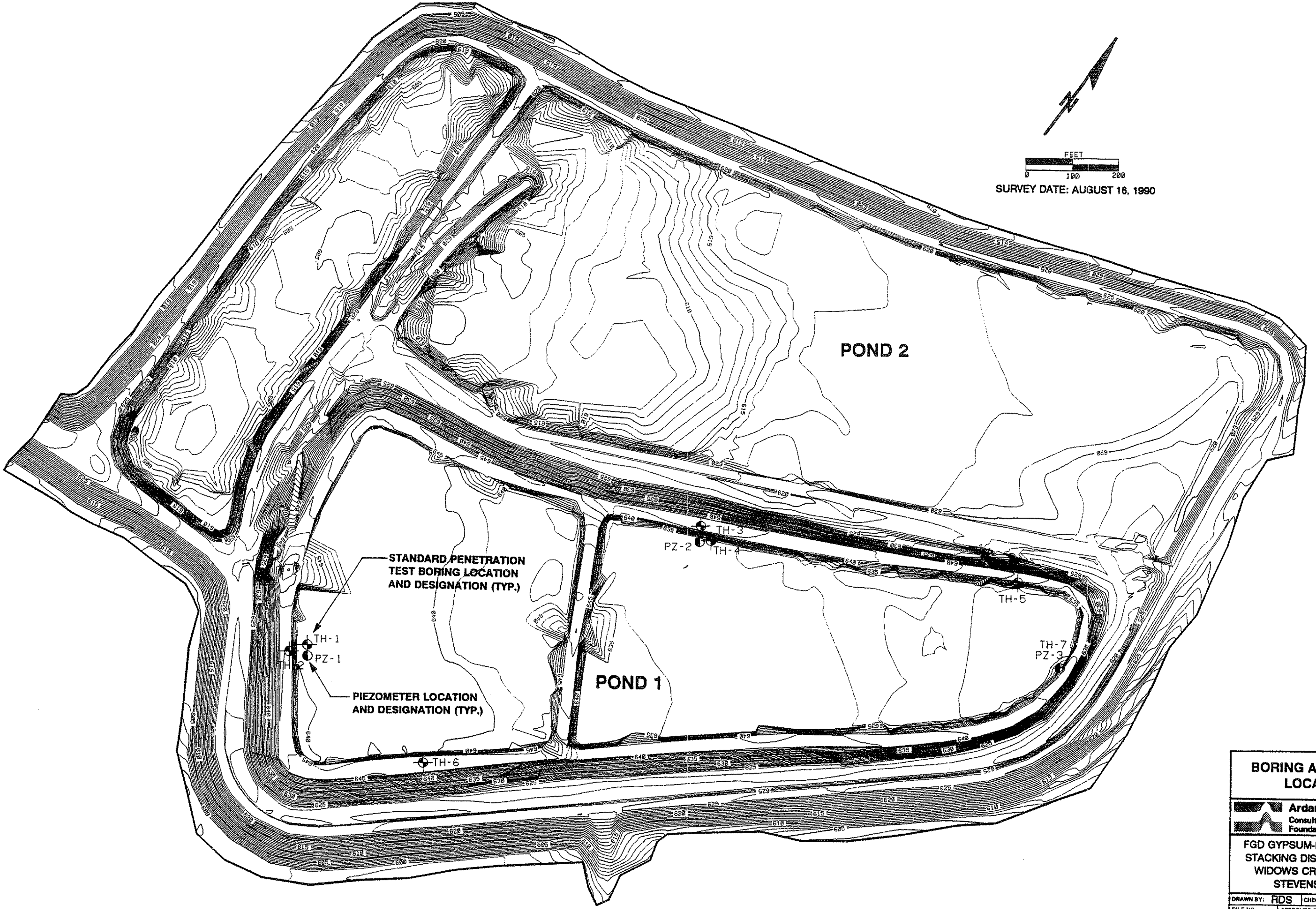
FILE NO.: 90-059	APPROVED BY: John E. Garlanger	

FIGURE 15

Appendix A

SIMPLIFIED BORING LOG PROFILES

4300'



BORING AND PIEZOMETER LOCATION PLAN

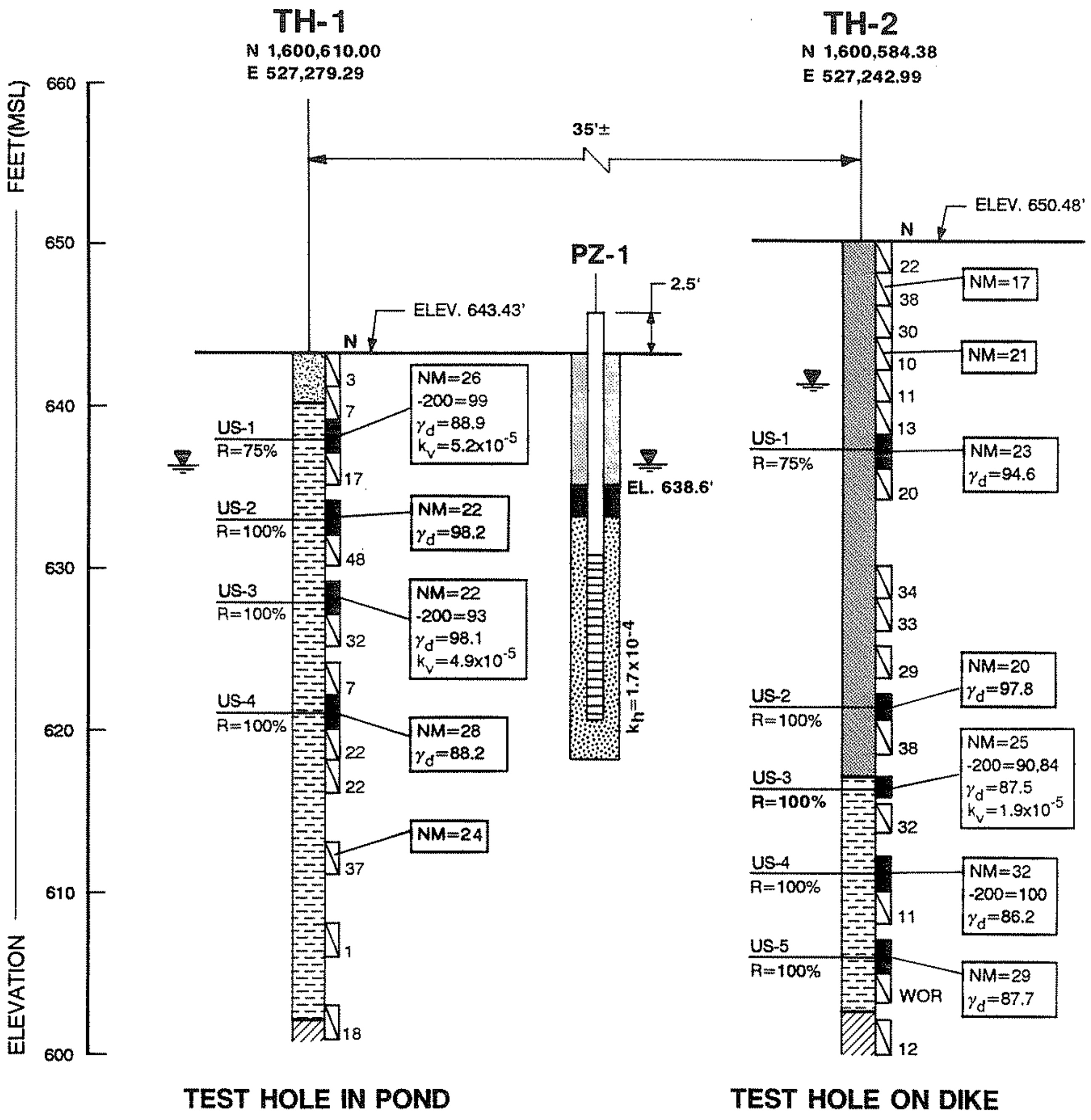
Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-
STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY: RDS	CHECKED BY: EJW	DATE: 4/11/91
FILE NO. 90-059	APPROVED BY: John E. Garlanger	

N39695

FIGURE 2.1



LEGEND

▨	FILL	▤	SEDIMENTED GYPSUM-FLYASH
▩	CAST GYPSUM-FLYASH	▨	CLAY

k_h = HORIZONTAL COEFFICIENT OF PERMEABILITY (cm/sec)

k_v = VERTICAL COEFFICIENT OF PERMEABILITY (cm/sec)

NM = MOISTURE CONTENT (%)

-200 = FINES CONTENT (%)

γ_d = DRY DENSITY (PCF)

SIMPLIFIED BORING PROFILES FOR TH-1 & TH-2

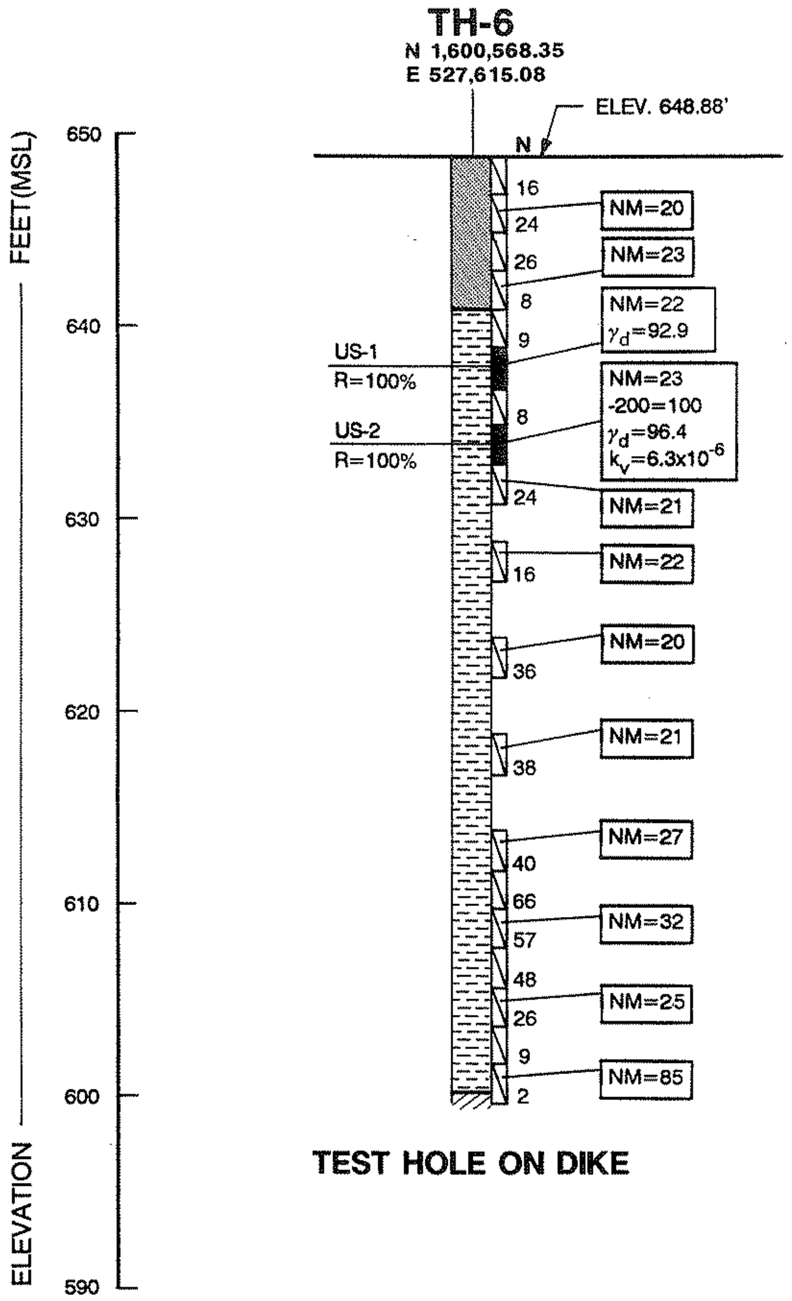
Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY: RBE	CHECKED BY: EJW	DATE: 4/18/91
FILE NO. 90-059	APPROVED BY:	

N39695

FIGURE 2.2



TEST HOLE ON DIKE

LEGEND

▨ FILL ▤ SEDIMENTED GYPSUM-FLYASH

▩ CAST GYPSUM-FLYASH ▨ CLAY

k_h = HORIZONTAL COEFFICIENT OF PERMEABILITY (cm/sec)

k_v = VERTICAL COEFFICIENT OF PERMEABILITY (cm/sec)

NM = MOISTURE CONTENT (%)

-200 = FINES CONTENT (%)

γ_d = DRY DENSITY (PCF)

SIMPLIFIED BORING PROFILE FOR TH-6

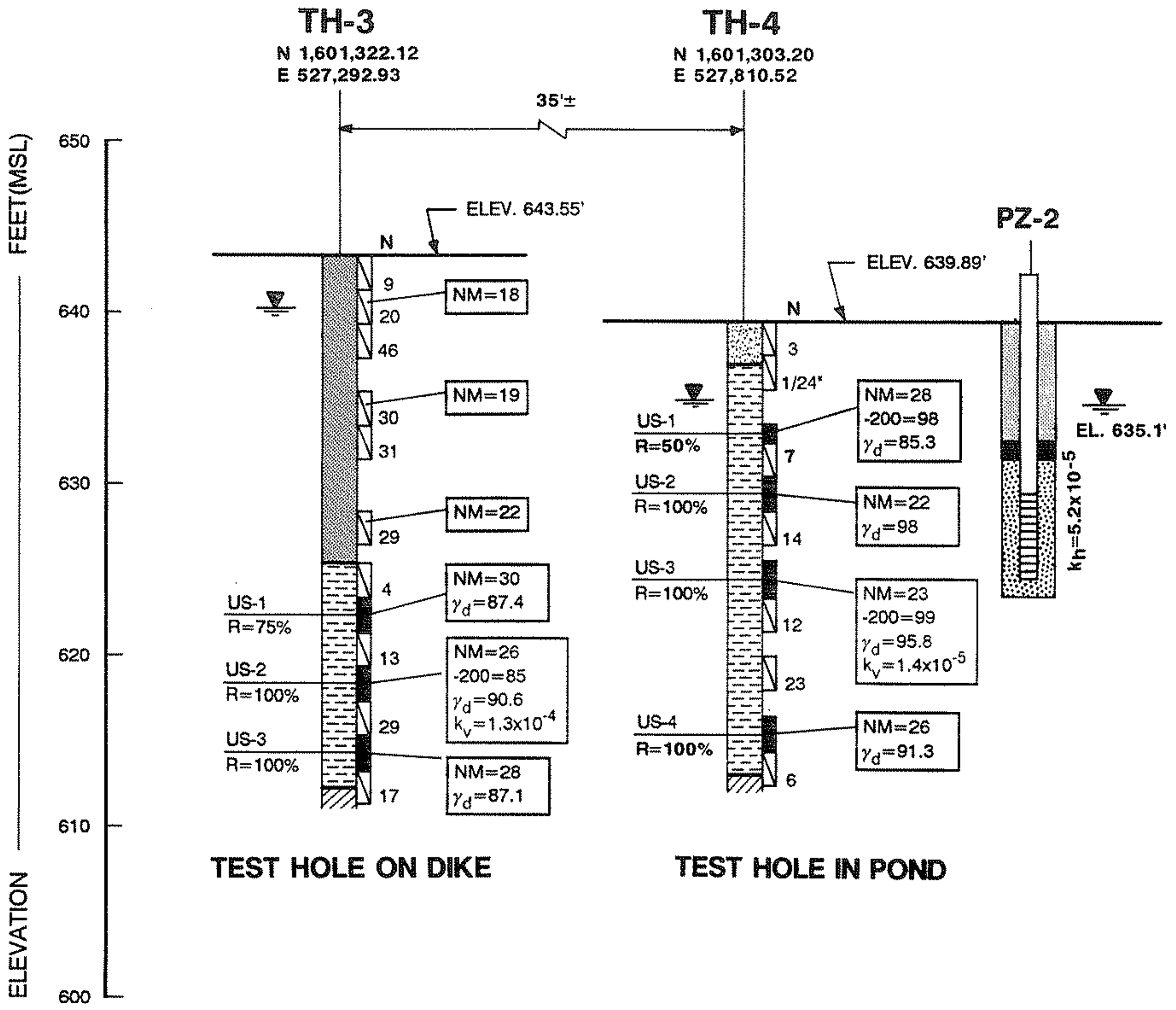
Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY: RBE	CHECKED BY: EJW	DATE: 4/18/91
FILE NO. 90-059	APPROVED BY:	

N36488

FIGURE 2.3



LEGEND

▒ FILL

☰ SEDIMENTED GYPSUM-FLYASH

▓ CAST GYPSUM-FLYASH

▨ CLAY

k_h = HORIZONTAL COEFFICIENT OF PERMEABILITY (cm/sec)

k_v = VERTICAL COEFFICIENT OF PERMEABILITY (cm/sec)

NM = MOISTURE CONTENT (%)

-200 = FINES CONTENT (%)

γ_d = DRY DENSITY (PCF)

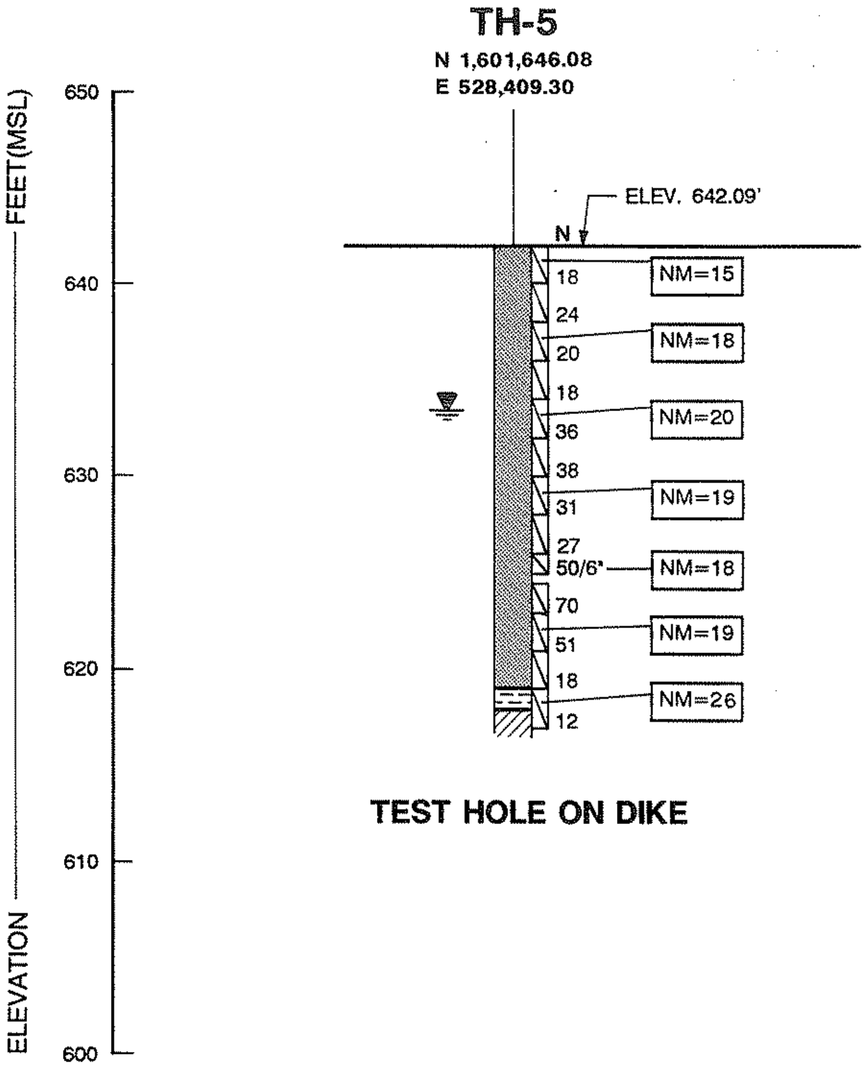
SIMPLIFIED BORING PROFILES FOR TH-3 & TH-4

Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY: RBE	CHECKED BY: EJW	DATE: 8/1/91
FILE NO. 90-059	APPROVED BY:	

FIGURE 2.4



TEST HOLE ON DIKE

LEGEND

▨ FILL

▤ SEDIMENTED GYPSUM-FLYASH

▩ CAST GYPSUM-FLYASH

▧ CLAY

k_h = HORIZONTAL COEFFICIENT OF PERMEABILITY (cm/sec)

k_v = VERTICAL COEFFICIENT OF PERMEABILITY (cm/sec)

NM = MOISTURE CONTENT (%)

-200 = FINES CONTENT (%)

γ_d = DRY DENSITY (PCF)

SIMPLIFIED BORING PROFILE FOR TH-5

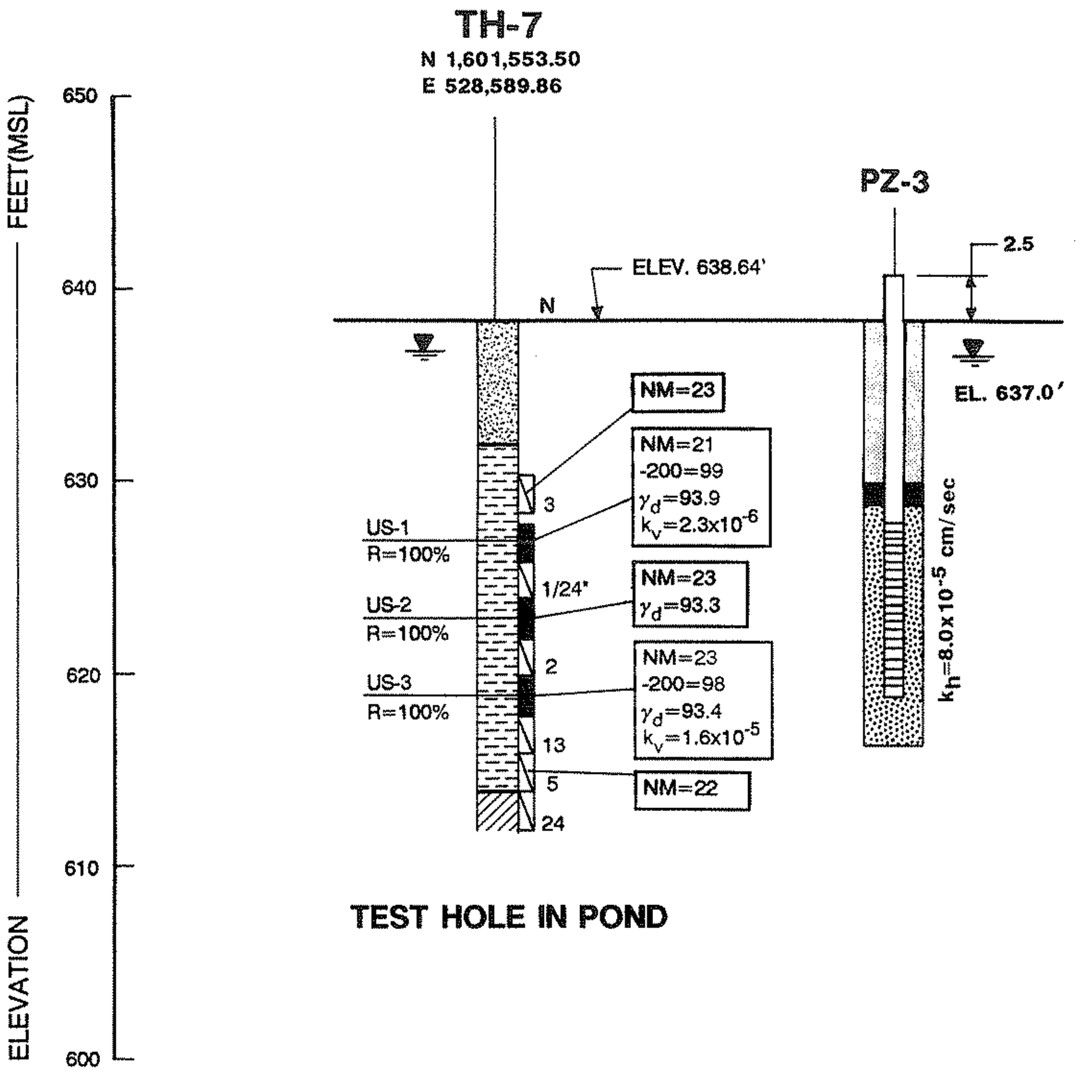
Ardaman & Associates, Inc.
Consulting Engineers in Soils, Hydrogeology, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY: RBE | CHECKED BY: EJW | DATE: 4/18/91
FILE NO. 90-059 | APPROVED BY:

N39695

FIGURE 2.5



LEGEND

░ FILL
☰ SEDIMENTED GYPSUM-FLYASH
▓ CAST GYPSUM-FLYASH
▨ CLAY

k_h = HORIZONTAL COEFFICIENT OF PERMEABILITY (cm/sec)

k_v = VERTICAL COEFFICIENT OF PERMEABILITY (cm/sec)

NM = MOISTURE CONTENT (%)

-200 = FINES CONTENT (%)

γ_d = DRY DENSITY (PCF)

SIMPLIFIED BORING PROFILE FOR TH-7

Ardaman & Associates, Inc.
Consulting Engineers in Soils, Hydrogeology, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY: RBE	CHECKED BY: EJW	DATE: 4/18/91
FILE NO. 90-059	APPROVED BY:	

FIGURE 2.6

REPORT OF GEOTECHNICAL DRILLING

GYPSUM/FLY ASH STORAGE FACILITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

Prepared For:

TENNESSEE VALLEY AUTHORITY

Chattanooga, Tennessee

Prepared By:

MACTEC ENGINEERING AND CONSULTING, INC.

Knoxville, Tennessee

MACTEC Project 3043041026/01

June 23, 2004

MACTEC

MACTEC

June 23, 2004

Mr. Ron Purkey
Tennessee Valley Authority
1101 Market Street, LP-2G
Chattanooga, TN 37402

Subject: **Report of Geotechnical Drilling**
Gypsum/Fly Ash Storage Facility
TVA Widows Creek Fossil Plant
Stevenson, Alabama
MACTEC Project 3043041026/01

Dear Mr. Purkey:

We at MACTEC Engineering and Consulting, Inc., (MACTEC) are pleased to submit this Summary Report of Geotechnical Drilling for your project. Our services, as authorized through TAO No. MAC-0698-00056 were provided in general accordance with our proposal number Prop04Knox/188 dated May 14, 2004.

This report summarizes our drilling services performed at the Gypsum/Fly Ash facility. The Appendices contain a brief description of the Field Exploratory Procedures, Field Boring Logs, Piezometer Installation Records, and Water Level Data.

We will be pleased to discuss the contents of our report with you and would welcome the opportunity to provide any engineering, drilling, or material testing services needed for the success of your project.

Sincerely,

MACTEC ENGINEERING AND CONSULTING, INC.

Hussein A. Benkhayal, P.E.
Senior Engineer
Alabama Registration No. 25302

No. 25302
Hussein Amien Benkhayal

Carl Tockstein by sjm with permission

Carl D. Tockstein, P.E.
Chief Engineer - Tennessee Operations

HAB/CDT:sjm

MACTEC Engineering and Consulting
1725 Louisville Drive • Knoxville, TN 37921-5904
865-588-8544 • Fax: 865-588-8026

REPORT OF GEOTECHNICAL DRILLING

GYPSUM/FLY ASH STORAGE FACILITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

Prepared For:

TENNESSEE VALLEY AUTHORITY

Chattanooga, Tennessee

Prepared By:

MACTEC ENGINEERING AND CONSULTING, INC.

Knoxville, Tennessee

MACTEC Project 3043041026/01

June 23, 2004

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Figure

EXECUTIVE SUMMARY

MACTEC was selected by the Tennessee Valley Authority (TVA) to perform geotechnical drilling for the existing Gypsum/Fly Ash storage facility at the Widows Creek Fossil Plant in Stevenson, Alabama. The drilling was performed in conjunction with design activities associated with the gypsum/fly ash storage facility. The drilling services performed for this project are summarized as follows:

- MACTEC drilled six test borings to depths ranging from about 36.5 to 66.5 feet. Standard penetration testing (SPT) was performed in these borings at 5-foot intervals. These borings typically encountered Gypsum and Fly Ash underlain by residual soils. The depth to the residual soils ranged from about 33.0 to 65.5 feet.

- Four sampling borings were drilled to obtain relative undisturbed samples to depths ranging from about 32.0 to 62.0 feet. A total of 30 attempts were made to obtain undisturbed samples from these borings.

- MACTEC personnel installed six sealed standpipe piezometers along the top of the Gypsum/Fly Ash stack and near the outside slope of the Gypsum/Fly Ash stack. The location of these piezometers corresponds to the locations of the six test borings. The total depth for the piezometers ranged from 30 to 45 feet.

- Five shallow standpipe piezometers were manually installed on the outside slope of the Gypsum/Fly Ash stack immediately downgradient from the piezometers installed at the top of the stack. The total depth of these piezometers ranged from about 4.2 to 7.2 feet.

This summary is only an overview and should not be used as a separate document or in place of reading the entire report, including the appendices.

1.0 INTRODUCTION

This report presents the field data and summary of our geotechnical drilling recently performed for the Gypsum/Fly Ash facility at TVA's Widows Creek Fossil Plant. Our services were authorized by Mr. Ron Purkey of TVA.

2.0 OBJECTIVES OF SERVICES

The objectives of our services were to provide geotechnical drilling support for design activities for the Gypsum/Fly Ash storage facility. An assessment of site environmental conditions, or an assessment for the presence or absence of pollutants in the soil, bedrock, surface water, or ground water of the site was beyond the proposed objectives of our exploration.

3.0 SCOPE OF EXPLORATION

The scope of our exploration was based on our proposal number Prop04Knox/188 dated May 14, 2004, and the geotechnical scope of work outlined in the project's scope of work prepared by Ardaman & Associates. It includes the following:

- Geotechnical drilling including installing standpipe piezometers
- Data report summarizing our field activities and field data

The drilling and sampling were performed in general accordance with ASTM procedures. The procedures are included in Appendix A. The field exploration was performed from May 24 to June 11, 2004. The equipment used consisted of a CME Model 75 truck-mounted drill rig equipped with a manual hammer. Standard penetration tests (SPTs) were performed at 5-foot vertical intervals. In addition to the SPT samples, several relatively undisturbed samples were obtained using the piston sampler.

Upon completion of drilling, the test borings were plugged and abandoned by backfilling the full depth with cement grout. All SPT and undisturbed samples were transferred to the custody of the Ardaman on-site representative.

The scope of the geotechnical drilling services for this project consisted of the following:

- Six test borings (including SPT testing) were drilled to depths ranging from about 35 to 65 feet. The SPT sampling was performed at 5-foot depth intervals in all test borings. Summary of these borings is presented in Table 1.
- Four sampling borings were drilled to obtain undisturbed samples using the piston sampler. These borings were advanced to depths ranging from about 32 to 62 feet. A total of 30 attempts were made to obtain undisturbed samples at depths intervals as directed by Ardaman. A summary of the sampling borings is presented in Table 2.
- Six sealed two-inch PVC standpipe piezometers were installed along the top of the Gypsum/Fly Ash stack and extended to near the base of the stack. The total depth of these piezometers ranged from about 30 to 45 feet.
- Five two-inch PVC standpipe piezometers were manually installed on the outside slopes of the stack. The total depth of these piezometers ranged from about 4.2 to 7.2 feet.

Table 1
Test Boring Summary

Test Boring Number	**Approximate Depth to Natural Ground (Residual Soils) (Feet)**	**Total Depth of Boring (Feet)**
SPT-1	45.5	46.5
SPT-2	65.5	66.5
SPT-3	33.0	36.5
SPT-4	42.5	46.5
SPT-5	48.5	51.5
SPT-6	47.0	51.5

Prepared By HAB Date 6/23/04 Checked By CDT Date 6/23/04

Table 2
Sampling Borings Summary

Sampling Boring Number	**Total Depth of Boring (Feet)**	**Sample Depth (Feet)**	**Sample Recovery (Feet)**
BH-1	41.5	20 - 22	2.0
		30 - 32	2.0
		40 - 41.5	1.2
BH-2	62.0	5 - 7	1.5
		10 - 12	2.0
		15 - 17	1.8
		20 - 22	2.0
		25 - 27	1.8
		30 - 32	1.7

Table 2
Sampling Borings Summary

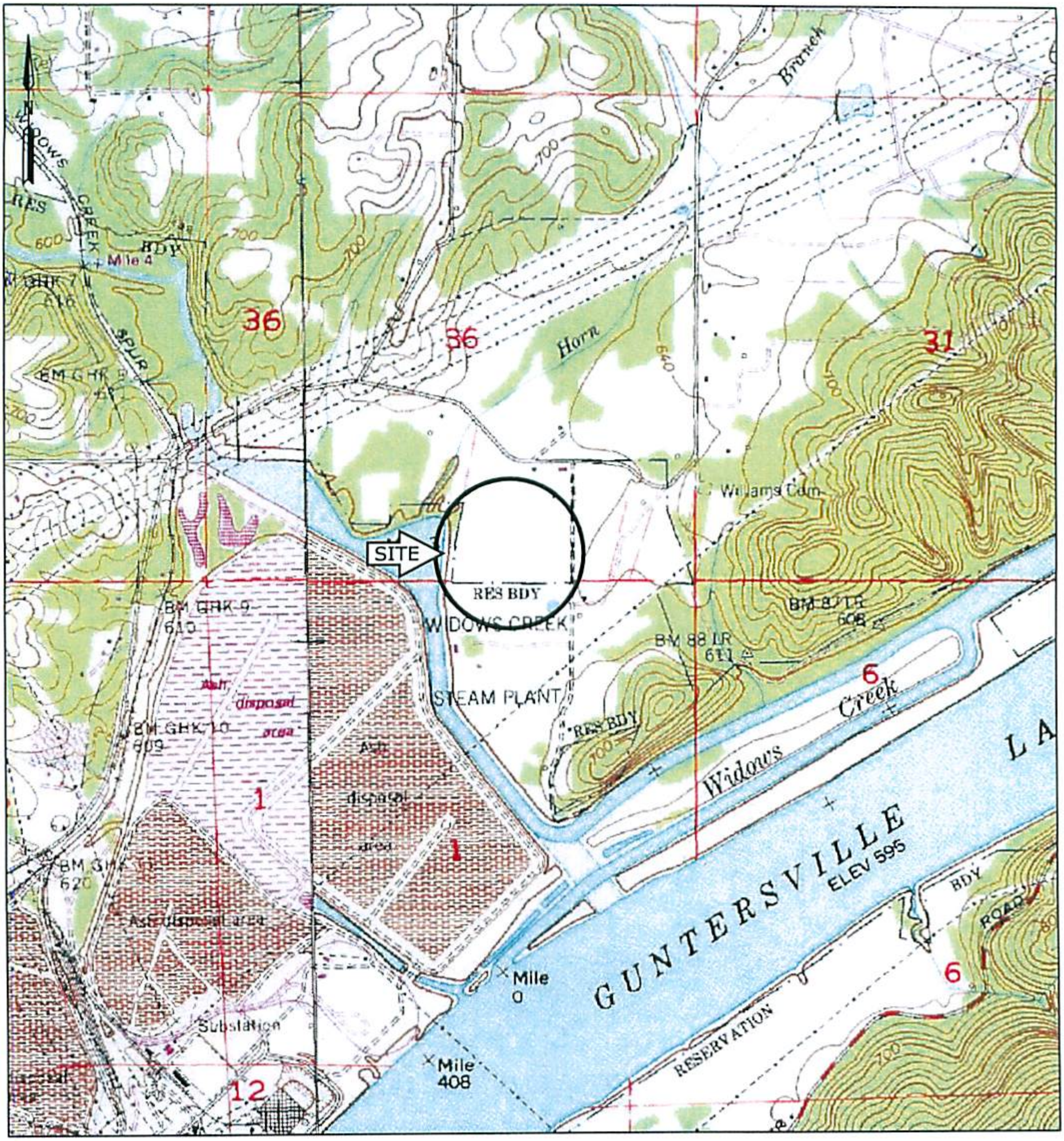
Sampling Boring Number	Total Depth of Boring (Feet)	Sample Depth (Feet)	Sample Recovery (Feet)
BH-2	62.0	35 - 37	0.8
		40 - 42	2.0
		45 - 47	1.6
		50 - 52	1.7
		55 - 57	1.1 (damaged)
		60 - 62	1.8
BH-3	32.0	10 - 12	1.7
		15 - 17	1.9
		20 - 22	0.5
		22.5 - 24.5	2.0
		25 - 27	1.8
		30 - 32	0.0
BH-4	42.0	5 - 7	1.0
		10 - 12	0.3
		12.5 - 14.5	2.0
		15 - 17	1.7
		20 - 22	1.7
		25 - 27	2.0
		30 - 32	2.0
		35 - 37	1.9
		40 - 42	2.0

Prepared By HAB Date 6/23/04 Checked By CDT Date 6/23/04

The field logs for the geotechnical test borings are included in Appendix B. The material descriptions provided on these logs were based on our visual-manual inspection of the samples in the field at the time of drilling. Therefore, these descriptions should not be considered final. The piezometer installation details are presented on the Piezometer Installation Records in Appendix C. Finally, water level readings obtained from the installed piezometers are presented in Appendix D.

At this time, the actual boring locations have not been surveyed and, therefore, we have not been able to obtain a site plan with actual boring locations from Ardaman. As a result, no Boring Location Plan is submitted in this report.

FIGURES



SOURCE: USGS TOPOGRAPHIC MAPS OF BRIDGEPORT AND DORAN COVE, AL QUADRANGLES

MACTEC

MACTEC Engineering and Consulting, Inc.
1725 Louisville Drive
Knoxville, Tennessee 37921-5904
865-588-8544 • Fax: 865-588-8026

FIGURE 1: SITE LOCATION MAP
GYPSUM / FLY ASH FACILITY
TVA WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

DRAFTING BY: RSB	PREPARED BY: HAB	CHECKED BY: CDT
JOB NUMBER: 3043041026/0001	DATE: JUNE 16, 2004	SCALE: 0 2000'

COORDINATES: N XX°XX'XX" W XX°XX'XX"

APPENDIX A

FIELD EXPLORATORY PROCEDURES

FIELD EXPLORATORY PROCEDURES

Soil Test Boring (Hollow Stem) and Sampling

All boring and sampling operations were conducted in general accordance with ASTM D 1586. All borings were advanced by mechanically twisting continuous steel hollow-stem auger flights into the ground. Soil samples were obtained in the test borings utilizing a standard 1.4-inch I.D., 2-inch O.D., split-tube sampler. The sampler was first seated six inches to penetrate any loose cuttings and then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot of penetration was recorded and is designated the "standard penetration resistance (SPT)". Proper evaluation of the penetration resistance provides an index to the soil's strength, density, and ability to support loads. Representative portions of the soil samples obtained from the split-tube sampler were sealed in glass jars. The relatively undisturbed samples were obtained from the sampling borings by pushing a section of 3-inch O.D., 16-gauge steel tubing into the soil at the depths assigned by Ardaman. A piston sampler was used to obtain the undisturbed samples. After pushing the tube into the soil, the tube was carefully removed from the ground and made airtight. All SPT and undisturbed samples were placed in the custody of Ardaman's field representative. Field Boring Logs are attached.

Boring Backfill

The borings were backfilled to the ground surface with cement grout. The owner is advised that, even with this backfill technique, there is the possibility of future borehole subsidence depending on actual subsurface conditions, surface drainage, etc. The property owner should monitor the boring locations over time to discover subsidence and make the necessary repairs.

APPENDIX B

FIELD BORING LOGS

MACTEC SOIL TEST BORING FIELD REPORT

BORING NO. SPT-1 PG. 1 OF 2

JOB NO. 3043 04 1026 DRILLER G. Akins HOURS DRILLING ______ GROUND SURFACE ELEV. ______

JOB NAME TVA WCF LOGGED BY H. Benkhayal HOURS MOVING ______ DATE: 5/26/04 WEATHER: Cloudy Hot

SAMPLING		"N"			SCALE	UD	REC	SOIL CLASSIFICATION	REMARKS
No.	Depth	1ST 6"	2ND 6"	3RD 6"					
1	0-1.5	2	5	9	0			Firm Lt. brown moist silty fine sand - gypsum	
2	5-6.5	8	6	6	5			Same as above. w/ fly ash	
3	10-11.5	2	9	14	0			Firm Gray moist si sand/SDY silt gypsum & fly Ash	
4	15-16.5	5	20	26	5			Dense Gray moist si fine sand gypsum & fly Ash	
5	20-21.5	2	9	12	0			Firm Gray wet si sand/SDY silt - gypsum & Fly Ash water introduced in augers ≈ 20'	
6	25-26.5	5	13	16	5			Same as above	
7	30-31.5	2	WOH	WOH	0			V. soft gray wet clayey silt - Fly ash with little gypsum	
8	35-36.5	1	1	WOH	5			Same as above.	
9	40-41.5	4	5	5	0			Stiff gray wet clayey & SDY silt - Fly Ash w/some gypsum	

+STANDARD PENETRATION RESISTANCE IS SUM OF BLOWS FOR 2ND 6" AND 3RD 6" TO DRIVE 1-3/8" I.D., 2" O.D. SPLIT BARREL SAMPLER WITH 140 POUND HAMMER FALLING 30 INCHES.

BORING TERMINATED: 46.5

BORING REFUSAL: NA

WATER TOB DEPTH ~17.0'

WATER 24 HR.: DEPTH ______

WATER LOSSES ______

CAVE-IN DEPTHS ______

CASING: SIZE ______ LENGTH ______

STANDBY TIME ______ BORING LAYOUT ______

METHOD OF ADVANCING BORING		DEPTH
POWER AUGER	3¼"	0 TO 45
HAND SHOP: W/MUD: W/WATER		___ TO ___
ROTARY DRILL: W/MUD: W/WATER		___ TO ___
DIAMOND CORE		___ TO ___
CORE SIZE		___ TO ___

UNDISTURBED SAMPLES NO ___ SIZE ___

BAG SAMPLES NO ______

MACTEC SOIL TEST BORING FIELD REPORT

BORING NO. SPT-1 PG. 2 OF 2

JOB NO. 3043 04 1026 DRILLER G. Akins HOURS DRILLING ______ GROUND SURFACE ELEV. ______

JOB NAME TVA WCF gypsum LOGGED BY H. Benkhayal HOURS MOVING ______ DATE: 5/26/04 WEATHER: Cloudy Hot

SAMPLING					SCALE	UD	REC	SOIL CLASSIFICATION	REMARKS
		"N"							
No.	Depth	1ST 6"	2ND 6"	3RD 6"					
					0				
0	45-46.5	WOH	3	4	5			45 → 45.5 V. Soft same as above	
								45.5 → 46.5 Firm R-b & Yellow moist si clay - Residuum	
					0				
								Boring Terminated @ 46.5'	
					5			Hole was grouted upon completion (8 Cement bags)	
					0				
					5				
					0				
					5				
					0				

+STANDARD PENETRATION RESISTANCE IS SUM OF BLOWS FOR 2ND 6" AND 3RD 6" TO DRIVE 1-3/8" I.D., 2" O.D. SPLIT BARREL SAMPLER WITH 140 POUND HAMMER FALLING 30 INCHES.

BORING TERMINATED: 46.5
BORING REFUSAL: NA
WATER TOB DEPTH ~17.0'
WATER 24 HR.: DEPTH ______
WATER LOSSES ______
CAVE-IN DEPTHS ______
CASING: SIZE ______ LENGTH ______
STANDBY TIME ______ BORING LAYOUT ______

METHOD OF ADVANCING BORING	DEPTH
POWER AUGER 3 1/4"	0 TO 45
HAND SHOP: W/MUD: W/WATER	___ TO ___
ROTARY DRILL: W/MUD: W/WATER	___ TO ___
DIAMOND CORE	___ TO ___
CORE SIZE	___ TO ___
UNDISTURBED SAMPLES NO ___ SIZE ___	
BAG SAMPLES NO ______	

MACTEC SOIL TEST BORING FIELD REPORT

BORING NO. SPT_2 PG. 1 OF 2

JOB NO. 3043 04 1026 DRILLER G. Akins HOURS DRILLING ______ GROUND SURFACE ELEV. ______

JOB NAME TVA WCF Gypsum LOGGED BY H. Benkhayal HOURS MOVING ______ DATE: 5/25/04 WEATHER: P. Cloudy Hot

SAMPLING		"N"			SCALE	UD	REC	SOIL CLASSIFICATION	REMARKS
No.	Depth	1ST 6"	2ND 6"	3RD 6"					
					0				
1	0-1.5	2	5	7				Firm lt brown & gray moist silty fine sand - Gypsum & fly ash	
2	5-6.5	3	6	6	5			Same as above	
3	10-11.5	9	13	15	0			Same as above	
4	15-16.5	16	22	21	5			Same as above - Dense	
5	20-21.5	2	2	5	0			Firm Gray wet SDY Silt - Fly Ash w/ little gypsum	
								* Introduced water in augers *	
6	25-26.5	3	6	7	5			Firm Lt.-Brown & Gray wet silty sand - Gypsum with Fly ash	
7	30-31.5	4	5	7	0			Same as above.	
8	35-36.5	3	4	4	5			Same as above - Loose	
9	40-41.5	4	6	8	0			Same as above	

+STANDARD PENETRATION RESISTANCE IS SUM OF BLOWS FOR 2ND 6" AND 3RD 6" TO DRIVE 1-3/8" I.D., 2" O.D. SPLIT BARREL SAMPLER WITH 140 POUND HAMMER FALLING 30 INCHES.

BORING TERMINATED: 66.5'
BORING REFUSAL: NA
WATER TOB DEPTH ~18.5'
WATER 24 HR.: DEPTH ______
WATER LOSSES ______
CAVE-IN DEPTHS ______
CASING: SIZE ______ LENGTH ______
STANDBY TIME ______ BORING LAYOUT ______

METHOD OF ADVANCING BORING		DEPTH
POWER AUGER	3 1/4"	0 TO 65
HAND SHOP: W/MUD: W/WATER		___ TO ___
ROTARY DRILL: W/MUD: W/WATER		___ TO ___
DIAMOND CORE		___ TO ___
CORE SIZE		___ TO ___
UNDISTURBED SAMPLES	NO ___ SIZE ___	
BAG SAMPLES	NO ______	

MACTEC SOIL TEST BORING FIELD REPORT

BORING NO. SPT - 2 PG. 2 OF 2

JOB NO. 304304 1026 DRILLER G. Akins HOURS DRILLING ______ GROUND SURFACE ELEV. ______

JOB NAME TVA WCF Gyps LOGGED BY H. Benkhayal HOURS MOVING ______ DATE: 5/25/04 WEATHER: P. Cloudy Hot

SAMPLING No.	Depth	"N" 1ST 6"	2ND 6"	3RD 6"	SCALE	UD	REC	SOIL CLASSIFICATION	REMARKS
					0				
0	45-46.5	3	4	5	5			Same as above — Loose	
11	50-51.5	6	12	13	0			Same as above - Firm	
12	55-56.5	9	11	12	5			Same as above — Firm	
13	60-61.5	7	3	4	0			Firm Gray wet SDY silt- Fly Ash w/ little gypsum	
14	65-66.5	WOH	7	12	5			65 → 65.5 same as above V. Soft 65.5 → 66.5 V. Stiff R-br & Yell. moist silty Clay w/ RK frags - Residuum	
					0			Boring Terminated @ 66.5 Hole grouted on 5/26/04 a.m. (Used 12 Bags of Cement)	
					5				
					0				

+STANDARD PENETRATION RESISTANCE IS SUM OF BLOWS FOR 2ND 6" AND 3RD 6" TO DRIVE 1-3/8" I.D., 2" O.D. SPLIT BARREL SAMPLER WITH 140 POUND HAMMER FALLING 30 INCHES.

BORING TERMINATED: 66.5
BORING REFUSAL: NA
WATER TOB DEPTH ~ 18.5'
WATER 24 HR.: DEPTH ______
WATER LOSSES ______
CAVE-IN DEPTHS ______
CASING: SIZE ______ LENGTH ______
STANDBY TIME ______ BORING LAYOUT ______

METHOD OF ADVANCING BORING	DEPTH
POWER AUGER 3 1/4"	0 TO 65
HAND SHOP: W/MUD: W/WATER	TO
ROTARY DRILL: W/MUD: W/WATER	TO
DIAMOND CORE	TO
CORE SIZE	TO

UNDISTURBED SAMPLES NO ___ SIZE ___
BAG SAMPLES NO ______

F1024 8/00

MACTEC

SOIL TEST BORING FIELD REPORT

BORING NO. SPT- 3 PG. 1 OF 1

JOB NO. 3043 04 1022 DRILLER G. Akins HOURS DRILLING ______ GROUND SURFACE ELEV. ______

JOB NAME WCF Gypsum LOGGED BY H. Benkhayal HOURS MOVING ______ DATE: 5/24/04 WEATHER: P. Cloudy

SAMPLING		"N"			SCALE	UD	REC	SOIL CLASSIFICATION	REMARKS
No.	Depth	1ST 6"	2ND 6"	3RD 6"					
1	0-1.5	3	6	8	0			stiff Lt. Br. sl. moist SDY silt - Fly Ash & Gypsum	
2	5-6.5	7	7	7	5			Firm Gray wet silty fine Sand - Fly Ash	
3	10-11.5	6	9	9	0			Same as above	
4	15-16.5	2	2	3	5			Firm Gray wet sandy silt - Fly Ash	
5	20-21.5	1	1	1	0			V. soft DK-Gray wet silt - Fly Ash	
								Drilling firm from 23.5 - 25.0'	
6	25-26.5	4	5	6	5			Stiff DK-Gray wet SDY silt - Fly Ash	
7	30-31.5	4	5	5	0			Same as above.	
								Driller Notes clay at ≈ 33.0'	
8	35-36.5	2	5	7	5			Stiff R-brown and Yellow moist silty clay - Residuum	
								Boring Terminated @ 36.5	
					0			Hole Grouted on 5/25/04 a.m. (5 Bags)	

BORING TERMINATED: 36.5

BORING REFUSAL: N/A

WATER TOB DEPTH ~ 5.0

WATER 24 HR.: DEPTH ______

WATER LOSSES ______

CAVE-IN DEPTHS ______

CASING: SIZE ______ LENGTH ______

STANDBY TIME ______ BORING LAYOUT ______

METHOD OF ADVANCING BORING	DEPTH
POWER AUGER 3 1/4'	0 TO 35
HAND SHOP: W/MUD: W/WATER	___ TO ___
ROTARY DRILL: W/MUD: W/WATER	___ TO ___
DIAMOND CORE	___ TO ___
CORE SIZE	___ TO ___

UNDISTURBED SAMPLES NO ___ SIZE ___

BAG SAMPLES NO ______

+STANDARD PENETRATION RESISTANCE IS SUM OF BLOWS FOR 2ND 6" AND 3RD 6" TO DRIVE 1-3/8" I.D., 2" O.D. SPLIT BARREL SAMPLER WITH 140 POUND HAMMER FALLING 30 INCHES.

MACTEC **SOIL TEST BORING FIELD REPORT**

BORING NO. SPT-4 PG. 1 OF 2

JOB NO. 3043 04 1026 DRILLER G. Akins HOURS DRILLING ______ GROUND SURFACE ELEV. ______

JOB NAME TVA WCF Gypsum LOGGED BY H. Benkhayal HOURS MOVING ______ DATE: 5/27/04 WEATHER: P. Cloudy Hot

SAMPLING					SCALE	UD	REC	SOIL CLASSIFICATION	REMARKS
		"N"							
No.	Depth	1ST 6"	2ND 6"	3RD 6"					
1	0/1.5	2	2	4	0			Loose Lt-brown moist silty fine sand - Gypsum	
2	5/6.5	5	6	5	5			Firm Lt. Brown & Lt. gray moist Si fine sand - Gypsum	
3	10/11.5	1	2	9	0			Firm Lt Brow & gray wet Si fine Sand - gypsum w/some ash	
4	15/16.5	5	17	18	5			Dense Lt Brown wet si fine Sand - Gypsum and gray ~~s~~ SDY silt - Ash	
5	20/21.5	3	2	3	0			Firm Gray & Lt. Brown Wet SDY Si/Si SD - Fly Ash and gypsum	
6	25/26.5	2	2	8	5			stiff - same as above	
7	30/31.5	5	7	17	0			V. stiff - Same as above	
8	35/36.5	5	7	7	5			Stiff - Same as above	
9	40/41.5	4	3	3	0			Firm Gray wet SDY-Clayey silt - Fly Ash w/gypsum	

+STANDARD PENETRATION RESISTANCE IS SUM OF BLOWS FOR 2ND 6" AND 3RD 6" TO DRIVE 1-3/8" I.D., 2" O.D. SPLIT BARREL SAMPLER WITH 140 POUND HAMMER FALLING 30 INCHES.

BORING TERMINATED: 46.5
BORING REFUSAL: NA
WATER TOB DEPTH ~10
WATER 24 HR.: DEPTH ______
WATER LOSSES ______
CAVE-IN DEPTHS ______
CASING: SIZE ______ LENGTH ______
STANDBY TIME ______ BORING LAYOUT ______

METHOD OF ADVANCING BORING	DEPTH
POWER AUGER 3 1/4"	0 TO 45
HAND SHOP: W/MUD: W/WATER	___ TO ___
ROTARY DRILL: W/MUD: W/WATER	___ TO ___
DIAMOND CORE	___ TO ___
CORE SIZE	___ TO ___

UNDISTURBED SAMPLES NO ___ SIZE ___
BAG SAMPLES NO ______

MACTEC

SOIL TEST BORING FIELD REPORT

BORING NO. SPT_4 PG. 2 OF 2

JOB NO. 3043 04 1026 DRILLER G. Akins HOURS DRILLING ______ GROUND SURFACE ELEV. ______

JOB NAME TVA WCF Gypsum LOGGED BY H. Benkhayal HOURS MOVING ______ DATE: 5/27/04 WEATHER: P. Cloudy Hot

SAMPLING					SCALE	UD	REC	SOIL CLASSIFICATION	REMARKS
No.	Depth	"N" 1ST 6"	2ND 6"	3RD 6"					
					0				
	45/465	8	11	15	5			V. Stiff R-br, Yellow & gray moist Si clay — Residuum	
								Boring Terminated at 46.5'	
					0			Hole was grouted after Completion (used 9 Bags of Cement)	
					5				
					0				
					5				
					0				
					5				
					0				

+STANDARD PENETRATION RESISTANCE IS SUM OF BLOWS FOR 2ND 6" AND 3RD 6" TO DRIVE 1-3/8" I.D., 2" O.D. SPLIT BARREL SAMPLER WITH 140 POUND HAMMER FALLING 30 INCHES.

BORING TERMINATED: 46.5'
BORING REFUSAL: NA
WATER TOB DEPTH ~10
WATER 24 HR.: DEPTH ______
WATER LOSSES ______
CAVE-IN DEPTHS ______
CASING: SIZE ______ LENGTH ______
STANDBY TIME ______ BORING LAYOUT ______

METHOD OF ADVANCING BORING	DEPTH
POWER AUGER 3 1/4"	0 TO 45
HAND SHOP: W/MUD: W/WATER	___ TO ___
ROTARY DRILL: W/MUD: W/WATER	___ TO ___
DIAMOND CORE	___ TO ___
CORE SIZE	___ TO ___
UNDISTURBED SAMPLES NO ___ SIZE ___	
BAG SAMPLES NO ______	

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SOIL TEST BORING FIELD REPORT

BORING NO. SPT_5 PG. 1 OF 2

JOB NO. 3043 04 1026 DRILLER G. AKins HOURS DRILLING ______ GROUND SURFACE ELEV. ______

JOB NAME TVA WCF Gypsum LOGGED BY H. Benkhayal HOURS MOVING ______ DATE: 5/25/04 WEATHER: P. Cloudy Hot

SAMPLING		"N"			SCALE	UD	REC	SOIL CLASSIFICATION	REMARKS
No.	Depth	1ST 6"	2ND 6"	3RD 6"					
1	0-1.5	3	4	5	0			Firm Gray moist sandy silt - Fly Ash and light brown silty sand - gypsum	
2	5-6.5	3	11	15	5			V. stiff Gray & light brown moist sandy silt - Fly Ash & gypsum	
3	10-11.5	5	11	13	0			V. stiff gray wet sandy silt - Fly Ash with some bands of Lt. brown si SD - gypsum	
4	15-16.5	6	15	13	5			Same as above	
5	20-21.5	1	1	1	0			V. Soft gray wet SDY silt - Fly Ash *water introduce in augers ≈ 22'*	
6	25-26.5	3	8	3	5			same as above - stiff	
7	30-31.5	2	1	2	0			Soft gray wet SDY silt/silty Sand - Fly Ash	
8	35-36.5	WOH	2	2	5			Same as above - soft	
9	40-41.5	9	6	2	0			stiff Lt. Brown and gray wet si SD/SDY si - Fly ash & gypsum to soft gray wet SDY si - Fly Ash	

+STANDARD PENETRATION RESISTANCE IS SUM OF BLOWS FOR 2ND 6" AND 3RD 6" TO DRIVE 1-3/8" I.D., 2" O.D. SPLIT BARREL SAMPLER WITH 140 POUND HAMMER FALLING 30 INCHES.

BORING TERMINATED: 51.5
BORING REFUSAL: NA
WATER TOB DEPTH ~10.0
WATER 24 HR.: DEPTH ______
WATER LOSSES ______
CAVE-IN DEPTHS ______
CASING: SIZE ______ LENGTH ______
STANDBY TIME ______ BORING LAYOUT ______

METHOD OF ADVANCING BORING	DEPTH
POWER AUGER 3¼"	0 TO 50
HAND SHOP: W/MUD: W/WATER	____ TO ____
ROTARY DRILL: W/MUD: W/WATER	____ TO ____
DIAMOND CORE	____ TO ____
CORE SIZE	____ TO ____
UNDISTURBED SAMPLES NO ____ SIZE ____	
BAG SAMPLES NO ______	

MACTEC SOIL TEST BORING FIELD REPORT

BORING NO. SPT-5 PG. 2 OF 2

JOB NO. 3043041026 DRILLER G. Akins HOURS DRILLING ______ GROUND SURFACE ELEV. ______

JOB NAME TVA WCF Gypsum LOGGED BY H. Benkhayal HOURS MOVING ______ DATE: 5/25/04 WEATHER: P. Cloudy Hot

SAMPLING					SCALE	UD	REC	SOIL CLASSIFICATION	REMARKS
No.	Depth	"N"							
		1ST 6"	2ND 6"	3RD 6"	0				
0	45-46.5	3	1	WOH	5			V. Soft DK-Gray wet SDY Clayey Silt - Fly Ash	
								Driller's Note: Firm drilling from 48.5'-50.0'	
11	50-51.5	WOH	5	11	0			V. Stiff R-br & Yellow moist silty & sandy Clay - - Residuum	
					5			Boring Terminated @ 51.5'	
								Hole grouted upon Completion (9 Bags of Cement)	
					0				
					5				
					0				
					5				
					0				

+STANDARD PENETRATION RESISTANCE IS SUM OF BLOWS FOR 2ND 6" AND 3RD 6" TO DRIVE 1-3/8" I.D., 2" O.D. SPLIT BARREL SAMPLER WITH 140 POUND HAMMER FALLING 30 INCHES.

BORING TERMINATED: 51.5
BORING REFUSAL: NA
WATER TOB DEPTH ~10.0'
WATER 24 HR.: DEPTH ______
WATER LOSSES ______
CAVE-IN DEPTHS ______
CASING: SIZE ______ LENGTH ______
STANDBY TIME ______ BORING LAYOUT ______

METHOD OF ADVANCING BORING		DEPTH
POWER AUGER	3 1/4"	0 TO 50
HAND SHOP: W/MUD: W/WATER		___ TO ___
ROTARY DRILL: W/MUD: W/WATER		___ TO ___
DIAMOND CORE		___ TO ___
CORE SIZE		___ TO ___
UNDISTURBED SAMPLES	NO ___ SIZE ___	
BAG SAMPLES	NO ______	

MACTEC SOIL TEST BORING FIELD REPORT

BORING NO. SPT-6 PG. 1 OF 2

JOB NO. 3043 04 1026 DRILLER G. Akins HOURS DRILLING ______ GROUND SURFACE ELEV. ______

JOB NAME TVA WCF Gypsum LOGGED BY H. BenKhaya HOURS MOVING ______ DATE: 5/26/04 5/27/04 WEATHER: P. Cloudy Hot

SAMPLING		"N"			SCALE	UD	REC	SOIL CLASSIFICATION	REMARKS
No.	Depth	1ST 6"	2ND 6"	3RD 6"					
1	0-1.5	2	3	2	0			Loose Light br & gray moist w/little Fly Ash	si SD - gypsum
2	5-6.5	2	2	5	5			Loose gray & lt-br V. moist si SD/SDY SI- Fly Ash & gypsum	
3	10-11.5	1	3	6	0			Same as above - Wet	
4	15-16.5	2	2	2	5			Soft gray to DK gray wet clayey & SDY silt - Fly Ash	
	5/27/04							* Water introduced in augers	
5	20-21.5	2	1	1	0			V. Soft gray wet Clayey & SDY silt - fly Ash	
								* Firm drilling from 20' → 25'	
6	25/26.5	12	19	23	5			Dense Lt gray & lt brown wet si sand gypsum w/some fly Ash	
7	30/31.5	10	10	9	0			V. stiff gray to dark gray wet SDY & clayey silt - Fly Ash w/some gypsum	
8	35/36.5	6	6	8	5			Stiff gray & dark gray wet SDY silt- Fly Ash & gypsum	
9	40/41.5	10	22	23	0			Dense Lt gray, Lt brown & gray wet silty sand - Gypsum w/some fly Ash.	

+STANDARD PENETRATION RESISTANCE IS SUM OF BLOWS FOR 2ND 6" AND 3RD 6" TO DRIVE 1-3/8" I.D., 2" O.D. SPLIT BARREL SAMPLER WITH 140 POUND HAMMER FALLING 30 INCHES.

BORING TERMINATED: 51.5'
BORING REFUSAL: NA
WATER TOB DEPTH ~ 15'
WATER 24 HR.: DEPTH ______
WATER LOSSES ______
CAVE-IN DEPTHS ______
CASING: SIZE ______ LENGTH ______
STANDBY TIME ______ BORING LAYOUT ______

METHOD OF ADVANCING BORING		DEPTH
POWER AUGER	3 1/4"	0 TO 50
HAND SHOP: W/MUD: W/WATER		___ TO ___
ROTARY DRILL: W/MUD: W/WATER		___ TO ___
DIAMOND CORE		___ TO ___
CORE SIZE		___ TO ___
UNDISTURBED SAMPLES	NO ___ SIZE ___	
BAG SAMPLES	NO ___	

MACTEC **SOIL TEST BORING FIELD REPORT**

BORING NO. SPT-6 **PG.** 2 **OF** 2

JOB NO. 3043 04 1026 **DRILLER** G. Akins **HOURS DRILLING** ____ **GROUND SURFACE ELEV.** ____

JOB NAME TVA WCF Gypsum **LOGGED BY** H. Benkhayal **HOURS MOVING** ____ **DATE:** 5/27/04 **WEATHER:** P. Cloudy HOT

SAMPLING					SCALE	UD	REC	SOIL CLASSIFICATION	REMARKS
No.	Depth	"N"							
		1ST 6"	2ND 6"	3RD 6"	0				
0	45-46.5	8	4	2	5			Firm gray & lt br. wet ~~sd~~ clayey & SDY silt - Fly Ash & silty sand - gypsum.	
								Driller's Note: clay @ ≈ 47.0'	
11	50/51.5	3	6	11	0			V. stiff R-br, Yellow & lt gray moist si clay w/ Blk mang. st. - Resid.	
								Boring Terminated at 51.5'	
					5			Hole was grouted upon completion (Used 19 Bags of Cement)	
					0				
					5				
					0				
					5				
					0				

+STANDARD PENETRATION RESISTANCE IS SUM OF BLOWS FOR 2ND 6" AND 3RD 6" TO DRIVE 1-3/8" I.D., 2" O.D. SPLIT BARREL SAMPLER WITH 140 POUND HAMMER FALLING 30 INCHES.

BORING TERMINATED: 51.5
BORING REFUSAL: N/A
WATER TOB DEPTH ~ 15
WATER 24 HR.: DEPTH
WATER LOSSES
CAVE-IN DEPTHS
CASING: SIZE ____ LENGTH ____
STANDBY TIME ____ BORING LAYOUT ____

METHOD OF ADVANCING BORING	DEPTH
POWER AUGER 3 1/4"	0 TO 50
HAND SHOP: W/MUD: W/WATER	TO
ROTARY DRILL: W/MUD: W/WATER	TO
DIAMOND CORE	TO
CORE SIZE	TO
UNDISTURBED SAMPLES NO___ SIZE ___	
BAG SAMPLES NO___	

MACTEC SOIL TEST BORING FIELD REPORT

BORING NO. BH - 1 PG. 1 OF 1

JOB NO. 3043 04 1026 DRILLER G. Akins HOURS DRILLING ______ GROUND SURFACE ELEV. ______

JOB NAME TVA WCF LOGGED BY H. Benkhayal HOURS MOVING ______ DATE: 6/03/04 WEATHER: P.C, Hot

SAMPLING					SCALE	UD	REC	SOIL CLASSIFICATION	REMARKS
No.	Depth	"N"							
		1ST 6"	2ND 6"	3RD 6"					
					0				
					5				
					0				
					5				
UD - 1					20 22	X	2.0'		
					5				
UD_2					30 32	X	2.0'		
					5				
								Hole was grouted after Completion used 7 Cement bags	
UD-3					40 41.5'	X	1.2'		

BORING TERMINATED: 41.5'

BORING REFUSAL: NA

WATER TOB DEPTH ______

WATER 24 HR.: DEPTH ______

WATER LOSSES ______

CAVE-IN DEPTHS ______

CASING: SIZE ______ LENGTH ______

STANDBY TIME ______ BORING LAYOUT ______

METHOD OF ADVANCING BORING	DEPTH
POWER AUGER 3 1/4"	0 TO 40
HAND SHOP: W/MUD: W/WATER	TO
ROTARY DRILL: W/MUD: W/WATER	TO
DIAMOND CORE	TO
CORE SIZE	TO
UNDISTURBED SAMPLES NO 3 SIZE 3"	Used a Piston Sampler
BAG SAMPLES NO ______	

+STANDARD PENETRATION RESISTANCE IS SUM OF BLOWS FOR 2ND 6" AND 3RD 6" TO DRIVE 1-3/8" I.D., 2" O.D. SPLIT BARREL SAMPLER WITH 140 POUND HAMMER FALLING 30 INCHES.

F1024 8/00

MACTEC **SOIL TEST BORING FIELD REPORT**

BORING NO. BH-2 PG. 1 OF 2

JOB NO. 3043 04 1026 DRILLER G. Akins HOURS DRILLING ______ GROUND SURFACE ELEV. ______

JOB NAME TVA WCF LOGGED BY H. Benkhayal HOURS MOVING ______ DATE: 6/02/04 WEATHER: P. Cloudy Hot

SAMPLING No. Depth	"N" 1st 6"	"N" 2nd 6"	"N" 3rd 6"	SCALE	UD	REC	SOIL CLASSIFICATION	REMARKS
				0				
UD-1				5 7	⧗	18.5" 1.5'		
UD-2				10 12	⧗	2.0'		
UD-3				15 17	⧗	21.5" 1.8'		
UD-4				20 22	⧗	2.0'		
UD-5				25 27	⧗	1.8'		
UD-6				30 32	⧗	1.7'		
UD-7				35 37	⧗	0.8'		
				0				

+STANDARD PENETRATION RESISTANCE IS SUM OF BLOWS FOR 2ND 6" AND 3RD 6" TO DRIVE 1-3/8" I.D., 2" O.D. SPLIT BARREL SAMPLER WITH 140 POUND HAMMER FALLING 30 INCHES.

BORING TERMINATED: 62.0
BORING REFUSAL: NA
WATER TOB DEPTH ______
WATER 24 HR.: DEPTH ______
WATER LOSSES ______
CAVE-IN DEPTHS ______
CASING: SIZE ______ LENGTH ______
STANDBY TIME ______ BORING LAYOUT ______

METHOD OF ADVANCING BORING	DEPTH
POWER AUGER 3 1/4"	0 TO 60
HAND SHOP: W/MUD: W/WATER	___ TO ___
ROTARY DRILL: W/MUD: W/WATER	___ TO ___
DIAMOND CORE	___ TO ___
CORE SIZE	___ TO ___
UNDISTURBED SAMPLES NO 12 SIZE 3	Used Piston Samples
BAG SAMPLES NO ______	

F1024 8/00

MACTEC SOIL TEST BORING FIELD REPORT

JOB NO. 3043 04 1026 DRILLER G. Akins BORING NO. BH-2 PG. 2 OF 2
HOURS DRILLING ______ GROUND SURFACE ELEV. ______
JOB NAME TVA WCF LOGGED BY H. Benkhayal HOURS MOVING ______ DATE: 6/02/04 WEATHER: P. Cloudy Hot

SAMPLING No.	Depth	"N" 1ST 6"	2ND 6"	3RD 6"	SCALE	UD	REC	SOIL CLASSIFICATION	REMARKS
		UD-8			40 42	X	2.0'		
		UD-9			45 47	X	1.6'		
		UD-10			50 52	X	1.7'		
		UD-11			55 57	X	1.1'	Tube bent - sample was discarded	
		UD-12			60 62	X	1.8'		

Boring Terminated @ 62.0'
Hole was grouted after completion
used 12 bags of cement

+STANDARD PENETRATION RESISTANCE IS SUM OF BLOWS FOR 2ND 6" AND 3RD 6" TO DRIVE 1-3/8" I.D., 2" O.D. SPLIT BARREL SAMPLER WITH 140 POUND HAMMER FALLING 30 INCHES.

BORING TERMINATED: 62.0
BORING REFUSAL: NA
WATER TOB DEPTH ______
WATER 24 HR.: DEPTH ______
WATER LOSSES ______
CAVE-IN DEPTHS ______
CASING: SIZE ______ LENGTH ______
STANDBY TIME ______ BORING LAYOUT ______

METHOD OF ADVANCING BORING	DEPTH
POWER AUGER 3 1/4"	0 TO 60
HAND SHOP: W/MUD: W/WATER	TO
ROTARY DRILL: W/MUD: W/WATER	TO
DIAMOND CORE	TO
CORE SIZE "	TO
UNDISTURBED SAMPLES NO 12 SIZE 3"	used Piston Samples
BAG SAMPLES NO ______	

MACTEC SOIL TEST BORING FIELD REPORT

BORING NO. BH-3 PG. 1 OF 1

JOB NO. 304304 1026 DRILLER G. Akins HOURS DRILLING ______ GROUND SURFACE ELEV. ______

JOB NAME TVA WCF LOGGED BY H. Benkhayal HOURS MOVING ______ DATE: 6/03/04 WEATHER: P. Cloudy Hot

SAMPLING No.	Depth	"N" 1st 6"	2nd 6"	3rd 6"	SCALE	UD	REC	SOIL CLASSIFICATION	REMARKS
					0				
					5				
UD-1					10	⧗	24"		
					12		1.7		
UD-2					15	⧗	23"		
					17		1.9		
UD-3					20	⧗	0.5'	Sample was discarded	
					22				
UD-4					22.5	⧗	2.0'		
					24.5				
UD-5					25	⧗	22"		
					27		1.8'		
UD-6					30	⧗	0		
					32			Boring Terminated @ 32.0'	
								Hole was grouted on 6/04/04 a.m.	
					5			Used 5 bags of Cement	
					0				

+STANDARD PENETRATION RESISTANCE IS SUM OF BLOWS FOR 2ND 6" AND 3RD 6" TO DRIVE 1-3/8" I.D., 2" O.D. SPLIT BARREL SAMPLER WITH 140 POUND HAMMER FALLING 30 INCHES.

BORING TERMINATED: 32.0'
BORING REFUSAL: NA
WATER TOB DEPTH ______
WATER 24 HR.: DEPTH ______
WATER LOSSES ______
CAVE-IN DEPTHS ______
CASING: SIZE ______ LENGTH ______
STANDBY TIME ______ BORING LAYOUT ______

METHOD OF ADVANCING BORING	DEPTH
POWER AUGER 3 1/4"	0 TO 30
HAND SHOP: W/MUD: W/WATER	___ TO ___
ROTARY DRILL: W/MUD: W/WATER	___ TO ___
DIAMOND CORE	___ TO ___
CORE SIZE	___ TO ___
UNDISTURBED SAMPLES NO 6 SIZE 3"	Used a Piston Sampler
BAG SAMPLES NO ______	

F1024 8/00

MACTEC

SOIL TEST BORING FIELD REPORT

JOB NO. 3043041026 DRILLER G. Akins
JOB NAME TVA WCF LOGGED BY H. Benkhayal
BORING NO. BH-4 PG. 1 OF 1
HOURS DRILLING ______ GROUND SURFACE ELEV. ______
HOURS MOVING ______ DATE: 6/01/04 WEATHER: P. Cloudy Hot

SAMPLING No.	Depth	"N" 1ST 6"	2ND 6"	3RD 6"	SCALE	UD	REC	SOIL CLASSIFICATION	REMARKS
					0				
UD-1					5 7	X	1.0'		
UD-2					10 12	X	0.3'		
UD-3					12.5 14.5	X	2.0'		
UD-4					15 17	X	1.7'		
UD-5					20 22	X	1.7'		
UD-6					25 27	X	2.0'		
UD-7					30 32	X	2.0'		
UD-8					35 37	X	1.9	Hole Was Grouted after Completion (used 9 Bags of Cement)	
UD-9					40 42	X	2.0'		

+STANDARD PENETRATION RESISTANCE IS SUM OF BLOWS FOR 2ND 6" AND 3RD 6" TO DRIVE 1-3/8" I.D., 2" O.D. SPLIT BARREL SAMPLER WITH 140 POUND HAMMER FALLING 30 INCHES.

BORING TERMINATED: 42'
BORING REFUSAL: NA
WATER TOB DEPTH ______
WATER 24 HR.: DEPTH ______
WATER LOSSES ______
CAVE-IN DEPTHS ______
CASING: SIZE ______ LENGTH ______
STANDBY TIME ______ BORING LAYOUT ______

METHOD OF ADVANCING BORING	DEPTH
POWER AUGER 3¼"	0 TO 40
HAND SHOP: W/MUD: W/WATER	TO
ROTARY DRILL: W/MUD: W/WATER	TO
DIAMOND CORE	TO
CORE SIZE	TO
UNDISTURBED SAMPLES NO 9 SIZE 3	using Piston Sampler
BAG SAMPLES NO ______	

F1024 8/00

APPENDIX C

PIEZOMETER INSTALLATION RECORDS

PIEZOMETER INSTALLATION RECORD

PIEZOMETER NUMBER PZ-1

INSTALLATION DATE 06/09/2004

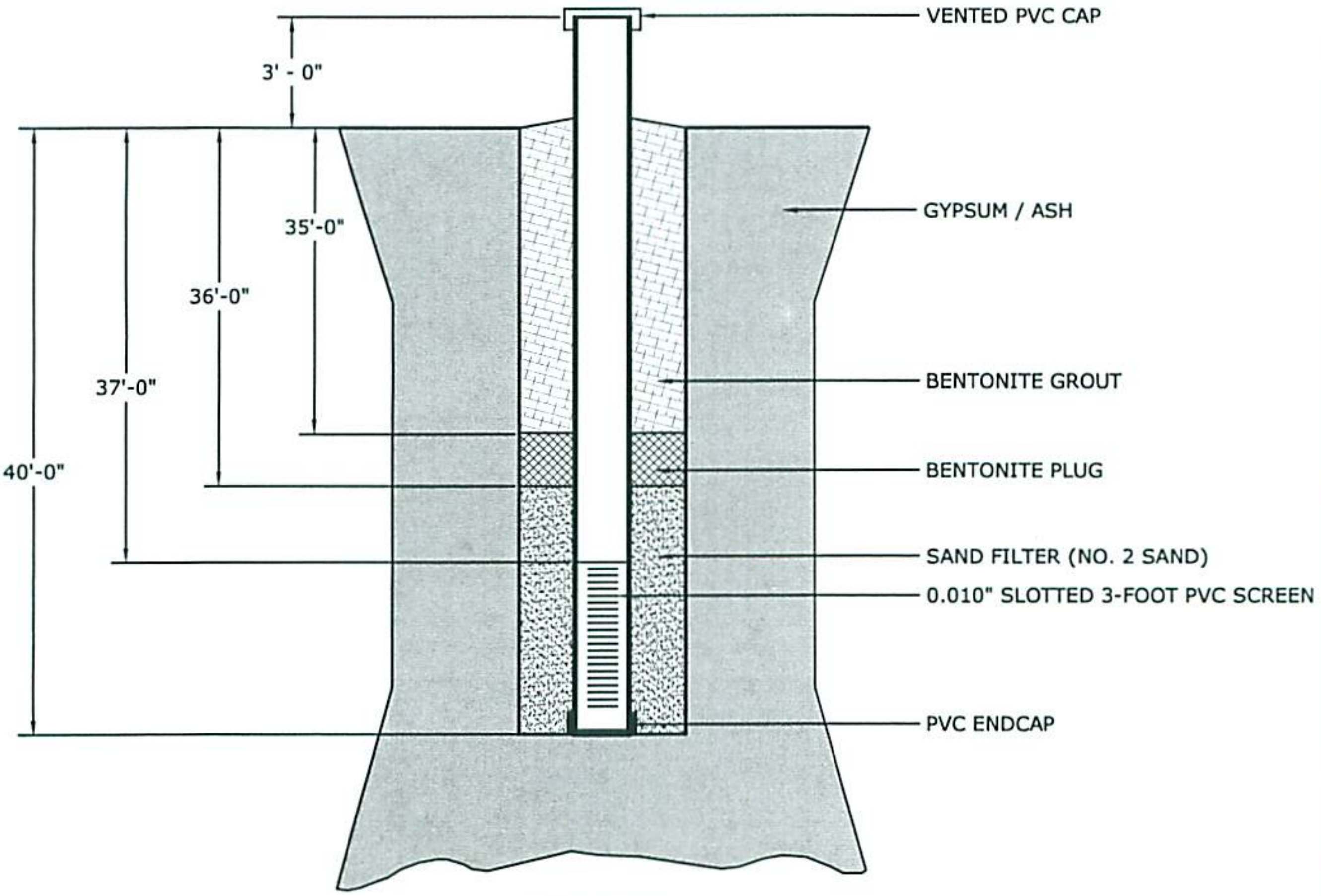
TOTAL DEPTH 40' - 0"

RISER/SCREEN

MATERIAL SCHEDULE 40 PVC

DIAMETER 2.0"

SLOT SIZE 0.010"



(NOT TO SCALE)

MACTEC

MACTEC Engineering and Consulting, Inc.
1725 Louisville Drive
Knoxville, Tennessee 37921-5904
865-588-8544 • Fax: 865-588-8026

PIEZOMETER INSTALLATION RECORD
TVA - WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

DRAFTING BY:	PREPARED BY: HAB	CHECKED BY: CDT
JOB NUMBER: 3043041026/0001	DATE: JUNE 16, 2004	SCALE: NOT TO SCALE

COORDINATES: N xx° W xx°

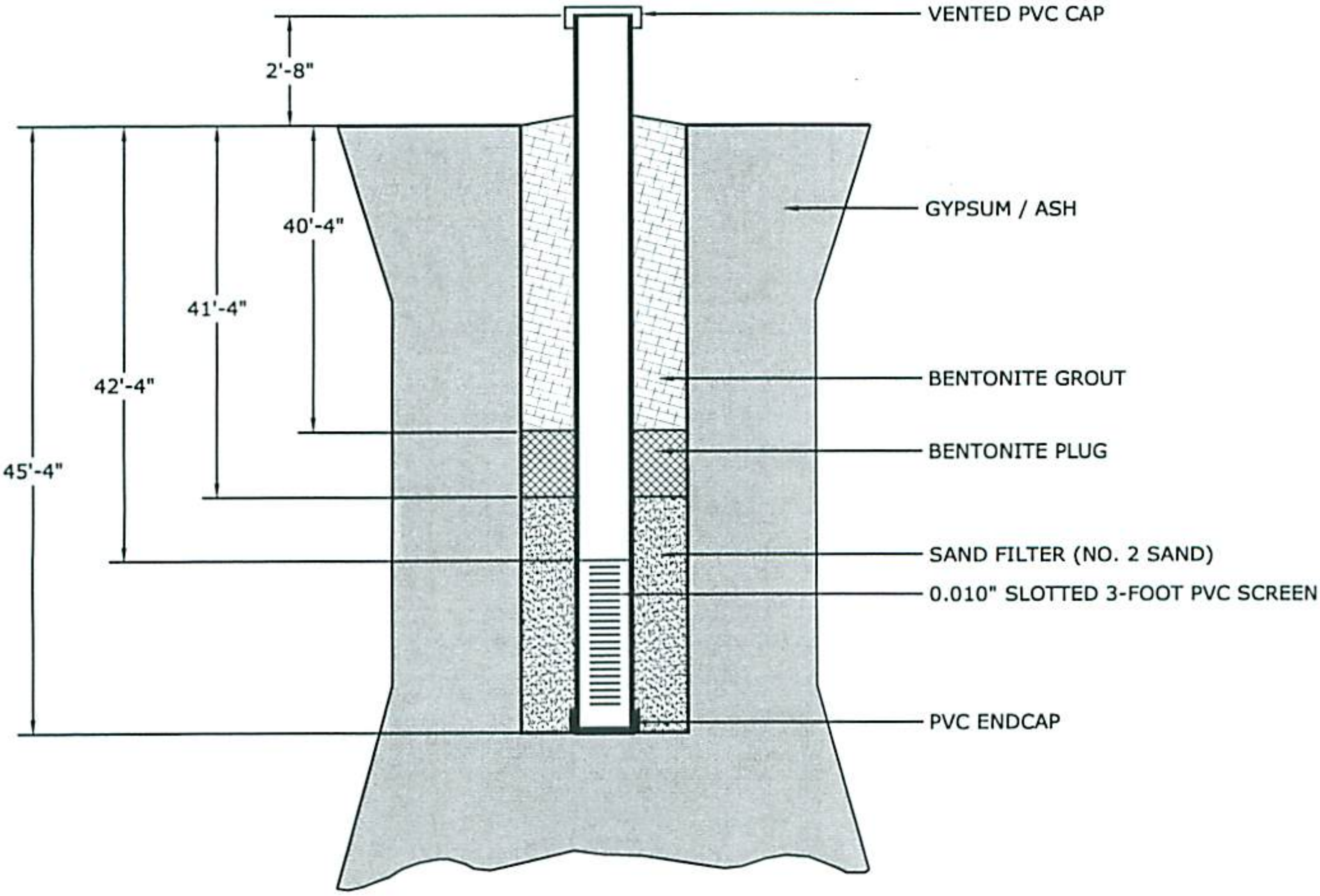
PIEZOMETER INSTALLATION RECORD

PIEZOMETER NUMBER *PZ-2*

INSTALLATION DATE *06/10/2004*

TOTAL DEPTH *45' - 4"*

RISER/SCREEN
MATERIAL *SCHEDULE 40 PVC*
DIAMETER *2.0"*
SLOT SIZE *0.010"*



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Knoxville, Tennessee 37921-5904
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PIEZOMETER INSTALLATION RECORD
TVA - WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

COORDINATES: N xx° W xx°

DRAFTING BY:	PREPARED BY: HAB	CHECKED BY: CDT
JOB NUMBER: 3043041026/0001	DATE: JUNE 16, 2004	SCALE: NOT TO SCALE

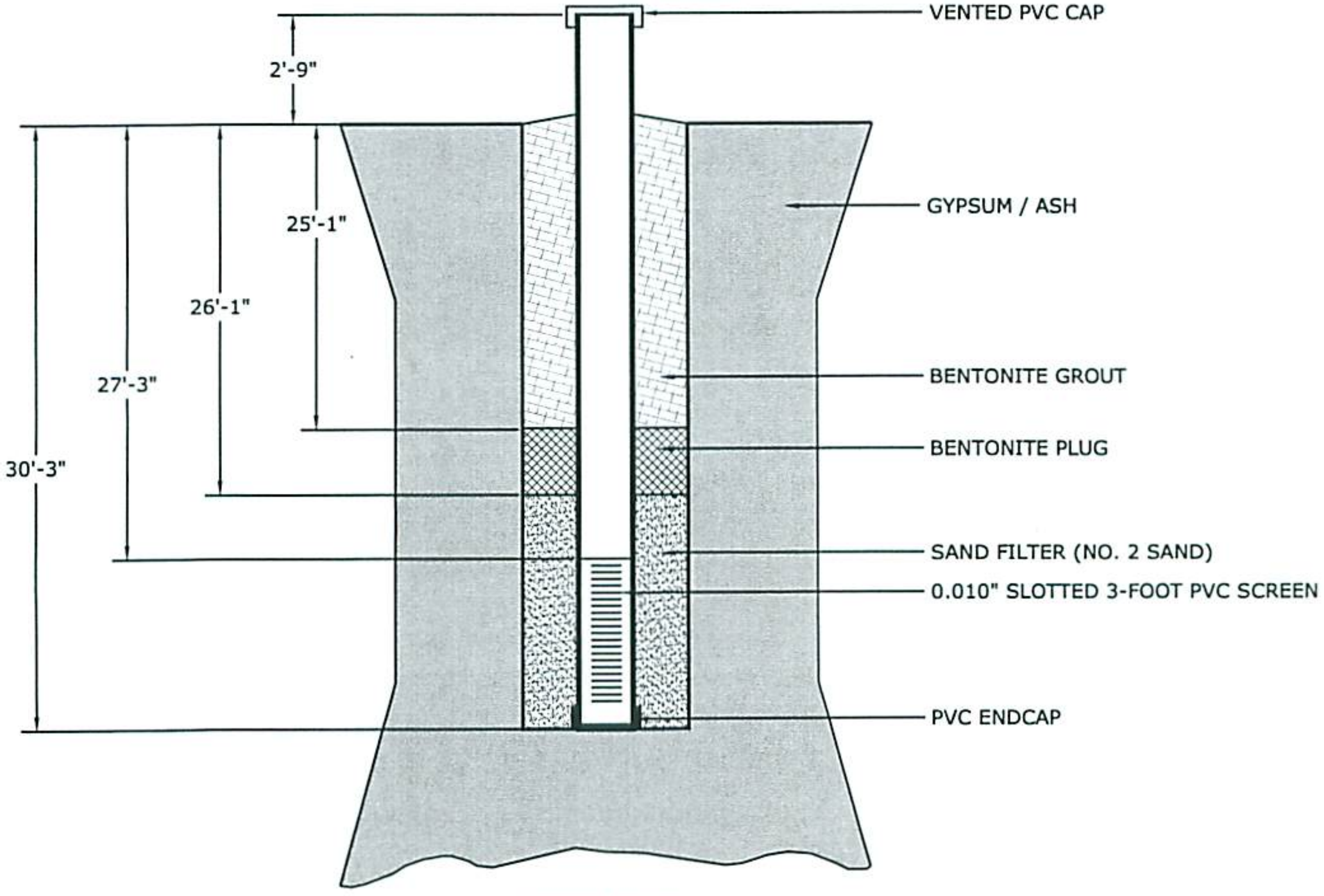
PIEZOMETER INSTALLATION RECORD

PIEZOMETER NUMBER PZ-3

INSTALLATION DATE 06/04/2004

TOTAL DEPTH 30' - 3"

RISER/SCREEN
MATERIAL SCHEDULE 40 PVC
DIAMETER 2.0"
SLOT SIZE 0.010"



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PIEZOMETER INSTALLATION RECORD
TVA - WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

COORDINATES: N xx° W xx°

DRAFTING BY:	PREPARED BY: HAB	CHECKED BY: CDT
JOB NUMBER: 3043041026/0001	DATE: JUNE 16, 2004	SCALE: NOT TO SCALE

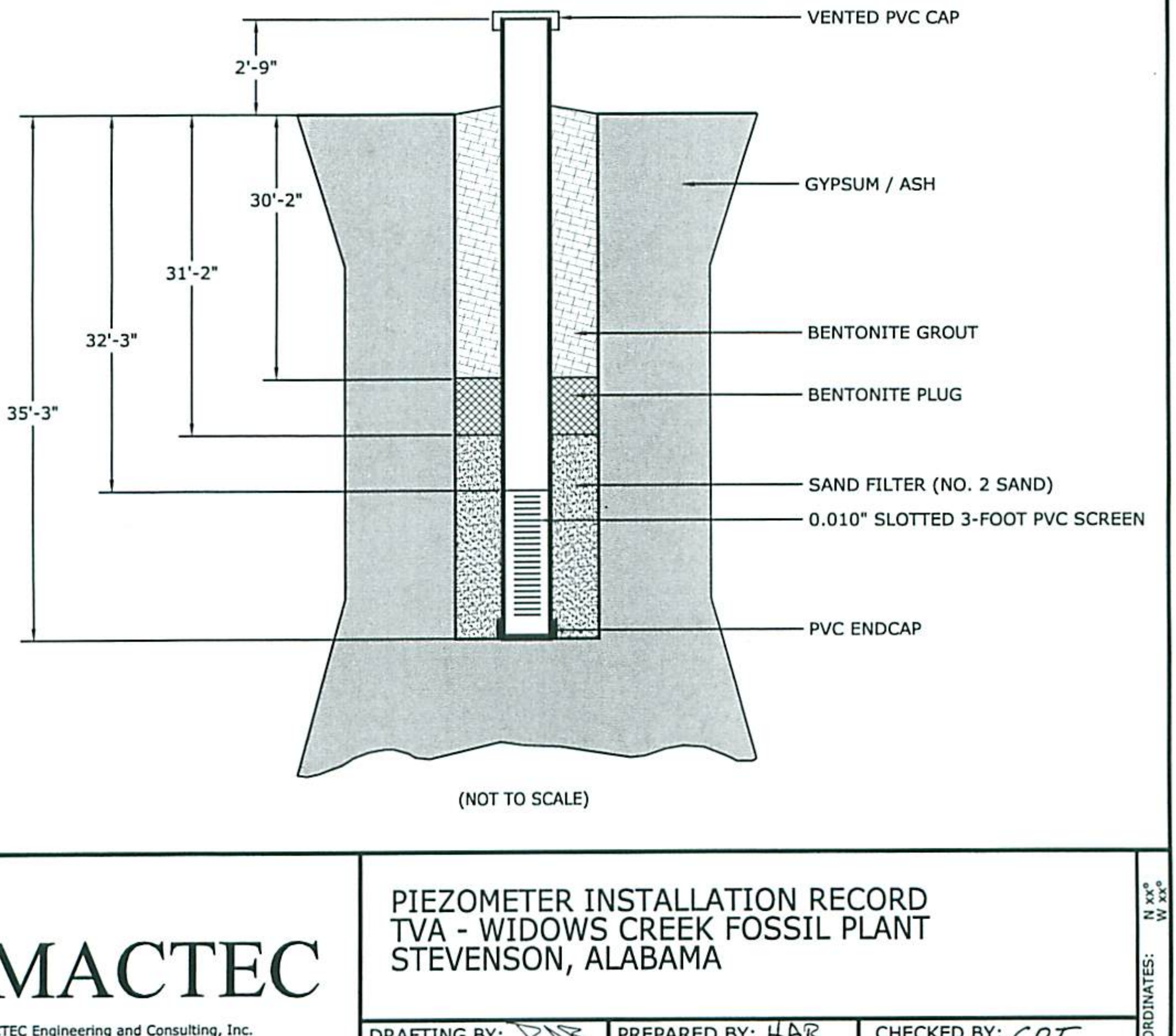
PIEZOMETER INSTALLATION RECORD

PIEZOMETER NUMBER PZ-4

TOTAL DEPTH 35' - 3"

INSTALLATION DATE 06/08/2004

RISER/SCREEN
MATERIAL SCHEDULE 40 PVC
DIAMETER 2.0"
SLOT SIZE 0.010"



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PIEZOMETER INSTALLATION RECORD
TVA - WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

DRAFTING BY: RJB	PREPARED BY: HAB	CHECKED BY: CDT
JOB NUMBER: 3043041026/0001	DATE: JUNE 16, 2004	SCALE: NOT TO SCALE

COORDINATES: N xx° W xx°

PIEZOMETER INSTALLATION RECORD

PIEZOMETER NUMBER PZ-5

INSTALLATION DATE 06/09/2004

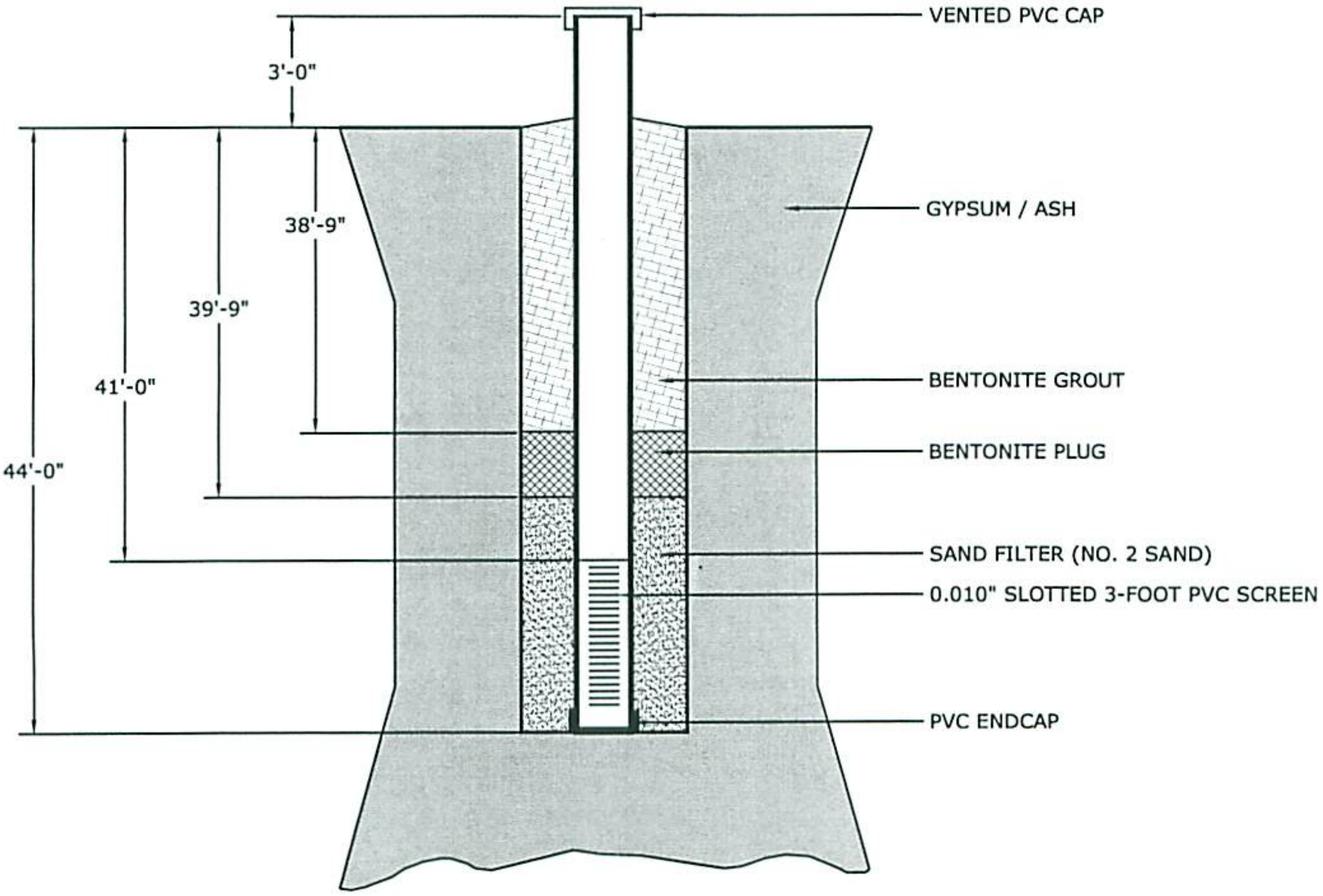
TOTAL DEPTH 44' - 0"

RISER/SCREEN

MATERIAL SCHEDULE 40 PVC

DIAMETER 2.0"

SLOT SIZE 0.010"



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PIEZOMETER INSTALLATION RECORD
TVA - WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

COORDINATES: N xx° W xx°

DRAFTING BY: RJB

PREPARED BY: HAB

CHECKED BY: CDT

JOB NUMBER: 3043041026/0001

DATE: JUNE 16, 2004

SCALE: NOT TO SCALE

PIEZOMETER INSTALLATION RECORD

PIEZOMETER NUMBER PZ-6

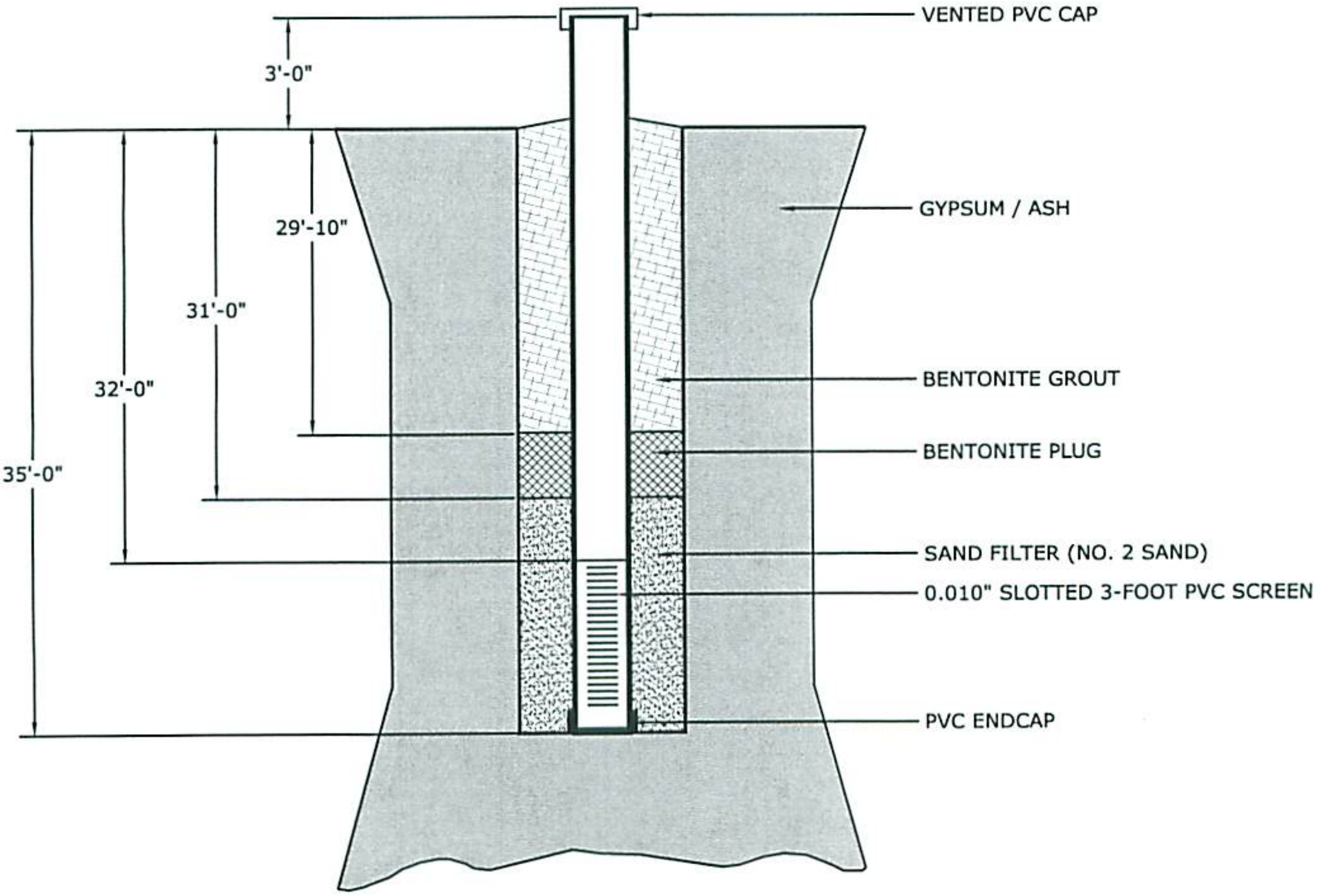
INSTALLATION DATE 06/08/2004

TOTAL DEPTH 35' - 0"

RISER/SCREEN
MATERIAL SCHEDULE 40 PVC

DIAMETER 2.0"

SLOT SIZE 0.010"



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PIEZOMETER INSTALLATION RECORD
TVA - WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

COORDINATES: N xx° W xx°

DRAFTING BY: RSB

PREPARED BY: HAB

CHECKED BY: CDT

JOB NUMBER: 3043041026/0001

DATE: JUNE 16, 2004

SCALE: NOT TO SCALE

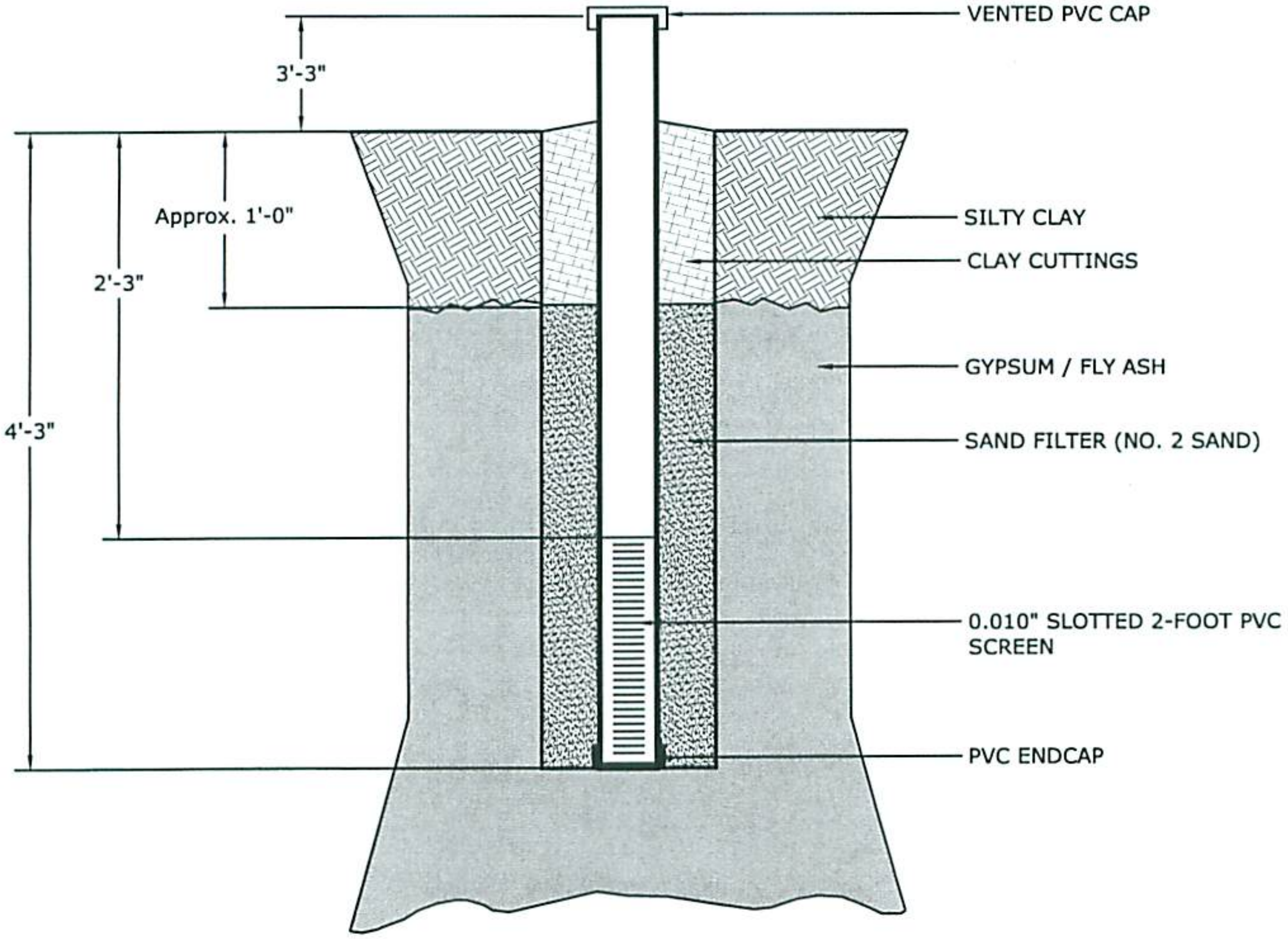
PIEZOMETER INSTALLATION RECORD

PIEZOMETER NUMBER *PZ-1S*

TOTAL DEPTH *4' - 3"*

INSTALLATION DATE *6/03/04*

RISER/SCREEN
MATERIAL *SCHEDULE 40 PVC*
DIAMETER *2.0"*
SLOT SIZE *0.010"*



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PIEZOMETER INSTALLATION RECORD
TVA - WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

DRAFTING BY: RJB	PREPARED BY: HAB	CHECKED BY: CDT
JOB NUMBER: 3043041026/0001	DATE: JUNE 16, 2004	SCALE: NOT TO SCALE

COORDINATES: N xx° W xx°

PIEZOMETER INSTALLATION RECORD

PIEZOMETER NUMBER PZ-2S

INSTALLATION DATE 6/03/04

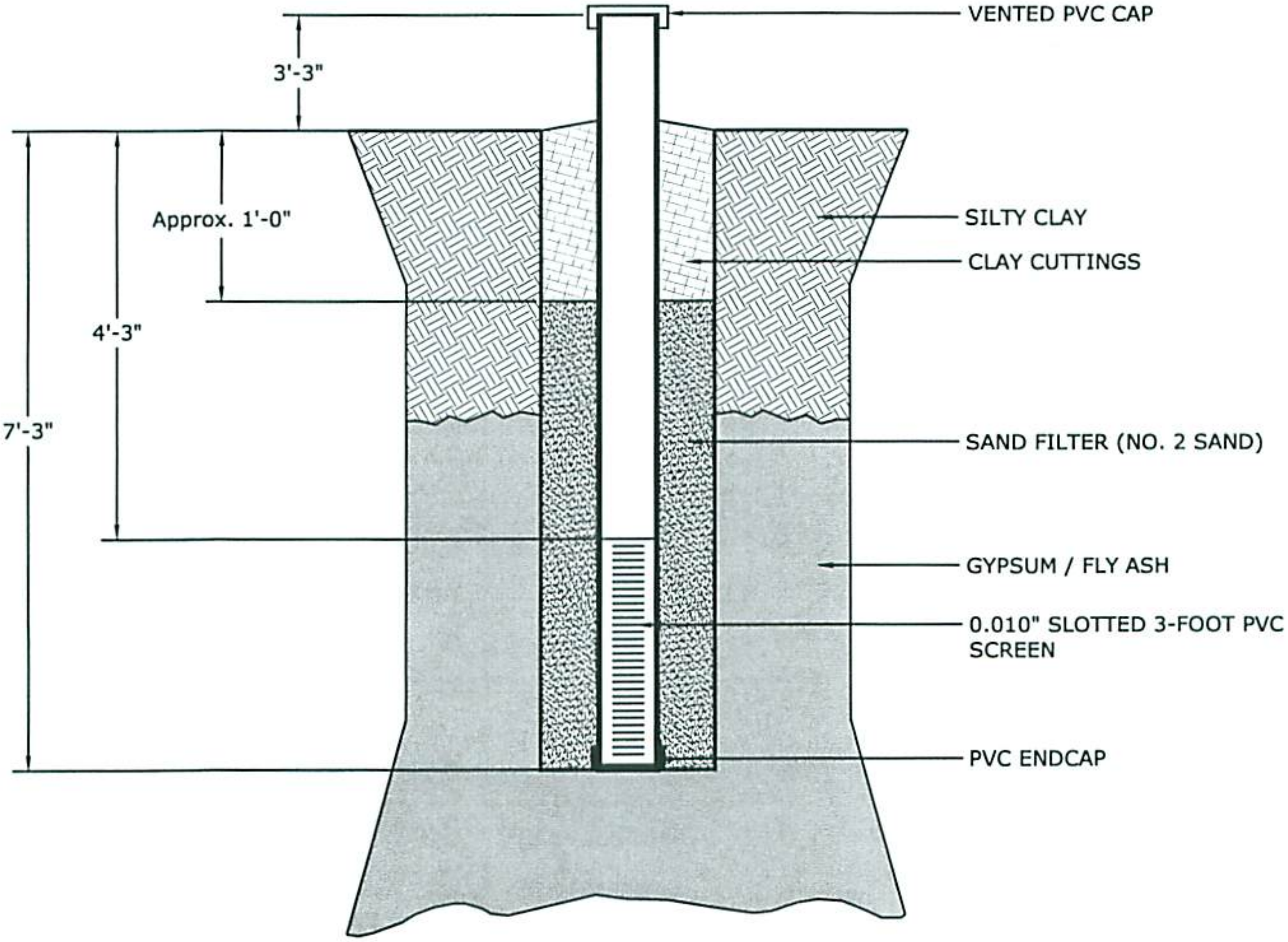
TOTAL DEPTH 7' - 3"

RISER/SCREEN

MATERIAL SCHEDULE 40 PVC

DIAMETER 2.0"

SLOT SIZE 0.010"



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PIEZOMETER INSTALLATION RECORD
TVA - WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

COORDINATES: N xx° W xx°

DRAFTING BY: RBB	PREPARED BY: HAB	CHECKED BY: CDT
JOB NUMBER: 3043041026/0001	DATE: JUNE 16, 2004	SCALE: NOT TO SCALE

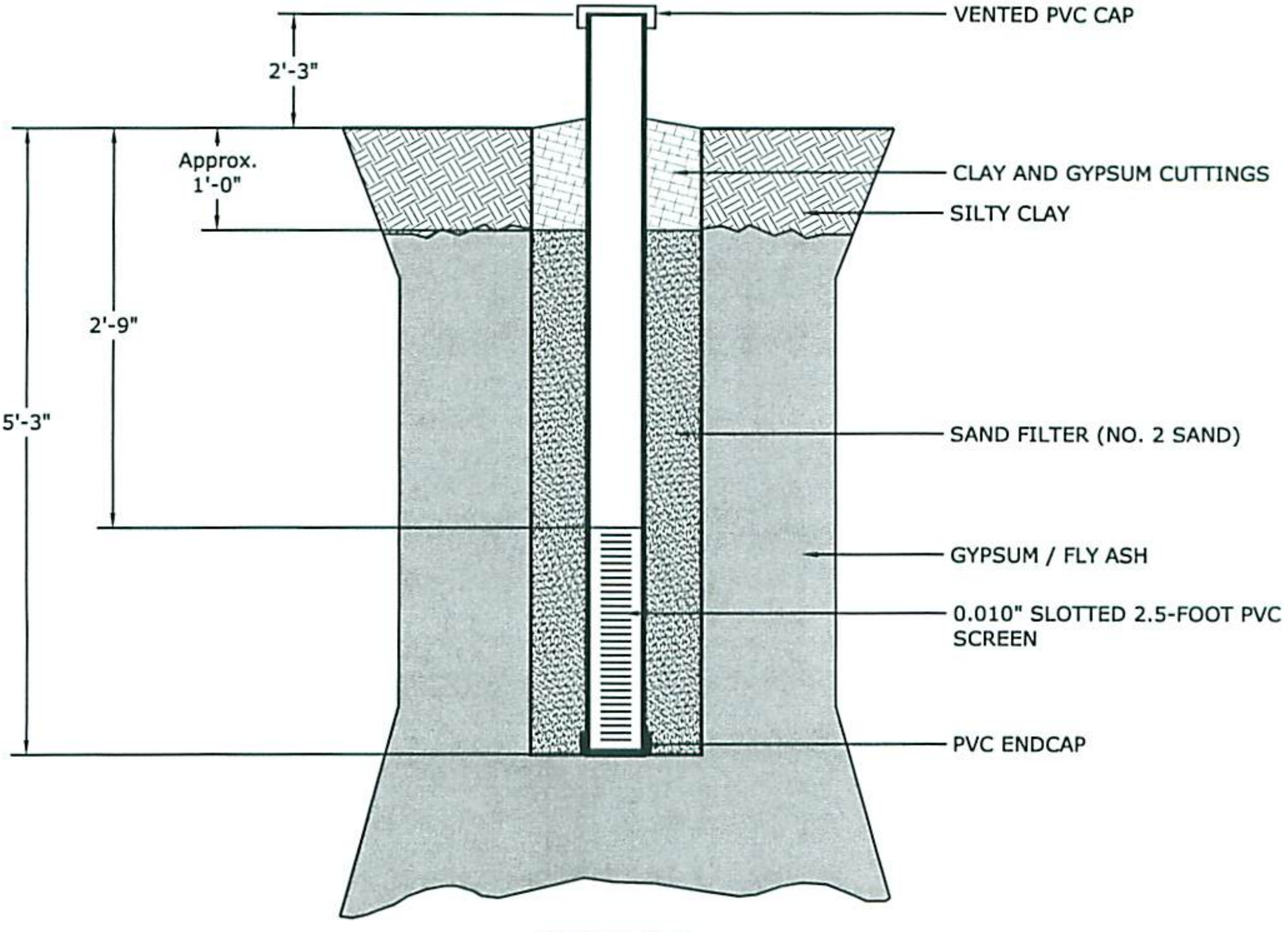
PIEZOMETER INSTALLATION RECORD

PIEZOMETER NUMBER *PZ-4S*

INSTALLATION DATE *6/04/04*

TOTAL DEPTH *5' - 3"*

RISER/SCREEN
MATERIAL *SCHEDULE 40 PVC*
DIAMETER *2.0"*
SLOT SIZE *0.010"*



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Knoxville, Tennessee 37921-5904
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PIEZOMETER INSTALLATION RECORD
TVA - WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

COORDINATES: N xx° W xx°

DRAFTING BY:	PREPARED BY: HAB	CHECKED BY: CDT
JOB NUMBER: 3043041026/0001	DATE: JUNE 22, 2004	SCALE: NOT TO SCALE

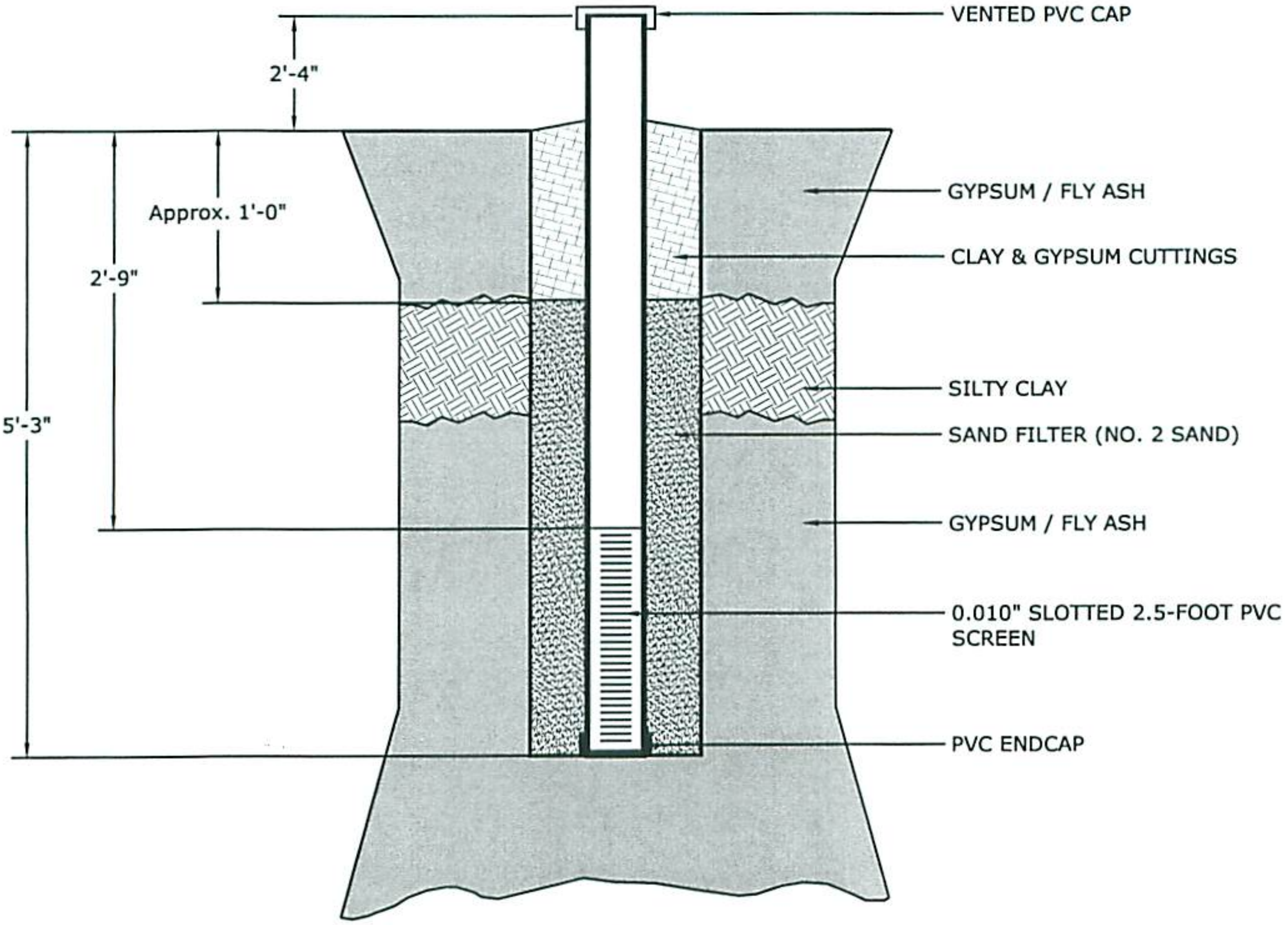
PIEZOMETER INSTALLATION RECORD

PIEZOMETER NUMBER PZ-5S

INSTALLATION DATE 6/03/04

TOTAL DEPTH 5' - 3"

RISER/SCREEN
MATERIAL SCHEDULE 40 PVC
DIAMETER 2.0"
SLOT SIZE 0.010"



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PIEZOMETER INSTALLATION RECORD
TVA - WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

DRAFTING BY:	PREPARED BY: HAB	CHECKED BY: CDT
JOB NUMBER: 3043041026/0001	DATE: JUNE 18, 2004	SCALE: NOT TO SCALE

COORDINATES: N xx° W xx°

PIEZOMETER INSTALLATION RECORD

PIEZOMETER NUMBER PZ-6S

INSTALLATION DATE 6/04/04

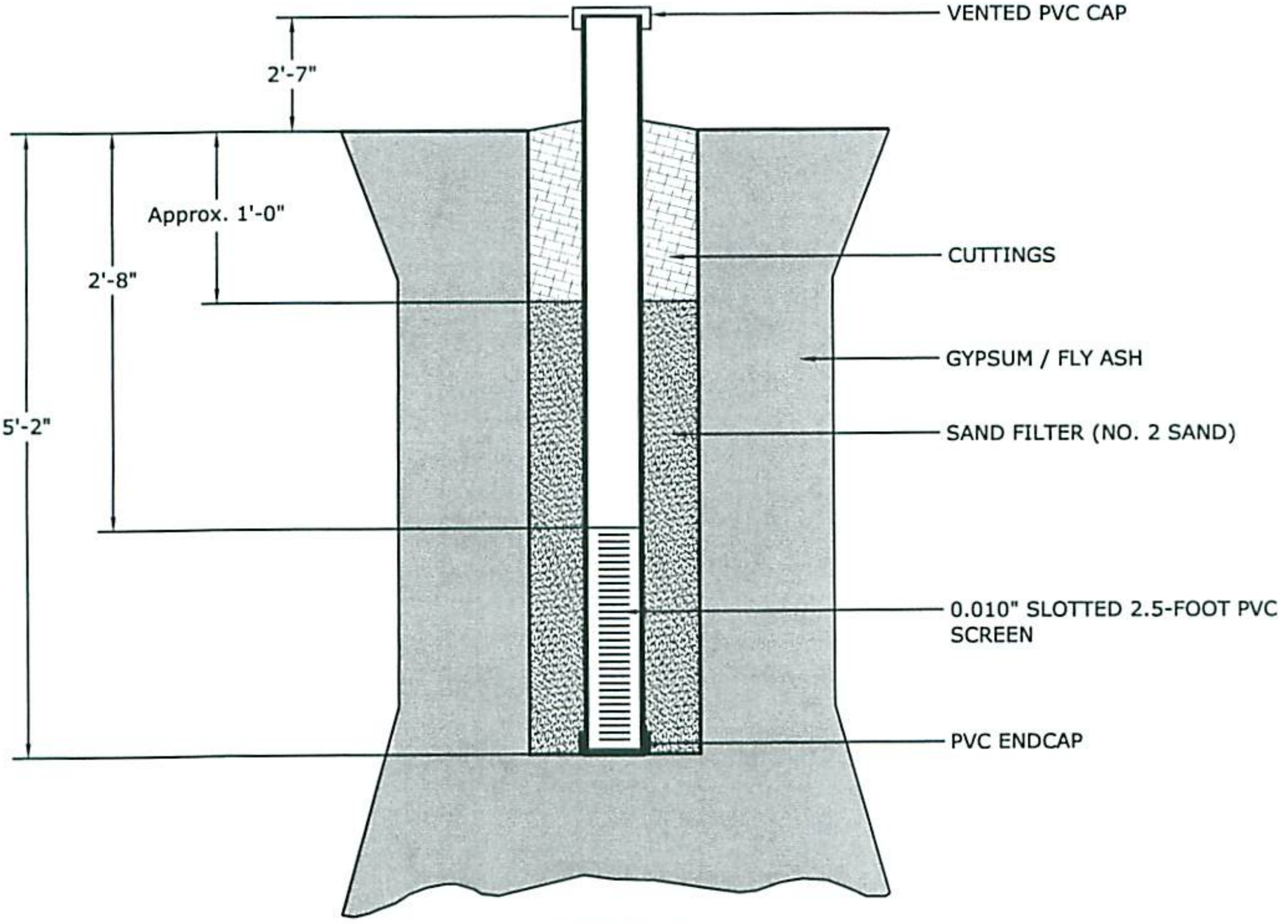
TOTAL DEPTH 5' - 2"

RISER/SCREEN

MATERIAL SCHEDULE 40 PVC

DIAMETER 2.0"

SLOT SIZE 0.010"



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PIEZOMETER INSTALLATION RECORD
TVA - WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

DRAFTING BY:	PREPARED BY: HAB	CHECKED BY: CDT
JOB NUMBER: 3043041026/0001	DATE: JUNE 18, 2004	SCALE: NOT TO SCALE

COORDINATES: N xx° W xx°

APPENDIX D

WATER LEVEL DATA

Table D1
Water Level Data

Piezometer Number	Installation Date	Water Level Reading on 6/9/04 (Feet)	Water Level Reading on 6/11/04 (Feet)	Water Level Reading on 6/18/04 (Feet)
PZ-1	6/9/04	--	18.90	18.80
PZ-2	6/10/04	--	28.2	27.80
PZ-3	6/4/04	20.95	20.95	20.85
PZ-4	6/8/04	19.60	19.70	19.50
PZ-5	6/9/04	--	24.00	23.50
PZ-6	6/8/04	22.10	22.10	22.05
PZ-1S	6/3/04	4.20	--	4.25
PZ-2S	6/3/04	6.15	--	6.10
PZ-4S	6/4/04	5.95	--	5.95
PZ-5S	6/3/04	7.10	--	7.00
PZ-6S	6/4/04	4.75	--	4.60

Note: All readings were measured from the top of the PVC pipe.

Prepared By HAB Date 6/23/04 Checked By CDT Date 6/23/04

Engineering Evaluation and Design Recommendations for Renovation of Widows Creek Gypsum-Fly Ash Storage Facility

Tennessee Valley Authority
Widows Creek Fossil Plant
Stevenson, Alabama

Ardaman & Associates, Inc.

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Tallahassee, 3175 West Tharpe Street, Tallahassee, Florida 32303, Phone (850) 576-6131
Tampa, 3925 Coconut Palm Drive, Suite 115, Tampa, Florida 33619, Phone (813) 620-3389
West Palm Beach, 2200 North Florida Mango Road, Suite 101, West Palm Beach, Florida 33409, Phone (561) 687-8200

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Ardaman & Associates, Inc.

Geotechnical, Environmental and
Materials Consultants

May 9, 2005
File Number 04-056A

Tennessee Valley Authority, LP 3G-C
1101 Market Street
Chattanooga, Tennessee 37402

Attention: Mr. Ron Purkey

Subject: Engineering Evaluation and Design Recommendations for Renovation of the Widows Creek Gypsum-Fly Ash Storage Facility, Widows Creek Fossil Plant, Stevenson, Alabama

Dear Mr. Purkey:

As requested and authorized by Tennessee Valley Authority (TVA) Contract No. 35113, Ardaman & Associates, Inc. (Ardaman) has completed an engineering evaluation of the Widows Creek Gypsum-Fly Ash storage facility (Gypsum Stack) that addresses operational safety and gypsum stack stability concerns identified by a TVA inspection team in December 2003. This report contains and documents the results of the field exploration and sampling programs, the laboratory materials testing program, associated engineering analyses, and presents design recommendations for renovation of the existing facility for continued safe operation.

The results of our assessment indicate that the existing underdrain system, required for seepage and stability control, is not working effectively and/or was never installed at some locations, and that the side slopes of the stack are generally being raised too steeply. Recommended corrective actions contained herein include installation of additional seepage collection drains, regrading and flattening portions of the existing gypsum stack side slopes to a more stable configuration and modifications to the toe ditch to improve surface water control.

This report has been prepared for the exclusive use of TVA in accordance with accepted geotechnical engineering practices for specific application to the above referenced project. No other warranty, expressed or implied, is made.

It has been a pleasure assisting you with this project. If you have any questions or need additional information or assistance, please do not hesitate to contact the undersigned or our Dr. John Garlanger.

Very truly yours,
ARDAMAN & ASSOCIATES, INC.

Bill E. Jackson, P.E.
Senior Project Manager

Anwar E. Z. Wissa, Sc.D., P.E.
President

BEJ/AEZW/ed
Encl.

T:\Projects\2004\04-056A\04-056A TVA bej 001.wpd

8008 S. Orange Avenue 32809, Post Office Box 593003, Orlando, Florida 32859-3003 Phone (407) 855-3860 FAX (407) 859-8121
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Chapter 1

INTRODUCTION AND BACKGROUND

1.1 Introduction

Ardaman & Associates, Inc. (Ardaman) was retained by the Tennessee Valley Authority (TVA) to perform an engineering assessment of the Gypsum-Fly Ash storage facility (Gypsum Stack) at the Widows Creek Fossil Plant, near Stevenson, Alabama, to address operational safety and stability issues raised by an internal inspection team of TVA personnel in December 2003. In that regard, Dr. Anwar Wissa and Mr. Bill Jackson of Ardaman & Associates, Inc. made an initial site visit to the Widows Creek Fossil Plant on Tuesday, March 23, 2004 for the specific purpose of reviewing and discussing operational safety and stability issues identified by the TVA inspection team. A preliminary assessment of the existing gypsum stack performance and a recommended scope of services needed to complete a more detailed engineering assessment were prepared based on the results of our meeting with the inspection team members and visual observations of the existing gypsum stack made during that visit and presented in our letter to Ms. Stacci Thomas, dated March 30, 2004.

The originally proposed scope of services was subsequently modified at the request of TVA and presented in our letter of April 14, 2004. The revised scope of services for this project may be summarized as follows:

- Layout and define requirements for a field exploration and testing program to be undertaken by a local contract driller (MACTEC), to include Standard Penetration Test (SPT) borings at several locations around the perimeter of the stack, the recovery of SPT split-spoon and relatively undisturbed Shelby or Pitcher tube samples of the gypsum-fly ash deposits and the installation of piezometers for the determination of piezometric levels and seepage flow patterns within the existing stack.

- Provide on-site supervision (senior drill crew chief or senior field technician) of the field sampling and testing program performed by MACTEC.

- Perform laboratory materials testing on recovered samples of the gypsum-fly ash deposits for determination of various engineering material properties (e.g., in-place density, natural moisture content, grain size distribution, shear strength, hydraulic conductivity, etc.) needed for the proposed engineering analyses. Five duplicate samples were provided to TVA for determination of the percent composition of gypsum, fly ash, unreacted limerock and calcium sulfite.

- Prepare a Construction Best Management Practices Plan (CBMPP) for the proposed construction signed by a professional engineer registered in the state of Alabama.

- Complete an engineering assessment of the existing gypsum stack and determine the need for corrective measures. Evaluate alternative corrective measures (anticipated to be a combination of side slope regrading and additional seepage control features) and revise seepage and stability analyses for proposed final geometry at various stages of construction to document that the required factor of safety is achieved. Reevaluate available storage volume and remaining life for the proposed final configuration and review the existing operation plan relative to the proposed modifications.

- Issue a final engineering report to present and document the results of the field and laboratory materials testing programs, the selection of engineering material properties, the results of all seepage and stability analyses, and provide recommendations for remedial action and any needed changes in the gypsum stack operating plan or procedures.
- Prepare detailed design and construction drawings for the proposed remedial action plan to be undertaken immediately and for subsequent stages of construction accomplished through normal gypsum stacking operations, in AutoCAD 2002 format, tied to the applicable state plane coordinate system and using TVA drafting standards
- Attend three design review and progress meetings at the 10%, 50% and 100% stages of completion.

1.2 Site Location and Description

The Widows Creek Gypsum-Fly Ash storage facility is located near Stevenson, Alabama in Jackson County in the northeast corner of the state. The approximate location of the site is shown on Figure 1.1, a reproduction of the U.S.G.S. quadrangle maps for Doran Cove and Bridgeport, Alabama. As shown, the site is located in portions of Section 36 of Township 1 South, Range 8 East and Section 1 of Township 2 South, Range 8 East.

An aerial photograph of the site of unknown date is provided as Figure 1.2 and a topographic map of the site dated March 8, 2004 is provided as Figure 1.3. The existing facility encompasses a total base area of approximately 160 acres, that includes an earthen perimeter containment dike and a series of settling ponds used for wet slurry distribution, water clarification, and storage of gypsum-fly ash produced by the Widows Creek fossil fuel plant. The gypsum stacking area is raised with time by the upstream method of construction.

The top of the existing storage facility encompasses a total area of approximately 100 acres. Surface water runoff from the perimeter ditch system and decant water from the settling ponds on top of the stack report to an existing 7.5 acre stilling basin and sedimentation/detention pond located near the southwest corner of the stack. Clarified water is decanted from the southwest corner of the stilling basin for ultimate discharge into the Tennessee River through a permitted outfall location. As noted on Figure 1.3, the highest top elevation of the existing gypsum stack is approximately 665 feet (NGVD), which equates to a maximum stack height of 65 feet relative to the lowest surrounding natural ground elevation of 600 feet (NGVD), or not more than about 40 feet high relative to the lowest perimeter dike crest elevation of 625 feet (NGVD).

1.3 Background Information

Development of engineering properties for the Widows Creek flue gas desulfurization (FGD) waste and an assessment of the feasibility of wet stacking that waste was first undertaken by Ardaman

& Associates, Inc. (Ardaman) in the early 1980's (Garlanger & Ingra, 1983)*. The results of that study were subsequently used as the basis for the conceptual design and layout of Phase I of the existing storage facility. Ardaman was retained again in the early 1990's to evaluate the performance of the Phase I gypsum-fly ash wet stacking facility relative to the original design concepts and to develop recommendations for operation and management of the Phase I stack and proposed Phase II expansion area. The results of the latter study culminated in the following engineering reports:

1. "Interim Report on Evaluation of the FGD Gypsum-Flyash Waste Wet-Stacking Disposal Facility, Widows Creek Steam Plant, Stevenson, Alabama, Contract No. 90PKA-89214B", dated April 22, 1991, Ardaman File No. 90-059.

2. "Proposed Management Plan, Widows Creek Gypsum-Flyash Storage Facility, Stevenson, Alabama, Contract No. 90PKA-89214B", dated June 18, 1991, Ardaman File No. 90-059.

3. "Preliminary Evaluation of Proposed Underdrain System for the Widows Creek Gypsum-Flyash Storage Facility, Stevenson, Alabama, Contract No. 90PKA-89214B, dated August 2, 1991, Ardaman File No. 90-059.

To the best of our knowledge, the engineering design recommendations and proposed operation and management plan presented in the reports listed above constitute the basis of the facility operation plan as it exists today. Portions of these reports are referenced in the discussions and/or used in part as the basis of the design recommendations presented herein.

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*Garlanger, J.E. and Ingra T.S. (1983). "Evaluation of Engineering Properties and Wet Stacking Disposal of Widows Creek FGD Gypsum-Flyash Waste", Tennessee Valley Authority, Office of Power, Division of Energy Demonstration and Technology, Contract TVA-58330A, December 1983.

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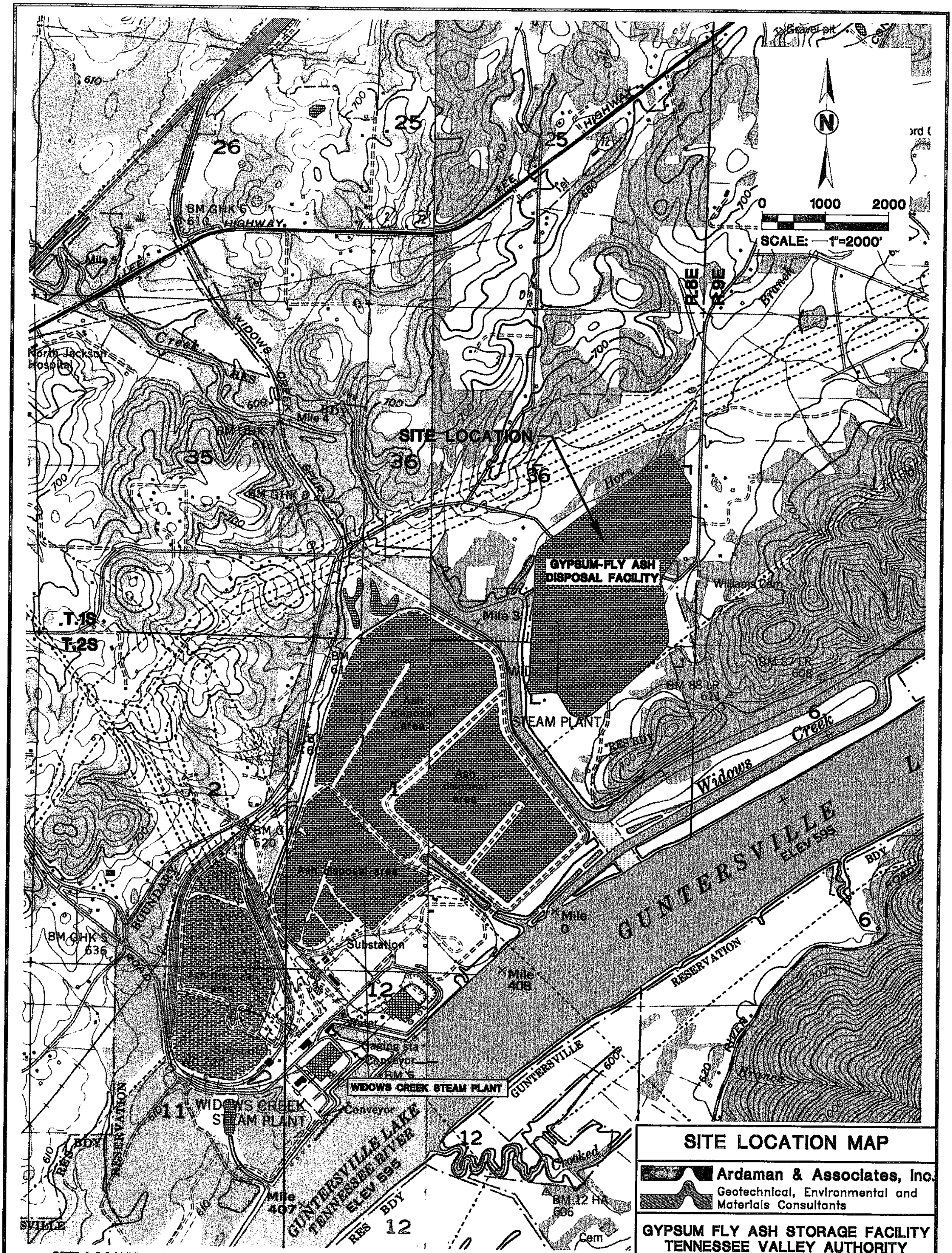

SITE LOCATION: SECTION 36, TOWNSHIP 1 SOUTH, RANGE 8 EAST AND SECTION 1, TOWNSHIP 2 SOUTH, RANGE 8 EAST

SOURCE: USGS TOPOGRAGHIC MAPS OF DORAN COVE AND BRIDGEPORT, ALABAMA

SITE LOCATION MAP

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

GYPSUM FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

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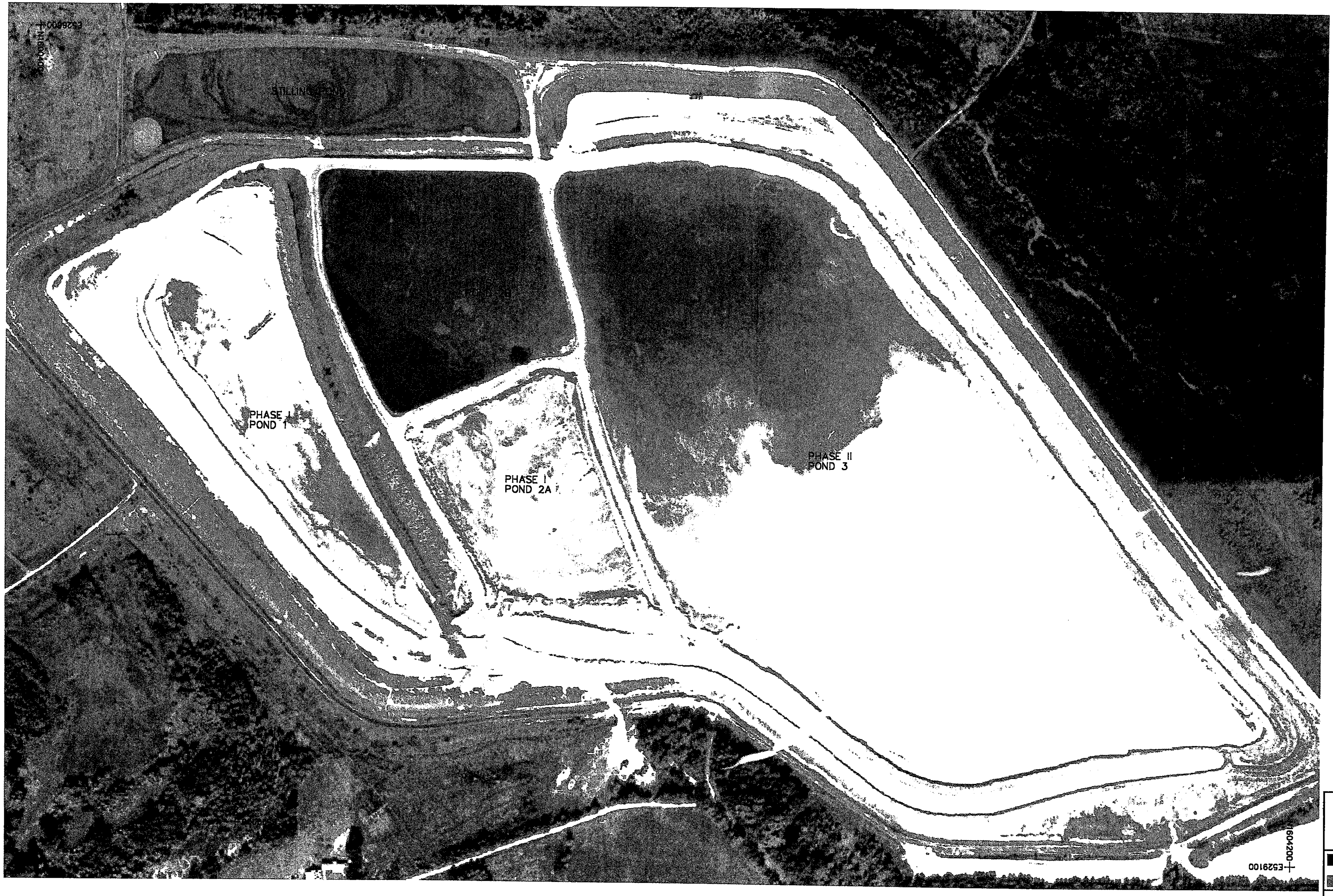
0 150 300
SCALE: — 1"=300'

OLDER AERIAL PHOTOGRAPHIC MAP OF UNKNOWN DATE PROVIDED BY TVA



SITE AERIAL PHOTOGRAPH
SCALE: 1" = 300'

AERIAL PHOTOGRAPH
OF SITE

Ardaman & Associates, Inc.
Geotechnical, Environmental and
Materials Consultants

GYPSUM FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

DRAWN BY: NTD	CHECKED BY:	DATE: 09/23/04
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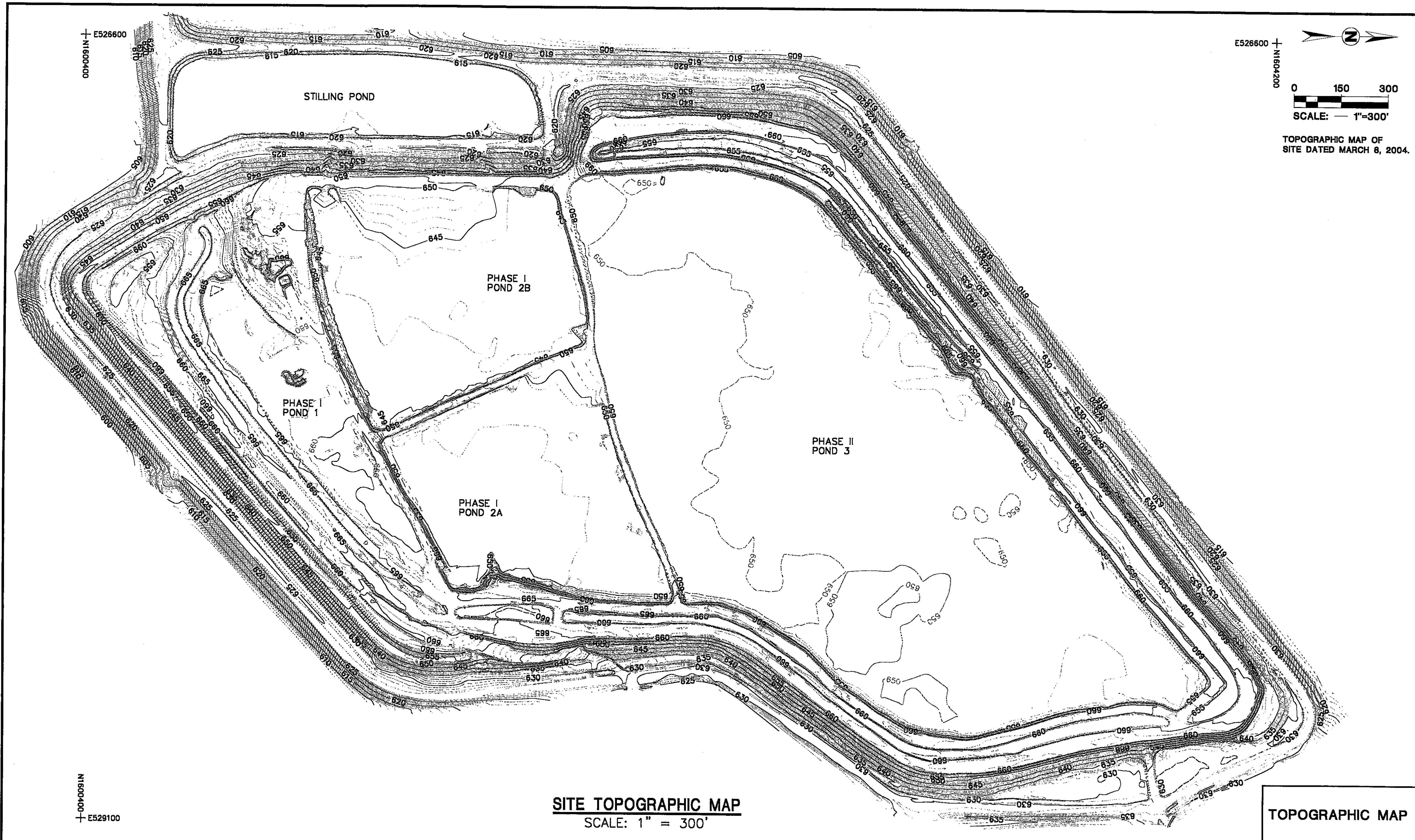

SITE TOPOGRAPHIC MAP

SCALE: 1" = 300'

TOPOGRAPHIC MAP OF SITE

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

GYPSUM FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

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Chapter 2

FIELD EXPLORATION AND SITE INSPECTION

2.1 Site Inspection

An initial site visit and inspection of the Widows Creek Gypsum-Fly Ash storage facility was made by Dr. Anwar Wissa and Mr. Bill Jackson of Ardaman & Associates, Inc. on Tuesday, March 23, 2004 for the specific purpose of reviewing and discussing operational safety and stability issues identified by a TVA inspection team in an independent audit. Based on the results of that inspection and our meeting with the TVA inspection team members, several elements of the existing operation were identified as potential concerns that needed to be addressed by a more detailed engineering assessment. Key issues identified at that time are discussed below.

2.1.1 Seepage Control

Generalized seepage was observed on the lower slope and toe of the gypsum stack around essentially the entire perimeter of the facility. Many of the underdrain outlet pipes could not be located in the field and some of those that were located were not flowing or were flowing only a small to insignificant quantity of water at the time of the inspection. Although three rings of drains were reportedly installed in the Phase I area, we were not able to locate all of the outlet pipes. The drains that were located in the Phase I area appear to have only one outlet pipe at the end of each drain section (i.e., instead of separate outlets for each of the three drains), which precludes assessing individual drain performance.

It is our understanding from conversations with TVA personnel that the entire length of the previously recommended underdrain system for the Phase II expansion area may not have been installed as originally proposed. Outlet pipes were located on the north and west sides of the Phase II expansion area but no outlet pipes were observed on the east side. The Phase II drains that we observed on the north side have two drain outlet pipes, but this arrangement still precludes assessing individual drain performance. These drains were likewise not flowing or flowing only a small to insignificant quantity of water at the time of the inspection.

As noted above, seepage was observed on the lower slope and toe of the gypsum stack around most of the perimeter, especially in the Phase II expansion area. The lower slope has also been covered with a clayey soil fill used to support vegetation that has been provided for erosion control. It appears that the clayey soil fill may be less pervious than the underlying gypsum and is restricting seepage flow from the face of the lower gypsum slope. Seepage at some locations was flowing beneath the clay cover at the interface with the underlying gypsum. Seepage related sloughing and instability of the lower slope of the gypsum-fly ash stack was also observed at several locations.

The clayey soil cover at toe of the slope around most of the Phase II expansion area is saturated and soft and will not support equipment needed for mowing and routine maintenance. The toe ditch and lower slope of the stack were heavily overgrown at the time of our inspection, restricting visual inspection.

2.1.2 Stack Stability

The currently recommended side slope geometry for the Widows Creek gypsum-fly ash stacking facility is based on the seepage and stability analyses performed under the assumption that a properly operating underdrain system is in place and depressing the phreatic surface sufficiently to prevent seepage from exiting on the face and lower side slope of the stack. As discussed above, however, seepage was observed on the toe and lower slope around much of the stack perimeter and seepage related sloughing of the stack side slope was occurring at several locations. These observations indicate that existing seepage patterns through the gypsum stack are not consistent with the design assumptions used in the original stability analyses. In particular, field observations indicate that the phreatic surface in the stack is much higher than anticipated, which, in turn, will reduce the computed factors of safety for side slope stability.

The upper, active portion of the gypsum stack is also being raised much too steeply at some locations, which will likewise reduce the factor of safety against overall side slope failure. The steep upper slopes could potentially lead to localized failure of the uppermost portion of the perimeter gypsum dike. Additional seepage control measures, in conjunction with regrading and flattening of the upper slopes of the gypsum stack, will be required to improve overall stability of the stack as the stack height increases.

2.1.3 Operating Procedures

Operational procedures currently being used to raise the gypsum-fly ash stack are not in full compliance with the previously provided design recommendations or operation plan. In particular, the upper portion of the gypsum stack at many locations is being raised much too steeply relative to the recommended overall average design slope of 3.0H to 1.0V.

The internal divider dikes separating the various settlement/clarification ponds on top of the stack and the perimeter dike adjacent to the stilling pond do not have an associated rim-ditch and can not be raised using the conventional upstream method of construction. Given the current configuration, it is necessary to raise these particular dikes with mechanically hauled and placed gypsum fill materials, which, without proper moisture and compaction control, are inherently not as strong as the wet cast materials and are more susceptible to collapse or subsidence when initially wetted or inundated. In addition, it is generally very difficult to raise the perimeter gypsum dike in the inboard direction without the presence of an internal beach of sedimented gypsum to support the dike fill materials. Mechanically raised dikes constructed in deep water environments (i.e., without the presence of an adjacent gypsum beach) tend to become very steep, often with a significant depth of clear water immediately adjacent to the dike (deep water and steep, potentially unstable slope on upstream side of dike), which does not offer the degree of safety afforded by a dike that is reinforced on the inside by sedimented gypsum deposits.

It is our understanding that the slurry pipelines that normally discharge into the southwest corner of Pond 3 in the Phase II expansion area are leaking and have not been used in over a year. Repair and reactivation of this slurry discharge location would facilitate gypsum distribution and stacking operations on top of the stack and would be beneficial when reestablishing rim-ditches on the internal divider dike and the perimeter dike on the west wall of Pond 2B (next to stilling pond).

The stack is currently operated with the perimeter gypsum dike and inner berm of the rim-ditch placed in a "double dike" configuration, where both the perimeter dike and inner berm are maintained sufficiently wide to afford direct access to construction equipment. Although the double dike configuration may be desirable due to the erodibility of the gypsum-fly ash mixture (i.e., compared to gypsum without the fly ash addition), the dikes appear to be excessively wide and high at many locations and much wider than needed for safe and efficient operation of the stack. The inside slope of the inner berm at many locations is very steep and eroded and does not appear to be well supported with an adjacent "beach" of sedimented deposits.

Two decant structures (steel pipe with fixed weir board riser) are installed through the perimeter west wall dike of Pond 2B and discharge into the lowermost stilling pond located on the west side of the Phase I stacking area. This type of decant must be excavated and raised at intervals as the height of the stack increases. Other than the steel headwall at the pipe inlet, it is our understanding that neither decant pipe is provided with a seepage collar(s) to limit seepage or erosional piping along the pipe alignment. It has been our experience that failures in the perimeter gypsum dike of similar facilities typically occur at the location of a decant pipe excavation or excavation backfill after the pipe has been moved. Additional safeguards should be implemented relative to installation, removal and operation of the existing decants. A safer alternative to the buried decant pipes might be a siphon decant system where the discharge pipe crosses over the top of the perimeter dike and is raised with each lift of the dike, precluding the need for a dike penetration or periodic excavation and removal of the decant outfall pipe.

2.1.4 Surface Water Control

Much of the perimeter ditch system between the toe of the gypsum-fly ash stack and the perimeter toe road is infilled with gypsum-fly ash sediments eroded from the upper, ungrassed side slopes of the stack and from excavated debris cast onto the lower side slope of the stack from previous ditch cleaning operations. The perimeter ditch system does not appear to have adequate capacity to handle the runoff from a significant storm event, especially as the height of the stack and associated side slope watershed area increases with time.

2.2 Field Exploration

A field exploration program was developed by Ardaman & Associates, Inc. to acquire field data and recover material samples needed for an engineering assessment of the existing storage facility. The field exploration program, as described in greater detail below, included performing Standard Penetration Test (SPT) borings at several locations around the perimeter of the stack, the recovery of SPT split-spoon and relatively undisturbed Shelby or Pitcher tube samples of the gypsum-fly ash deposits and the installation of piezometers for the determination of piezometric levels and seepage flow patterns within the gypsum stack.

The specified field exploration program was undertaken by TVA's contract drilling company, MACTEC Engineering and Consulting, during the period of May 24 to June 11, 2004. A description of the work performed and the procedures used by MACTEC is contained in their report of geotechnical drilling, a copy of which is provided in Appendix 1. All field work was performed under the supervision of an on-site representative of Ardaman & Associates, Inc. A description of the field work performed is provided below.

2.2.1 Standard Penetration Test Borings

Six Standard Penetration Test (SPT) borings (SPT-1 to SPT-6) were performed around the perimeter of the gypsum stack at the approximate locations shown on Figure 2.1. These borings were performed using procedures in general accord with ASTM D1586, as outlined in Appendix A of the MACTEC report contained in Appendix 1 of this report. Each test boring fully penetrated the gypsum-fly ash deposits and was terminated in the underlying natural ground foundation soils. The test borings varied in depth from 36.5 to 66.5 feet.

SPT split-spoon samples of the gypsum-fly ash deposits and the underlying natural ground soils recovered during performance of the Standard Penetration Tests were visually classified in the field and representative portions of each sample were placed in sealed sample jars and transported to our Orlando laboratory for further classification and laboratory testing.

Surveyed locations and ground surface elevations of each boring were provided by TVA upon completion of all field work. The location, depth and ground surface elevation at each test boring is tabulated below.

Boring	Surface Elevation* (feet)	Boring Location**		Total Depth (feet)
		Northing	Easting	
SPT-1	649.90	1,601,472.40	527,068.47	46.5
SPT-2	661.89	1,602,279.91	527,011.36	66.5
SPT-3	659.79	1,603,928.41	528,728.12	36.5
SPT-4	663.34	1,602,691.02	528,555.72	46.5
SPT-5	660.18	1,603,183.60	527,640.86	51.5
SPT-6	660.50	1,601,092.33	527,910.09	51.5

* NGVD 29
** NAD 27 - Alabama Mercator East

The results of the test borings are presented schematically on Figures 2.2 through 2.7, including a graphical plot of the SPT blow count values (N-values) as a function of depth and various laboratory material test results are discussed in a subsequent section of this report. Copies of the field boring logs are provided in Appendix B of the MACTEC report.

In general, the test borings show some variability in density and composition of the gypsum-fly ash deposits. The recorded SPT blowcount values (N-values) in the gypsum-fly ash mix varied considerably from less than 1 blow/foot in borings SPT-1 and SPT-5, to values greater than 40 blows/foot in borings SPT-1, SPT-2 and SPT-6. The SPT blowcount value represents the resistance to penetration of the 2-inch diameter split-spoon sampler driven by successive blows of a 140-pound hammer freely dropped from a height of 30 inches. The higher N-values (greater than 30) represent dense to very dense conditions, while the lower values (less than 10) represent loose to very loose or soft conditions. Visual inspection and testing of the recovered samples revealed that the softer materials were typically very fine and contained a high percentage of fly ash (dark grey to black in color). Some of the denser materials were encountered closer to the ground surface and are most likely influenced by mechanical compaction and dessication associated with normal operation and construction of the perimeter dike and rim-ditch system.

The natural ground soils encountered at the base of the gypsum stack consist a reddish brown to yellowish brown silty clay with SPT blowcount values in the range of 7 to 26 blows/foot, with an average of 16 blows/foot. The natural ground soils may be generally classified as a stiff to very stiff silty clay with trace rock fragments.

2.2.2 Undisturbed Sampling

A total of 26 relatively undisturbed Shelby tube samples of the *in situ* gypsum-fly ash deposits were obtained with depth from four of the test boring locations using a 2 7/8-inch inside diameter, 30-inch long, thin-walled, fixed piston sampler. Considering the internal length of the piston and sampler head, this size Shelby tube can be advanced to a maximum length of 24 inches.

The undisturbed samples were recovered from separate boreholes advanced immediately adjacent to the standard penetration test borings SPT-1 through SPT-4. These boreholes are designated herein as BH-1 through BH-4, respectively. All Shelby tube samples were sealed in the field with non-shrink wax and hand carried by the on-site Ardaman representative to our Orlando office for testing. An inventory of recovered Shelby tube samples, including sample depth and percent recovery is provided below. The relative location of the undisturbed samples are also shown on the generalized soil boring profiles presented in Figure 2.2 through 2.7.

Boring	Sample	Depth (feet)	Sample Recovery* (%)
BH-1	US-1	20 - 22	100
	US-2	30 - 32	100
	US-3	40 - 41.5	80
BH-2	US-1	5 - 7	75
	US-2	10 - 12	100
	US-3	15 - 17	90
	US-4	20 - 22	100
	US-5	25 - 27	90
	US-6	30 - 32	85
	US-7	35 - 37	40
	US-8	40 -42	100
	US-9	45 - 47	80
	US-10	50 - 52	85
		55- 57	Discarded
	US-11	60 -62	90
BH-3	US-1	10 - 12	85
	US-2	15 - 17	95
	US-3	22.5 - 24.5	100
	US-4	25 - 27	90
BH-4	US-1	5 - 7	50
	US-2	12.5 - 14.5	100
	US-3	15 - 17	85
	US-4	20 - 22	85
	US-5	25 - 27	100
	US-6	30 - 32	100
	US-7	35 - 37	95
	US-8	40 - 42	100

*Where sample recovery is defined as the ratio of the length of gypsum-fly ash recovered to the length of penetration of the Shelby tube (generally 24 inches), as defined by field measurement.

Recovered undisturbed samples of the gypsum-fly ash deposits were used for laboratory testing and determination of *in situ* moisture content, dry density as a function of depth, triaxial shear strength and vertical coefficient of permeability, or hydraulic conductivity. The results of the laboratory materials testing are discussed in greater detail in Section 3 of this report.

2.2.3 Piezometer Installation and Measured Water Levels

Six sealed standpipe piezometers (PZ-1 through PZ-6) were installed around the outside edge of the gypsum dike crest road at the approximate locations shown in Figure 2.1 to determine and document the water level and seepage gradients within the gypsum stack. The total depth of these piezometers ranged from 30 to 45 feet, with the sealed collection zones set near the base of the gypsum stack. Five shallow standpipe piezometers (PZ-1S through PZ-6S, excluding PZ-3S where the side slope was too steep to afford access) were also installed on the outside face of the gypsum stack side slope, immediately downgradient from the corresponding sealed piezometer on top of the stack. The total depth of the shallow slope piezometers varied from 4.25 to 7.25 feet. Installation details for each piezometer are provided in Table 2.1 and in Appendix C of the MACTEC report.

As noted, each of the deeper sealed standpipe piezometers extended to a depth near the base of the gypsum stack and was provided with a 3 feet section of slotted PVC well screen, set in a 4-foot sensing zone of filter sand. The top of the filter sand was provided with a 1-foot thick seal of bentonite pellets and grouted to the surface with a high-solids bentonite grout.

The relative location of each piezometer is shown on the simplified boring profiles provided in Figures 2.2 through 2.7 and on the simplified cross sections of existing conditions shown on Figures 4.2 through 4.4. The surveyed location, top-of-pipe elevation and measured water level in each piezometer is also provided in Table 2.1.

Table 2.1

INSTALLATION DETAILS AND MEASURED WATER LEVELS IN WIDOWS CREEK PIEZOMETERS

Piez. No.	Installation Date	Top of Pipe Elevation* (feet)	Surface Elevation* (feet)	Piezometer Location**		Collection Zone		Water Level*** (feet)		
				Northing	Easting	Depth from Surface (feet)	Elevation* (feet)	06/09/2004	06/11/2004	06/18/2004
PZ-1	06/09/2004	653.06	650.42	1,601,485.79	527,048.45	36.0-40.0	617.1-613.1	–	634.16	634.26
PZ-1S	06/03/2004	633.73	630.61	1,601,489.54	527,006.97	1.0-4.3	632.7-629.4	629.53	–	629.48
PZ-2	06/10/2004	663.73	661.06	1,602,286.07	526,862.20	41.3-45.3	622.4-618.4	–	635.53	635.93
PZ-2S	06/03/2004	637.45	634.22	1,602,279.97	526,784.42	1.0-7.3	636.5-630.2	631.30	–	631.35
PZ-3	06/04/2004	665.06	662.51	1,603,957.89	528,809.97	26.1-30.3	639.0-634.8	644.11	644.11	644.21
PZ-4	06/08/2004	665.08	662.29	1,602,636.32	528,628.82	31.2-35.3	633.9-629.8	645.48	645.38	645.58
PZ-4S	06/04/2004	645.84	643.41	1,602,607.48	528,668.95	1.0-5.3	644.8-640.5	640.25	–	640.25
PZ-5	06/06/2004	665.38	662.33	1,603,287.84	527,557.79	39.8-44.0	625.6-621.4	–	641.38	641.88
PZ-5S	06/03/2004	641.69	639.38	1,603,317.88	527,533.55	1.0-5.3	640.7-636.4	634.59	–	634.69
PZ-6	06/08/2004	663.18	659.91	1,600,978.51	528,017.30	31.0-35.0	632.2-628.2	641.08	641.08	641.13
PZ-6S	06/04/2004	630.23	627.71	1,600,886.81	528,098.21	1.0-5.3	629.2-624.9	625.48	–	625.63

* NGVD 29
** NAD 27 - Alabama Mercator East
*** Water elevations measured on dates indicated.

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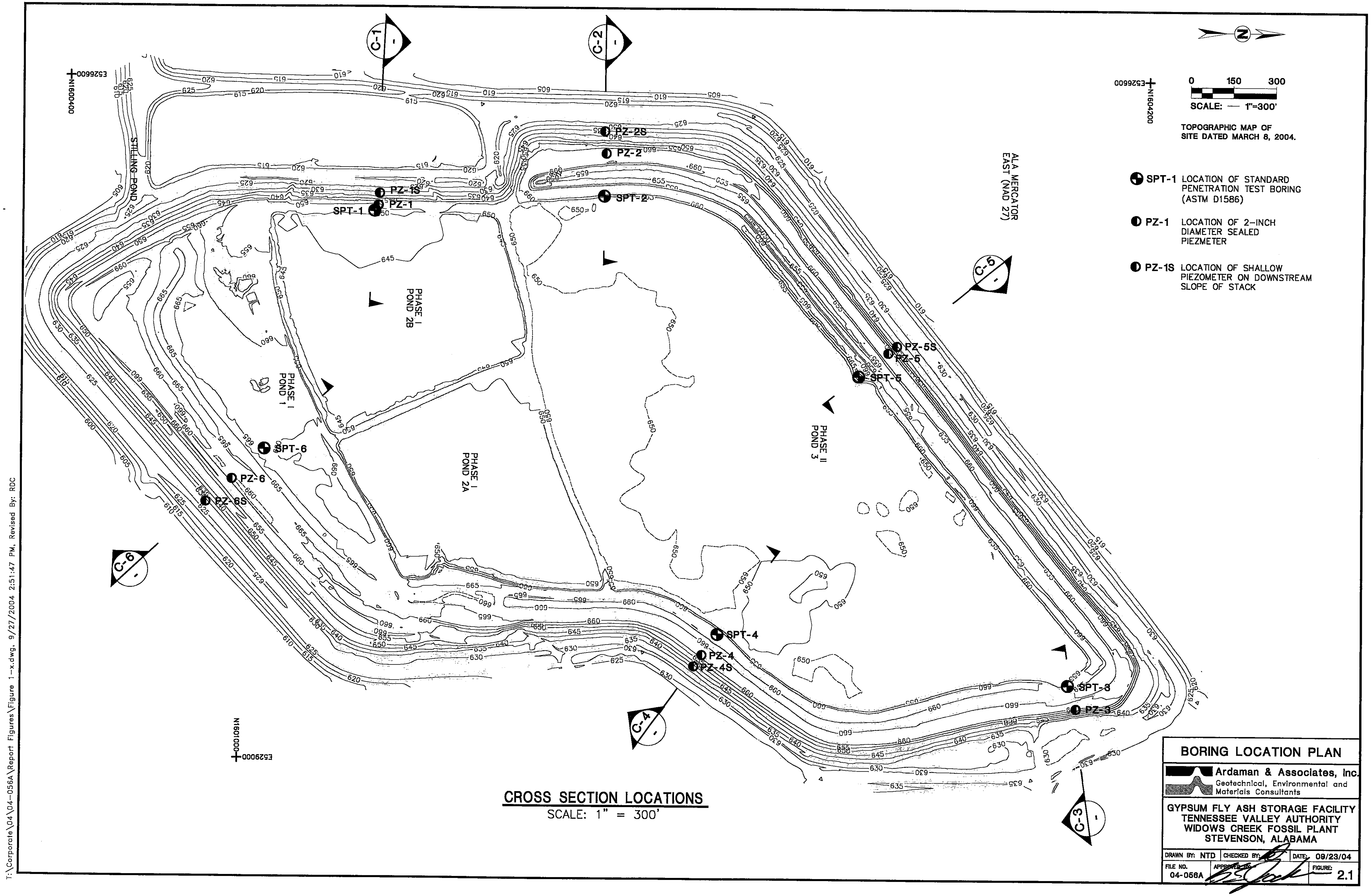

CROSS SECTION LOCATIONS
SCALE: 1" = 300'

BORING LOCATION PLAN

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

GYPSUM FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

DRAWN BY: NTD	CHECKED BY:	DATE: 09/23/04
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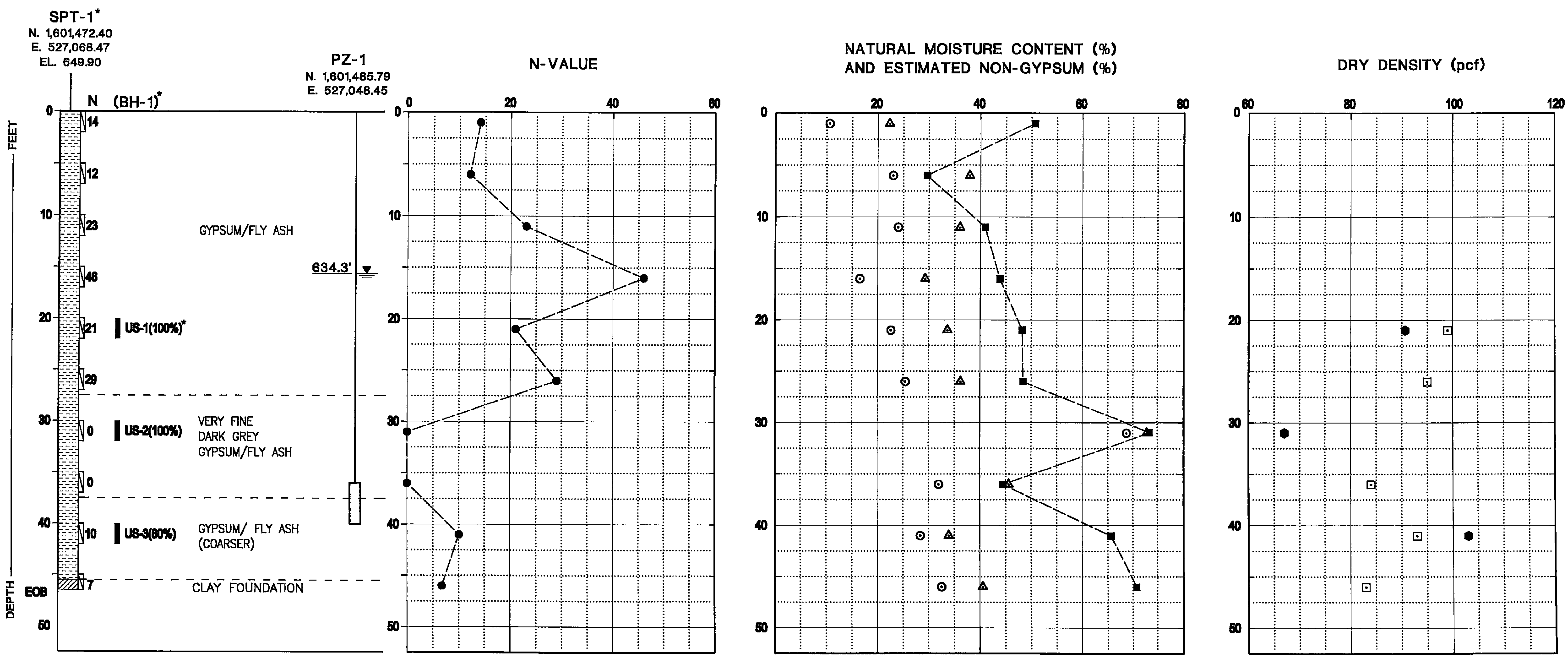

LEGEND

- ▯ SPT SPLIT–SPOON SAMPLE LOCATION
- ▮ UNDISTURBED SHELBY TUBE SAMPLE LOCATION AND % RECOVERY
- ▼ WATER LEVEL IN PIEZOMETER ON 06/18/04
- N STANDARD PENETRATION TEST BLOWCOUNT VALUE
- * UNDISTURBED SAMPLES OBTAINED FROM SEPARATE BOREHOLE (BH–1) ADJACENT TO SPT–1

SPT SAMPLES

- ⊙ MOISTURE CONTENT AT 40°C OVEN
- △ MOISTURE CONTENT AT 200°C OVEN
- ■ ESTIMATED PERCENT NON–GYPSUM

- ● SHELBY TUBE DRY DENSITY
- ⊡ ESTIMATED SATURATED DRY DENSITY OF SPT SAMPLES BELOW W.T. (G_S=2.5)

**SIMPLIFIED BORING PROFILE
AND TEST DATA
FOR BORING SPT-1**

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

GYPSUM FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

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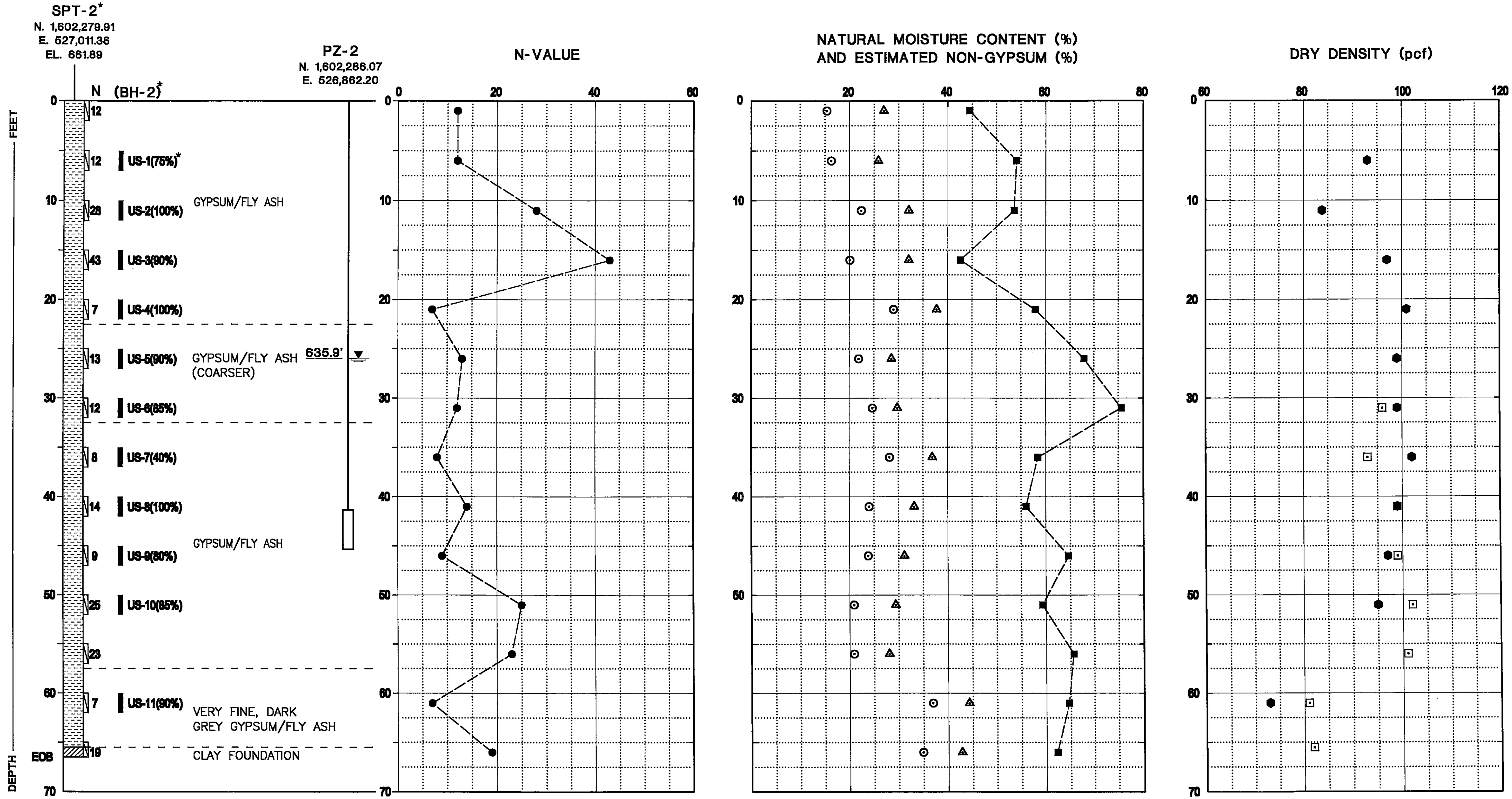

LEGEND

- ⍂ SPT SPLIT-SPOON SAMPLE LOCATION
- ▮ UNDISTURBED SHELBY TUBE SAMPLE LOCATION AND % RECOVERY
- ▽ WATER LEVEL IN PIEZOMETER ON 06/18/04
- N STANDARD PENETRATION TEST BLOWCOUNT VALUE
- * UNDISTURBED SAMPLES OBTAINED FROM SEPARATE BOREHOLE (BH-2) ADJACENT TO SPT-2

SPT SAMPLES

- ⊙ MOISTURE CONTENT AT 40°C OVEN
- △ MOISTURE CONTENT AT 200°C OVEN
- ■ ESTIMATED PERCENT NON-GYPSUM
- ⬢ SHELBY TUBE DRY DENSITY
- ⊡ ESTIMATED SATURATED DRY DENSITY OF SPT SAMPLES BELOW W.T. (G_S=2.5)

SIMPLIFIED BORING PROFILE AND TEST DATA FOR BORING SPT-2

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

GYPSUM FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

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FILE NO. 04-056A	APPROVED BY:	FIGURE: 2.3

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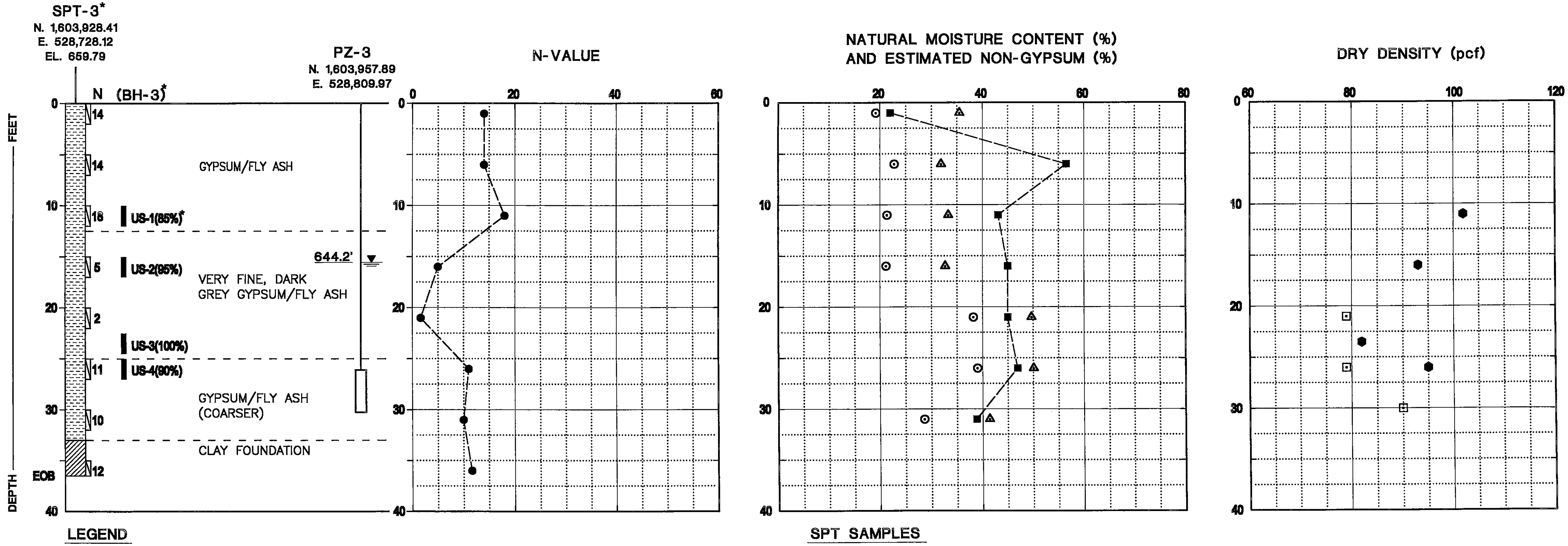

LEGEND

- ▯ SPT SPLIT-SPOON SAMPLE LOCATION
- ▮ UNDISTURBED SHELBY TUBE SAMPLE LOCATION AND % RECOVERY
- ▼ WATER LEVEL IN PIEZOMETER ON 06/18/04
- N STANDARD PENETRATION TEST BLOWCOUNT VALUE
- * UNDISTURBED SAMPLES OBTAINED FROM SEPARATE BOREHOLE (BH-3) ADJACENT TO SPT-3

SPT SAMPLES

- ⊙ MOISTURE CONTENT AT 40°C OVEN
- ▲ MOISTURE CONTENT AT 200°C OVEN
- ■ ESTIMATED PERCENT NON-GYPSUM

- ● SHELBY TUBE DRY DENSITY
- ⊡ ESTIMATED SATURATED DRY DENSITY OF SPT SAMPLES BELOW W.T. (G_S=2.5)

SIMPLIFIED BORING PROFILE AND TEST DATA FOR BORING SPT-3

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

GYPSUM FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

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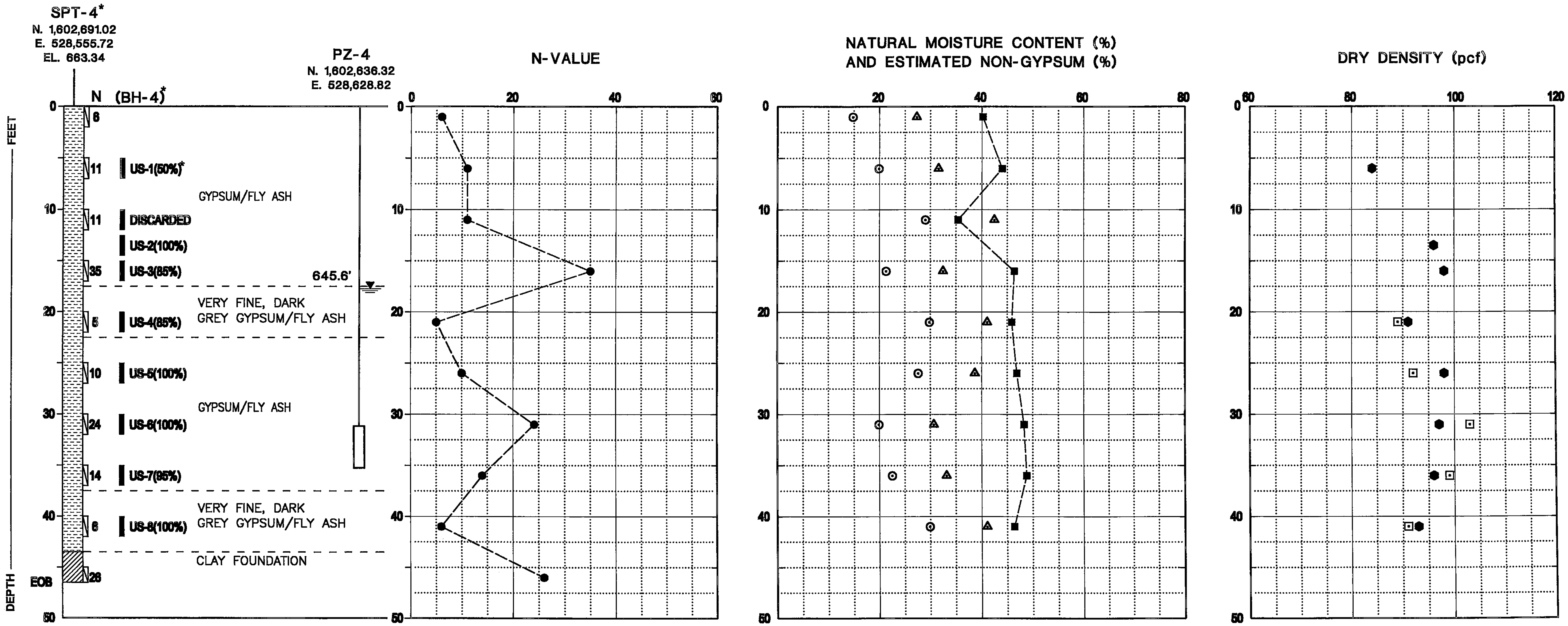
FILE NO. 04-056A	APPROVED BY:	FIGURE: 2.4



LEGEND

- ▧ SPT SPLIT-SPOON SAMPLE LOCATION
- ▮ UNDISTURBED SHELBY TUBE SAMPLE LOCATION AND % RECOVERY
- ▽ WATER LEVEL IN PIEZOMETER ON 06/18/04
- N STANDARD PENETRATION TEST BLOWCOUNT VALUE
- * UNDISTURBED SAMPLES OBTAINED FROM SEPARATE BOREHOLE (BH-4) ADJACENT TO SPT-4

SPT SAMPLES

- ⊙ MOISTURE CONTENT AT 40°C OVEN
- △ MOISTURE CONTENT AT 200°C OVEN
- ■ ESTIMATED PERCENT NON-GYPSUM

- ● SHELBY TUBE DRY DENSITY
- ⊡ ESTIMATED SATURATED DRY DENSITY OF SPT SAMPLES BELOW W.T. (G_S=2.5)

SIMPLIFIED BORING PROFILE AND TEST DATA FOR BORING SPT-4

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

GYPSUM FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

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FILE NO. 04-056A	APPROVED BY:	FIGURE: 2.5	

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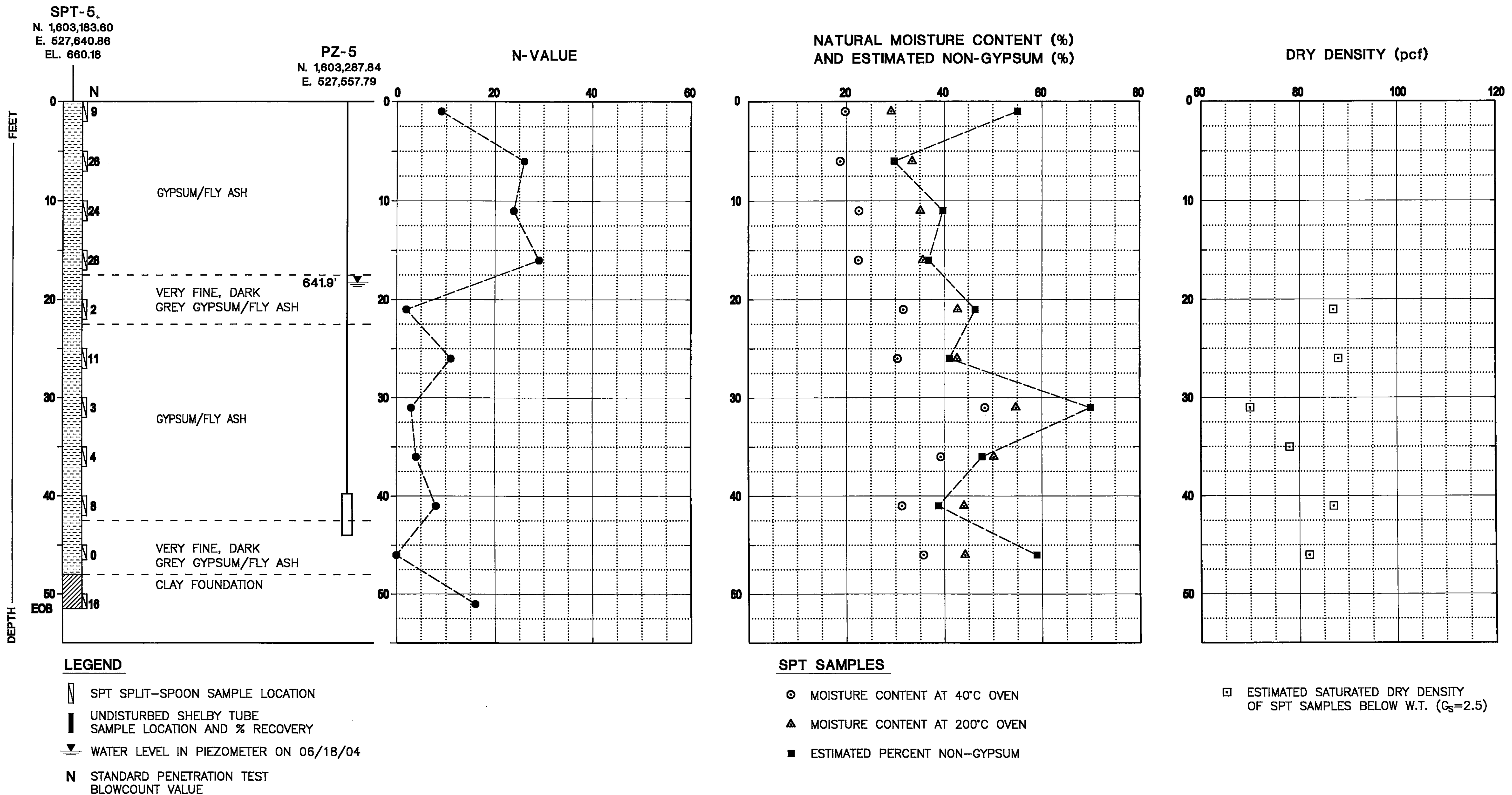

SIMPLIFIED BORING PROFILE AND TEST DATA FOR BORING SPT-5

Ardaman & Associates, Inc.
Geotechnical, Environmental and
Materials Consultants

GYPSUM FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

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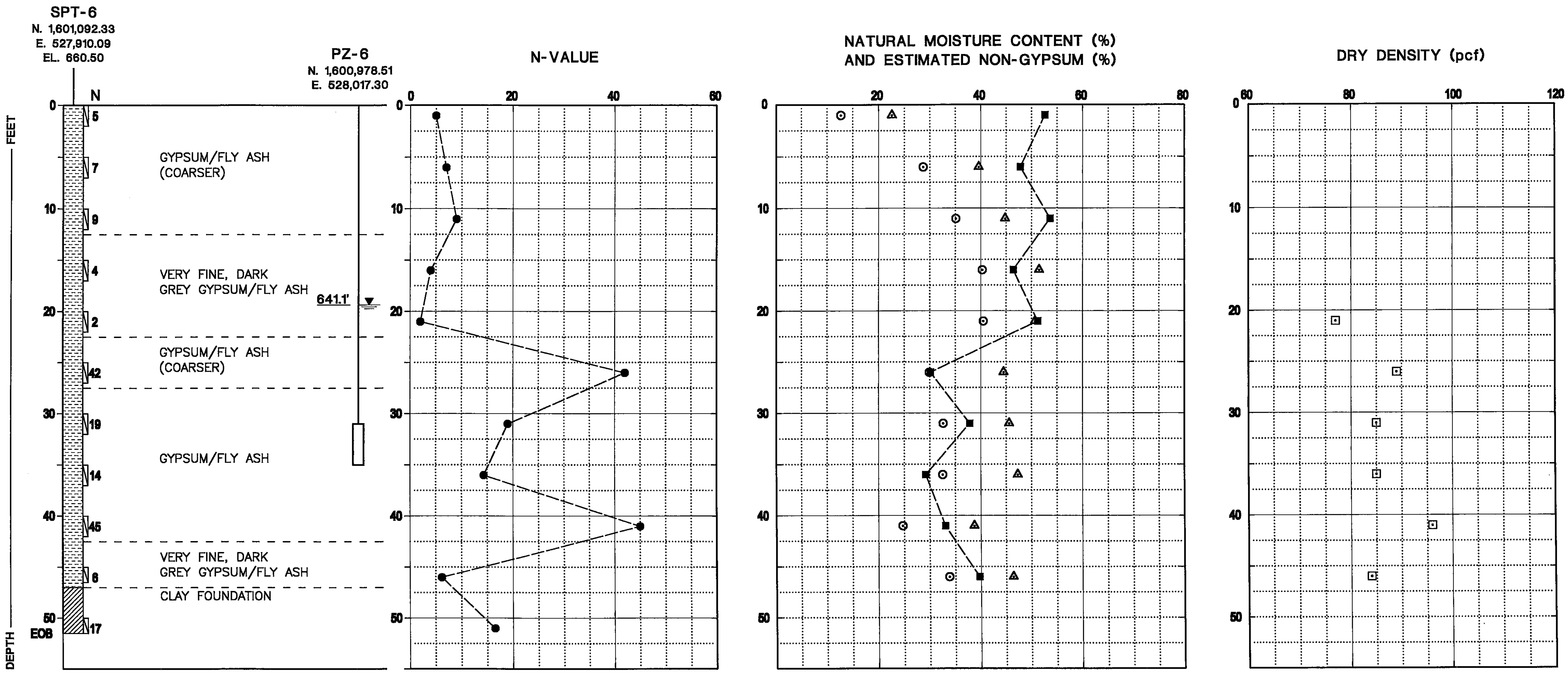

LEGEND

- ▯ SPT SPLIT-SPOON SAMPLE LOCATION
- ▮ UNDISTURBED SHELBY TUBE SAMPLE LOCATION AND % RECOVERY
- ▼ WATER LEVEL IN PIEZOMETER ON 06/18/04
- N STANDARD PENETRATION TEST BLOWCOUNT VALUE

SPT SAMPLES

- ⊙ MOISTURE CONTENT AT 40°C OVEN
- △ MOISTURE CONTENT AT 200°C OVEN
- ■ ESTIMATED PERCENT NON-GYPSUM

⊡ ESTIMATED SATURATED DRY DENSITY OF SPT SAMPLES BELOW W.T. (G_S=2.5)

**SIMPLIFIED BORING PROFILE
AND TEST DATA
FOR BORING SPT-6**

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

GYPSUM FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

DRAWN BY: RDC	CHECKED BY:	DATE: 08/03/04
FILE NO. 04-056A	APPROVED BY:	FIGURE: 2.7

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Chapter 3

LABORATORY MATERIALS TESTING

The undisturbed Shelby tube samples and representative portions of the SPT split-spoon samples recovered from the test borings were transported to our Orlando laboratory for additional testing and materials classification. A summary of the tests performed, testing procedures used and the accompanying results are provided below. All laboratory tests, where applicable, were performed in general accordance with ASTM standards.

3.1 Nomenclature

The fields of geotechnical and chemical engineering use common terms to describe various relationships between the solid and liquid phase of a sample, although the definitions may be different. The following geotechnical engineering definitions are adopted herein.

- Moisture content, w_c = [(weight of water)/(weight of dry solids)]. This definition is used in lieu of the chemical engineering definition of (weight of water)/(weight of water and dry solids) which yields a lower value.
- Solids content, S = [(weight of dry solids)/(weight of water and dry solids)]. The moisture content and solids content are related by the expressions: $S = [1/(1+w_c)]$ and $w_c = [(1-S)/S]$.
- Void ratio, e = [(volume of voids)/(volume of solids)]. The moisture content and void ratio are related by the expression: $w_c = [(S_w)(e)/G_s]$ where S_w = degree of saturation and G_s = specific gravity of solids.

3.2 Index Properties

3.2.1 Drying Temperature

Gypsum in the gypsum-fly ash deposits at the Widows Creek facility can be chemically described as dihydrate calcium sulfate ($CaSO_4 \cdot 2H_2O$), which contains two attached molecules of water. It has been our experience that the chemically attached water will start to be expelled from laboratory samples at oven drying temperatures greater about 60°C and will be completely expelled at drying temperatures above 200°C. Since we define moisture content in terms of dry wight of sample (see above), the apparent moisture content of gypsum can vary with drying temperature. For this reason, we dry all gypsum sample to a constant dry weight at an oven temperature of 40°C to prevent the loss of the chemically bound water that occurs at the 110°C oven temperature conventionally used for drying soils (ASTM Standard D-2216).

3.2.2 Natural Moisture Content

Natural moisture content determinations were performed on the undisturbed samples and on 60 slit-spoon samples, using an oven drying temperature of 40°C to prevent the loss of chemically bound water, as discussed above. After initial drying in the 40°C oven, the SPT split-spoon samples were subsequently dried in a 200°C oven to determine the change in apparent moisture content, as it relates to determining the percentage of gypsum and non-gypsum solids in the sample. The results of the moisture content determinations are presented graphically on the simplified boring profiles presented as Figures 2.2 through 2.7, and also listed on Tables 3.1 and 3.2. The results of these tests are discussed in greater detail below.

The quality of a gypsum sample can be estimated based on the apparent change in moisture content when dried at 40°C and 200°C oven temperatures. For a sample comprised of 100% gypsum, the theoretical change in apparent moisture content between the low and high oven temperatures is 20.92%, decreasing linearly to 0% for a sample containing no gypsum.

Table 3.1 summarizes the results of moisture content determinations performed on recovered samples of the Widows Creek gypsum-fly ash deposits at 40°C and 200°C oven temperatures, with the estimated gypsum and non-gypsum components, assuming that the gypsum component is in the dihydrate form. These data are also plotted on the simplified soil boring profiles presented on Figures 2.2 through 2.7. The estimated non-gypsum component ranges from a low of about 22 % to a high of 76 %, with an average of 49 % (i.e., 51% gypsum).

3.2.3 Chemical Composition and Specific Gravity

Six samples of the Widows Creek gypsum-fly ash deposits, as tabulated below, were also sent to TVA's Central Laboratories Services in Chattanooga for laboratory determinations of composition by percent dry weight of fly ash (acid insoluble), un-reacted limestone (Dolomite [$CaCO_3.MgCO_3$] and Calcium Carbonate [$CaCO_3$]) and Calcium Sulfite. The results of the TVA chemical analyses are presented in Appendix 2 and also tabulated below:

Boring	Sample	Chemical Composition (% of dry weight basis)				Specific Gravity G_s
		Acid Insoluble (Fly ash)	Gypsum	Un-reacted Limestone*	Calcium Sulfite	
BH-2	US-4 US-5	18 12	44 29	37 59	<1 <1	2.51 2.58
SPT-3	5 6	41 19	37 52	22 28	<1 1	2.49 2.47
BH-4	US-4 US-6	20 20	59 54	20 22	<1 4	2.45 2.45
Average		22	46	31	1	2.49

* Includes Dolomite ($CaCO_3.MgCO_3$) and Calcium Carbonate ($CaCO_3$)

As noted, the percent gypsum varies from 29 to 59%, with an average of 46%, equating to a non-gypsum component of 54%, which is slightly higher but generally consistent with the non-gypsum component of 49 percent estimated above from the SPT samples. Analyses of gypsum-fly ash samples tested in the early 1990's (see Ardaman report dated April 22, 1991) indicated an average gypsum component of 47%, with a non-gypsum component of 53%. Although considerable variation is noted in individual samples, the measured average percentages of gypsum and non-gypsum components in the Widows Creek gypsum-fly ash deposits is generally consistent with previous test results.

The table above also contains estimated specific gravities of the gypsum-fly ash samples calculated based on weighted specific gravities for the respective constituents (2.33 for gypsum, 2.50 for calcium sulfite, 2.70 for calcium carbonate, 2.85 for magnesium carbonate and 2.5 for fly ash). Higher specific gravities correspond to a higher percentage of non-gypsum solids in the gypsum-fly ash mix. The estimated average value of 2.49 is generally consistent with the average of 2.5 measured in earlier studies (Garlanger & Ingra, 1983) and with the values of 2.46 and 2.48 measured more recently (see Ardaman report dated April 22, 1991). An average specific gravity of 2.5 has been selected for use in all calculations presented herein.

3.2.4 Particle Size Distribution and Fines Content

Particle size distribution tests were performed on eight samples of the Widows Creek gypsum-fly ash deposits recovered from the standard penetration test borings, in general accord with ASTM Testing Method D-422, "Particle Size Analysis of Soils," using hydrometer analyses for the fraction smaller than 0.074mm (No. 200 sieve size) and sieve analyses for the soil fraction greater than 0.074 mm. Due to the solubility of gypsum, all analyses were performed with gypsum saturated water. The gradation tests were performed to aid in material classification and defining engineering design parameters. Individual grain size distribution curves generated from these tests are presented graphically in Appendix 3.

The tested samples were selected based on visual classifications to be representative of the approximate maximum range of gradations encountered at the site (finest to coarsest materials). As noted from the gradation curves presented in Appendix 3, the gypsum-fly ash consist largely of silt-size particles (finer than 0.074mm) with some coarser materials extending into the fine and medium sand sizes. The finest material tested, with more than 98% silt-sized particles, was encountered in boring SPT-1, sample No.7 at a depth of 30 to 31.5 feet. The coarsest materials, with approximately 55% silt-sized particles (45% fine to medium sand-sized) were encountered in borings SPT-1, Sample No. 2 at a depth of 40 to 41.5 feet and boring SPT-2, Sample No. 6 at a depth of 25 to 26.5 feet. The clay fraction was less than 1% for all of the samples tested.

3.3 Gypsum-Fly Ash Dry Density

A total of 26 undisturbed Shelby tube samples of the *in situ* gypsum-fly ash deposits were obtained from four of the test boring locations for use in laboratory determination of *in situ* moisture content and dry density as a function of depth. Dry unit weights, or in-place densities, were determined for all of these samples. The total weight and volume of the gypsum-fly ash within each tube was measured and used to calculate an average total density. The respective dry density for each sample was then calculated from the respective total density and an average of several natural moisture contents taken from each sample tube.

The results of the in-place density tests are summarized in Table 3.2 and are also plotted graphically on the simplified boring profiles presented on Figures 2.2 through 2.7. In addition, all of the measured in-place dry densities are plotted as a function of depth on Figure 3.1, which also includes the result of previous testing performed in 1991 (see Ardaman report dated April 22, 1991).

With the exception of two unusually low densities (66.7 pcf in US-2, BH-1 and 72.9 pcf in US-11 BH-2), the in-place densities measured during the current sampling and testing program are in general agreement with the previously measured (1991) data, although somewhat more dense at most locations.

At the time of our site visits in March and June 2004, the Widows Creek stack was being operated with minimal ponded water areas and substantial gypsum beaches at most locations. Sedimented gypsum deposits on the exposed beaches can drain and consolidate more rapidly than underwater deposits and are also subject surface drying and desiccation, all of which will increase the in-place density relative to materials deposited and normally consolidated under water. Some of the higher densities near the ground surface are the direct result of material disturbance and compactive effort applied by construction equipment used to raise the perimeter wall of the stack, which will not occur in the central portion of the stack where the majority of the sedimented deposits are contained.

It is our opinion, therefore, that utilization of the higher densities as a function of depth would be unconservative relative to facility design. In that regard, we recommend that the lower-bound relationship shown on Figure 3.1 be used for design purposes. The mathematical expression for the recommended density versus depth relationship is:

$$\gamma_d = 81+0.157(Z)$$

where γ_d is the in-place gypsum dry density, expressed in units of pounds per cubic foot, and Z is depth below the ground surface in feet.

3.4 Shear Strength Characteristics

Consolidated undrained triaxial compression tests with pore pressure measurements ($\overline{\text{CIUC}}$) were performed on six undisturbed samples of the Widows Creek gypsum-fly ash deposits. These tests were performed to obtain shear strength parameters for use in stability analyses of the gypsum stack. All undisturbed samples were tested at their *in situ* densities using strain-controlled, consolidated-undrained $\overline{\text{CU}}$ triaxial shear tests with pore pressure measurements. Each sample was consolidated under a back pressure of 12 kg/cm^2 with gypsum saturated water to achieve sample saturation prior to shear. The consolidated samples were then sheared at a rate that was slow enough to allow for pore pressure equilibration and measurement with a rigid, flush-diaphragm pressure transducer. During shear, the axial load, vertical strain, cell pressure and pore pressure were continuously monitored and electronically recorded via an automated data acquisition system. All shear strength testing was conducted in general accordance with the procedures outlined in ASTM D 4767.

Table 3.3 presents a summary of the initial and pre-shear (i.e., post-consolidation) conditions of each sample prior to testing. Initial and pre-shear parameters monitored include moisture content, dry density, degree of saturation and void ratio. The final test results are summarized in Table 3.4 for maximum stress ratio (σ'_1/σ'_3, major principal effective stress divided by minor principal effective stress) and maximum stress difference ($\sigma_1 - \sigma_3$, major principal stress minus minor principal stress) failure criteria. The latter of these two failure criteria typically indicate a lower material strength that occurs at very large strains and, in effect, represents a remolded strength, which is seldom used for design due to the large strains involved. The peak strength is defined by the maximum stress ratio failure criteria, which normally occurs at lower strains that are more consistent with design assumptions.

Table 3.1

SUMMARY OF MOISTURE CONTENT DETERMINATIONS AT 40°C AND 200°C OVEN TEMPERATURES AND ESTIMATE OF NON-GYPSUM COMPONENT

Boring	SPT Slit-Spoon Sample Depth Interval (feet)	Moisture Content			-200 (%)	+200 (%)	Gypsum (%)	Non-Gypsum Component* (%)
		W_{40} (%)	W_{200} (%)	D_{wc} (%)				
SPT-1	0-1.5	11.9	22.3	10.4			49.8	50.2
	5-6.5	23.1	37.8	14.7			70.3	29.7
	10-11.5	24.1	36.3	12.2			58.4	41.6
	15-16.5	17.1	28.9	11.8			56.5	43.5
	20-21.5	22.6	33.5	10.9			52.2	47.8
	25-26.5	25.5	36.4	10.9			52.2	47.8
	30-31.5	67.8	73.4	5.6	97.0	3.0	26.8	73.2
	35-36.5	33.8	45.4	11.6			55.5	44.5
	40-41.5	26.7	33.9	7.2			34.4	65.6
	45-46.5	34.9	41.1	6.2			29.7	70.3
SPT-2	0-1.5	15.4	27.0	11.6			55.5	44.5
	5-6.5	16.3	25.9	9.6			45.9	54.1
	10-11.5	22.4	32.1	9.7			46.4	53.6
	15-16.5	20.1	32.1	12.0			57.4	42.6
	20-21.5	29.0	37.8	8.8	82.0	18.0	42.1	57.9
	25-26.5	21.9	28.6	6.7	62.0	38.0	32.1	67.9
	30-31.5	24.7	29.8	5.1			24.4	75.6
	35-36.5	28.2	36.9	8.7			41.6	58.4
	40-41.5	24.0	33.2	9.2			44.0	56.0
	45-46.5	23.8	31.2	7.4			35.4	64.6
	50-51.5	20.9	29.4	8.5			40.7	59.3
	55-56.5	20.9	28.1	7.2			34.4	65.6
	60-61.5	36.9	44.3	7.4			35.4	64.6
	65-66.5	34.9	42.8	7.9			37.8	62.2
SPT-3	0-1.5	19.2	35.5	16.3			78.0	22.0
	5-6.5	22.8	31.9	9.1			43.5	56.5
	10-11.5	21.4	33.3	11.9			56.9	43.1
	15-16.5	21.2	32.7	11.5			55.0	45.0
	20-21.5	38.2	49.7	11.5	96.0	4.0	55.0	45.0
	25-26.5	39.0	50.1	11.1	92.0	8.0	53.1	46.9
	30-31.5	28.6	41.4	12.8			61.2	38.8
SPT-4	0-1.5	14.8	27.3	12.5			59.8	40.2
	5-6.5	19.9	31.6	11.7			56.0	44.0
	10-11.5	29.0	42.5	13.5			64.6	35.4
	15-16.5	21.3	32.5	11.2			53.6	46.4
	20-21.5	29.8	41.1	11.3	90.0	10.0	54.1	45.9
	25-26.5	27.6	38.7	11.1	89.0	11.0	53.1	46.9
	30-31.5	19.9	30.7	10.8			51.7	48.3
	35-36.5	22.5	33.2	10.7			51.2	48.8
	40-41.5	29.9	41.1	11.2			53.6	46.4

Where: W_{40} = Moisture content at 40°C; W_{200} = Moisture content at 200°C; D_{wc} = Change in apparent moisture content [W_{200} - W_{40}]; and -200 = Percent fines content by dry weight of solids.

* Assumes that the calcium sulfate phase (gypsum) is in dihydrate form.

Table 3.2

SUMMARY OF MOISTURE CONTENT, DENSITY, AND INDEX PROPERTIES OF UNDISTURBED SAMPLES OF GYPSUM-FLY ASH

Boring	Sample	Depth (feet)	Sample Center Elevation (feet, NGVD)	Natural Moisture Content Range (%)	Average Natural Moisture Content (%)	Total Unit Weight γ_t (lb/ft^3)	Dry Density γ_d (lb/ft^3)	Degree of Saturation* (%)	Void Ratio* e	Porosity* n
BH-1	US-1	20-22	628.9	18.7-23.3	21.7	110.5	90.9	76.0	0.71	0.41
	US-2	30-32	618.9	30.1-65.6	53.5	102.4	66.7	100.0	1.56	0.61
	US-3	40-41.5	608.9	16.7-23.1	20.6	124.3	103.0	100.0	0.61	0.38
BH-2	US-1	5-7	655.89	17.8-19.0	18.6	109.4	92.3	67.0	0.72	0.42
	US-2	10-12	650.89	23.4-34.7	30.0	109.6	84.3	88.0	0.89	0.47
	US-3	15-17	645.89	22.2-24.6	23.3	119.4	96.8	95.0	0.57	0.36
	US-4	20-22	640.89	19.7-26.6	22.3	122.5	100.2	100.0	0.61	0.38
	US-5	25-27	635.89	20.8-26.8	22.7	122.0	99.4	100.0	0.69	0.41
	US-6	30-32	630.89	17.5-24.0	21.6	119.8	98.6	100.0	0.75	0.43
	US-7	35-37	625.89	19.6-22.7	21.0	123.0	101.6	98.0	0.59	0.37
	US-8	40-42	620.89	21.5-24.7	23.6	121.4	98.2	100.0	0.63	0.39
	US-9	45-47	615.89	19.7-24.0	21.9	117.7	96.6	95.0	0.71	0.42
	US-10	50-52	610.89	22.2-25.1	24.0	117.8	95.0	100.0	0.71	0.41
	US-11	60-62	600.89	42.5-52.0	45.6	106.2	72.9	100.0	1.27	0.56
BH-3	US-1	10-12	648.79	17.8-23.4	19.0	120.9	101.6	96.0	0.50	0.33
	US-2	15-17	643.79	18.7-26.8	22.1	113.7	93.2	87.0	0.64	0.93
	US-3	22.5-24.5	636.29	25.4-48.8	35.8	110.5	81.3	100.0	0.88	0.47
	US-4	25-27	633.79	18.3-29.1	25.4	119.5	95.3	100.0	0.62	0.38
BH-4	US-1	5-7	657.34	13.7-25.3	20.7	101.2	83.8	60.0	0.82	0.45
	US-2	12.5-14.5	649.84	19.6-24.8	23.0	117.5	95.6	91.0	0.56	0.36
	US-3	15-17	647.34	19.8-25.8	21.9	119.4	98.0	92.0	0.57	0.36
	US-4	20-22	642.34	25.6-28.0	26.7	114.1	90.1	100.0	0.71	0.41
	US-5	25-27	637.34	20.9-24.2	22.9	120.1	97.8	96.0	0.58	0.37
	US-6	30-32	632.34	19.9-25.4	23.5	119.3	96.6	96.0	0.61	0.38
	US-7	35-37	627.34	21.1-23.9	22.7	117.4	95.7	90.0	0.63	0.38
	US-8	40-42	622.34	21.8-28.9	25.8	116.8	92.8	95.0	0.66	0.40

* Based on assumed average specific gravity of 2.50.

Table 3.3

SUMMARY OF PRE-SHEAR PROPERTIES OF TRIAXIAL SHEAR STRENGTH TESTS ON UNDISTURBED SAMPLES OF GYPSUM-FLY ASH

Boring	Sample	Depth (feet)	Sample Center Elevation (NGVD)	Shelby Tube Dry Density γ_d (lb/ft^3)	Initial Conditions				Pre-Shear Conditions			
					Total Density γ_t (lb/ft^3)	Moisture Content (%)	Dry Density γ_d (lb/ft^3)	Degree of Saturation* (%)	Total Density γ_t (lb/ft^3)	Moisture Content (%)	Dry Density γ_d (lb/ft^3)	Degree of Saturation (%)
BH-1	US-2	30-32	618.9	66.7	103.0	52.2	71.5	100	109.2	40.0	75.6	100
BH-2	US-4	20-22	640.89	100.2	123.1	21.7	103.5	100	123.7	21.1	102.2	100
	US-6	30-32	630.89	98.6	120.9	24.0	106.8	100	122.0	22.8	99.4	100
BH-3	US-3	22.5-24.5	636.29	81.3	118.0	27.3	98.5	100	122.7	22.1	96.6	100
BH-4	US-4	22-24	642.34	90.1	118.1	27.2	95.3	100	123.0	21.8	101.1	100
	US-8	40-42	622.34	92.8	119.4	25.7	91.7	91.4	121.6	23.2	98.7	100

* Based on assumed average specific gravity of 2.50.

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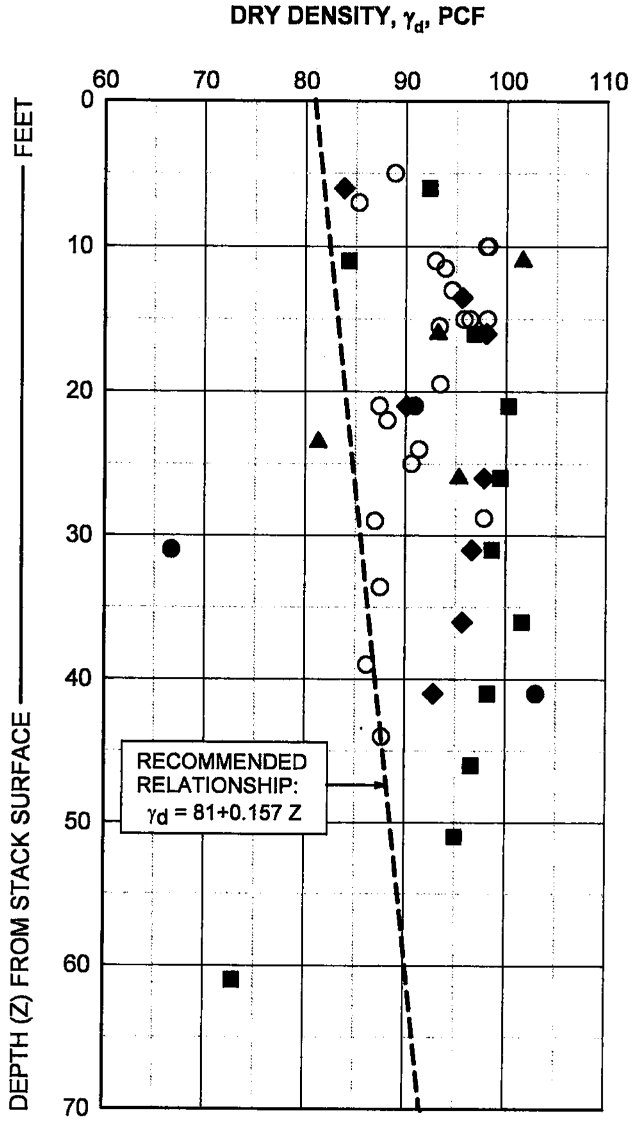

DRY DENSITY OF GYPSUM-FLY ASH VERSUS DEPTH

SYMBOL	LOCATION
	BH-1
	BH-2
	BH-3
	BH-4
	1991 STUDY

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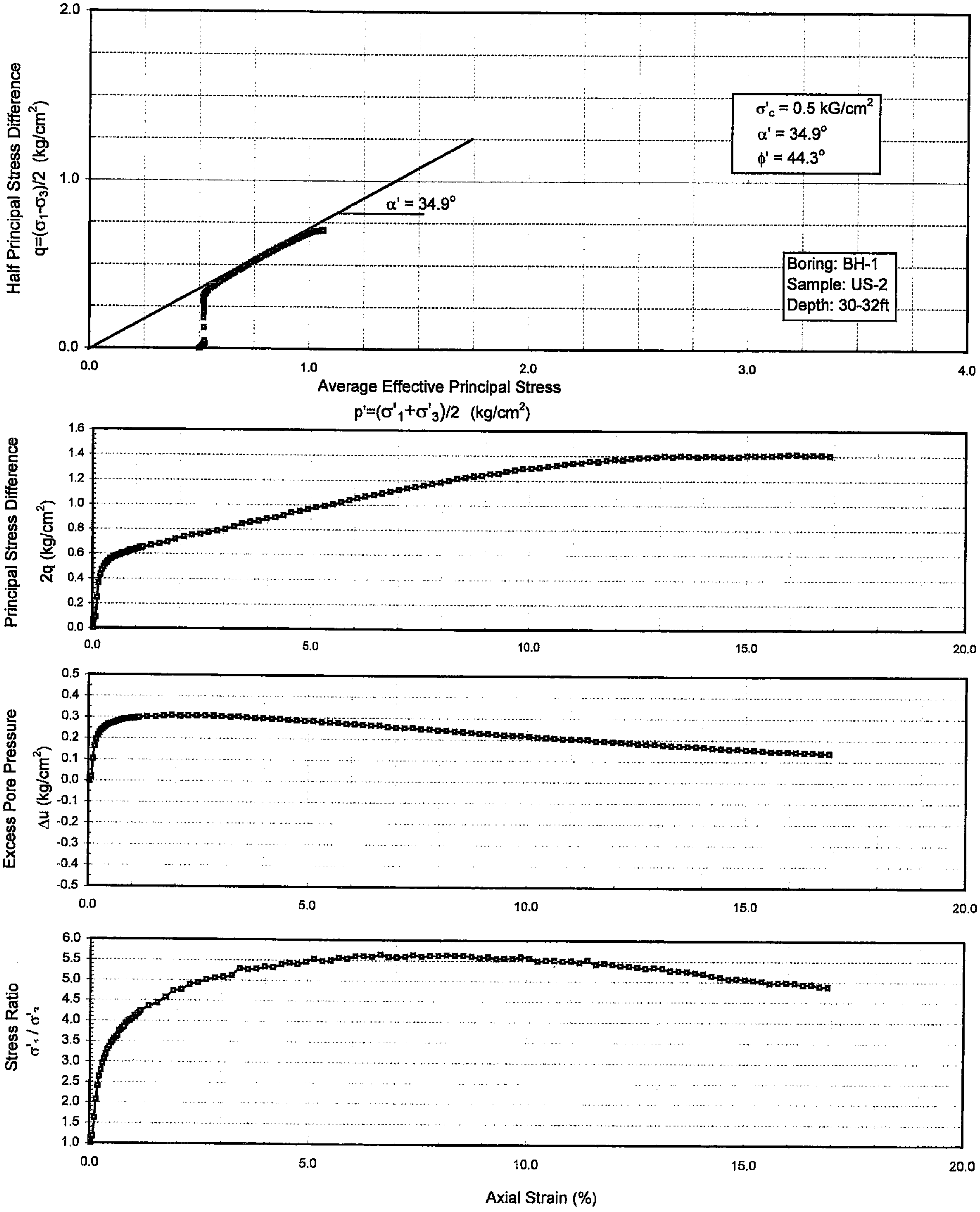
GYPSUM-FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

DRAWN BY: NTD
CHECKED BY:
DATE: 07/06/04
FILE NO. 04-056A
APPROVED BY:
FIGURE 3.1

NTD TVA 04-056A\LAB\DRY DENSITY VS DEPTH.JNB

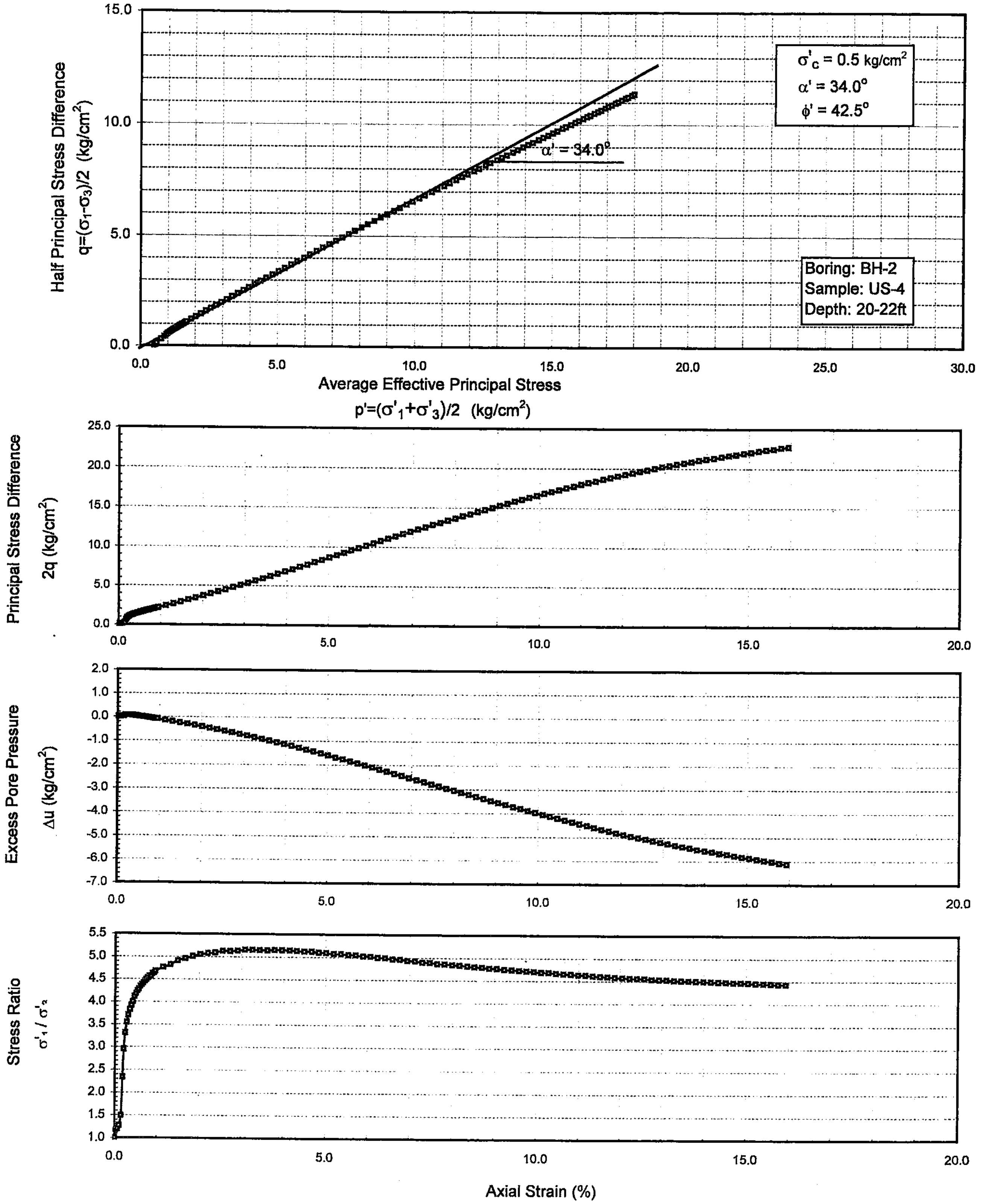


CONSOLIDATED UNDRAINED ($\overline{\text{CIUC}}$) TRIAXIAL TEST ON UNDISTURBED SPECIMEN FROM BORING BH-1, US-2, 30 - 32 FT

Ardaman & Associates, Inc.
Geotechnical, Environmental and
Materials Consultants

GYPSUM-FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

DRAWN BY: SA	CHECKED BY: SA	DATE: 07-02-04
FILE NO.: 04-056A	APPROVED BY:	FIGURE: 3.2



CONSOLIDATED UNDRAINED ($\overline{\text{CIUC}}$) TRIAXIAL TEST ON UNDISTURBED SPECIMEN FROM BORING BH-2, US-4, 20 - 22 FT

Ardaman & Associates, Inc.
Geotechnical, Environmental and
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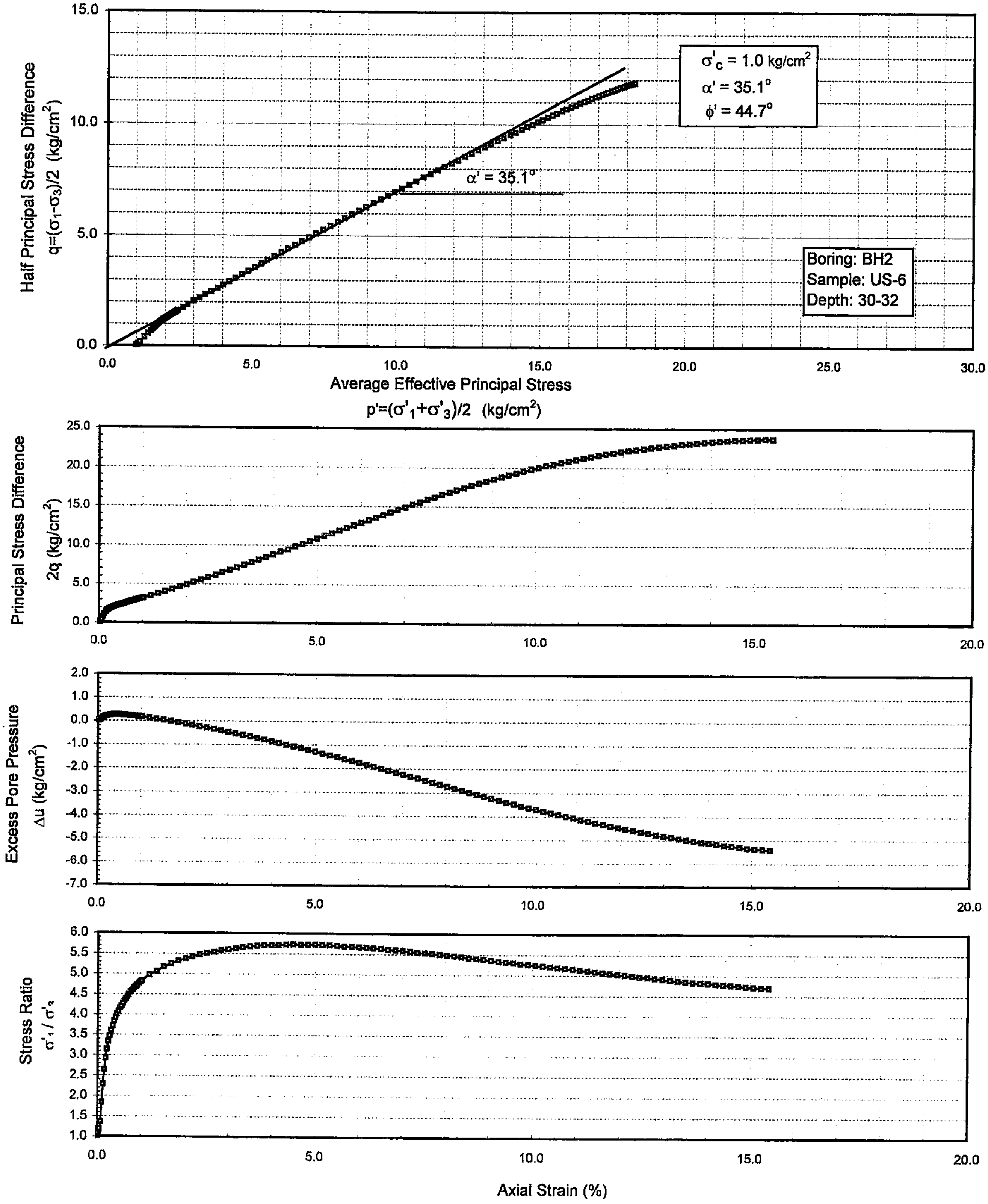
GYPSUM-FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

DRAWN BY: SA	CHECKED BY: SA	DATE: 07-22-04
FILE NO.: 04-056A	APPROVED BY:	FIGURE: 3.3



CONSOLIDATED UNDRAINED $(\overline{\text{CIUC}})$ TRIAXIAL TEST ON UNDISTURBED SPECIMEN FROM BORING BH-2, US-6, 30 - 32 FT

Ardaman & Associates, Inc.
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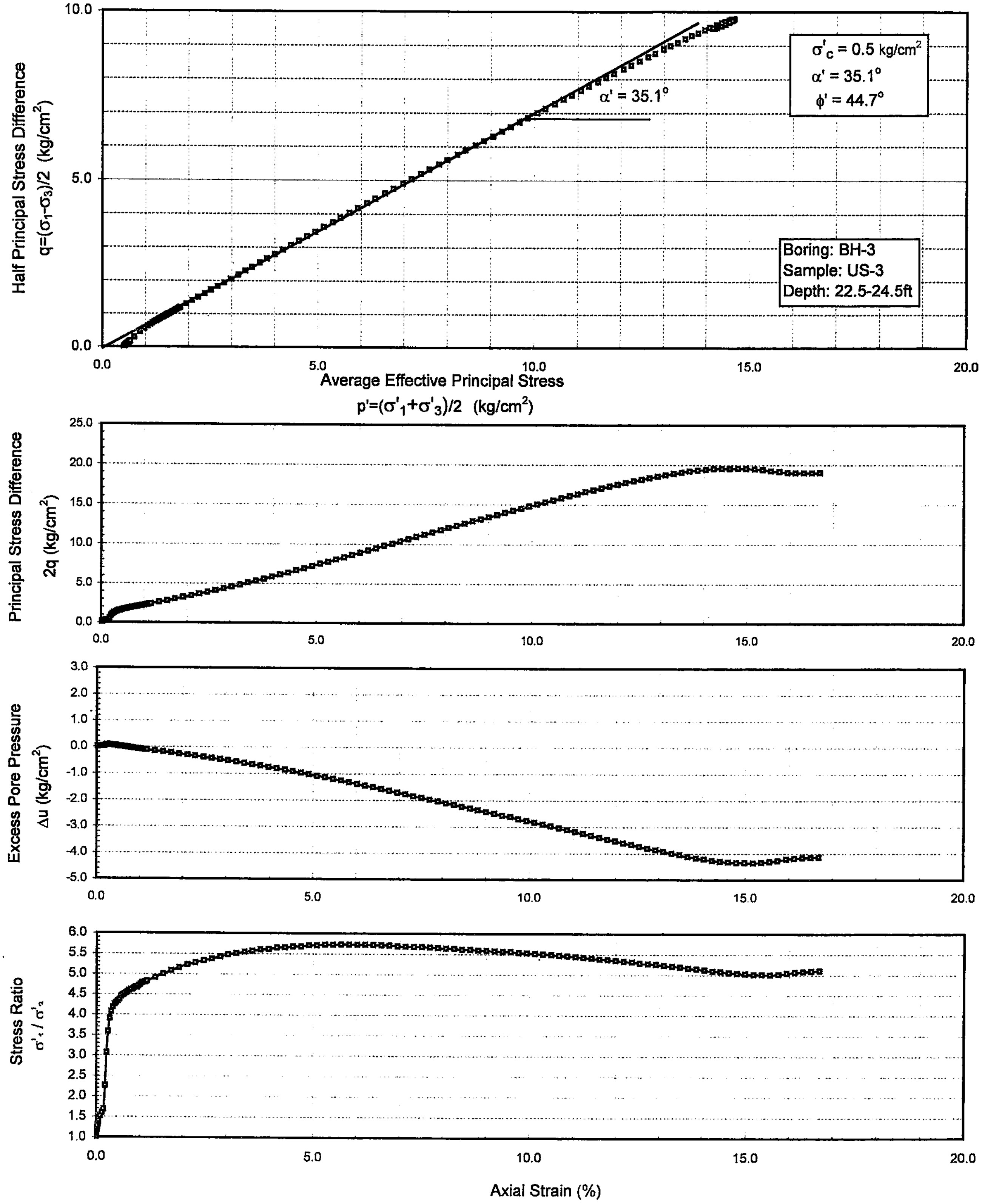
GYPSUM-FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

DRAWN BY: SA	CHECKED BY: SA	DATE: 07-22-04
FILE NO.: 04-056A	APPROVED BY:	FIGURE: 3.4

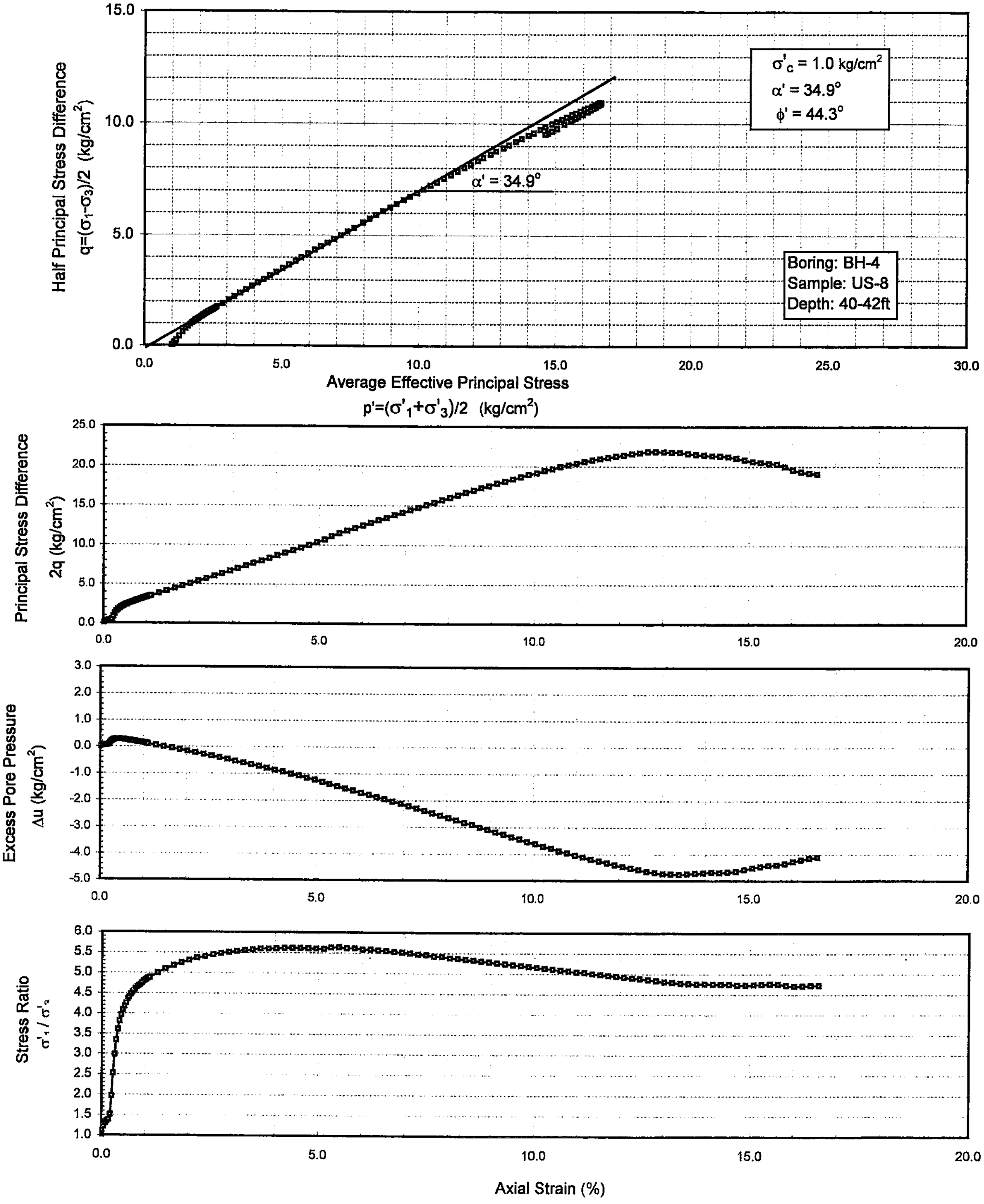


CONSOLIDATED UNDRAINED (CIUC) TRIAXIAL TEST ON UNDISTURBED SPECIMEN FROM BORING BH-3, US-3, 22.5 - 24.5 FT

Ardaman & Associates, Inc.
Geotechnical, Environmental and
Materials Consultants

GYPSUM-FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

DRAWN BY: SA	CHECKED BY: SA	DATE: 07-02-04
FILE NO.: 04-056A	APPROVED BY:	FIGURE: 3.5



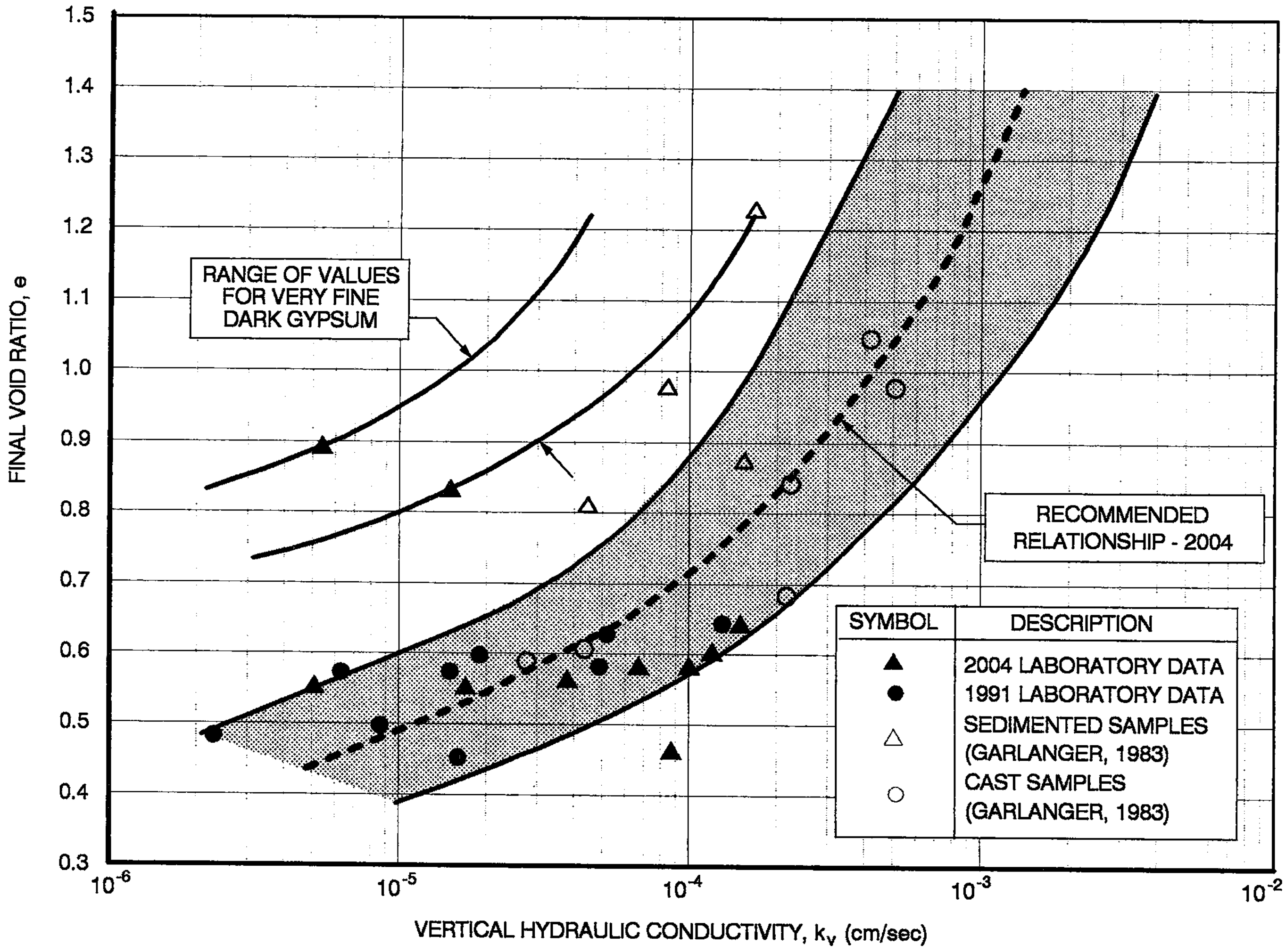
CONSOLIDATED UNDRAINED ($\overline{\text{CIUC}}$) TRIAXIAL TEST ON UNDISTURBED SPECIMEN FROM BORING BH-4, US-8, 40 - 42 FT

Ardaman & Associates, Inc.
Geotechnical, Environmental and
Materials Consultants

GYPSUM-FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

DRAWN BY: SA	CHECKED BY: SA	DATE: 07-22-04
FILE NO.: 04-056A	APPROVED BY:	FIGURE: 3.7

C:\TVA\04-056A\LAB\FIGURE\PERM\KVSEGYP.DRW



VERTICAL HYDRAULIC CONDUCTIVITY VERSUS VOID RATIO FOR GYPSUM-FLY ASH MIX

Ardaman & Associates, Inc.
Geotechnical, Environmental and
Materials Consultants

GYPSUM-FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

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FILE NO.: 04-056A	APPROVED BY:	FIGURE: 3.8

SECTION 4

ENGINEERING EVALUATION AND RECOMMENDATIONS

The following section summarizes and documents the results of engineering calculations (seepage and stability analyses) for the Widows Creek gypsum-fly ash storage facility using the measured material properties and strength parameters discussed above (Section 3). Also included are our recommendations for remedial or corrective action needed for continued operation of the facility at increased heights.

4.1 Engineering Design Parameters

4.1.1 Gypsum-Fly Ash Density

As discussed in Section 3.3, the measured in-place densities are somewhat more dense than previously measured values (most likely due to surface drying and desiccation and/or mechanical compaction) and may not be representative of the majority of the sedimented deposits contained in the central portion of the stack. Since it is unconservative to use higher densities in the engineering calculations, we recommend that the lower-bound relationship shown on Figure 3.1 be used for design purposes. The mathematical expression for the recommended density versus depth relationship is:

$$\gamma_d = 81+0.157(Z)$$

where γ_d is the in-place gypsum dry density, expressed in units of pounds per cubic foot, and Z is depth below the ground surface in feet.

4.1.2 Hydraulic Conductivity

The coefficient of permeability (hydraulic conductivity) of the Widows Creek gypsum will vary as a function of material dry density (void ratio), which in turn will vary with depth within the stack. For purposes of the engineering analyses presented herein, the vertical hydraulic conductivity is determined from the recommended relationship provided in Figure 3.8, as a function of void ratio, where void ratio is calculated using the dry density versus depth relationship presented above, and an assumed average specific gravity of 2.50. The relationship between dry density and void ratio is defined as follows:

$$e = (G_s{*}\gamma_w/\gamma_d) - 1$$

where “e” is the material void ratio, G_s is specific gravity (2.50), γ_w is the unit weight of water and γ_d is the material dry density.

4.1.3 Gypsum Shear Strength

As discussed in Section 3.4, the measured effective angle of internal shearing resistance (φ'), with zero cohesion, varies from a low of 42.5 degrees to a high of 44.7 degrees. Even though all of the samples recovered from depths equal to or greater than 30 feet indicated internal friction angles greater than 44 degrees, we have conservatively selected an effective angle of internal friction of

42 degrees, with zero cohesion, for the existing and projected stack heights up to the second setback bench (Elevation 685 feet). For the proposed final stack height (Elevation 755 feet) a friction angle of 42 degrees is used in the upper part of the stack and 44 degrees is used in the lower portion of the stack below the 685-foot elevation bench.

4.1.4 Shear Strength of Foundation Soils

No additional strength testing was performed on the underlying natural ground foundation soils encountered at the base of the stack. Strength parameters used in the stability analyses for the foundation soils, therefore, are consistent with values previously measured and provided by TVA. In particular, an effective friction angle of 25 degrees, with zero cohesion, is used for the remolded clays in the upper portion of the foundation soils (i.e., surface of clay immediately beneath the gyp-fly ash) and 27 degrees, with zero cohesion for the undisturbed natural ground soils underlying the remolded surface layer.

4.2 Existing Geometry and Piezometer Readings

4.2.1 Existing Side Slope Geometry

Six typical cross sections of the existing gypsum stack side slope geometry were taken from the March 2004 topographic map at the approximate locations shown on Figure 4.1. The resulting cross sections are shown on Figures 4.2 through 4.4. Superimposed on each of these sections is the originally proposed design slope and toe ditch geometry, as presented in the April 22, 1991engineering report. A copy of the recommended design geometry and stability analyses taken from the 1991 report are also provided in Appendix 5 for reference.

As noted, the side slope geometry of the existing gypsum stack is, in general, positioned closer to the perimeter starter dike than originally proposed, with a reduced toe ditch geometry (narrow and shallow) relative to the design section. The side slope angle of the existing gypsum stack is generally consistent with the design slope of 2.5H to 1.0V at most locations (see cross sections C-4 and C-6) but the upper portion of the stack is being raised much too steeply at some locations (see cross sections C-1, C-3 and C-5). The existing toe ditch does not appear adequate for larger storm events and will become less adequate as the height of the stack and the associated watershed area increase with time. Recommendations for side slope regrading and improvement of the toe ditch are provided below.

4.2.1 Measured Water Levels and Drain Performance

Also shown on Figures 4.2 through 4.4 are the approximate location and depth of the sealed standpipe piezometers and observation wells installed around the perimeter of the stack, with indicated water levels measured on June 18, 2004. The indicated water levels in the shallow piezometers installed on the side slope of the gypsum stack (observation wells) represent the approximate elevation of the "spring line" for seepage exiting the outside face of the stack. With the exception of piezometer PZ-6S on the south side of Phase 1, Pond 1, all of the side slope piezometers indicate seepage spring lines that are elevated well above the toe of the gypsum stack and crest elevation of the perimeter containment dike. It is evident from these data that the toe drain at most locations is not working, or was never installed. Based on the water level reading in piezometer PZ-6S, it appears that the toe drain on the south side of the Phase 1 gypsum stack may be more effective. The lower phreatic surface at this location may also be influenced by the current position of the gypsum slurry channel, which is located almost 100 feet inboard of the outer crest road of the gypsum stack.

In reference to the original (1991) design recommendations presented in Appendix 5, it can be noted that the recommended design includes a toe drain that was to have been installed not less than 5 feet below the lower bench elevation that existed at that time. The invert elevation of the toe drain, therefore, should be approximately 5 to 6 feet below the perimeter dike crest elevation at the drain outlet. Surveyed invert elevations of the existing drain outlet pipes that could be field located (3 outlet locations, with 2 pipes each, on the north side of the Phase 2 expansion area and 2 outlet locations, with one pipe each, on the south side of Phase 1) indicate pipe invert elevations that are typically only 1 to 2 feet below the elevation of the adjacent perimeter dike crest road (i.e., not 5 to 6 feet as proposed). If there is a toe drain around the perimeter of Pond 1 it is probably positioned too high to accommodate the proposed deeper ditch geometry.

Old TVA construction drawings provided for background information (Drawings 10E7416-2 and 10E7416-3, dated 9-7-95), call for the installation of two perimeter underdrains in the central portion of Pond 3, but not for the installation of a corresponding toe drain. The drain design detail shown on those drawings calls for an 8-inch perforated HDPE pipe, double wrapped in a non-woven geotextile fabric. The proposed drain design on the TVA drawings does not call for any gravel bedding or for a gravel collection zone, as previously recommend in the 1991 Ardaman report (see recommended drain details in Appendix 5). It has been our experience that a slotted drain pipe used without an associated gravel collection zone is generally not very efficient when installed in relatively low permeability materials, such as the Widows Creek gypsum-fly ash deposits. The small surface area afforded by the small diameter drain pipe (without a gravel collection zone) results in flow concentrations and large head losses in the immediate vicinity of the pipe that restrict flow to the drain. Field observations made during our site visit in March and June 2004 indicated that the existing drain outlet pipes were not flowing or were flowing only a small to insignificant quantity of water at the time of the inspection.

Although three rings of drains were reportedly installed in the Phase I area, design details of the individual drains were not available and we were not able to locate all of the outlet pipes. The drains that were located in the Phase I area have only one outlet pipe at the end of each drain section (i.e., instead of separate outlets for each of the three drains), which precludes assessing individual drain performance. These drains were also not flowing well, or flowing only a small to insignificant quantity of water at the time of the inspection.

Based on the above discussion, it appears that a toe drain was never installed around Pond 3 of the Phase 2 expansion area. Two inboard drains have apparently been installed on the north wall of Pond 3, but it appears that no drains at all were ever installed on the east side of Pond 3. There is heavy seepage at the toe of the east wall from the Pond 2A ramp road, back to the north. Although seepage is not as heavy on the south side of Pond 1, the invert elevation of the existing toe drain is probably positioned too high to accommodate the proposed deeper ditch geometry. (i.e., the elevated drain invert may not effectively control seepage on the upstream face of the ditch).

It is concluded, therefore, that the existing underdrain system is not operating properly, or was never installed and that some form of drain retrofit will be required for continued safe operation of the stack at greater heights.

4.3 Seepage and Stability Analyses

Seepage and stability analyses were performed for alternate side slope geometries and drain arrangements in an effort to optimize the proposed side slope regrading plan, without reducing the available gypsum storage volume and remaining operational life of the facility. Since the existing stack is positioned somewhat closer to the perimeter dike than originally proposed, there is less space available for an improved toe ditch, without significant modification to the existing gypsum stack side slopes. In that regard, the proposed design modification calls for removal of the previously recommended 15-foot wide bench at the toe of the stack, with slight steepening of the overall lower slope of the stack to 2.75H to 1.0V below the first bench. Recall that the overall slope in the original design, with the 15-foot bench, was approximately 3.0H to 1.0V.

4.3.1 Seepage Analyses

Seepage analyses of the proposed slope modifications were performed for an intermediate stack height (elevation 685 feet) and at the proposed final stack height (elevation 755 feet), for two cases, one without drains and the other with drains installed at the toe of the stack and at each bench elevation.

Seepage patterns through the gypsum stack were modeled for steady-state conditions using the computer program SEEP-W, developed by Geo-Slope International, LTD., Calgary, Alberta, Canada, a two-dimensional finite element seepage modeling program that generates the phreatic surface, hydraulic head distribution, and flow quantities within a seepage domain. The flow nets were developed assuming that the top of the stack was fully ponded, with a minimum of 3 feet of freeboard relative to the perimeter dike crest elevation.

The engineering properties of the sedimented gypsum-fly ash deposits were varied in the seepage model as a function of depth to account for variations in density and permeability that occur with depth due to the effects of self-weight consolidation and time-dependent secondary compression, or drained creep. To model this variation, the gypsum stack was divided into multiple layers and hydraulic conductivities were assigned to each layer using the relationship presented in Sections 4.1.1 and 4.1.2, above. In general, due to the layered structure of sedimented gypsum, the horizontal coefficient of permeability, k_h, tends to be higher than the vertical coefficient of permeability, k_v. To model this anisotropic behavior, the horizontal coefficient of permeability of the sedimented gypsum was taken as two times the vertical coefficient of permeability (i.e., $k_h = 2k_v$) in all layers. The model assumes that the natural ground clay at the base of the stack is relatively impervious compared to the overlying gypsum-fly ash deposits.

The resulting seepage patterns developed from these analyses are presented on Figures 4.5 and 4.8. The pore pressure distributions generated by these models were used in the slope stability analyses presented below. Flow patterns developed from the models were also used to estimate flow quantities to the proposed seepage collection drains, needed for detailed design and sizing of the drain pipes and outlet spacings.

4.3.2 Stability Analyses

Stability analyses were performed on the modified design section for both static and seismic loading conditions. The purpose of these analyses was to confirm, and document, that the existing gypsum stack, at the proposed design geometry and height, will perform safely during normal operations and under the applied loads generated by seismic activity.

The computer model SLOPE-W was used to analyze the various stability considerations. SLOPE-W is a fully integrated slope stability analysis program developed by Geo-Slope International, LTD., Calgary, Alberta, Canada. The computer program computes a critical shear (failure) surface for each failure mode by converging on the critical shear surface through an iterative procedure. Final stability analyses on the most critical failure surfaces identified in the search routine were completed using Spencer's method, which satisfies total force and moment equilibrium. The stability analyses were performed using the pore pressure distributions obtained from the respective seepage analyses, along with the shear strengths and unit weights selected and discussed in Section 4.1.

Stability of the gypsum stack under seismic loading conditions was analyzed using conventional pseudo-static methods in the SLOPE-W computer program. In the pseudo-static method, a horizontal force is applied at the approximate center of gravity for each free body slice to simulate the forces generated by earthquake shaking. This is accomplished by multiplying the weight of each slice by a seismic coefficient, which is then used to obtain the horizontal body force. Pseudo-static limit equilibrium stability analyses were performed using a seismic coefficient of 0.05, as determined from the applicable USGS Seismic Hazard Map for the southeastern United States.

Both circular arc and sliding block failure mechanisms were analyzed, but in all the case the most critical failure surface (i.e., lowest factor of safety) was generated by the sliding block model, wherein the failure plane follows the lower strength remolded clay at the surface of the underlying natural ground foundation.

Figures 4.9 and 4.10 present the results of the stability analyses for the intermediate and final stack heights (critical failure surface only), assuming that no drains are provided. As noted, the computed minimum factors of safety are 1.15 and 1.05, for static conditions and 0.96 and 0.93 for seismic conditions, respectively, which represent unsafe conditions (i.e., a factor of safety less than 1.0 represents a failure condition). These two models are provided as a demonstration that the stack will be unstable at increased heights if seepage control drains are not provided.

Figures 4.11 and 4.12 present the results of the stability analyses for the intermediate and final stack heights, assuming that seepage control drains are provided at the toe of the stack and at each setback bench, as the stack height increases. The computed minimum factors of safety for both circular arc and sliding block failure mechanism are presented. As noted, the computed minimum factor of safety for the circular arc mode of failure is 1.54 for the intermediate stack height and 1.41 for the final stack height. The sliding block failure mechanism through the remolded foundation clay is lower, with minimum values of 1.48 and 1.39, respectively. These latter values are generally consistent with the previous analyses presented in Appendix 5. For the pseudo-static seismic analysis, the computed minimum factors of safety are reduced to 1.23 and 1.15, respectively.

4.3.3 Estimated Remaining Life of Facility

The remaining life of the Widows Creek gypsum-fly ash storage facility was estimated relative to the March 8, 2004 topographic map of the site provided as Figure 1.3, using the lower bound gypsum-fly ash density profile provided on Figure 3.1 and the design gypsum-fly ash production rate of 2,886 tons per day, previously provided by TVA. The estimated remaining storage volume of the stack raised to the final design top elevation of 755 feet, is just under 7,380 acre-feet. At an average gypsum in-place density of 90 pcf, the remaining life of the facility will be approximately 13.7 years, relative to March 2004.

4.4 Recommendations for Design Modification

Recommended design modifications to the existing gypsum-fly ash storage facility include: (1) deepening and widening the perimeter toe ditch for improved surface water control as the height of the stack increases; (2) installation of a seepage collection toe drain around the entire perimeter of the stack and additional drains at each of the setback bench elevations as the height of the stack increases; and (3) regrading the existing side slopes to establish a more stable configuration, consistent with the design assumptions.

The plan view layout of the Widows Creek storage facility at the proposed final top elevation of 755 feet and a typical cross section showing the recommended design slope geometry are provided on Figures 4.13 and 4.14, respectively. Conceptual design details for the proposed seepage collection drains are provided on Figure 4.15. The following key elements of the recommended design modifications are noted:

- The toe ditch will be deepened to a nominal depth of 5 feet (actual depths will be in the range of 3 to 5 feet relative to the existing perimeter dike crest road elevation), with a design bottom width of 5 feet. The ditch slope on the dike side will be no steeper than 2.0H to 1.0V and the not steeper than 2.75H to 1.0V on the gypsum stack side.

- The previously recommended 15-foot wide bench at the toe of the stack will be eliminated and the lower side slope of the gypsum stack between the ditch invert and the first setback bench will be no steeper than 2.75H to 1.0V.

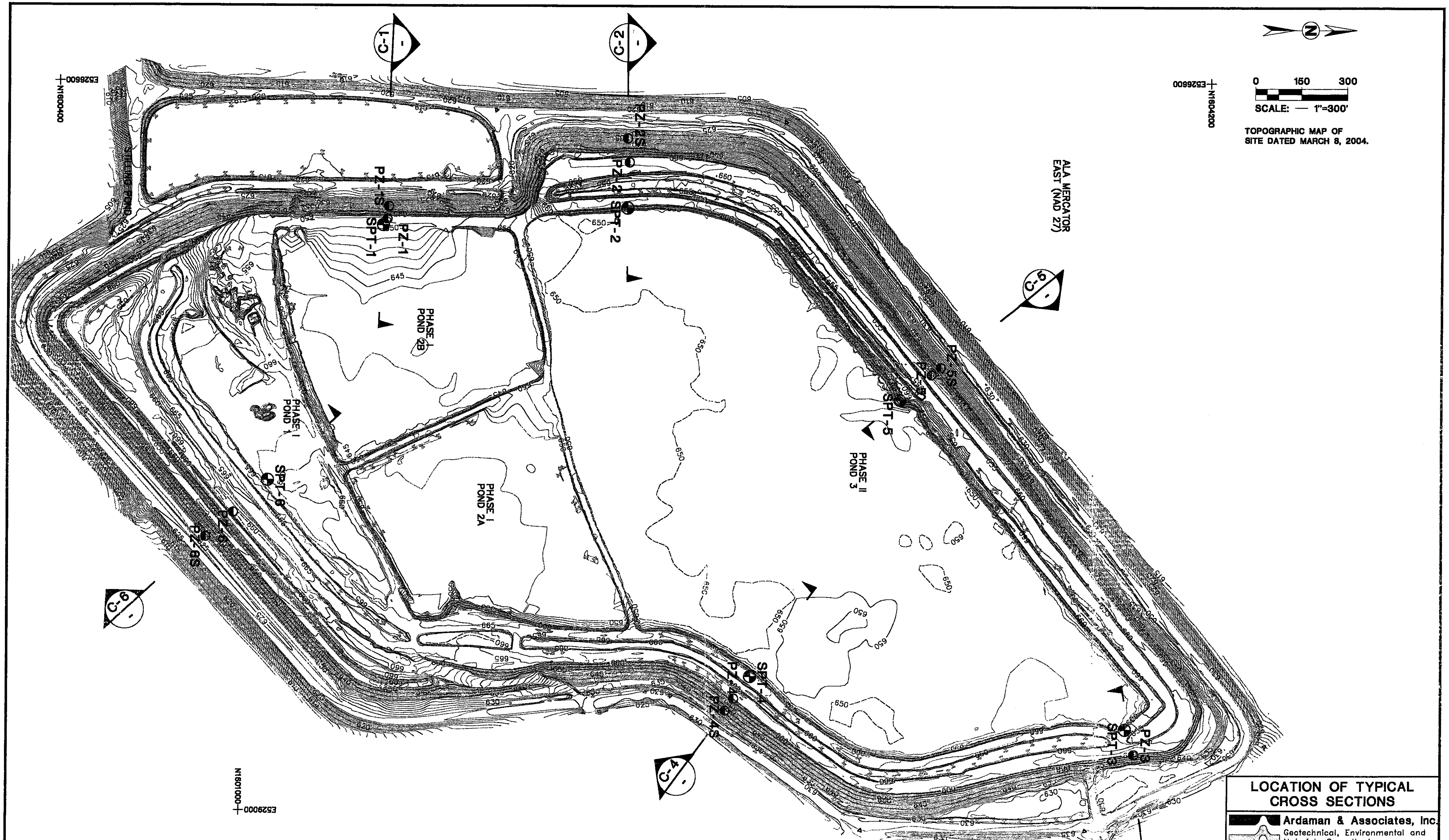
- Twenty-foot wide benches will be provided at vertical height intervals of approximately 35 feet. These benches are required for stabilization of the gypsum stack side slope and for surface water control. Shallow swales and drop inlet structures will be provided at each bench level to transport surface water runoff to the toe ditch at the base of the stack to minimize side slope erosion.

- The side slope of the gypsum stack above the first bench (EL 650 to 655 feet) and between subsequent bench elevations will be no steeper than 2.5H to 1.0V.

- Seepage collection drains will be provided at the toe of the existing stack and at each bench elevation as the height of the stack increases. As noted on Figure 4.15, the bench drains will be located not less than 25 feet inboard of the bench road centerline and be not less than 15 feet deep relative to the bench elevation.

- All drain outlet pipes and surface water control drop inlets and associated discharge piping will be buried beneath the stack surface to facilitate access to the slopes for routine maintenance (mowing) and inspection. It is recommended that existing above-grade surface water control structures and conveyances likewise be replaced with buried structures to improve access to the lower slopes.

- The outside slope of the gypsum-fly ash stack will need to be stabilized against erosion. The current practice of covering the slopes with a low permeability clay soil to support vegetation is not recommended in areas where seepage is present. Alternatives would be to use 4 to 6 inches of sandier or more pervious topsoil as a cover material, or to forego the topsoil cover entirely and attempt to establish vegetation directly on the exposed gypsum-fly ash surface. Phosphogypsum stacks in Florida have been able to establish fairly good Bermuda grass covers on the side slopes of closed facilities after the application of appropriate nutrients and pH adjustments, as needed. It is recommended that TVA work with their agronomists and establish grass test plots on the side slope of the stack to determine the feasibility of growing vegetation directly on the gypsum-fly ash surface and to develop site specific requirements for surface preparation, application of fertilizer, seeding, mulching, etc.



CROSS SECTION LOCATIONS

SCALE: 1" = 300'

LOCATION OF TYPICAL CROSS SECTIONS

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

GYPSUM FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

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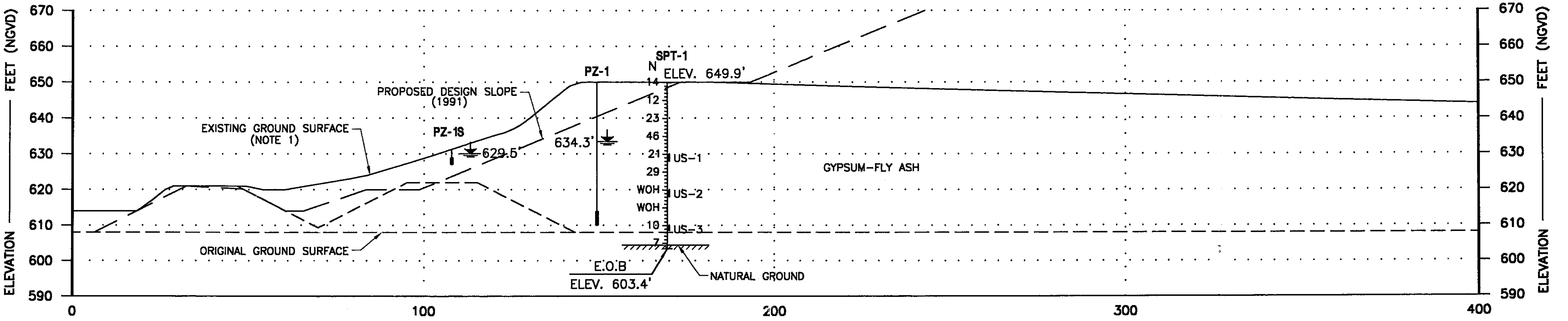
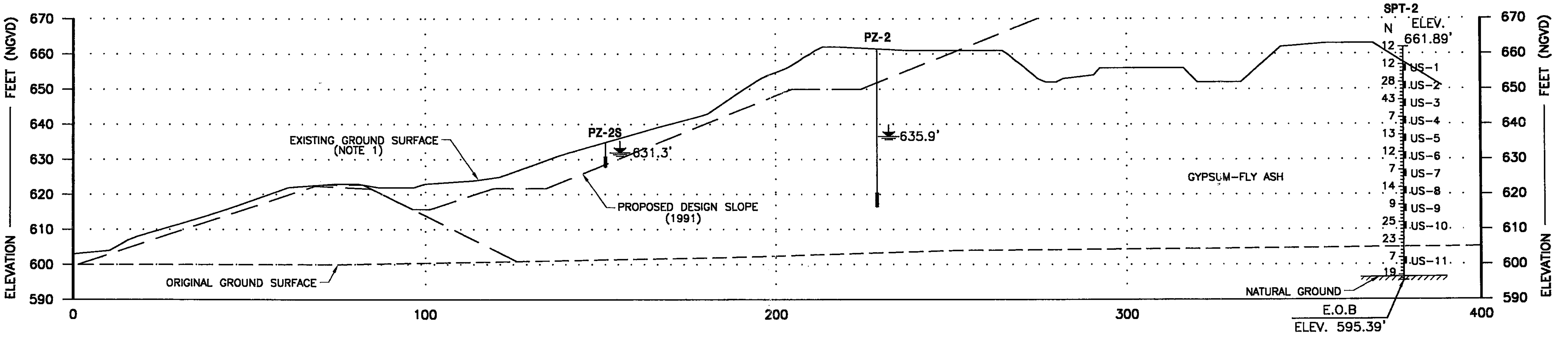
FILE NO. 04-056A	APPROVED BY:	FIGURE: 4.1



C-1 / - CROSS SECTION

SCALE: 1" = 30'



C-2 / - CROSS SECTION

SCALE: 1" = 30'

NOTE:

1– EXISTING GROUND SURFACE BASED ON TOPOGRAPHIC MAP DATED MARCH 08, 2004.

LEGEND:

— — — ORIGINAL NATURAL GROUND SURFACE BASED ON TOPOGRAPHIC MAP DATED MARCH 18, 1985.

▨ NATURAL GROUND SURFACE ENCOUNTERED IN TEST BORING, MAY 2004.

▼ WATER LEVEL IN PIEZOMETER ON JUNE 18, 2004.

CROSS SECTIONS
C1 AND C2

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TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

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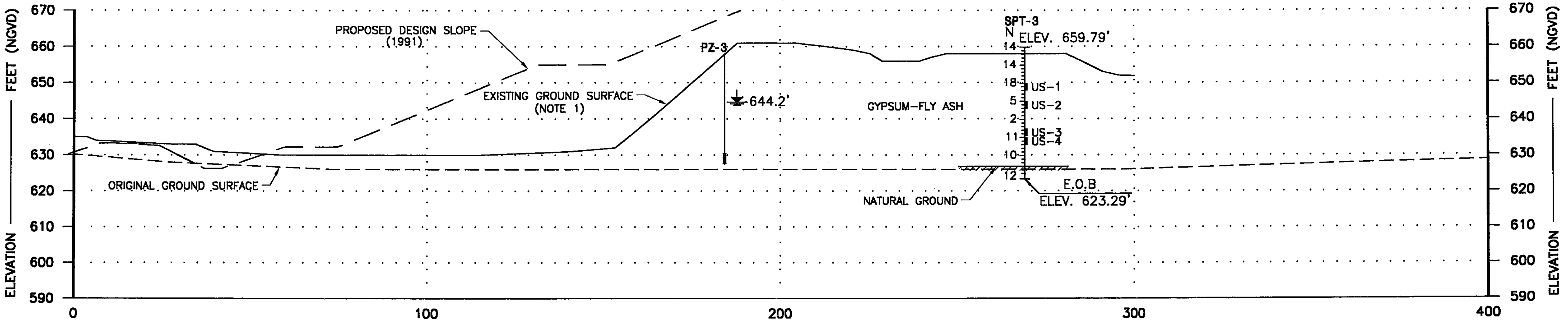
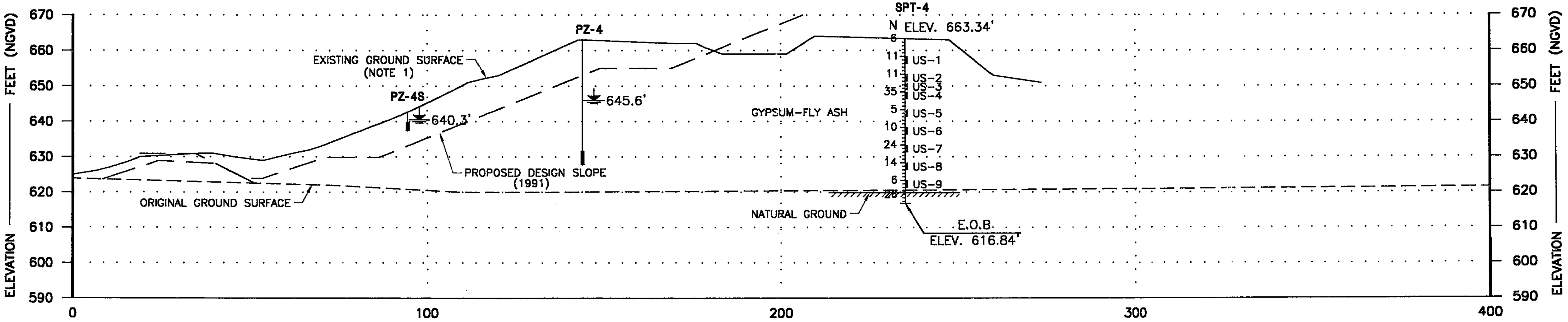
FILE NO. 04-056A	APPROVED BY:	FIGURE: 4.2



C-3 CROSS SECTION

-

SCALE: 1" = 30'



C-4 CROSS SECTION

-

SCALE: 1" = 30'

NOTE:

1– EXISTING GROUND SURFACE BASED ON TOPOGRAPHIC MAP DATED MARCH 08, 2004.

LEGEND:

— — — ORIGINAL NATURAL GROUND SURFACE BASED ON TOPOGRAPHIC MAP DATED MARCH 18, 1985.

▨ NATURAL GROUND SURFACE ENCOUNTERED IN TEST BORING, MAY 2004.

▼ WATER LEVEL IN PIEZOMETER ON JUNE 18, 2004.

CROSS SECTIONS
C3 AND C4

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

GYPSUM FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

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FILE NO. 04-056A	APPROVED BY:	FIGURE: 4.3

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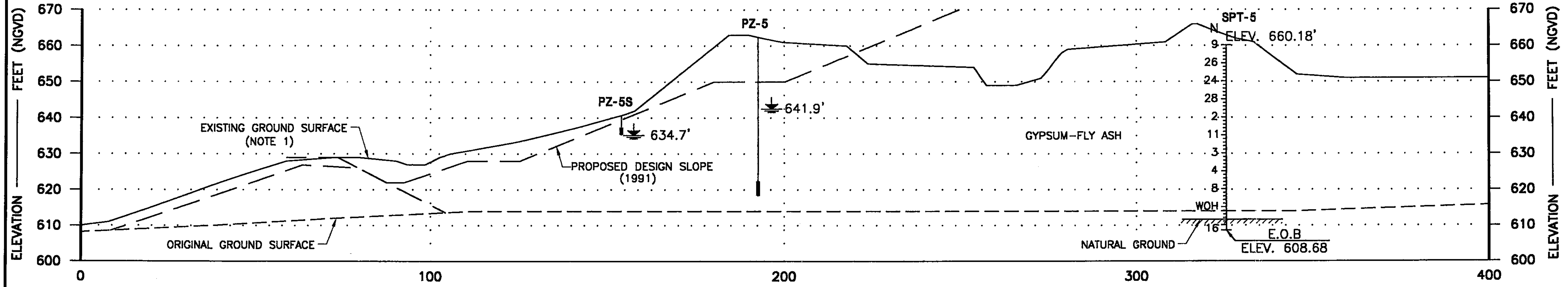
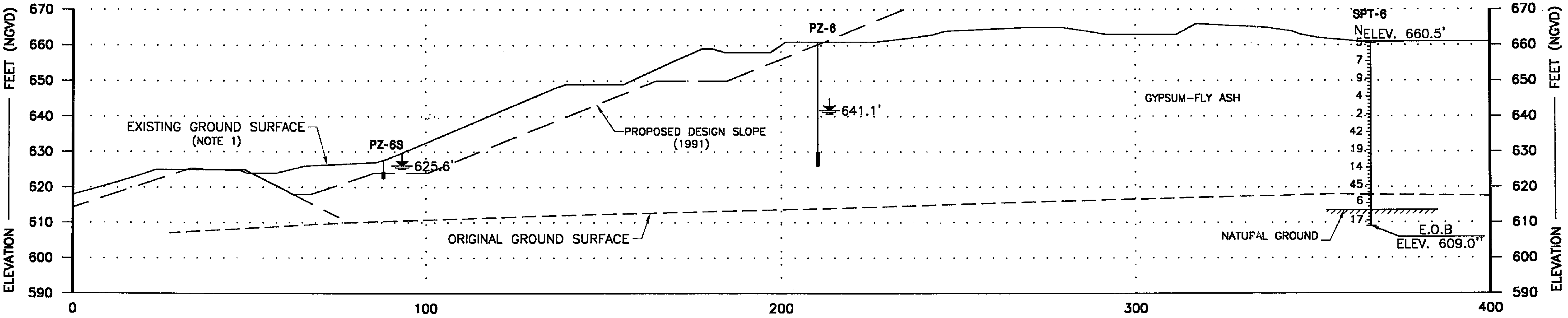


C-5 CROSS SECTION

SCALE: 1" = 30'



C-6 CROSS SECTION

SCALE: 1" = 30'

NOTE:

1– EXISTING GROUND SURFACE BASED ON TOPOGRAPHIC MAP DATED MARCH 08, 2004.

LEGEND:

— — — ORIGINAL NATURAL GROUND SURFACE BASED ON TOPOGRAPHIC MAP DATED MARCH 18, 1985.

▨ NATURAL GROUND SURFACE ENCOUNTERED IN TEST BORING, MAY 2004.

▼ WATER LEVEL IN PIEZOMETER ON JUNE 18, 2004.

CROSS SECTIONS
C5 AND C6

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

GYPSUM FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

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FILE NO. 04-056A	APPROVED BY:	FIGURE: 4.4

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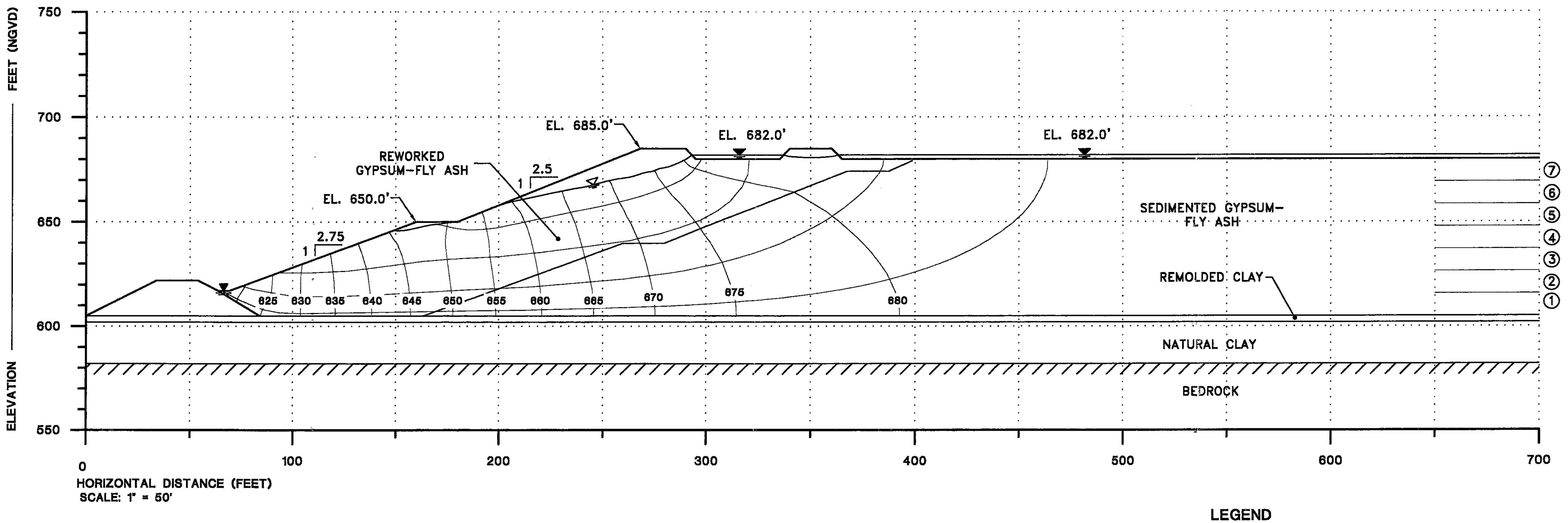

SEEPAGE ANALYSES FOR PROPOSED SLOPE OF GYPSUM-FLY ASH STORAGE FACILITY WITHOUT SEEPAGE COLLECTION DRAIN (INTERMEDIATE POND ELEVATION 682 FEET)

LEGEND

680— PIEZOMETRIC ELEVATION CONTOUR (FEET)
▽ PHREATIC SURFACE
▼ POND LEVEL

GYPSUM-FLY ASH MIX PROPERTIES

LAYER NUMBER	DESCRIPTION	γ_d (1) (pcf)	k_v (cm/sec)	k_h (cm/sec)	Void Ratio (2)
①	SEDIMENTED GYPSUM-FLY ASH	92.0	9.52×10^{-5}	1.90×10^{-4}	0.70
②		90.4	1.12×10^{-4}	2.24×10^{-4}	0.73
③		88.9	1.32×10^{-4}	2.64×10^{-4}	0.76
④		87.3	1.55×10^{-4}	3.10×10^{-4}	0.79
⑤		85.3	1.90×10^{-4}	3.80×10^{-4}	0.83
⑥		83.4	2.32×10^{-4}	4.64×10^{-4}	0.87
⑦		81.8	2.72×10^{-4}	5.45×10^{-4}	0.91
⑧	REWORKED GYPSUM -FLY ASH	95.0	1.00×10^{-4}	2.00×10^{-4}	0.70

NOTES

(1)–SEE FIGURE 3.1
(2)–BASED ON THE AVERAGE SPECIFIC GRAVITY OF THE GYPSUM–FLY ASH
k_h –HORIZONTAL HYDRAULIC CONDUCTIVITY
k_v –VERTICAL HYDRAULIC CONDUCTIVITY
γ_d –DRY UNIT WEIGHT

SEEPAGE ANALYSES FOR INTERMEDIATE HEIGHT (NO DRAIN CASE)

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

GYPSUM-FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

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FILE NO. 04-056A	APPROVED BY:	FIGURE: 4.5

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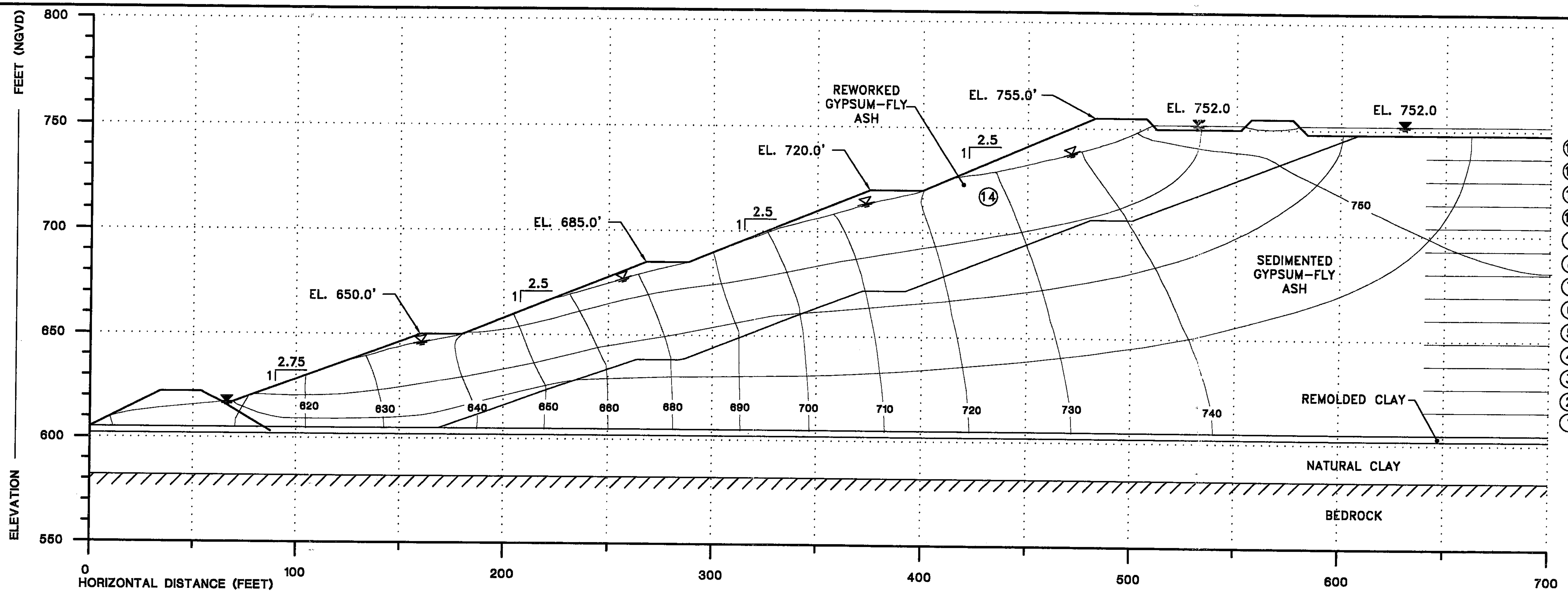

SEEPAGE ANALYSES FOR PROPOSED SLOPE OF GYPSUM-FLY ASH STORAGE FACILITY WITHOUT SEEPAGE COLLECTION DRAIN (MAXIMUM POND ELEVATION 752 FEET)

LEGEND

- 680— PIEZOMETRIC ELEVATION CONTOUR (FEET)
- ▽ PHREATIC SURFACE
- ▼ POND LEVEL

GYPSUM-FLY ASH MIX PROPERTIES

LAYER NUMBER	DESCRIPTION	γ_d (pcf) (1)	k_v (cm/sec)	k_h (cm/sec)	Void Ratio (2)
①	SEDIMENTED GYPSUM-FLY ASH	103.0	1.41×10^{-5}	2.82×10^{-5}	0.51
②		101.4	1.85×10^{-5}	3.70×10^{-5}	0.54
③		99.8	2.42×10^{-5}	4.83×10^{-5}	0.56
④		98.3	3.15×10^{-5}	6.29×10^{-5}	0.59
⑤		96.3	4.36×10^{-5}	8.72×10^{-5}	0.62
⑥		94.3	7.42×10^{-5}	1.48×10^{-4}	0.65
⑦		92.8	8.76×10^{-5}	1.75×10^{-4}	0.68
⑧	SEDIMENTED GYPSUM-FLY ASH	90.8	1.08×10^{-4}	2.15×10^{-4}	0.72
⑨		88.9	1.32×10^{-4}	2.64×10^{-4}	0.76
⑩		87.3	1.55×10^{-4}	3.10×10^{-4}	0.79
⑪		85.3	1.90×10^{-4}	3.80×10^{-4}	0.83
⑫		83.4	2.32×10^{-4}	4.64×10^{-4}	0.87
⑬		81.8	2.72×10^{-4}	5.45×10^{-4}	0.91
⑭	REWORKED GYPSUM -FLY ASH	95.0	1.00×10^{-4}	2.00×10^{-4}	0.70

NOTES

(1)–SEE FIGURE 3.1

(2)–BASED ON THE AVERAGE SPECIFIC GRAVITY OF THE GYPSUM-FLY ASH

k_h –HORIZONTAL HYDRAULIC CONDUCTIVITY

k_v –VERTICAL HYDRAULIC CONDUCTIVITY

γ_d –DRY UNIT WEIGHT

SEEPAGE ANALYSES FOR FINAL HEIGHT (NO DRAIN CASE)

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

GYPSUM-FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

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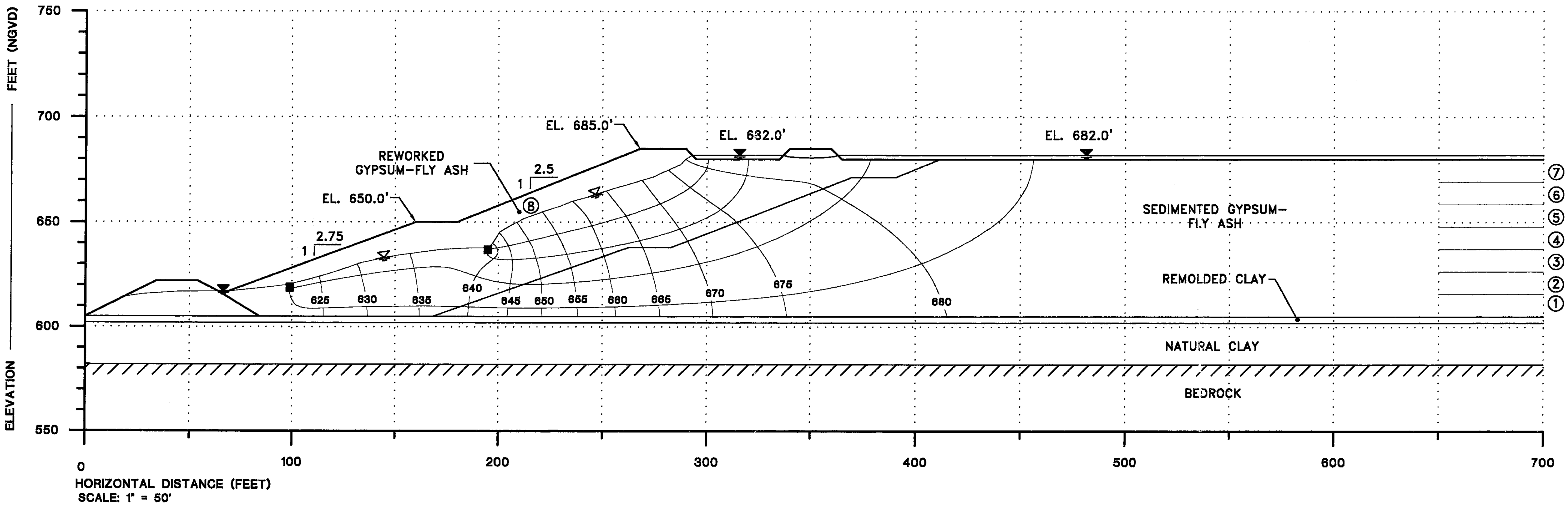

SEEPAGE ANALYSES FOR PROPOSED SLOPE OF GYPSUM-FLY ASH STORAGE FACILITY (INTERMEDIATE POND ELEVATION 682 FEET)

LEGEND

680—	PIEZOMETRIC ELEVATION CONTOUR (FEET)
■	PROPOSED SEEPAGE COLLECTION DRAIN
▽	PHREATIC SURFACE
▼	POND LEVEL

GYPSUM-FLY ASH MIX PROPERTIES

LAYER NUMBER	DESCRIPTION	γ_d (1) (pcf)	k_v (cm/sec)	k_h (cm/sec)	Void Ratio (2)
①	SEDIMENTED GYPSUM–FLY ASH	92.0	9.52×10^{-5}	1.90×10^{-4}	0.70
②		90.4	1.12×10^{-4}	2.24×10^{-4}	0.73
③		88.9	1.32×10^{-4}	2.64×10^{-4}	0.76
④		87.3	1.55×10^{-4}	3.10×10^{-4}	0.79
⑤		85.3	1.90×10^{-4}	3.80×10^{-4}	0.83
⑥		83.4	2.32×10^{-4}	4.64×10^{-4}	0.87
⑦		81.8	2.72×10^{-4}	5.45×10^{-4}	0.91
⑧	REWORKED GYPSUM –FLY ASH	95	1.00×10^{-4}	2.00×10^{-4}	0.70

NOTES

(1)–SEE FIGURE 3.1

(2)–BASED ON THE AVERAGE SPECIFIC GRAVITY OF THE GYPSUM–FLY ASH

k_h–HORIZONTAL HYDRAULIC CONDUCTIVITY

k_v–VERTICAL HYDRAULIC CONDUCTIVITY

γ_d–DRY UNIT WEIGHT

SEEPAGE ANALYSES FOR INTERMEDIATE HEIGHT (WITH DRAINS)

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

GYPSUM-FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

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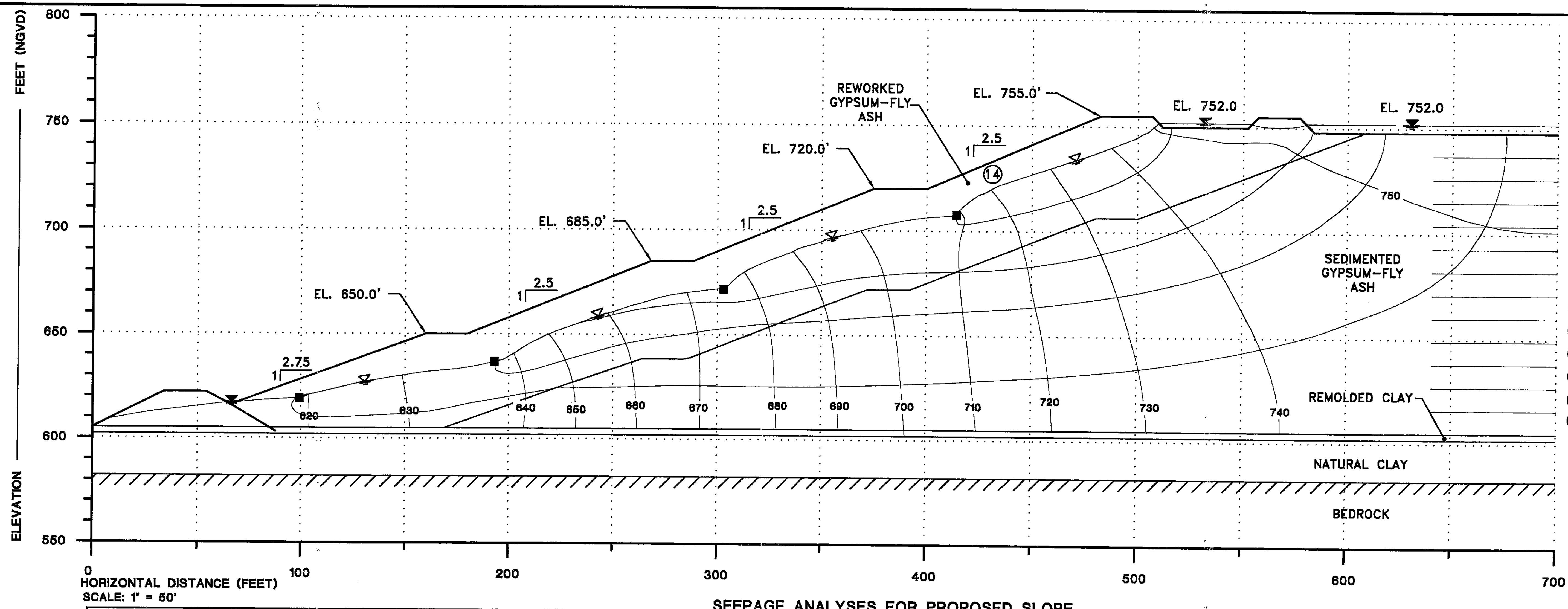
FILE NO. 04-056A	APPROVED BY:	FIGURE. 4.7



SEEPAGE ANALYSES FOR PROPOSED SLOPE OF GYPSUM-FLY ASH STORAGE FACILITY (MAXIMUM POND ELEVATION 752 FEET)

LEGEND

680— PIEZOMETRIC ELEVATION CONTOUR (FEET)
■ PROPOSED SEEPAGE COLLECTION DRAIN
▽ PHREATIC SURFACE
▼ POND LEVEL

GYPSUM-FLY ASH MIX PROPERTIES

LAYER NUMBER	DESCRIPTION	γ_d (pcf) (1)	k_v (cm/sec)	k_h (cm/sec)	Void Ratio (2)
①	SEDIMENTED GYPSUM-FLY ASH	103.0	1.41×10^{-5}	2.82×10^{-5}	0.51
②		101.4	1.85×10^{-5}	3.70×10^{-5}	0.54
③		99.8	2.42×10^{-5}	4.83×10^{-5}	0.56
④		98.3	3.15×10^{-5}	6.29×10^{-5}	0.59
⑤		96.3	4.36×10^{-5}	8.72×10^{-5}	0.62
⑥		94.3	7.42×10^{-5}	1.48×10^{-4}	0.65
⑦		92.8	8.76×10^{-5}	1.75×10^{-4}	0.68
⑧	SEDIMENTED GYPSUM-FLY ASH	90.8	1.08×10^{-4}	2.15×10^{-4}	0.72
⑨		88.9	1.32×10^{-4}	2.64×10^{-4}	0.76
⑩		87.3	1.55×10^{-4}	3.10×10^{-4}	0.79
⑪		85.3	1.90×10^{-4}	3.80×10^{-4}	0.83
⑫		83.4	2.32×10^{-4}	4.64×10^{-4}	0.87
⑬		81.8	2.72×10^{-4}	5.54×10^{-4}	0.91
⑭	REWORKED GYPSUM -FLY ASH	95.0	1.00×10^{-4}	2.00×10^{-4}	0.70

NOTES

(1)-SEE FIGURE 3.1
(2)-BASED ON THE AVERAGE SPECIFIC GRAVITY OF THE GYPSUM-FLY ASH
k_h-HORIZONTAL HYDRAULIC CONDUCTIVITY
k_v-VERTICAL HYDRAULIC CONDUCTIVITY
γ_d-DRY UNIT WEIGHT

SEEPAGE ANALYSES FOR FINAL HEIGHT (WITH DRAINS)

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

GYPSUM-FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

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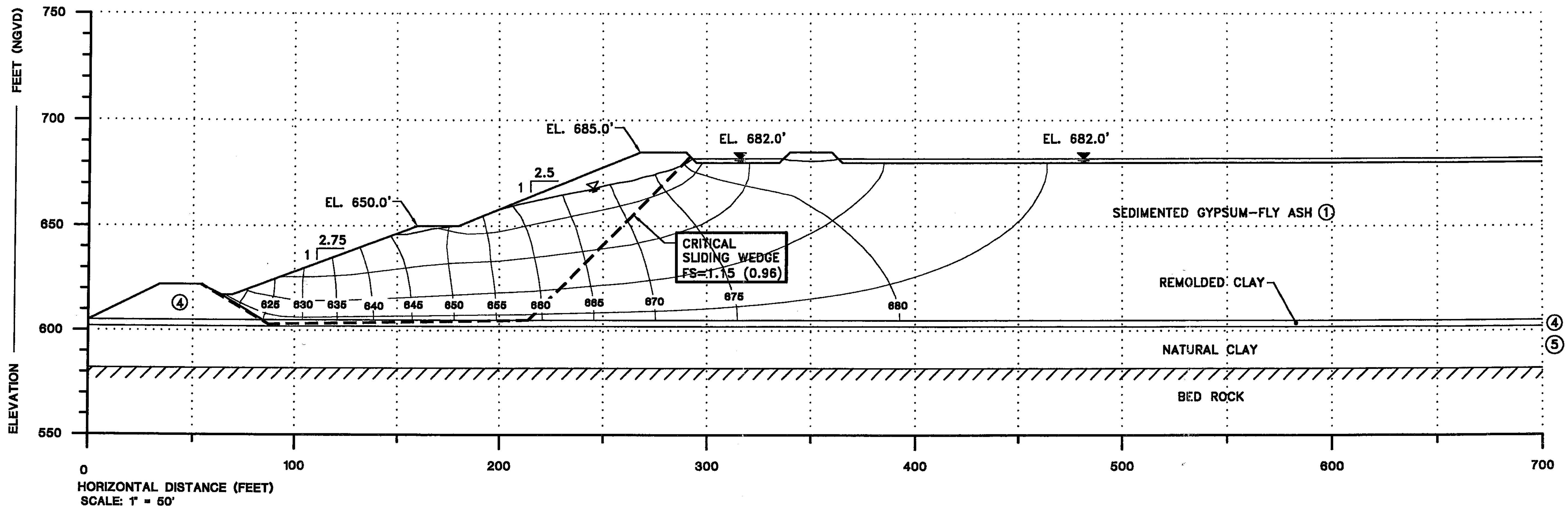
FILE NO. 04-056A	APPROVED BY:	FIGURE: 4.8



STABILITY ANALYSES FOR PROPOSED SLOPE OF GYPSUM-FLY ASH STORAGE FACILITY WITHOUT SEEPAGE COLLECTION DRAIN (INTERMEDIATE STACK HEIGHT, ELEVATION 685 FEET)

GYPSUM-FLY ASH PROPERTIES

LAYER NUMBER	DESCRIPTION	γ_t (pcf)	STRENGTH PARAMETERS	
			$\overline{\phi}$ (degrees)	$\overline{C}$ (psf)
①	GYPSYM-FLY ASH	114	42	0

FOUNDATION SOIL PROPERTIES

LAYER NUMBER	DESCRIPTION	γ_t (pcf)	STRENGTH PARAMETERS	
			$\overline{\phi}$ (degrees)	$\overline{C}$ (psf)
④	REMOLDED CLAY	125	25	0
⑤	NATURAL CLAY	125	27	0

LEGEND

680—	PIEZOMETRIC ELEVATION CONTOUR (FEET)
▽	PHREATIC SURFACE
▼	PONDED WATER LEVEL
FS	FACTOR OF SAFETY (NUMBER IN PARENTHESIS IS PSEUDO-STATIC FACTOR OF SAFETY FOR SEISMIC COEFFICIENT OF 0.05)
γ_t	TOTAL UNIT WEIGHT
$\overline{\phi}$	EFFECTIVE FRICTION ANGLE
$\overline{C}$	EFFECTIVE COHESION

STABILITY ANALYSES FOR INTERMEDIATE HEIGHT (NO DRAIN CASE)

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

GYPSUM-FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

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FILE NO. 04-056A | APPROVED BY: | FIGURE: 4.9

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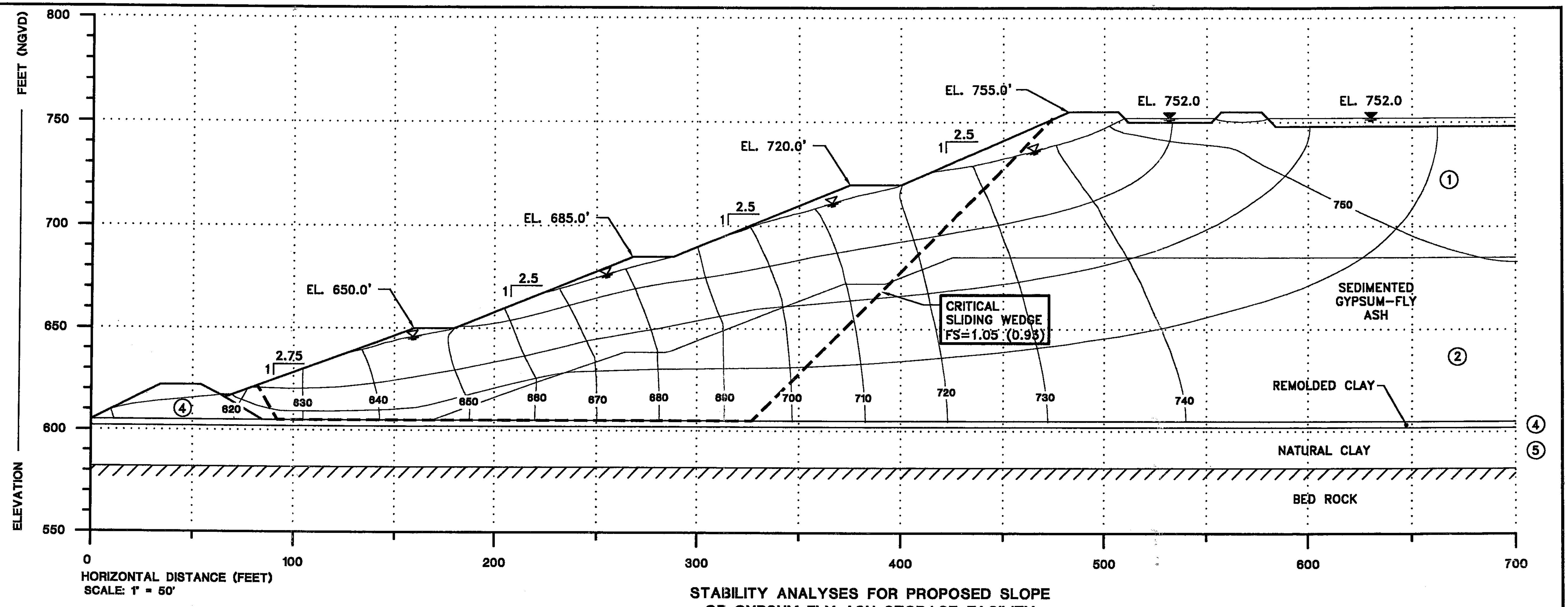

STABILITY ANALYSES FOR PROPOSED SLOPE OF GYPSUM-FLY ASH STORAGE FACILITY WITHOUT SEEPAGE COLLECTION DRAIN (FINAL STACK HEIGHT, ELEVATION 755 FEET)

GYPSUM-FLY ASH PROPERTIES

LAYER NUMBER	DESCRIPTION	γ_t (pcf)	STRENGTH PARAMETERS	
			$\overline{\phi}$ (degrees)	$\overline{c}$ (psf)
①	GYPSYM-FLY ASH	114	42	0
②	GYPSYM-FLY ASH	121	44	0

FOUNDATION SOIL PROPERTIES

LAYER NUMBER	DESCRIPTION	γ_t (pcf)	STRENGTH PARAMETERS	
			$\overline{\phi}$ (degrees)	$\overline{c}$ (psf)
④	REMOLDED CLAY	125	25	0
⑤	NATURAL CLAY	125	27	0

LEGEND

680—	PIEZOMETRIC ELEVATION CONTOUR (FEET)
▽	PHREATIC SURFACE
▼	PONDED WATER LEVEL
FS	FACTOR OF SAFETY (NUMBER IN PARENTHESIS IS PSEUDO-STATIC FACTOR OF SAFETY FOR SEISMIC COEFFICIENT OF 0.05)
γ_t	TOTAL UNIT WEIGHT
$\overline{\phi}$	EFFECTIVE FRICTION ANGLE
$\overline{c}$	EFFECTIVE COHESION

STABILITY ANALYSES FOR FINAL HEIGHT (NO DRAIN CASE)

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

GYPSUM-FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

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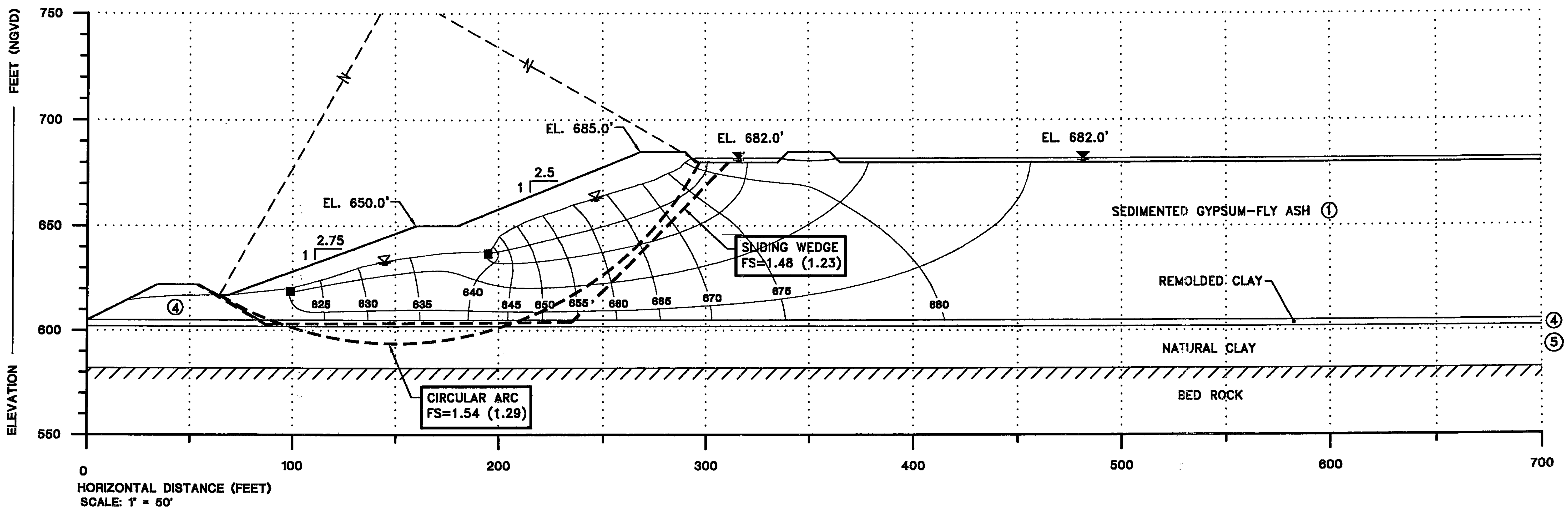

STABILITY ANALYSES FOR PROPOSED SLOPE OF GYPSUM-FLY ASH STORAGE FACILITY (INTERMEDIATE STACK HEIGHT, ELEVATION 685 FEET)

GYPSUM-FLY ASH PROPERTIES

LAYER NUMBER	DESCRIPTION	γ_t (pcf)	STRENGTH PARAMETERS	
			$\overline{\phi}$ (degrees)	$\overline{C}$ (psf)
①	GYPSYM-FLY ASH	114	42	0

FOUNDATION SOIL PROPERTIES

LAYER NUMBER	DESCRIPTION	γ_t (pcf)	STRENGTH PARAMETERS	
			$\overline{\phi}$ (degrees)	$\overline{C}$ (psf)
④	REMOLDED CLAY	125	25	0
⑤	NATURAL CLAY	125	27	0

LEGEND

680	PIEZOMETRIC ELEVATION CONTOUR (FEET)
▽	PHREATIC SURFACE
▼	PONDED WATER LEVEL
FS	FACTOR OF SAFETY (NUMBER IN PARENTHESIS IS PSEUDO-STATIC FACTOR OF SAFETY FOR SEISMIC COEFFICIENT OF 0.05)
γ_t	TOTAL UNIT WEIGHT
$\overline{\phi}$	EFFECTIVE FRICTION ANGLE
$\overline{C}$	EFFECTIVE COHESION

STABILITY ANALYSES FOR INTERMEDIATE HEIGHT (WITH DRAINS)

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

GYPSUM-FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

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FIGURE: 4.11

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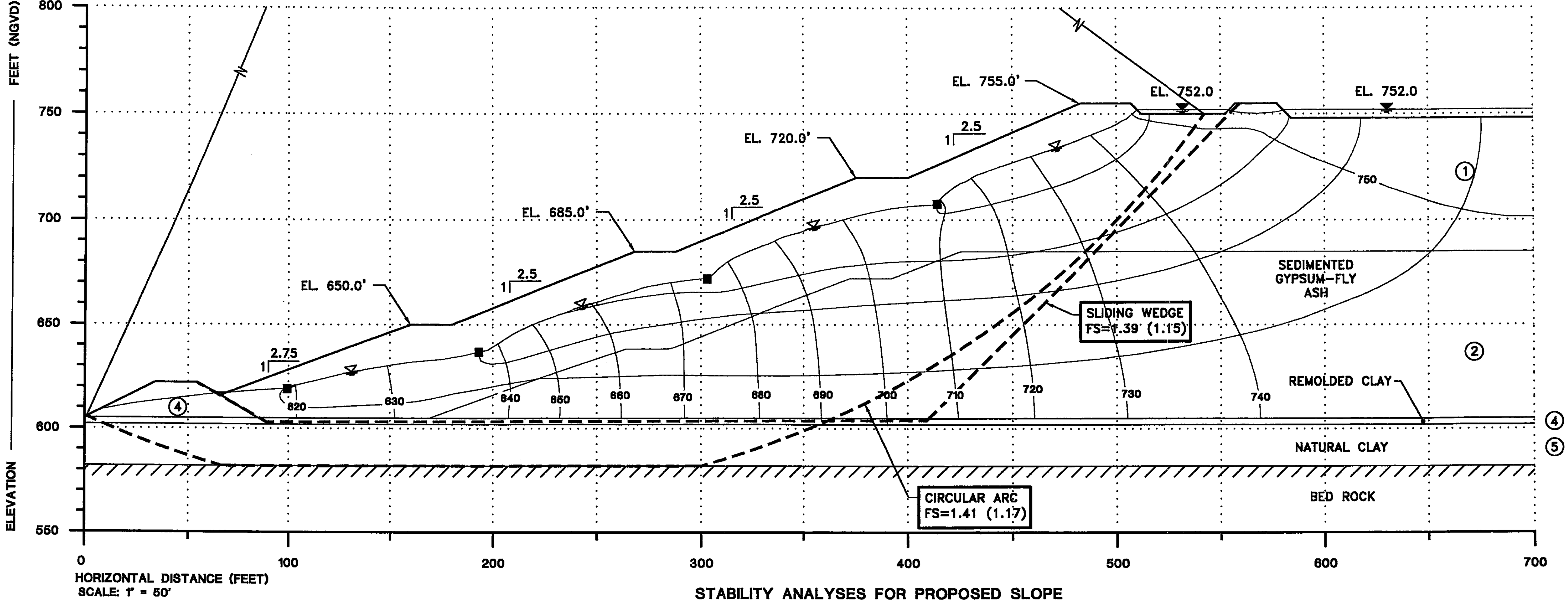

STABILITY ANALYSES FOR PROPOSED SLOPE OF GYPSUM-FLY ASH STORAGE FACILITY (FINAL STACK HEIGHT, ELEVATION 755 FEET)

GYPSUM-FLY ASH PROPERTIES

LAYER NUMBER	DESCRIPTION	γ_t (pcf)	STRENGTH PARAMETERS	
			$\overline{\phi}$ (degrees)	$\overline{C}$ (psf)
①	GYPSYM-FLY ASH	114	42	0
②	GYPSYM-FLY ASH	121	44	0

FOUNDATION SOIL PROPERTIES

LAYER NUMBER	DESCRIPTION	γ_t (pcf)	STRENGTH PARAMETERS	
			$\overline{\phi}$ (degrees)	$\overline{C}$ (psf)
④	REMOLDED CLAY	125	25	0
⑤	NATURAL CLAY	125	27	0

LEGEND

680—	PIEZOMETRIC ELEVATION CONTOUR (FEET)
▽	PHREATIC SURFACE
▼	PONDED WATER LEVEL
FS	FACTOR OF SAFETY (NUMBER IN PARENTHESIS IS PSEUDO-STATIC FACTOR OF SAFETY FOR SEISMIC COEFFICIENT OF 0.05)
γ_t	TOTAL UNIT WEIGHT
$\overline{\phi}$	EFFECTIVE FRICTION ANGLE
$\overline{C}$	EFFECTIVE COHESION

STABILITY ANALYSES FOR FINAL HEIGHT (WITH DRAINS)

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

GYPSUM-FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

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FIGURE: 4.12

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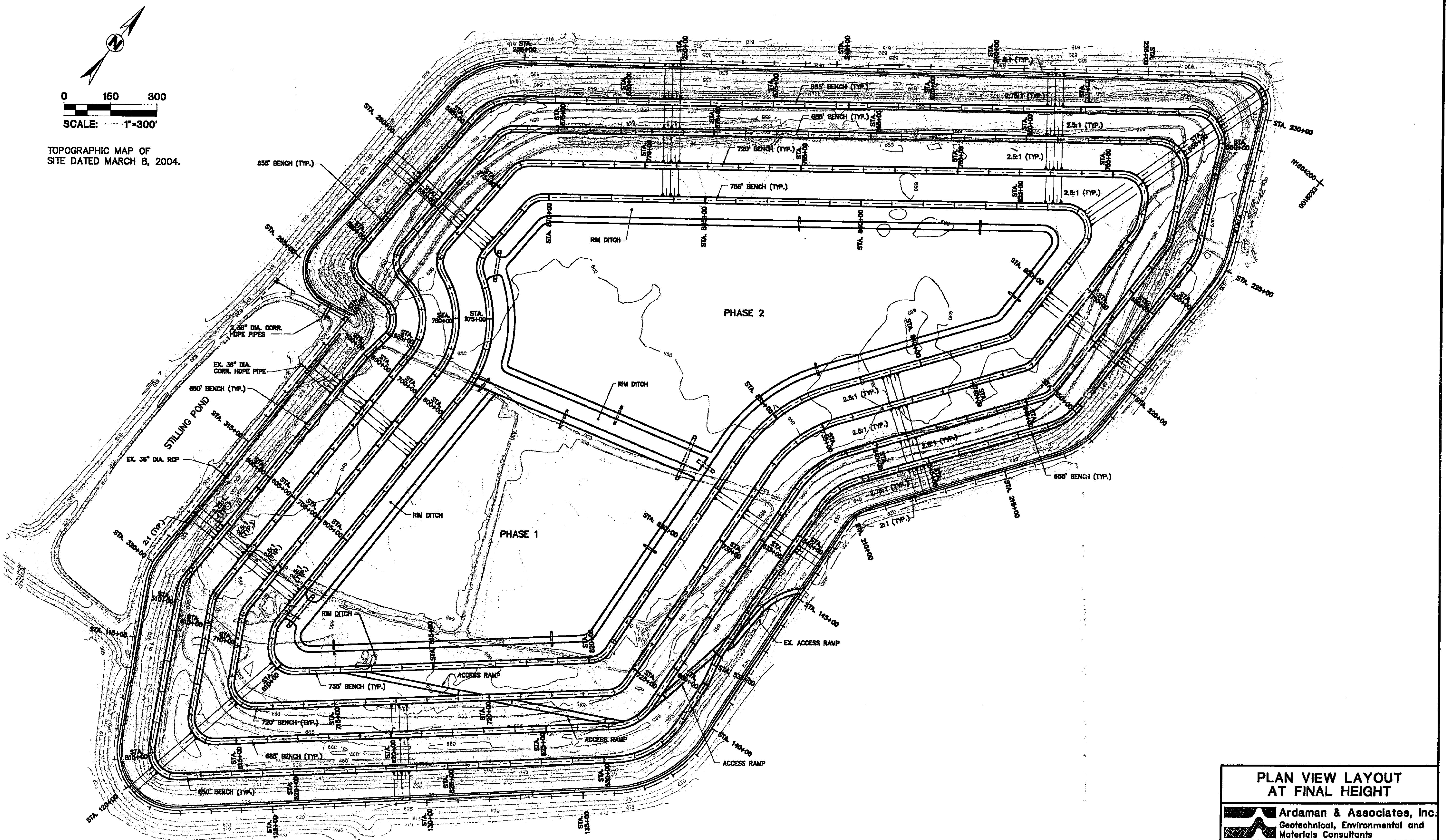

TOPOGRAPHIC MAP OF
SITE DATED MARCH 8, 2004.

PLAN VIEW LAYOUT AT FINAL HEIGHT

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

GYPSUM - FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

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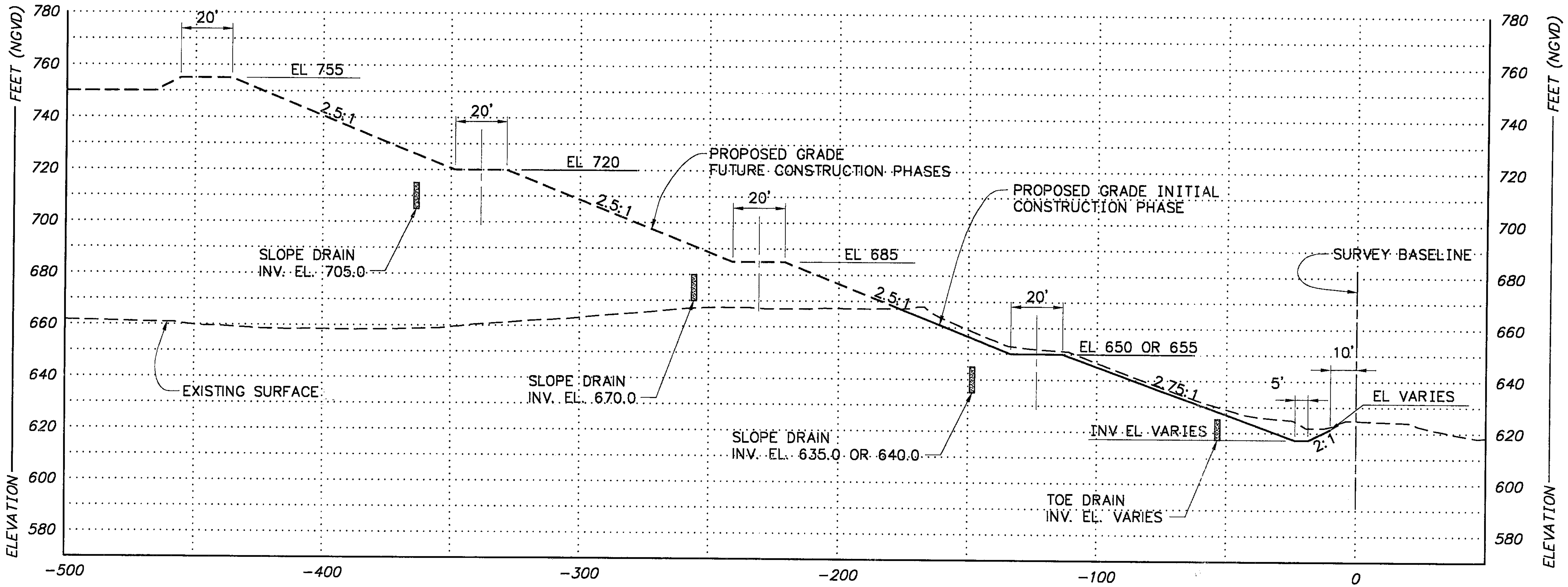

TYPICAL SECTION

SCALE: 1" = 40'

PROPOSED SIDE SLOPE DESIGN MODIFICATIONS

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

GYPSUM - FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

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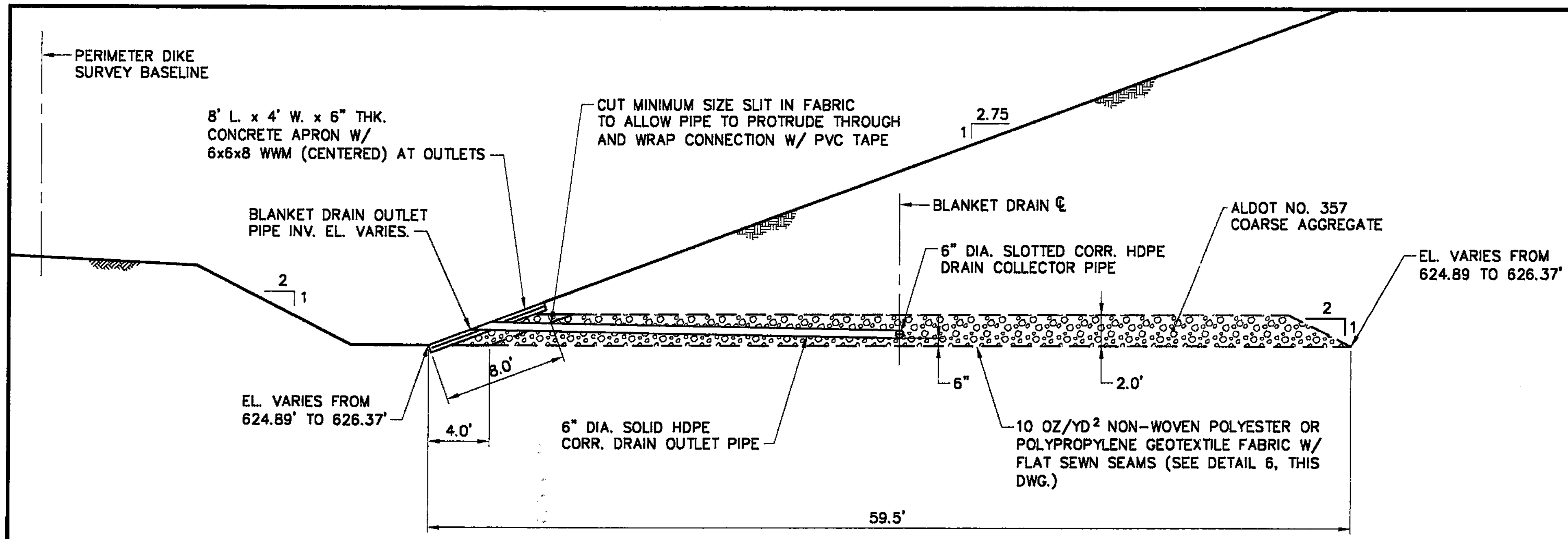
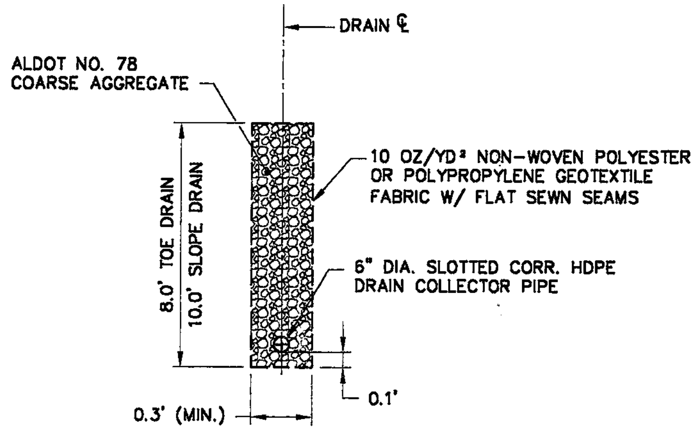
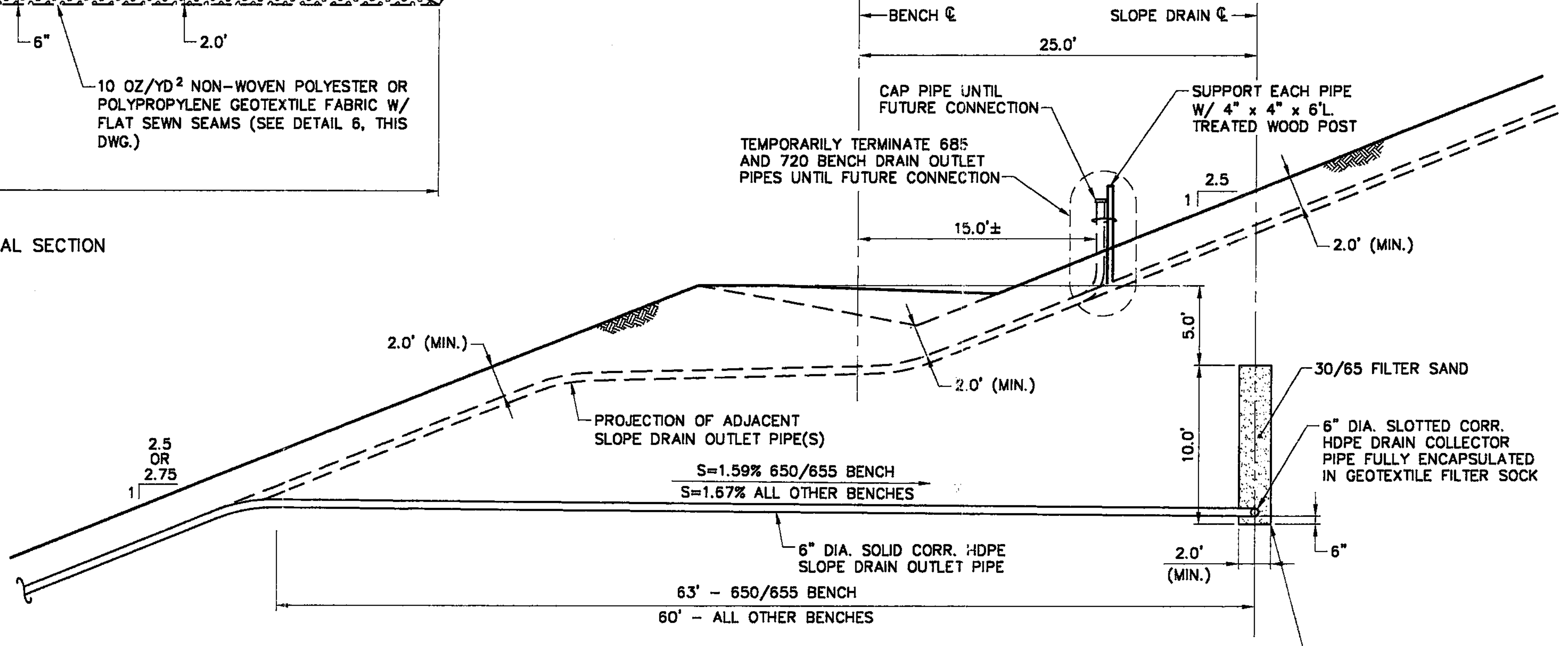


DETAIL 1
BLANKET DRAIN AND OUTLET TYPICAL SECTION
SCALE: 1"=10'



DETAIL 11
ALTERNATE DRAIN DETAIL
NTS



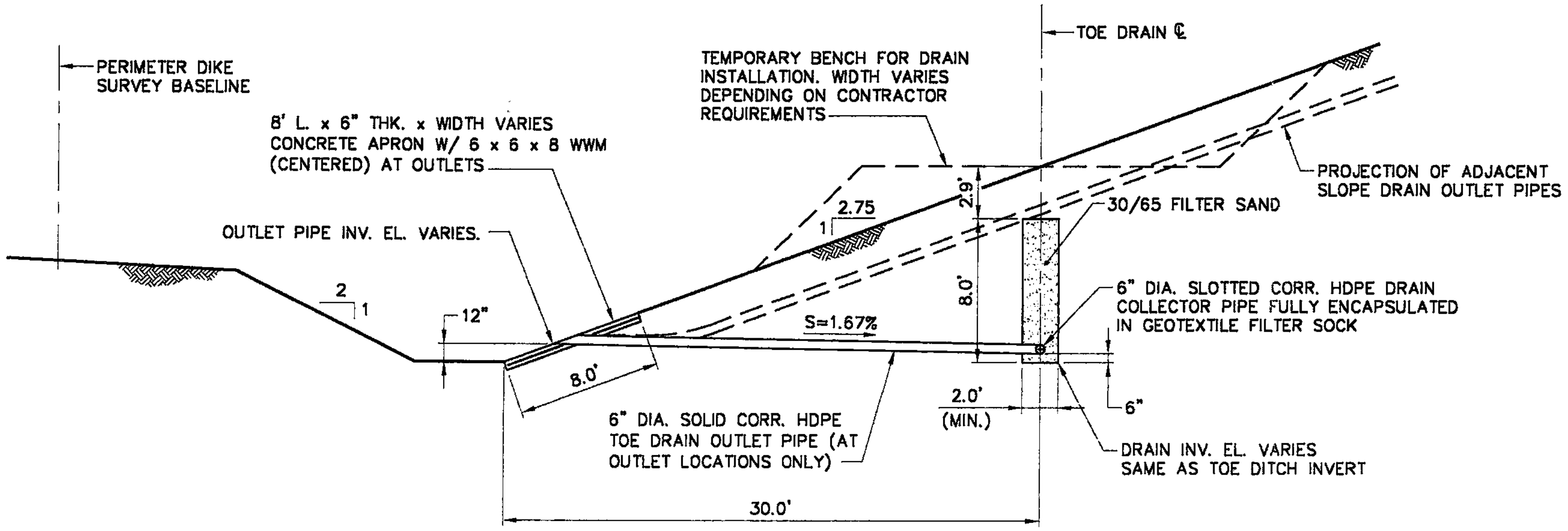
DETAIL 3
SLOPE DRAIN AND OUTLET TYPICAL SECTION
SCALE: 1"=10'

650/655 BENCH STA. 500+00 TO 534+85 AND STA. 594+20 TO 594+69.50-INV. EL. 635.0'

650/655 BENCH STA. 534+85 TO STA. 594+20-INV. EL. 640.0'

685 BENCH-INV. EL. 670.0'

720 BENCH-INV. EL. 705.0'



DETAIL 2
TOE DRAIN AND OUTLET TYPICAL SECTION
SCALE: 1"=10'

SEEPAGE COLLECTION DRAIN DETAILS

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

GYPSUM - FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

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SECTION 5

OPERATING GUIDELINES FOR GYPSUM STACKING FACILITY

The TVA Widows Creek gypsum-fly ash storage facility will be operated and gradually raised using the upstream method of construction, in conjunction with a perimeter rim ditch system for distribution of gypsum slurry. In this method, settled gypsum-fly ash deposits are periodically excavated from the rim ditch and wet cast onto the perimeter gypsum dike or inner berm of the rim ditch to provide material needed for raising the top elevation of the gypsum stack with time. Operation of the gypsum stack, therefore, will require managing: (i) the hydraulic deposition of gypsum-fly ash slurry and construction of the associated perimeter gypsum dike and rim ditch inner berm; (ii) the storage of water in sedimentation ponds on top the gypsum stack needed for water clarification; (iii) the decanting of clarified water from the top of the stack to the stilling basin; and (iv) raising the side slopes of the gypsum stack at the appropriate geometry to maintain overall stability of the gypsum stack. Guidelines and information for managing the operation and raising of the gypsum stack are presented in this section.

5.1 Rim Ditch Method of Slurry Distribution

Open sedimentation ponds that utilize single-point slurry discharge systems can be difficult to operate since the sedimented deposits at the remote end of the pond are generally comprised of finer grained materials that do not settle as quickly as the coarser materials, which tend to settle more rapidly near the slurry discharge pont. The finer materials are typically less pervious and do not drain or dry as rapidly as the coarser materials and are generally more difficult to handle and stack. Utilization of an elevated rim ditch for slurry distribution can minimize the effects of segregation in the sedimentation pond and direct some of the coarser materials to the remote end of the stack for use in dike construction. Elevating the rim ditch above the ponded water level in the interior sedimentation pond also promotes drainage and dewatering of the sedimented deposits in the rim ditch, reduces drying periods prior to excavation and likewise improves handling and stacking characteristics of the excavated materials.

A elevated rim ditch consists of an outer gypsum dike (often referred to as a starter dike) and an inner berm or dike that form a relatively narrow flow corridor (ditch) that contains and directs the gypsum-fly ash slurry around the perimeter of the stack to the more remote locations. To operate properly, the rim ditch must be elevated above the ponded water level in the interior sedimentation pond and have sufficient slope along the axis of the ditch to maintain flow velocities within the ditch, and sufficient dike height or freeboard to prevent the slurry from overtopping the perimeter dike. The slope along the axis of the rim ditch will be a function of the slurry composition (particle size and distribution), percent solids in the slurry flow and other environmental factors, which can vary with time. The rim ditch slope, therefore, must be field adjusted based on local experience and observed performance of the slurry at any given time. Rim ditch slopes are typically on the order of 3 to 4 feet vertical change in height for every 1,000 feet of ditch length.

Previous experience indicates that the Widows Creek gypsum-fly ash deposits are more erodible than conventional gypsum deposits without fly ash. The greater erodibility of the gypsum-fly ash mixture dictates the use of a somewhat more massive perimeter dike and inner berm and precludes the normal operating procedure of making open cuts through the inner berm of the rim ditch for slurry distribution into the interior sedimentation pond. Discrete slurry discharge points through the inner berm, therefore, must be protected from erosion. This is normally accomplished by the installation of individual pipelines that extend through the inner berm of the rim ditch, into the interior sedimentation pond. These pipes must be raised periodically as the height of the stack increases and also moved laterally to ensure uniform distribution of gypsum slurry around the perimeter of the pond.

The recommended rim ditch geometry for the Widows Creek gypsum-fly ash stack is provided on Figure 5.1. As noted the recommended geometry includes a 25-foot wide perimeter gypsum dike and a 20-foot wide inner dike that is sufficiently wide for equipment access. Utilization of the wider inner dike (instead of a narrow windrow berm) also facilitates periodic removal and repositioning of slurry discharge pipes through the interior berm, as needed to provide uniform distribution of gypsum slurry within the compartment and to adjust for elevation changes in the rim ditch as the height of the stack increases.

The nominal rim ditch width of 50 feet shown on 5.1 should be sufficient to allow excavation from either side of the ditch using conventional equipment, without the need for a long-reach excavator. Utilization of a slightly wider or narrower ditch based on field experience is acceptable and should have little to no effect on operating costs.

5.2 Slurry Discharge Locations

Two slurry discharge locations are provided on top of the Widows Creek stack, one on the west end of Pond 1 and the other at the southwest corner of Pond 3 in the Phase 2 expansion (see Figure 5.2). It is our understanding that the slurry pipelines at the latter of these two locations are leaking and have not been used in over a year. Repair and reactivation of this slurry discharge location would facilitate gypsum distribution and stacking operations on top of the stack and would be beneficial when establishing rim-ditches adjacent to the internal divider dikes and the perimeter dike on the west wall of Pond 2B (west side of Phase 1, next to stilling pond).

5.3 Existing Operating Procedures

In reference to the March 2004 topographic map of existing conditions presented as Figure 5.2, it can be noted that the south wall of Pond 1, the east wall of Pond 2A and the exterior walls of Pond 3 are currently being raised in a double-dike rim ditch configuration, similar to the proposed geometry above. The internal divider dikes separating the various sedimentation ponds on top of the stack and the perimeter dike on the west wall of Pond 2B, however, are single width dikes, with no associated rim ditch. The internal divider dikes can not be raised by conventional rim ditch techniques and are currently being raised with mechanically placed gypsum fill materials, hauled by scraper pan from other portions of the stack.

It has been our experience that hauled and mechanically raised dikes, especially when constructed in deep water environments (i.e., without the presence of an adjacent gypsum beach), tend to become very steep, often with a significant depth of clear water immediately adjacent to the dike and have the potential for localized instability. In addition, without proper moisture and compaction control, mechanically placed gypsum dikes are inherently not as strong as those constructed with wet cast materials and are more susceptible to collapse or subsidence when initially wetted or inundated.

The narrow dike width, steep and potentially unstable side slopes and greater clear water depth that typically result from this type of construction does not offer the degree of safety afforded by a wider double dike configuration that is reinforced on the upstream side by sedimented gypsum deposits. It is recommended that all dikes that are currently being raised with hauled and mechanically placed fill materials be converted to a rim ditch configuration that will facilitate dike construction and gypsum slurry distribution needed to place and maintain a sedimented gypsum beach immediately adjacent to the dike fill materials. Maintaining a gypsum beach against the perimeter walls of the stack (exterior walls) is especially important to improve stability and minimize the potential for an off-site spill or release of gypsum-fly ash sediments.

5.4 **Operating Guidelines**

5.4.1 Upstream Method of Construction

As discussed above, the Widows Creek gypsum/fly ash stack will be raised by the upstream method of construction, using rim ditch techniques for slurry distribution. Figure 5.3 schematically illustrates the steps involved in the upstream method of construction utilizing the recommended double dike rim ditch geometry discussed above.

As noted, sedimented gypsum is excavated from the elevated rim ditch and used to raise the perimeter gypsum dike and the inner berm of the rim ditch (dike in this case). The excavated material is wet cast onto the adjacent dike and allowed to dry prior to final shaping. After drying, the excavated material is dozer-shaped and compacted to form a new, elevated gypsum dike and inner berm that provide additional height and freeboard for the deposition of additional gypsum slurry.

Gypsum slurry is then discharged into the previously excavated rim ditch and the ditch refilled with fresh gypsum sediments. The newly sedimented material is subsequently excavated and used to construct the next lift of the perimeter dike and/or inner berm. This process is repeated until the gypsum stack has reached its maximum design height.

Each lift is accomplished by placing the excavated materials on the top and interior side of the gypsum dike and/or inner berm, with sufficient setback to maintain the overall design slope of the gypsum stack exterior wall (2.5H to 1.0V). Note that the quantity of fill required on the inboard side of the inner berm can become excessive if the gypsum "beach" in the adjacent sedimentation pond is not maintained and raised in conjunction with the perimeter rim ditch. If the depth of water adjacent to the inner berm is too great, or too much freeboard is provided, the volume of fill materials required to move the inner berm to the inside with each incremental lift of the perimeter dike can easily exceed the volume of material available in the rim ditch, requiring several refilling operations and a lot of equipment time to raise the dike. To be efficient, the depth of clear water on the pond side of the inner berm should generally not exceed 2 to 3 feet.

5.4.2 Rim Ditch and Perimeter Dike Construction

Each incremental lift of the perimeter gypsum dike and rim ditch should typically not exceed 2 to 3 feet in vertical thickness. Thicker lifts require longer drying times and the base of a thicker lift can not be adequately compacted from the fill surface with a dozer. Utilization of excessively thick lifts can result in a very loose and wet layer of low strength material being encapsulated at the base of the fill, potentially leading to localized instability or erosional piping when the rim ditch is refilled with slurry.

Each lift of the perimeter dike and inner berm should be set inboard sufficiently to maintain the design minimum width of the rim ditch system (see Figures 5.1 and 5.3) and the exterior slope of the stack. Although Figure 5.3 conceptually illustrates that both dikes of the rim ditch are raised together, they are in reality raised separately. It is recommended that the outer dike be raised and shaped prior to raising the inner berm, such that the crest elevation of the outer dike is always higher than the inner dike. Always keeping the outer dike higher than the inner berm will ensure that the rim ditch will safely overflow to the inside in the event that the ditch is blocked or becomes overfilled. It is recommended that the crest elevation of the inner berm be maintained not less than 1 foot below the crest elevation of the perimeter gypsum dike.

Although not observed at the Widows Creek facility, the practice of using narrow windrows of gypsum along the edges of the rim ditch such that the slurry elevation in the rim ditch is higher than the perimeter dike should be avoided. In the event that the order of construction results in the inner berm being temporarily raised higher that the perimeter dike, the inner berm should be cut through a regular intervals to establish overflow locations that are lower than the perimeter dike crest elevation. The gypsum slurry in the rim ditch or the ponded water level in the interior settling ponds (through the use of temporary berms or windrows) should never be allowed to raise above the perimeter dike crest elevation.

5.4.3 Slurry Distribution and Dike Freeboard

Figure 5.4 illustrates recommended changes in the slurry distribution system on top of the stack. As noted, the existing perimeter rim ditch and slurry distribution system will be expanded to include the west wall of Pond 2B and the internal divider dike between Ponds 2 and 3 will also be converted to a double dike configuration that will allow gypsum slurry to be directed along the axis of the dike. Converting to the rim ditch configuration will allow these dikes to be raised by the more conventional upstream method of construction, precluding the need for hauling and raising the dikes with mechanically-placed fill materials. To minimize earthwork, it is recommended that the divider dike separating Ponds 2A and 2B eventually be eliminated.

As discussed above, proper operation of the perimeter rim ditch requires that the elevation of the ditch at the location of the slurry discharge pipeline(s) be elevated sufficiently to provide enough slope along the axis of the ditch to maintain flow velocities and direct slurry to the remote end of the stack, which, for this facility, is the northeast corner of Pond 3. The lowest perimeter dike crest elevation, therefore, should occur at the northeast corner of Pond 3. It is recommended that the minimum freeboard at this location (defined as the vertical distance between the perimeter gypsum dike crest road and the ponded water surface in the adjacent settling pond) be not less than 3 feet.

Operating with a sightly greater minimum freeboard (e.g., 5 feet) is often beneficial since the increased elevation in the rim ditch relative to the adjacent ponded water surface promotes better drainage of the sedimented deposits in the rim ditch, resulting in improved handling characteristics during subsequent excavation. Maintaining too much freeboard, however, can be detrimental, in that the volume of fill material required to raise the inner berm of the rim ditch can become excessive as the dike height increases. Since the slope along the axis of the rim ditch is a function of the gypsum slurry material characteristics, maintaining additional freeboard at the remote end of the stack requires that the additional dike height also be provided along the entire length of the ditch.

Because the clear water decant structures for the Widows Creek stack are located on the west wall of Pond 2B, it is not desirable or practical to maintain excess freeboard along this section of perimeter dike. If the dike is too high, excavation associated with periodic removal and relocation of the decant outfall pipes can become excessive and impractical. The perimeter dike height and freeboard along the west wall of Pond 2B, therefore, will need to be similar to the dike height and freeboard maintained at the remote end of Pond 3. As a consequence and as shown on Figure 5.4, the elevation of the rim ditch at the slurry pipeline discharge locations will be on the order of 10 to 12 feet higher than the rim ditch along the west wall of Pond 2B and the divider dike between Ponds 2A and 2B and Pond 3.

Directing gypsum slurry from the more elevated section of the rim ditch location into the lower elevation rim ditch associated with the divider dike or the west wall of Pond 2B will most likely need to be accomplished through an internal transfer pipe to prevent the inner dike of the more elevated ditch from being eroded down the base elevation of the lower ditch. Figure 5.4 illustrates three new slurry transfer pipelines at the ends of the lowermost rim ditches. Although rigid metal pipes may be used, it may be desirable to use a more flexible HDPE pipeline at the slurry transfer locations.

The above-water slope of a sedimented gypsum "beach" within the clarification pond will typically be on the order of 3 to 4 feet vertical change in height for every 1,000 feet of horizontal distance from the point of discharge. The slope of the underwater deposits, however, will be much steeper and more on the order of 3 to 6 feet of vertical drop for every 100 feet of horizontal distance. The ideal configuration of a gypsum sedimentation pond is to maintain a small gypsum beach around the entire perimeter of the pond, thereby confining the deeper water depths needed for clarification to the center of the compartment. The minimum volume of water needed for clarification will be a function of many variables, including the particle size and gradation of the gypsum-fly ash slurry, and will need to be determined based on observed field experience. To the degree possible, the gypsum stack should be operated in such a manner as to maintain the deeper portions of the clarification pond near the center of the settling compartment, avoiding deep water depths immediately adjacent to the perimeter dike.

5.4.4 Decant Procedures

The Widows Creek gypsum/fly ash stack currently has two decant structures located on the west wall of Pond 2B, which is used as the final clarification pond prior to discharge into the stilling basin. Each of these structures consist of a rigid metal pipe that penetrates through the perimeter gypsum dike, with an adjustable weir board riser located on the pond side of the dike. The weir board riser structure has a total height of about 6 to 8 feet and must be moved up periodically as the height of the stack increases. This type of structure has been successfully used in the past at other facilities and may continue to be used at the Widows Creek stack, considering the following guidelines.

Failures of the perimeter dike at other facilities have been known to occur at similar decant structures due to erosional piping along the base of the pipeline due to poor bedding and compaction of backfill around the pipe during installation, and at the base of a poorly backfilled and compacted excavation where a pipeline through the perimeter dike has been removed and the dike backfilled. Extreme care should be taken when removing and backfilling around a relocated decant structure or backfilling an open excavation from which a structure has been removed.

Prior to removal and as shown on Figure 5.5, a gypsum beach should be established immediately upstream of the decant structure and inner berm of the proposed rim ditch (rim ditch not yet established at this location) and the rim ditch immediately upstream of the riser structure filled with sediment. The gypsum beach should extend not less than 100 feet into the sedimentation pond and remain in place during the pipe excavation, removal and backfill operations. Gypsum cofferdams shall be provided across the rim ditch on both sides of the decant riser structure. The cofferdams should have a top width of not less than 10 feet and a top elevation that is no lower than the crest elevation of the inner berm. Gypsum slurry or decant water should not be directed to the clarification pond from which the structure is being removed and the water level in the pond should be controlled as necessary to ensure that the level does not rise during the construction period. In the event that the recommended rim ditch and inner berm have not yet been established, it will be necessary to establish a wider gypsum beach and install a circular cofferdam around the upstream side of the riser structure that achieves the minimum dimension shown on Figure 5.5.

Excavation, removal and backfill of decant pipes should be performed only during daylight hours under the direct supervision of the gypsum stack manager or senior supervisory personnel trained and experienced in decant removal methods and procedures. Backfill of open cut excavations and backfill beneath and around newly installed decant pipes should be accomplished using only freshly sedimented moist or wet gypsum that can be worked and molded around the sides of the pipe to form an effective seal. Dry or hard gypsum should not be used for backfill operations, even if it is moisture-conditioned.

The side slope of excavations should be flattened sufficiently to allow equipment access for placement and compaction of the backfill. If dry or hard, the side slopes and base of the excavation should be scarified and wetted as necessary to ensure good bonding with the fill materials. The thickness of each lift of fresh gypsum fill should generally not exceed 12 inches, depending on the method of placement and compaction.

After backfill operations are complete, gypsum slurry should not be introduced back into that section of the rim ditch for not less than a 48-hour waiting period for the fresh gypsum backfill to cure or set up around the pipe or base of the excavation. Initial introduction of slurry back into the rim ditch adjacent to the backfilled excavation should occur during daylight hours only and the backfill or newly installed pipe inspected closely for proper performance. Follow-up inspections should be performed at regular intervals over the next 2-day period to confirm continued proper operation.

Although the existing facility can continue to be operated with the two existing decant structures, it would probably be beneficial to add an additional decant in the southwest corner of Pond 3 (or move one of the decants from Pond 2 to Pond 3) to improve decant water clarity when gypsum slurry is being discharged into Pond 2. Utilization of a siphon decant in Pond 3, as discussed below, would preclude the need for another pipe penetration through the perimeter dike.

5.4.5 Alternate Decant Procedure

Although the current decant procedures are adequate, a safer alternative to the buried decant pipes would be a siphon decant system where the discharge pipe crosses over the top of the perimeter dike and is raised with each lift of the dike, precluding the need for a dike penetration or periodic excavation and removal of the decant outfall pipe. Figure 5.6 illustrates the concepts involved with a siphon decant. The siphon pipe is normally an HDPE pressure rated pipe that is provided with a flow control valve at the toe of slope and an optional fill valve and vacuum break at the top of slope. The pond end of the pipe can be provided with a float and turned-down section of pipe to maintain submergence, or the end of the pipe can simply be weighted and submerged. Another advantage of the submerged siphon decant is that oily films or any floating materials are retained on top of the stack and will not be discharged to the stilling pond. A disadvantage is that sufficient water depth must be maintained on top of the stack at all times to keep the end of the pipe submerged sufficiently to prevent a loss of suction.

5.5 Summary of Recommendations for Gypsum Stack Operation

Operational guidelines for the Widows Creek gypsum-fly ash stack discussed above may be summarized as follows:

- The Widows Creek gypsum stack will be raised using the upstream method of construction, in conjunction with a double-dike rim ditch slurry distribution system, similar to the configuration shown on Figure 5.1.
- The crest road of the perimeter gypsum dike should be not less than 25 feet wide and the inner dike of the rim ditch should be not less than 20 feet wide. Slightly wider dikes, if needed for equipment access or safety, are acceptable but will impact operating costs (more equipment time required to raise wider dikes).
- The crest elevation of the inner berm (dike) of the rim ditch should be maintained at all times lower than the crest elevation of the perimeter dike to ensure that the rim ditch will safely overflow to the inside in the event that the ditch is blocked or becomes overfilled. It is recommended that at least significant lengths of the crest elevation of the inner berm be maintained not less than 1 foot below the crest elevation of the perimeter gypsum dike.
- A nominal rim ditch width of 50 feet is shown on Figure 5.1. Utilization of a slightly wider or narrower ditch based on field experience is acceptable and should have little to no effect on operating costs, although we do not recommend using a ditch that is less than about 30 feet wide.
- It is recommended that the current practice of raising the internal divider dikes and the west wall of Pond 2B using mechanically hauled and placed fill materials be phased out and that these dikes be converted with time to a double dike rim ditch configuration that will facilitate more conventional dike construction techniques using gypsum slurry distribution methods in conjunction with the upstream method of construction.
- The divider dike between Ponds 2A and 2B should also be phased out and eliminated with time. Elimination of this dike should result in reduction in equipment operating time and associated operating costs.
- Freeboard between the water level in the settling pond and the lowest crest road elevation of the perimeter gypsum dike, under normal circumstances, should be not less than 3 feet and generally not more than about 5 feet. Greater dike heights and associated freeboards at the low end of the pond, although technically safer, may lead to increased operating cost and time required to raise the perimeter dike and rim ditch system. Since the Widows Creek stack is a flow through facility, water can be removed from the top of the stack in advance of an imminent storm to provide additional freeboard as needed to minimize wind generated wave action in the pond.

- The use of temporary berms or narrow windrows along the inside edges of the rim ditch should be generally avoided. Gypsum slurry in the rim ditch or the ponded water level in the interior settling ponds (through the use of temporary berms or windrows) should never be allowed to raise above the crest road elevation of the perimeter gypsum dike.

- The perimeter gypsum dike of the elevated rim ditch should be raised in vertical lifts that are not more than 3 feet in vertical thickness and each lift of fill should be set back sufficiently to maintain the gypsum stack design side slope geometry of 2.5H to 1.0V between stabilization benches (see Figure 4.14). The inner berm (dike) of the rim ditch should be raised to the inside in similar manner, providing sufficient setback to maintain the desired total top width of the rim ditch system.

- Slurry discharge from the elevated rim ditch into the interior sedimentation pond will be through individual pipelines installed through the inner berm (dike) of the rim ditch. It will be necessary to raise these pipes periodically as the height of the stack increases and also move the pipes laterally to ensure uniform distribution of gypsum slurry around the perimeter of the pond. These pipes will be field located, as necessary.

- To the degree possible, attempt to maintain a small gypsum beach around the entire perimeter of the sedimentation pond (especially adjacent to exterior walls) in an effort to minimize the depth of clear water adjacent to the dike. The depth of clear water on the pond side of the inner berm of the rim ditch should generally not exceed 2 to 3 feet.

- Excavation and backfill operations associated with removal and/or repositioning of decant structures should be undertaken in accordance with the criteria presented in Figure 5.5 and discussed in Section 5.4.4 above, during daylight hours only, and under the direct supervision of the gypsum stack manager or senior supervisory personnel trained and experienced in decant removal and backfill procedures.

- Consideration should be given to changing to a siphon decant system, instead of the rigid pipe and weir board riser structures currently used.

- It is recommended that a formal training and inspection program be developed and implemented for the gypsum-fly ash storage facility, to include requirements for facility maintenance needed to facilitate routine inspections and ensure proper operation of the gypsum stack underdrain and perimeter toe ditch systems.

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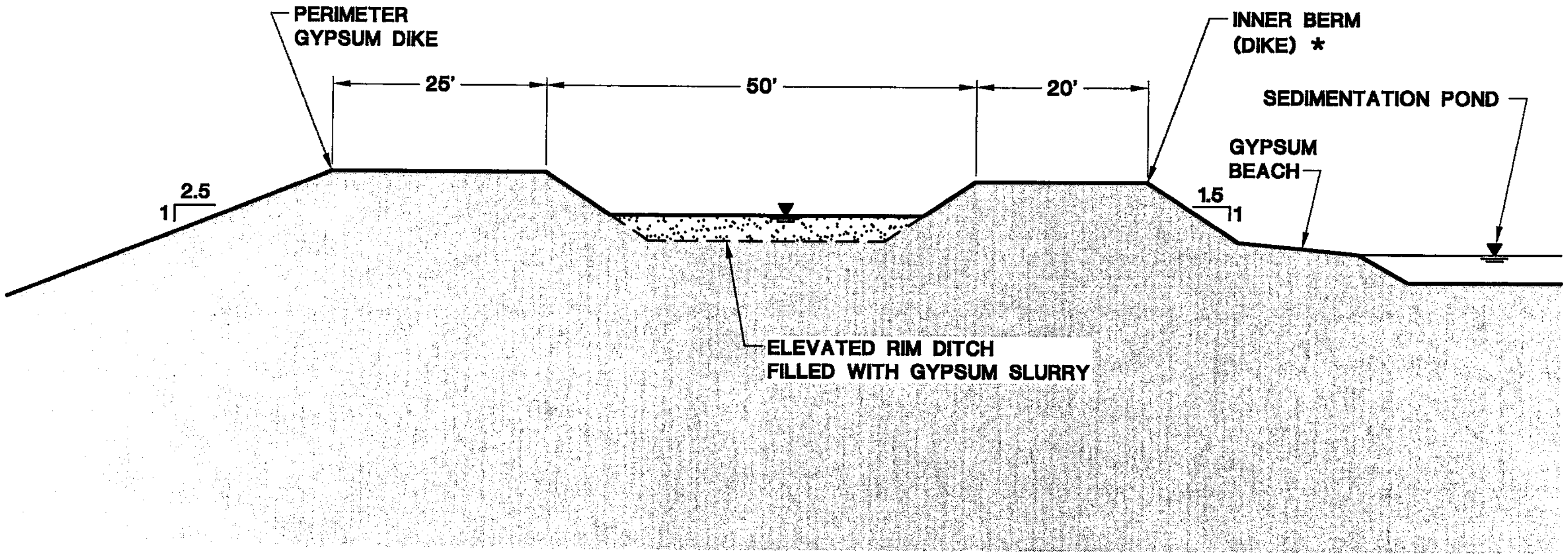

RECOMMENDED RIM DITCH GEOMETRY

*** NOTE:** CREST ELEVATION OF INNER BERM SHALL BE MAINTAINED LOWER THAN PERIMETER GYPSUM DIKE TO ENSURE RIM DITCH WILL SAFELY OVERFLOW TO INSIDE IN THE EVENT THAT RIM DITCH IS BLOCKED OR OVERFILLED.

TYPICAL RIM DITCH SECTION

Ardaman & Associates, Inc.
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STEVENSON, ALABAMA

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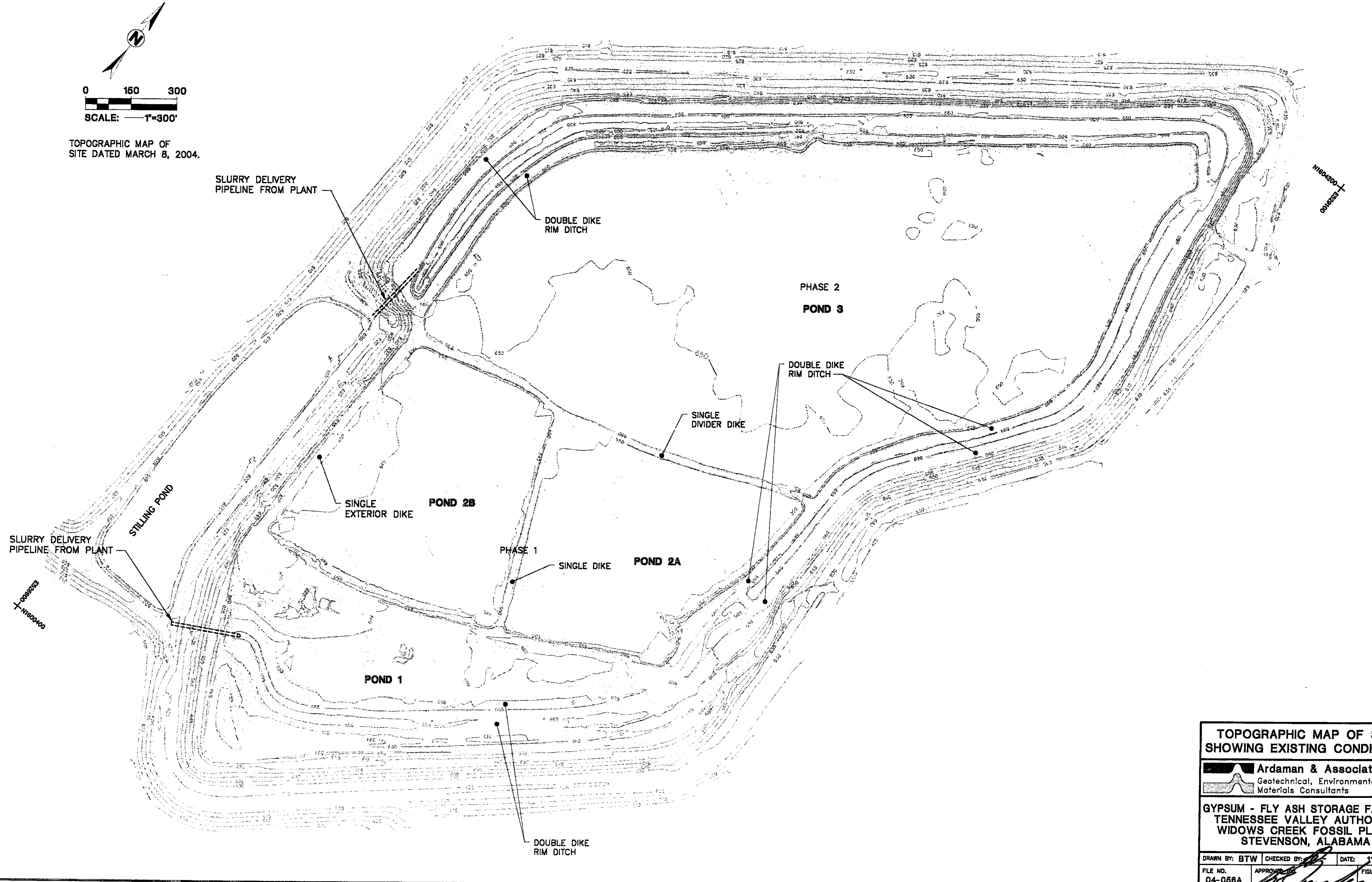

TOPOGRAPHIC MAP OF SITE DATED MARCH 8, 2004.

TOPOGRAPHIC MAP OF SITE SHOWING EXISTING CONDITIONS

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TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

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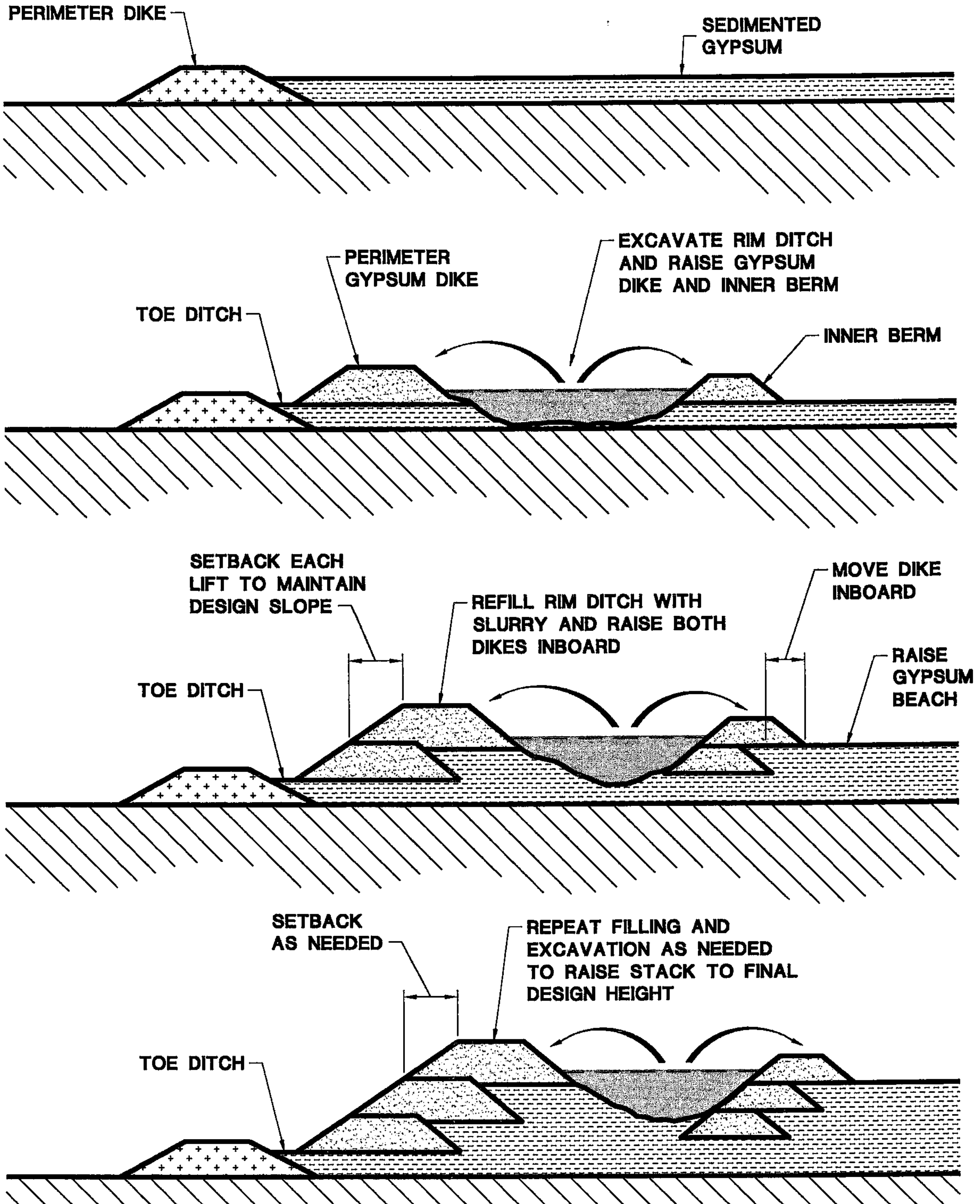

SCHEMATIC OF UPSTREAM METHOD OF GYPSUM STACK CONSTRUCTION

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WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

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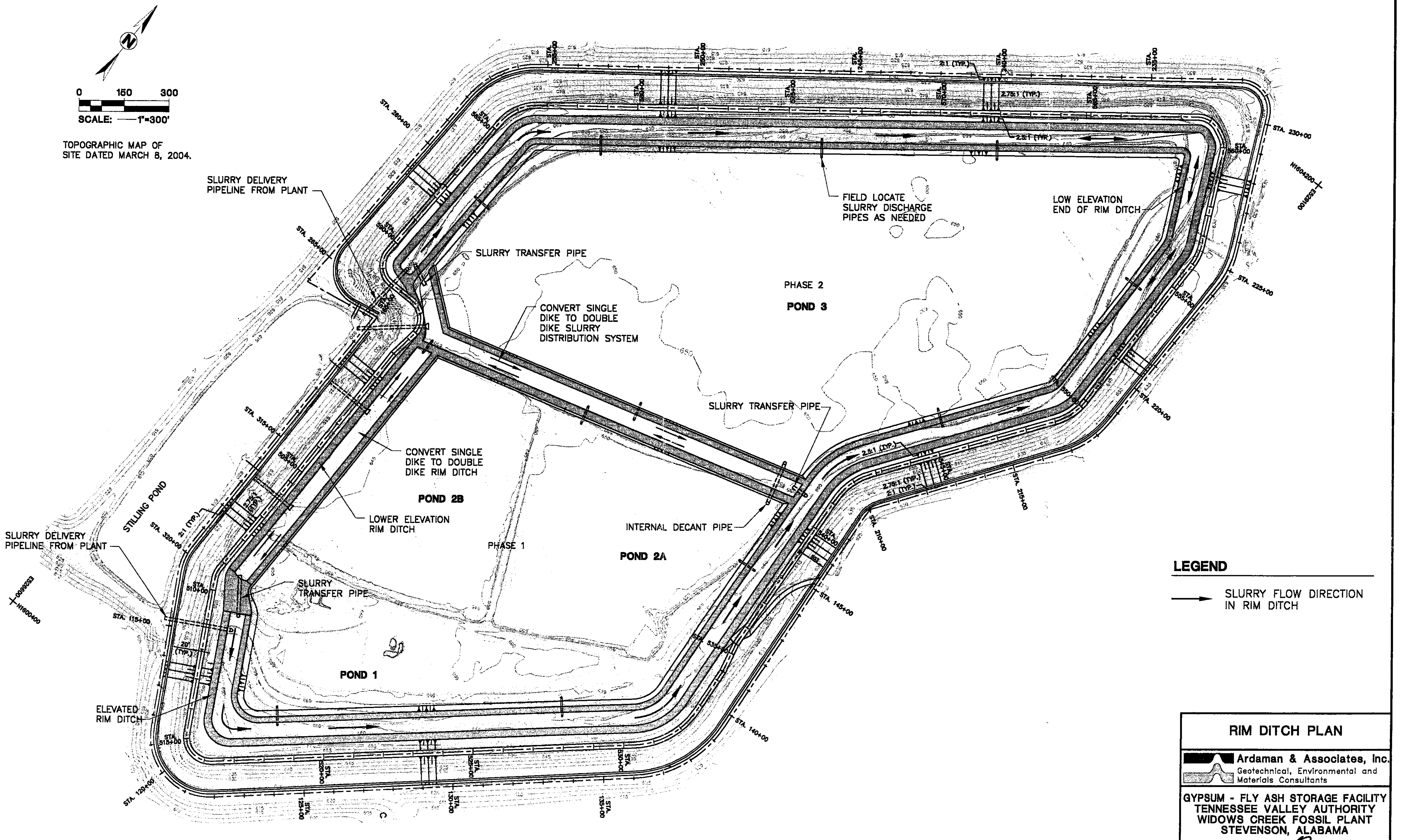

LEGEND

SLURRY FLOW DIRECTION IN RIM DITCH

RIM DITCH PLAN

Ardaman & Associates, Inc.
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WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

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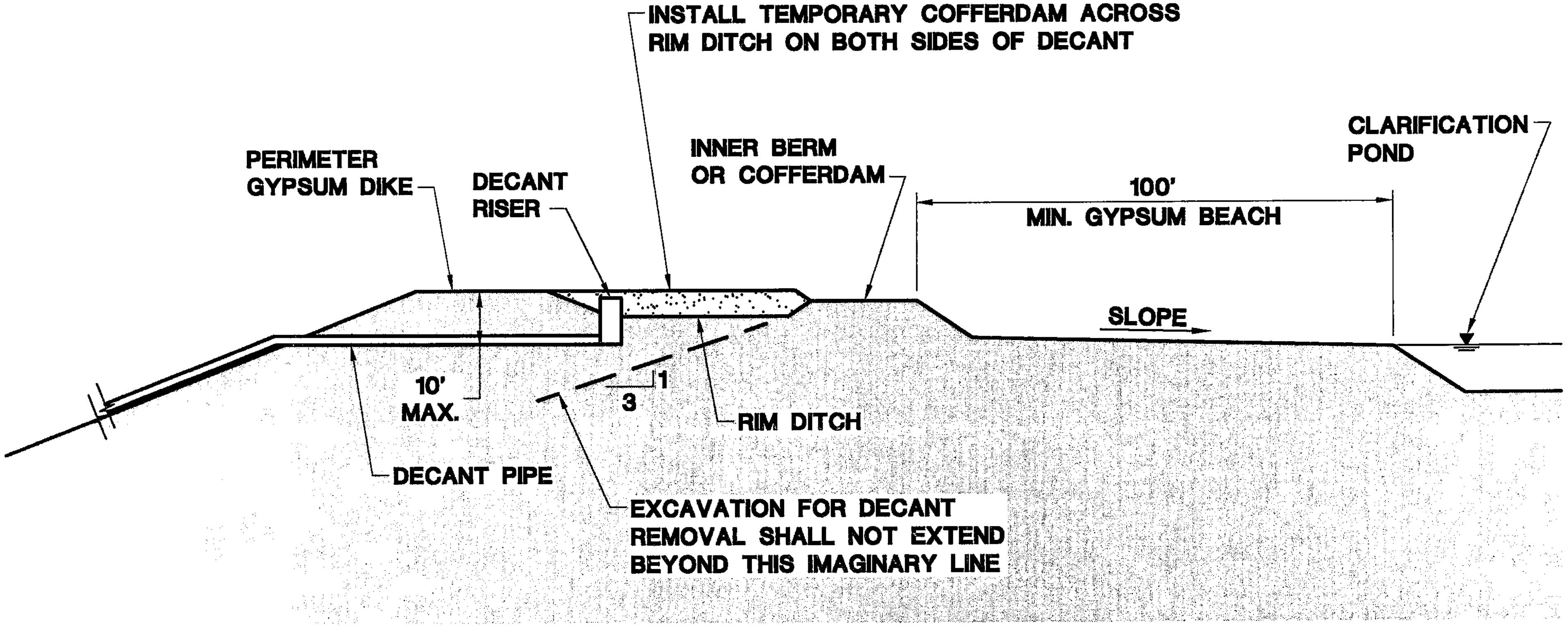

PRECAUTIONARY MEASURES TAKEN PRIOR TO DECANT EXCAVATION AND REMOVAL

DECANT REMOVAL

Ardaman & Associates, Inc.
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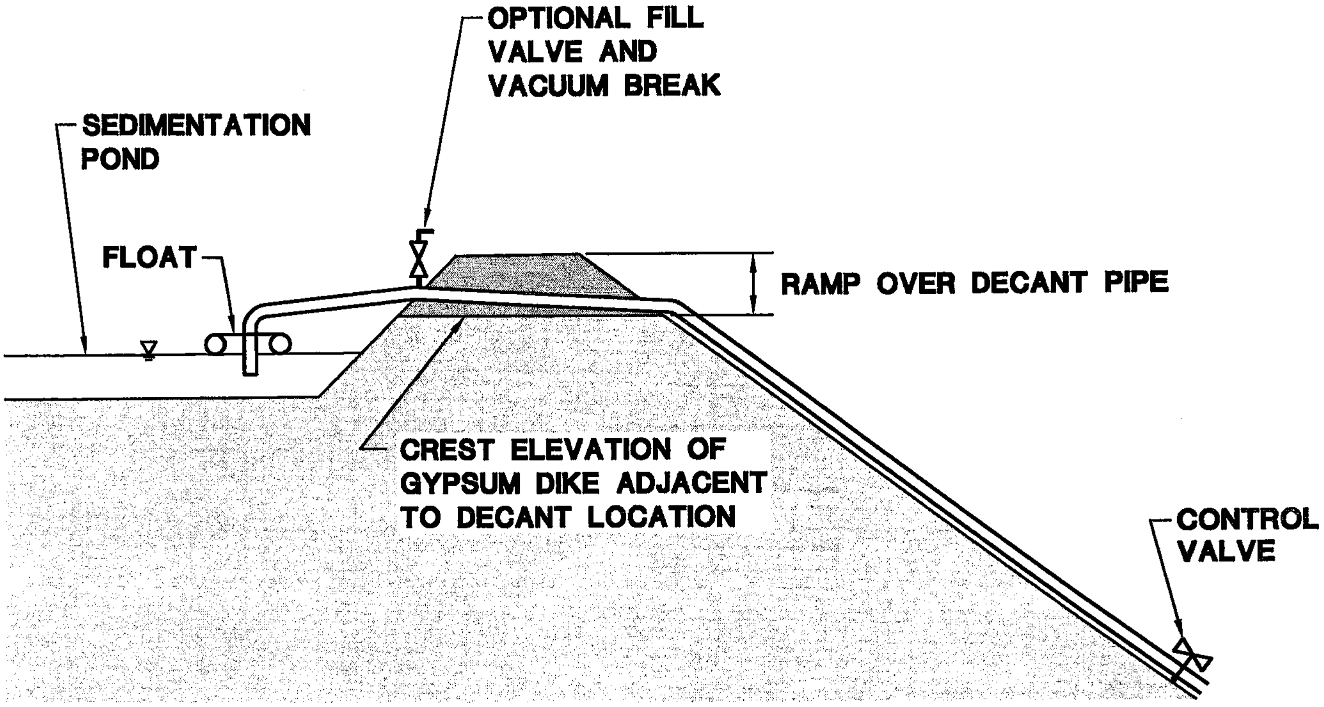

EXAMPLE OF SIPHON DECANT SYSTEM

SIPHON DECANT

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Appendix 1

Report of Geotechnical Drilling
MACTEC Engineering and Consulting, Inc.

REPORT OF GEOTECHNICAL DRILLING

GYPSUM/FLY ASH STORAGE FACILITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

Prepared For:

TENNESSEE VALLEY AUTHORITY

Chattanooga, Tennessee

Prepared By:

MACTEC ENGINEERING AND CONSULTING, INC.

Knoxville, Tennessee

MACTEC Project 3043041026/01

June 23, 2004

MACTEC

MACTEC

June 23, 2004

Mr. Ron Purkey
Tennessee Valley Authority
1101 Market Street, LP-2G
Chattanooga, TN 37402

Subject: **Report of Geotechnical Drilling**
Gypsum/Fly Ash Storage Facility
TVA Widows Creek Fossil Plant
Stevenson, Alabama
MACTEC Project 3043041026/01

Dear Mr. Purkey:

We at MACTEC Engineering and Consulting, Inc., (MACTEC) are pleased to submit this Summary Report of Geotechnical Drilling for your project. Our services, as authorized through TAO No. MAC-0698-00056 were provided in general accordance with our proposal number Prop04Knox/188 dated May 14, 2004.

This report summarizes our drilling services performed at the Gypsum/Fly Ash facility. The Appendices contain a brief description of the Field Exploratory Procedures, Field Boring Logs, Piezometer Installation Records, and Water Level Data.

We will be pleased to discuss the contents of our report with you and would welcome the opportunity to provide any engineering, drilling, or material testing services needed for the success of your project.

Sincerely,

MACTEC ENGINEERING AND CONSULTING, INC.

No. 25302
HUSSEIN AMIEN BENKHAYAL

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Senior Engineer
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Chief Engineer - Tennessee Operations

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REPORT OF GEOTECHNICAL DRILLING

GYPSUM/FLY ASH STORAGE FACILITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

Prepared For:

TENNESSEE VALLEY AUTHORITY

Chattanooga, Tennessee

Prepared By:

MACTEC ENGINEERING AND CONSULTING, INC.

Knoxville, Tennessee

MACTEC Project 3043041026/01

June 23, 2004

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EXECUTIVE SUMMARY

MACTEC was selected by the Tennessee Valley Authority (TVA) to perform geotechnical drilling for the existing Gypsum/Fly Ash storage facility at the Widows Creek Fossil Plant in Stevenson, Alabama. The drilling was performed in conjunction with design activities associated with the gypsum/fly ash storage facility. The drilling services performed for this project are summarized as follows:

- MACTEC drilled six test borings to depths ranging from about 36.5 to 66.5 feet. Standard penetration testing (SPT) was performed in these borings at 5-foot intervals. These borings typically encountered Gypsum and Fly Ash underlain by residual soils. The depth to the residual soils ranged from about 33.0 to 65.5 feet.
- Four sampling borings were drilled to obtain relative undisturbed samples to depths ranging from about 32.0 to 62.0 feet. A total of 30 attempts were made to obtain undisturbed samples from these borings.
- MACTEC personnel installed six sealed standpipe piezometers along the top of the Gypsum/Fly Ash stack and near the outside slope of the Gypsum/Fly Ash stack. The location of these piezometers corresponds to the locations of the six test borings. The total depth for the piezometers ranged from 30 to 45 feet.
- Five shallow standpipe piezometers were manually installed on the outside slope of the Gypsum/Fly Ash stack immediately downgradient from the piezometers installed at the top of the stack. The total depth of these piezometers ranged from about 4.2 to 7.2 feet.

This summary is only an overview and should not be used as a separate document or in place of reading the entire report, including the appendices.

1.0 INTRODUCTION

This report presents the field data and summary of our geotechnical drilling recently performed for the Gypsum/Fly Ash facility at TVA's Widows Creek Fossil Plant. Our services were authorized by Mr. Ron Purkey of TVA.

2.0 OBJECTIVES OF SERVICES

The objectives of our services were to provide geotechnical drilling support for design activities for the Gypsum/Fly Ash storage facility. An assessment of site environmental conditions, or an assessment for the presence or absence of pollutants in the soil, bedrock, surface water, or ground water of the site was beyond the proposed objectives of our exploration.

3.0 SCOPE OF EXPLORATION

The scope of our exploration was based on our proposal number Prop04Knox/188 dated May 14, 2004, and the geotechnical scope of work outlined in the project's scope of work prepared by Ardaman & Associates. It includes the following:

- Geotechnical drilling including installing standpipe piezometers
- Data report summarizing our field activities and field data

The drilling and sampling were performed in general accordance with ASTM procedures. The procedures are included in Appendix A. The field exploration was performed from May 24 to June 11, 2004. The equipment used consisted of a CME Model 75 truck-mounted drill rig equipped with a manual hammer. Standard penetration tests (SPTs) were performed at 5-foot vertical intervals. In addition to the SPT samples, several relatively undisturbed samples were obtained using the piston sampler.

Upon completion of drilling, the test borings were plugged and abandoned by backfilling the full depth with cement grout. All SPT and undisturbed samples were transferred to the custody of the Ardaman on-site representative.

The scope of the geotechnical drilling services for this project consisted of the following:

- Six test borings (including SPT testing) were drilled to depths ranging from about 35 to 65 feet. The SPT sampling was performed at 5-foot depth intervals in all test borings. Summary of these borings is presented in Table 1.
- Four sampling borings were drilled to obtain undisturbed samples using the piston sampler. These borings were advanced to depths ranging from about 32 to 62 feet. A total of 30 attempts were made to obtain undisturbed samples at depths intervals as directed by Ardaman. A summary of the sampling borings is presented in Table 2.
- Six sealed two-inch PVC standpipe piezometers were installed along the top of the Gypsum/Fly Ash stack and extended to near the base of the stack. The total depth of these piezometers ranged from about 30 to 45 feet.
- Five two-inch PVC standpipe piezometers were manually installed on the outside slopes of the stack. The total depth of these piezometers ranged from about 4.2 to 7.2 feet.

Table 1
Test Boring Summary

Test Boring Number	Approximate Depth to Natural Ground (Residual Soils) (Feet)	Total Depth of Boring (Feet)
SPT-1	45.5	46.5
SPT-2	65.5	66.5
SPT-3	33.0	36.5
SPT-4	42.5	46.5
SPT-5	48.5	51.5
SPT-6	47.0	51.5

Prepared By HAB Date 6/23/04 Checked By CHT Date 6/23/04

Table 2
Sampling Borings Summary

Sampling Boring Number	Total Depth of Boring (Feet)	Sample Depth (Feet)	Sample Recovery (Feet)
BH-1	41.5	20 - 22	2.0
		30 - 32	2.0
		40 - 41.5	1.2
BH-2	62.0	5 - 7	1.5
		10 - 12	2.0
		15 - 17	1.8
		20 - 22	2.0
		25 - 27	1.8
		30 - 32	1.7

Table 2
Sampling Borings Summary

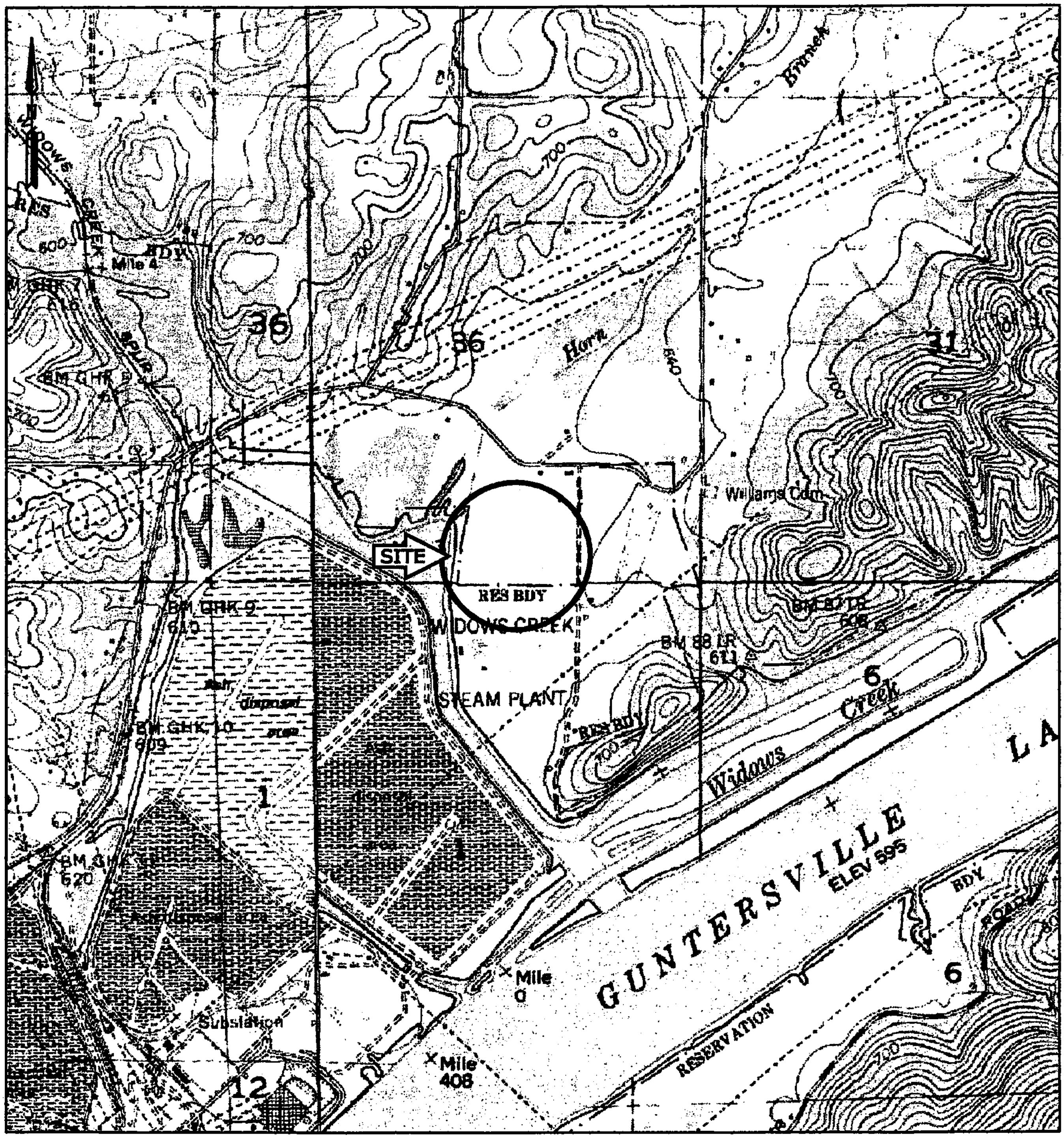
Sampling Boring Number	Total Depth of Boring (Feet)	Sample Depth (Feet)	Sample Recovery (Feet)
BH-2	62.0	35 - 37	0.8
		40 - 42	2.0
		45 - 47	1.6
		50 - 52	1.7
		55 - 57	1.1 (damaged)
		60 - 62	1.8
BH-3	32.0	10 - 12	1.7
		15 - 17	1.9
		20 - 22	0.5
		22.5 - 24.5	2.0
		25 - 27	1.8
		30 - 32	0.0
BH-4	42.0	5 - 7	1.0
		10 - 12	0.3
		12.5 - 14.5	2.0
		15 - 17	1.7
		20 - 22	1.7
		25 - 27	2.0
		30 - 32	2.0
		35 - 37	1.9
		40 - 42	2.0

Prepared By HAB Date 6/23/04 Checked By CMT Date 6/23/04

The field logs for the geotechnical test borings are included in Appendix B. The material descriptions provided on these logs were based on our visual-manual inspection of the samples in the field at the time of drilling. Therefore, these descriptions should not be considered final. The piezometer installation details are presented on the Piezometer Installation Records in Appendix C. Finally, water level readings obtained from the installed piezometers are presented in Appendix D.

At this time, the actual boring locations have not been surveyed and, therefore, we have not been able to obtain a site plan with actual boring locations from Ardaman. As a result, no Boring Location Plan is submitted in this report.

FIGURES



OURCE: USGS TOPOGRAPHIC MAPS OF BRIDGEPORT AND DORAN COVE, AL QUADRANGLES

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FIGURE 1: SITE LOCATION MAP
GYPSUM / FLY ASH FACILITY
TVA WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

DRAFTING BY:	PREPARED BY: HAB	CHECKED BY: CDT
JOB NUMBER: 3043041026/0001	DATE: JUNE 16, 2004	SCALE: 0 2000'

COORDINATES: N XX°XX'XX" W XX°XX'XX"

APPENDIX A

FIELD EXPLORATORY PROCEDURES

FIELD EXPLORATORY PROCEDURES

Soil Test Boring (Hollow Stem) and Sampling

All boring and sampling operations were conducted in general accordance with ASTM D 1586. All borings were advanced by mechanically twisting continuous steel hollow-stem auger flights into the ground. Soil samples were obtained in the test borings utilizing a standard 1.4-inch I.D., 2-inch O.D., split-tube sampler. The sampler was first seated six inches to penetrate any loose cuttings and then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot of penetration was recorded and is designated the "standard penetration resistance (SPT)". Proper evaluation of the penetration resistance provides an index to the soil's strength, density, and ability to support loads. Representative portions of the soil samples obtained from the split-tube sampler were sealed in glass jars. The relatively undisturbed samples were obtained from the sampling borings by pushing a section of 3-inch O.D., 16-gauge steel tubing into the soil at the depths assigned by Ardaman. A piston sampler was used to obtain the undisturbed samples. After pushing the tube into the soil, the tube was carefully removed from the ground and made airtight. All SPT and undisturbed samples were placed in the custody of Ardaman's field representative. Field Boring Logs are attached.

Boring Backfill

The borings were backfilled to the ground surface with cement grout. The owner is advised that, even with this backfill technique, there is the possibility of future borehole subsidence depending on actual subsurface conditions, surface drainage, etc. The property owner should monitor the boring locations over time to discover subsidence and make the necessary repairs.

APPENDIX B

FIELD BORING LOGS

MACTEC SOIL TEST BORING FIELD REPORT

BORING NO. SPT-1 PG. 1 OF 2

B NO. 3043 04 1026 DRILLER G. Akins HOURS DRILLING ______ GROUND SURFACE ELEV. ______

B NAME TVA WCF LOGGED BY H. Benkhayal HOURS MOVING ______ DATE: 5/26/04 WEATHER: Cloudy Hot

SAMPLING					SCALE	UD	REC	SOIL CLASSIFICATION	REMARKS
		"N"							
No.	Depth	1st 6"	2nd 6"	3rd 6"					
1	0-1.5	2	5	9	0			Firm Lt. brown moist silty fine sand - gypsum	
2	5-6.5	8	6	6	5			Same as above. w/ fly ash	
3	10-11.5	2	9	14	0			Firm Gray moist si sand/SDY silt gypsum & Fly Ash	
4	15-16.5	5	20	26	5			Dense Gray moist si fine sand gypsum & fly Ash	
5	20-21.5	2	9	12	0			Firm Gray wet si sand/SDY silt - gypsum & Fly Ash water introduced in augers ≈ 20'	
6	25-26.5	5	13	16	5			Same as above	
7	30-31.5	2	WoH	WoH	0			V. soft gray wet clayey silt - Fly ash with little gypsum	
8	35-36.5	1	1	WoH	5			Same as above.	
9	40-41.5	4	5	5	0			Stiff gray wet clayey & SDY silt - Fly Ash w/some gypsum	

+STANDARD PENETRATION RESISTANCE IS SUM OF BLOWS FOR 2ND 6" AND 3RD 6" TO DRIVE 1-3/8" I.D., 2" O.D.
+SPLIT BARREL SAMPLER WITH 140 POUND HAMMER FALLING 30 INCHES.

BORING TERMINATED: 46.5
BORING REFUSAL: NA
WATER TOB DEPTH ~17.0'
WATER 24 HR.: DEPTH ______
WATER LOSSES ______
CAVE-IN DEPTHS ______
CASING: SIZE ______ LENGTH ______
STANDBY TIME ______ BORING LAYOUT ______

METHOD OF ADVANCING BORING	DEPTH
POWER AUGER 3 1/4"	0 TO 45
HAND SHOP: W/MUD: W/WATER	___ TO ___
ROTARY DRILL: W/MUD: W/WATER	___ TO ___
DIAMOND CORE	___ TO ___
CORE SIZE	___ TO ___

UNDISTURBED SAMPLES NO ___ SIZE ___
BAG SAMPLES NO ______

F1024 8/00

MACTEC SOIL TEST BORING FIELD REPORT

BORING NO. SPT-1 PG. 2 OF 2

JOB NO. 3043 04 1026 DRILLER G. Akins HOURS DRILLING ______ GROUND SURFACE ELEV. ______

JOB NAME TVA WCF gypsum LOGGED BY H. Benkhaya HOURS MOVING ______ DATE: 5/26/04 WEATHER: Cloudy Hot

SAMPLING					SCALE	UD	REC	SOIL CLASSIFICATION	REMARKS
No.	Depth	"N" 1ST 6"	2ND 6"	3RD 6"					
					0				
10	45-46.5	WOH	3	4	5			45 → 45.5 V. Soft Same as above	
								45.5 → 46.5 Firm R-b & Yellow moist si clay - Residuum	
					0			Boring Terminated @ 46.5'	
					5			Hole was grouted upon Comletion (8 Cemet bags)	
					0				
					5				
					0				
					5				
					0				

+STANDARD PENETRATION RESISTANCE IS SUM OF BLOWS FOR 2ND 6" AND 3RD 6" TO DRIVE 1-3/8" I.D., 2" O.D. SPLIT BARREL SAMPLER WITH 140 POUND HAMMER FALLING 30 INCHES.

BORING TERMINATED: 46.5
BORING REFUSAL: NA
WATER TOB DEPTH ~17.0'
WATER 24 HR.: DEPTH ______
WATER LOSSES ______
CAVE-IN DEPTHS ______
CASING: SIZE ______ LENGTH ______
STANDBY TIME ______ BORING LAYOUT ______

METHOD OF ADVANCING BORING	DEPTH
POWER AUGER 3 1/4"	0 TO 45
HAND SHOP: W/MUD: W/WATER	___ TO ___
ROTARY DRILL: W/MUD: W/WATER	___ TO ___
DIAMOND CORE	___ TO ___
CORE SIZE	___ TO ___
UNDISTURBED SAMPLES NO___ SIZE ___	
BAG SAMPLES NO______	

MACTEC SOIL TEST BORING FIELD REPORT

BORING NO. SPT-2 PG. 1 OF 2

JOB NO. 3043 04 1026 DRILLER G. Akins HOURS DRILLING ______ GROUND SURFACE ELEV. ______

JOB NAME TVA WCF Gypsum LOGGED BY H. Benkhayal HOURS MOVING ______ DATE: 5/25/04 WEATHER: P. Cloudy Hot

SAMPLING					SCALE	UD	REC	SOIL CLASSIFICATION	REMARKS
No.	Depth	"N"							
		1ST 6"	2ND 6"	3RD 6"					
1	0-1.5	2	5	7	0			Firm Lt brown & gray moist silty fine	
								sand - Gypsum & fly ash	
2	5-6.5	3	6	6	5			Same as above	
3	10-11.5	9	13	15	0			Same as above	
4	15-16.5	16	22	21	5			Same as above - Dense	
5	20-21.5	2	2	5	0			Firm Gray wet SDY Silt - Fly Ash w/little	
								gypsum	
								* Introduced water in augers *	
6	25-26.5	3	6	7	5			Firm Lt.-Brown & Gray wet silty sand -	
								Gypsum with Fly ash	
7	30-31.5	4	5	7	0			Same as above.	
8	35-36.5	3	4	4	5			Same as above - Loose	
9	40-41.5	4	6	8	0			Same as above	

+STANDARD PENETRATION RESISTANCE IS SUM OF BLOWS FOR 2ND 6" AND 3RD 6" TO DRIVE 1-3/8" I.D., 2" O.D. SPLIT BARREL SAMPLER WITH 140 POUND HAMMER FALLING 30 INCHES.

BORING TERMINATED: 66.5'
BORING REFUSAL: NA
WATER TOB DEPTH ~18.5'
WATER 24 HR.: DEPTH ______
WATER LOSSES ______
CAVE-IN DEPTHS ______
CASING: SIZE ______ LENGTH ______
STANDBY TIME ______ BORING LAYOUT ______

METHOD OF ADVANCING BORING		DEPTH
POWER AUGER	3 1/4"	0 TO 65
HAND SHOP: W/MUD: W/WATER		______ TO ______
ROTARY DRILL: W/MUD: W/WATER		______ TO ______
DIAMOND CORE		______ TO ______
CORE SIZE		______ TO ______

UNDISTURBED SAMPLES NO ____ SIZE ____
BAG SAMPLES NO ______

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SOIL TEST BORING FIELD REPORT

BORING NO. SPT - 2 PG. 2 OF 2

OB NO. 304304 1026 DRILLER G. Akins HOURS DRILLING ______ GROUND SURFACE ELEV. ______

JOB NAME TVA WCF Gyps LOGGED BY H. Benkheyal HOURS MOVING ______ DATE: 5/25/04 WEATHER: P. Cloudy Hot

SAMPLING					SCALE	UD	REC	SOIL CLASSIFICATION	REMARKS
No.	Depth	"N"							
		1ST 6"	2ND 6"	3RD 6"	0				
0	45-46.5	3	4	5	5			Same as above – Loose	
11	50-51.5	6	12	13	0			Same as above – Firm	
12	55-56.5	9	11	12	5			Same as above – Firm	
13	60-61.5	7	3	4	0			Firm Gray wet SDY silt- Fly Ash w/ little gypsum	
14	65-66.5	WOH	7	12	5			65 → 65.5 same as above V. Soft	
								65.5 → 66.5 V. Stiff R-br & Yell. moist silty clay w/ RK frags - Residuum	
					0			Boring Terminated @ 66.5	
								Hole grouted on 5/26/04 a.m. (Used 12 Bags of Cement)	
					5				
					0				

+STANDARD PENETRATION RESISTANCE IS SUM OF BLOWS FOR 2ND 6" AND 3RD 6" TO DRIVE 1-3/8" I.D., 2" O.D. SPLIT BARREL SAMPLER WITH 140 POUND HAMMER FALLING 30 INCHES.

BORING TERMINATED: 66.5
BORING REFUSAL: NA
WATER TOB DEPTH ~ 18.5'
WATER 24 HR.: DEPTH ______
WATER LOSSES ______
CAVE-IN DEPTHS ______
CASING: SIZE ______ LENGTH ______
STANDBY TIME ______ BORING LAYOUT ______

METHOD OF ADVANCING BORING	DEPTH
POWER AUGER 3 1/4"	0 TO 65
HAND SHOP: W/MUD: W/WATER	______ TO ______
ROTARY DRILL: W/MUD: W/WATER	______ TO ______
DIAMOND CORE	______ TO ______
CORE SIZE	______ TO ______

UNDISTURBED SAMPLES NO ___ SIZE ___
BAG SAMPLES NO ______

MACTEC SOIL TEST BORING FIELD REPORT

BORING NO. SPT- 3 PG. 1 OF 1

OB NO. 3043041022 DRILLER G. Akins HOURS DRILLING ______ GROUND SURFACE ELEV. ______

JOB NAME WCF Gypsum LOGGED BY H. Benkhayal HOURS MOVING ______ DATE: 5/24/04 WEATHER: P. Cloudy

SAMPLING					SCALE	UD	REC	SOIL CLASSIFICATION	REMARKS
No.	Depth	"N" 1ST 6"	2ND 6"	3RD 6"					
1	0-1.5	3	6	8	0			stiff Lt.Br. sl. moist SDY silt - Fly Ash & Gypsum	
2	5-6.5	7	7	7	5			Firm Gray wet silty fine Sand - Fly Ash	
3	10-11.5	6	9	9	0			Same as above	
4	15-16.5	2	2	3	5			Firm Gray wet sandy silt - Fly Ash	
5	20-21.5	1	1	1	0			V. soft Dk. Gray wet silt - Fly Ash	
								Drilling firm from 23.5 - 25.0'	
6	25-26.5	4	5	6	5			Stiff Dk. Gray wet SDY silt - Fly Ash	
7	30-31.5	4	5	5	0			Same as above.	
								Driller Notes clay at ≈ 33.0'	
8	35-36.5	2	5	7	5			Stiff R-brown and Yellow moist silty clay - Residuum	
								Boring Terminated @ 36.5	
					0			Hole Grouted on 5/25/04 a.m. (5 Bags)	

BORING TERMINATED: 36.5
BORING REFUSAL: N/A
WATER TOB DEPTH ~ 5.0
WATER 24 HR.: DEPTH ______
WATER LOSSES ______
CAVE-IN DEPTHS ______
CASING: SIZE ______ LENGTH ______
STANDBY TIME ______ BORING LAYOUT ______

METHOD OF ADVANCING BORING	DEPTH
POWER AUGER 3 1/4'	0 TO 35
HAND SHOP: W/MUD: W/WATER	___ TO ___
ROTARY DRILL: W/MUD: W/WATER	___ TO ___
DIAMOND CORE	___ TO ___
CORE SIZE	___ TO ___

UNDISTURBED SAMPLES NO ___ SIZE ___
BAG SAMPLES NO ______

+STANDARD PENETRATION RESISTANCE IS SUM OF BLOWS FOR 2ND 6" AND 3RD 6" TO DRIVE 1-3/8" I.D., 2" O.D. SPLIT BARREL SAMPLER WITH 140 POUND HAMMER FALLING 30 INCHES.

MACTEC SOIL TEST BORING FIELD REPORT

BORING NO. SPT-4 PG. 1 OF 2

JOB NO. 3043 04 1026 DRILLER G. Akins HOURS DRILLING ______ GROUND SURFACE ELEV. ______

JOB NAME TVA WCF Gypsum LOGGED BY H. Benkhayal HOURS MOVING ______ DATE: 5/27/04 WEATHER: P. Cloudy Hot

SAMPLING					SCALE	UD	REC	SOIL CLASSIFICATION	REMARKS
No.	Depth	"N" 1st 6"	2nd 6"	3rd 6"					
1	0/1.5	2	2	4	0			Loose Lt-brown mo'st silty fine sand – Gypsum	
2	5/6.5	5	6	5	5			Firm Lt. Brown & Lt-gray moist Si, fine sand – Gypsum	
3	10/11.5	1	2	9	0			Firm Lt Brow & gray wet si fine sand – gypsum w/some ash	
4	15/16.5	5	17	18	5			Dense Lt Brown wet si fine sand – gypsum and gray SDY silt – Ash	
5	20/21.5	3	2	3	0			Firm Gray & Lt. Brown Wet SDY si/Si SD – Fly Ash and gypsum	
6	25/26.5	2	2	8	5			Stiff – same as above	
7	30/31.5	5	7	17	0			V. stiff – Same as above	
8	35/36.5	5	7	7	5			Stiff – Same as above	
9	40/41.5	4	3	3	0			Firm Gray wet SDY clayey silt – Fly Ash w/gypsum	

+STANDARD PENETRATION RESISTANCE IS SUM OF BLOWS FOR 2ND 6" AND 3RD 6" TO DRIVE 1-3/8" I.D., 2" O.D. SPLIT BARREL SAMPLER WITH 140 POUND HAMMER FALLING 30 INCHES.

BORING TERMINATED: 46.5
BORING REFUSAL: NA
WATER TOB DEPTH ~10
WATER 24 HR.: DEPTH ______
WATER LOSSES ______
CAVE-IN DEPTHS ______
CASING: SIZE ______ LENGTH ______
STANDBY TIME ______ BORING LAYOUT ______

METHOD OF ADVANCING BORING	DEPTH
POWER AUGER 3 1/4"	0 TO 45
HAND SHOP: W/MUD: W/WATER	___ TO ___
ROTARY DRILL: W/MUD: W/WATER	___ TO ___
DIAMOND CORE	___ TO ___
CORE SIZE	___ TO ___

UNDISTURBED SAMPLES NO ___ SIZE ___
BAG SAMPLES NO ______

MACTEC **SOIL TEST BORING FIELD REPORT**

BORING NO. SPT-4 PG. 2 OF 2

OB NO. 3043 04 1026 DRILLER G. Akins HOURS DRILLING ______ GROUND SURFACE ELEV. ______

JOB NAME TVA WCF Gypsum LOGGED BY H. Benkhayal HOURS MOVING ______ DATE: 5/27/04 WEATHER: P. Cloudy Hot

SAMPLING		"N"			SCALE	UD	REC	SOIL CLASSIFICATION	REMARKS
No.	Depth	1ST 6"	2ND 6"	3RD 6"					
					0				
0	45/46.5	8	11	15	5			V. Stiff R-br, Yellow & gray moist si clay	
								—Residuum	
								Boring Terminated at 46.5'	
					0				
								Hole was grouted after Completion	
								(Used 9 Bags of Cement)	
					5				
					0				
					5				
					0				
					5				
					0				

+STANDARD PENETRATION RESISTANCE IS SUM OF BLOWS FOR 2ND 6" AND 3RD 6" TO DRIVE 1-3/8" I.D., 2" O.D. SPLIT BARREL SAMPLER WITH 140 POUND HAMMER FALLING 30 INCHES.

BORING TERMINATED: 46.5'
BORING REFUSAL: NA
WATER TOB DEPTH ~10
WATER 24 HR.: DEPTH ______
WATER LOSSES ______
CAVE-IN DEPTHS ______
CASING: SIZE ______ LENGTH ______
STANDBY TIME ______ BORING LAYOUT ______

METHOD OF ADVANCING BORING		DEPTH
POWER AUGER	3 1/4"	0 TO 45
HAND SHOP: W/MUD: W/WATER		TO
ROTARY DRILL: W/MUD: W/WATER		TO
DIAMOND CORE		TO
CORE SIZE		TO

UNDISTURBED SAMPLES NO ____ SIZE ____
BAG SAMPLES NO ______

MACTEC **SOIL TEST BORING FIELD REPORT**

BORING NO. SPT-5 PG. 1 OF 2

OB NO. 3043 04 1026 DRILLER G. Akins HOURS DRILLING ______ GROUND SURFACE ELEV. ______

JOB NAME TVA WCF Gypsum LOGGED BY A. Benkhayal HOURS MOVING ______ DATE: 5/25/04 WEATHER: P. Cloudy Hot

SAMPLING					SCALE	UD	REC	SOIL CLASSIFICATION	REMARKS
No.	Depth	"N" 1ST 6"	"N" 2ND 6"	"N" 3RD 6"					
					0				
1	0-1.5	3	4	5				Firm Gray moist sandy silt - Fly Ash and light brown silty sand gypsum	
2	5-6.5	3	11	15	5			V. stiff Gray & light brown moist sandy silt - Fly Ash & gypsum	
3	10-11.5	5	11	13	0			V. Stiff gray wet sandy silt - Fly Ash with some bands of lt. brown si SD - gypsum	
4	15-16.5	6	15	13	5			Same as above	
5	20-21.5	1	1	1	0			V. Soft gray wet SDY silt - Fly Ash *water introduce in augers ≈ 22' *	
6	25-26.5	3	8	3	5			same as above - stiff	
7	30-31.5	2	1	2	0			Soft gray wet SDY silt/silty Sand - Fly Ash	
8	35-36.5	WOH	2	2	5			Same as above - soft	
9	40-41.5	9	6	2	0			Stiff Lt. Brown and gray wet si SD/SDY si - Fly ash & gypsum to soft gray wet SDY si - Fly Ash	

BORING TERMINATED: 51.5
BORING REFUSAL: NA
WATER TOB DEPTH ~10.0
WATER 24 HR.: DEPTH ______
WATER LOSSES ______
CAVE-IN DEPTHS ______
CASING: SIZE ______ LENGTH ______
STANDBY TIME ______ BORING LAYOUT ______

METHOD OF ADVANCING BORING		DEPTH
POWER AUGER	3 1/4"	0 TO 50
HAND SHOP: W/MUD: W/WATER		___ TO ___
ROTARY DRILL: W/MUD: W/WATER		___ TO ___
DIAMOND CORE		___ TO ___
CORE SIZE		___ TO ___
UNDISTURBED SAMPLES	NO ___ SIZE ___	
BAG SAMPLES	NO ______	

+STANDARD PENETRATION RESISTANCE IS SUM OF BLOWS FOR 2ND 6" AND 3RD 6" TO DRIVE 1-3/8" I.D., 2" O.D. +SPLIT BARREL SAMPLER WITH 140 POUND HAMMER FALLING 30 INCHES.

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SOIL TEST BORING FIELD REPORT

BORING NO. SPT-5 PG. 2 OF 2

JOB NO. 3043041026 DRILLER G. Akins HOURS DRILLING ______ GROUND SURFACE ELEV. ______

JOB NAME TVA WCF Gypsum LOGGED BY H. Benkhayal HOURS MOVING ______ DATE: 5/25/04 WEATHER: P. Cloudy Hot

SAMPLING					SCALE	UD	REC	SOIL CLASSIFICATION	REMARKS
No.	Depth	"N" 1st 6"	2nd 6"	3rd 6"					
					0				
10	45-46.5	3	1	WOH	5			V. Soft DK-Gray wet SDY Clayey silt – Fly Ash	
								Driller's Note: Firm drilling from 48.5'–50.0'	
11	50-51.5	WOH	5	11	0			V. Stiff R-br & Yellow moist silty & sandy Clay – Residuum	
					5			Boring Terminated @ 51.5'	
								Hole grouted upon completion	(9 Bags of Cement)
					0				
					5				
					0				
					5				
					0				

+STANDARD PENETRATION RESISTANCE IS SUM OF BLOWS FOR 2ND 6" AND 3RD 6" TO DRIVE 1-3/8" I.D., 2" O.D. SPLIT BARREL SAMPLER WITH 140 POUND HAMMER FALLING 30 INCHES.

BORING TERMINATED: 51.5
BORING REFUSAL: NA
WATER TOB DEPTH ~10.0'
WATER 24 HR.: DEPTH ______
WATER LOSSES ______
CAVE-IN DEPTHS ______
CASING: SIZE ______ LENGTH ______
STANDBY TIME ______ BORING LAYOUT ______

METHOD OF ADVANCING BORING	DEPTH
POWER AUGER 3¼"	0 TO 50
HAND SHOP: W/MUD: W/WATER	___ TO ___
ROTARY DRILL: W/MUD: W/WATER	___ TO ___
DIAMOND CORE	___ TO ___
CORE SIZE	___ TO ___
UNDISTURBED SAMPLES NO ___ SIZE ___	
BAG SAMPLES NO ______	

MACTEC SOIL TEST BORING FIELD REPORT

BORING NO. SPT-6 PG. 1 OF 2

JOB NO. 3043 04 1026 DRILLER G. Akins HOURS DRILLING ______ GROUND SURFACE ELEV. ______

JOB NAME TVA WCF Gypsum LOGGED BY H. BenKhaya HOURS MOVING ______ DATE: 5/26/04 5/27/04 WEATHER: P. Cloudy, Hot

SAMPLING		"N"			SCALE	UD	REC	SOIL CLASSIFICATION	REMARKS
No.	Depth	1ST 6"	2ND 6"	3RD 6"					
1	0-1.5	2	3	2	0			Loose Light br & gray moist	si SD - gypsum
								w/Little Fly Ash	
2	5-6.5	2	2	5	5			Loose gray & lt-br V. moist si SD/SDY si -	
								Fly Ash & gypsum	
3	10-11.5	1	3	6	0			Same as above - wet	
4	15-16.5	2	2	2	5			Soft gray to DK gray wet clayey &	
								SDY silt - fly Ash	
	5/27/04							* water introduced in augers	
5	20-21.5	2	1	1	0			V. Soft gray wet clayey & SDY silt - fly Ash	
								* Firm drilling from 20' → 25'	
6	25/26.5	12	19	23	5			Dense Lt gray & Lt brown wet si sand	
								gypsum w/some fly Ash	
7	30/31.5	10	10	9	0			V. stiff gray to dark gray wet SDY &	
								clayey silt - Fly Ash w/some gypsum	
8	35/36.5	6	6	8	5			Stiff gray & dark gray wet SDY silt -	
								Fly Ash & gypsum	
9	40/41.5	10	22	23	0			Dense Lt gray, Lt brown & gray wet silty Sand	
								Gypsum w/some fly Ash.	

+STANDARD PENETRATION RESISTANCE IS SUM OF BLOWS FOR 2ND 6" AND 3RD 6" TO DRIVE 1-3/8" I.D., 2" O.D. SPLIT BARREL SAMPLER WITH 140 POUND HAMMER FALLING 30 INCHES.

BORING TERMINATED: 51.5'
BORING REFUSAL: NA
WATER TOB DEPTH ~ 15'
WATER 24 HR.: DEPTH ______
WATER LOSSES ______
CAVE-IN DEPTHS ______
CASING: SIZE ______ LENGTH ______
STANDBY TIME ______ BORING LAYOUT ______

METHOD OF ADVANCING BORING		DEPTH
POWER AUGER	3¼"	0 TO 50
HAND SHOP: W/MUD: W/WATER		___ TO ___
ROTARY DRILL: W/MUD: W/WATER		___ TO ___
DIAMOND CORE		___ TO ___
CORE SIZE		___ TO ___
UNDISTURBED SAMPLES NO ___ SIZE ___		
BAG SAMPLES NO ______		

MACTEC SOIL TEST BORING FIELD REPORT

BORING NO. SPT-6 PG. 2 OF 2
JOB NO. 3043 04 1026 DRILLER G. Akins HOURS DRILLING ______ GROUND SURFACE ELEV. ______
JOB NAME TVA WCF Gypsum LOGGED BY H. Benkhayal HOURS MOVING ______ DATE: 5/27/04 WEATHER: P. Cloudy – HOT

SAMPLING					SCALE	UD	REC	SOIL CLASSIFICATION	REMARKS
No.	Depth	"N" 1ST 6"	2ND 6"	3RD 6"					
					0				
10	45–46.5	8	4	2	5			Firm gray & lt br. wet clayey & SDY silt –	
								Fly Ash & silty sand – gypsum.	
								Driller's Note: clay @ ≈ 47.0'	
11	50/51.5	3	6	11	0			V. stiff R-br, Yellow & lt gray moist si clay	
								w/ Blk mang. st – Resid.	
								Boring Terminated at 51.5'	
					5			Hole was grouted upon completion	
								(Used 19 Bags of cement)	
					0				
					5				
					0				
					5				
					0				

+STANDARD PENETRATION RESISTANCE IS SUM OF BLOWS FOR 2ND 6" AND 3RD 6" TO DRIVE 1-3/8" I.D., 2" O.D. SPLIT BARREL SAMPLER WITH 140 POUND HAMMER FALLING 30 INCHES.

BORING TERMINATED: 51.5
BORING REFUSAL: N/A
WATER TOB DEPTH ~ 15
WATER 24 HR.: DEPTH ______
WATER LOSSES ______
CAVE-IN DEPTHS ______
CASING: SIZE ______ LENGTH ______
STANDBY TIME ______ BORING LAYOUT ______

METHOD OF ADVANCING BORING	DEPTH
POWER AUGER 3¼"	0 TO 50
HAND SHOP: W/MUD: W/WATER	___ TO ___
ROTARY DRILL: W/MUD: W/WATER	___ TO ___
DIAMOND CORE	___ TO ___
CORE SIZE	___ TO ___

UNDISTURBED SAMPLES NO ___ SIZE ___
BAG SAMPLES NO ______

F1024 8/00

MACTEC **SOIL TEST BORING FIELD REPORT**

BORING NO. BH-1 **PG.** 1 **OF** 1

JOB NO. 3043 04 1026 **DRILLER** G. Akins **HOURS DRILLING** ______ **GROUND SURFACE ELEV.** ______

JOB NAME TVA WCF **LOGGED BY** H. Benkhayal **HOURS MOVING** ______ **DATE:** 6/03/04 **WEATHER:** P.C. Hot

SAMPLING					SCALE	UD	REC	SOIL CLASSIFICATION	REMARKS
No.	Depth	"N" 1ST 6"	2ND 6"	3RD 6"					
					0				
					5				
					0				
					5				
UD-1					20	X	2.0'		
					22				
					5				
UD-2					30	X	2.0'		
					32				
					5			Hole was grouted after Completion used 7 Cement bags	
UD-3					40	X	1.2'		
					41.5				

+STANDARD PENETRATION RESISTANCE IS SUM OF BLOWS FOR 2ND 6" AND 3RD 6" TO DRIVE 1-3/8" I.D., 2" O.D. SPLIT BARREL SAMPLER WITH 140 POUND HAMMER FALLING 30 INCHES.

BORING TERMINATED: 41.5'
BORING REFUSAL: NA
WATER TOB DEPTH ______
WATER 24 HR.: DEPTH ______
WATER LOSSES ______
CAVE-IN DEPTHS ______
CASING: SIZE ______ **LENGTH** ______
STANDBY TIME ______ **BORING LAYOUT** ______

METHOD OF ADVANCING BORING	DEPTH
POWER AUGER 3 1/4"	0 TO 40
HAND SHOP: W/MUD: W/WATER	___ TO ___
ROTARY DRILL: W/MUD: W/WATER	___ TO ___
DIAMOND CORE	___ TO ___
CORE SIZE	___ TO ___
UNDISTURBED SAMPLES NO 3 SIZE 3"	Used a Piston
BAG SAMPLES NO ______	

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SOIL TEST BORING FIELD REPORT

BORING NO. BH-2 PG. 1 OF 2

JOB NO. 3043 04 1026 DRILLER G. Akins HOURS DRILLING ____ GROUND SURFACE ELEV. ____

JOB NAME TVA WCF LOGGED BY H. Benkhayal HOURS MOVING ____ DATE: 6/02/04 WEATHER: P. Cloudy Hot

SAMPLING No.	Depth	"N" 1st 6"	2nd 6"	3rd 6"	SCALE	UD	REC	SOIL CLASSIFICATION	REMARKS
					0				
UD-1					5	X	18.5 1.5'		
					7				
UD-2					10	X	2.0'		
					12				
UD-3					15	X	21.5' 1.8'		
					17				
UD-4					20	X	2.0'		
					22				
UD-5					25	X	1.8'		
					27				
UD-6					30	X	1.7'		
					32				
UD-7					35	X	0.8'		
					37				

+STANDARD PENETRATION RESISTANCE IS SUM OF BLOWS FOR 2ND 6" AND 3RD 6" TO DRIVE 1-3/8" I.D., 2" O.D. SPLIT BARREL SAMPLER WITH 140 POUND HAMMER FALLING 30 INCHES.

BORING TERMINATED: 62.0
BORING REFUSAL: NA
WATER TOB DEPTH
WATER 24 HR.: DEPTH
WATER LOSSES
CAVE-IN DEPTHS
CASING: SIZE ____ LENGTH ____
STANDBY TIME ____ BORING LAYOUT ____

METHOD OF ADVANCING BORING		DEPTH
POWER AUGER	3 1/4"	0 TO 60
HAND SHOP: W/MUD: W/WATER		TO
ROTARY DRILL: W/MUD: W/WATER		TO
DIAMOND CORE		TO
CORE SIZE		TO

UNDISTURBED SAMPLES NO 12 SIZE 3 Used Piston Samples
BAG SAMPLES NO ____

MACTEC SOIL TEST BORING FIELD REPORT

BORING NO. BH-2 PG. 2 OF 2

JOB NO. 3043 04 1026 DRILLER G. AKins HOURS DRILLING ______ GROUND SURFACE ELEV. ______

JOB NAME TVA WCF LOGGED BY H. Benkhayat HOURS MOVING ______ DATE: 6/02/04 WEATHER: P. Cloudy Hot

SAMPLING					SCALE	UD	REC	SOIL CLASSIFICATION	REMARKS
No.	Depth	"N"							
		1ST 6"	2ND 6"	3RD 6"					
			UD-8		40 42	X	2.0'		
			UD-9		45 47	X	1.6'		
			UD-10		50 52	X	1.7'		
			UD-11		55 57	X	1.1'	Tube bent - sample was discarded	
			UD-12		60 62	X	1.8'		
					5			Boring Terminated @ 62.0' Hole was grouted after completion used 12 bags of cement	
					0				
					5				
					0				

+STANDARD PENETRATION RESISTANCE IS SUM OF BLOWS FOR 2ND 6" AND 3RD 6" TO DRIVE 1-3/8" I.D., 2" O.D. SPLIT BARREL SAMPLER WITH 140 POUND HAMMER FALLING 30 INCHES.

BORING TERMINATED: 62.0
BORING REFUSAL: NA
WATER TOB DEPTH ______
WATER 24 HR.: DEPTH ______
WATER LOSSES ______
CAVE-IN DEPTHS ______
CASING: SIZE ______ LENGTH ______
STANDBY TIME ______ BORING LAYOUT ______

METHOD OF ADVANCING BORING		DEPTH
POWER AUGER	3 1/4"	0 TO 60
HAND SHOP: W/MUD: W/WATER		TO
ROTARY DRILL: W/MUD: W/WATER		TO
DIAMOND CORE		TO
CORE SIZE		TO
UNDISTURBED SAMPLES	NO 12 SIZE 3" used Piston Samples	
BAG SAMPLES	NO ______	

MACTEC SOIL TEST BORING FIELD REPORT

BORING NO. BH-3 PG. 1 OF 1

JOB NO. 304304 1026 DRILLER G. Akins HOURS DRILLING ______ GROUND SURFACE ELEV. ______

JOB NAME TVA WCF LOGGED BY H. Benkhayal HOURS MOVING ______ DATE: 6/03/04 WEATHER: P. Cloudy Hot

SAMPLING					SCALE	UD	REC	SOIL CLASSIFICATION	REMARKS
No.	Depth	"N"							
		1ST 6"	2ND 6"	3RD 6"					
					0				
					5				
UD-1					10 12		24" 1.7		
UD-2					15 17		23" 1.9		
UD-3					20 22		0.5'	Sample was discarded	
UD-4					22.5 24.5		2.0'		
UD-5					25 27		22" 1.8'		
UD-6					30 32		0		
					5				
					0				

Boring Terminated @ 32.0'

Hole was grouted on 6/04/04 a.m.

Used 5 bags of Cement

+STANDARD PENETRATION RESISTANCE IS SUM OF BLOWS FOR 2ND 6" AND 3RD 6" TO DRIVE 1-3/8" I.D., 2" O.D. SPLIT BARREL SAMPLER WITH 140 POUND HAMMER FALLING 30 INCHES.

BORING TERMINATED: 32.0'
BORING REFUSAL: NA
WATER TOB DEPTH ______
WATER 24 HR.: DEPTH ______
WATER LOSSES ______
CAVE-IN DEPTHS ______
CASING: SIZE ______ LENGTH ______
STANDBY TIME ______ BORING LAYOUT ______

METHOD OF ADVANCING BORING		DEPTH
POWER AUGER	3¼"	0 TO 30
HAND SHOP: W/MUD: W/WATER		TO
ROTARY DRILL: W/MUD: W/WATER		TO
DIAMOND CORE		TO
CORE SIZE		TO
UNDISTURBED SAMPLES	NO 6 SIZE 3"	Used a Piston Sampler
BAG SAMPLES	NO ______	

MACTEC SOIL TEST BORING FIELD REPORT

BORING NO. BH-4 PG. 1 OF 1

JOB NO. 3043041026 DRILLER Q. Akins HOURS DRILLING ______ GROUND SURFACE ELEV. ______

JOB NAME TVA WCF LOGGED BY H. BenKhayal HOURS MOVING ______ DATE: 6/01/04 WEATHER: P. Cloudy Hot

SAMPLING					SCALE	UD	REC	SOIL CLASSIFICATION	REMARKS
No.	Depth	"N" 1ST 6"	2ND 6"	3RD 6"					
					0				
UD-1					5 7	X	1.0'		
UD-2					10 12	X	0.3'		
UD-3					12.5 14.5	X	2.0'		
UD-4					15 17	X	1.7'		
UD-5					20 22	X	1.7'		
UD-6					25 27	X	2.0'		
UD-7					30 32	X	2.0'		
UD-8					35 37	X	1.9	Hole Was Grouted after Completion (Used 9 Bags of Cement)	
UD-9					40 42	X	2.0'		

+STANDARD PENETRATION RESISTANCE IS SUM OF BLOWS FOR 2ND 6" AND 3RD 6" TO DRIVE 1-3/8" I.D., 2" O.D. SPLIT BARREL SAMPLER WITH 140 POUND HAMMER FALLING 30 INCHES.

BORING TERMINATED: 42'

BORING REFUSAL: NA

WATER TOB DEPTH ______

WATER 24 HR.: DEPTH ______

WATER LOSSES ______

CAVE-IN DEPTHS ______

CASING: SIZE ______ LENGTH ______

STANDBY TIME ______ BORING LAYOUT ______

METHOD OF ADVANCING BORING	DEPTH
POWER AUGER 3¼"	0 TO 40
HAND SHOP: W/MUD: W/WATER	___ TO ___
ROTARY DRILL: W/MUD: W/WATER	___ TO ___
DIAMOND CORE	___ TO ___
CORE SIZE	___ TO ___
UNDISTURBED SAMPLES NO 9 SIZE 3	using piston sampler
BAG SAMPLES NO ______	

51024 9/00

APPENDIX C

PIEZOMETER INSTALLATION RECORDS

PIEZOMETER INSTALLATION RECORD

PIEZOMETER NUMBER PZ-1

INSTALLATION DATE 06/09/2004

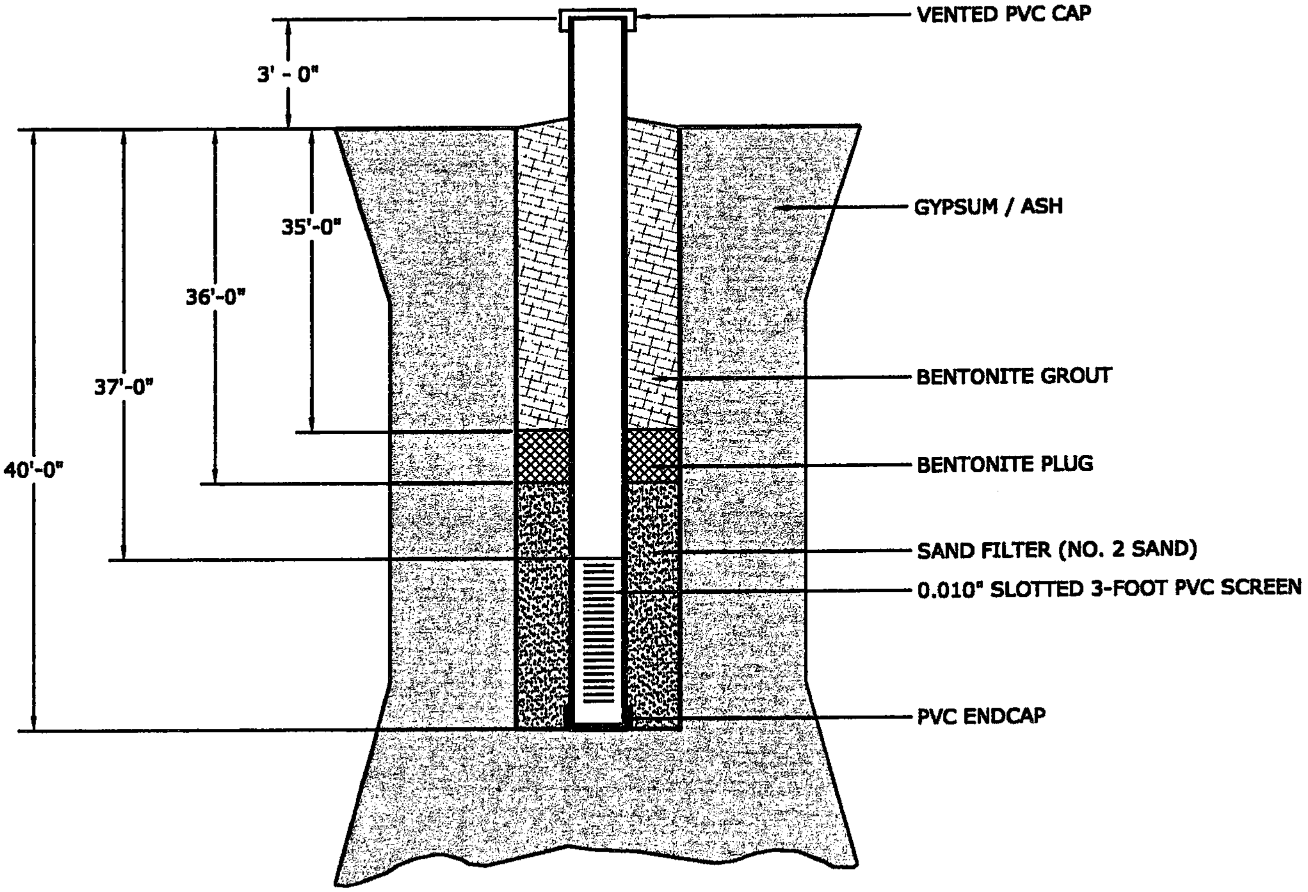
TOTAL DEPTH 40' - 0"

RISER/SCREEN

MATERIAL SCHEDULE 40 PVC

DIAMETER 2.0"

SLOT SIZE 0.010"



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865-588-8544 • Fax: 865-588-8026

PIEZOMETER INSTALLATION RECORD
TVA - WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

COORDINATES: N xx° W xx°

DRAFTING BY:	PREPARED BY: HAB	CHECKED BY: CDT
JOB NUMBER: 3043041026/0001	DATE: JUNE 16, 2004	SCALE: NOT TO SCALE

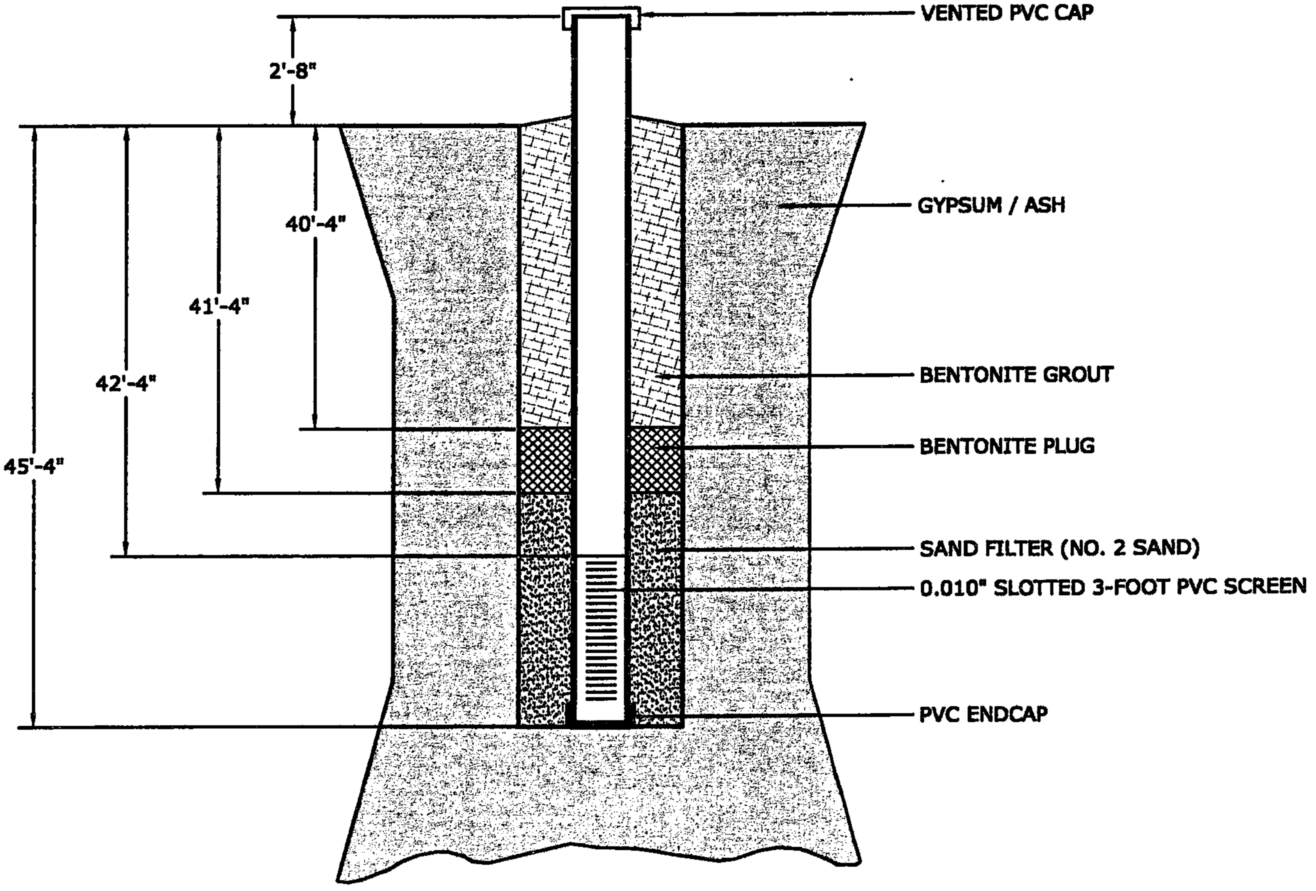
PIEZOMETER INSTALLATION RECORD

PIEZOMETER NUMBER PZ-2

INSTALLATION DATE 06/10/2004

TOTAL DEPTH 45' - 4"

RISER/SCREEN
MATERIAL SCHEDULE 40 PVC
DIAMETER 2.0"
SLOT SIZE 0.010"



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PIEZOMETER INSTALLATION RECORD
TVA - WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

DRAFTING BY: RBB	PREPARED BY: HAB	CHECKED BY: CDT
JOB NUMBER: 3043041026/0001	DATE: JUNE 16, 2004	SCALE: NOT TO SCALE

COORDINATES: N xx° W xx°

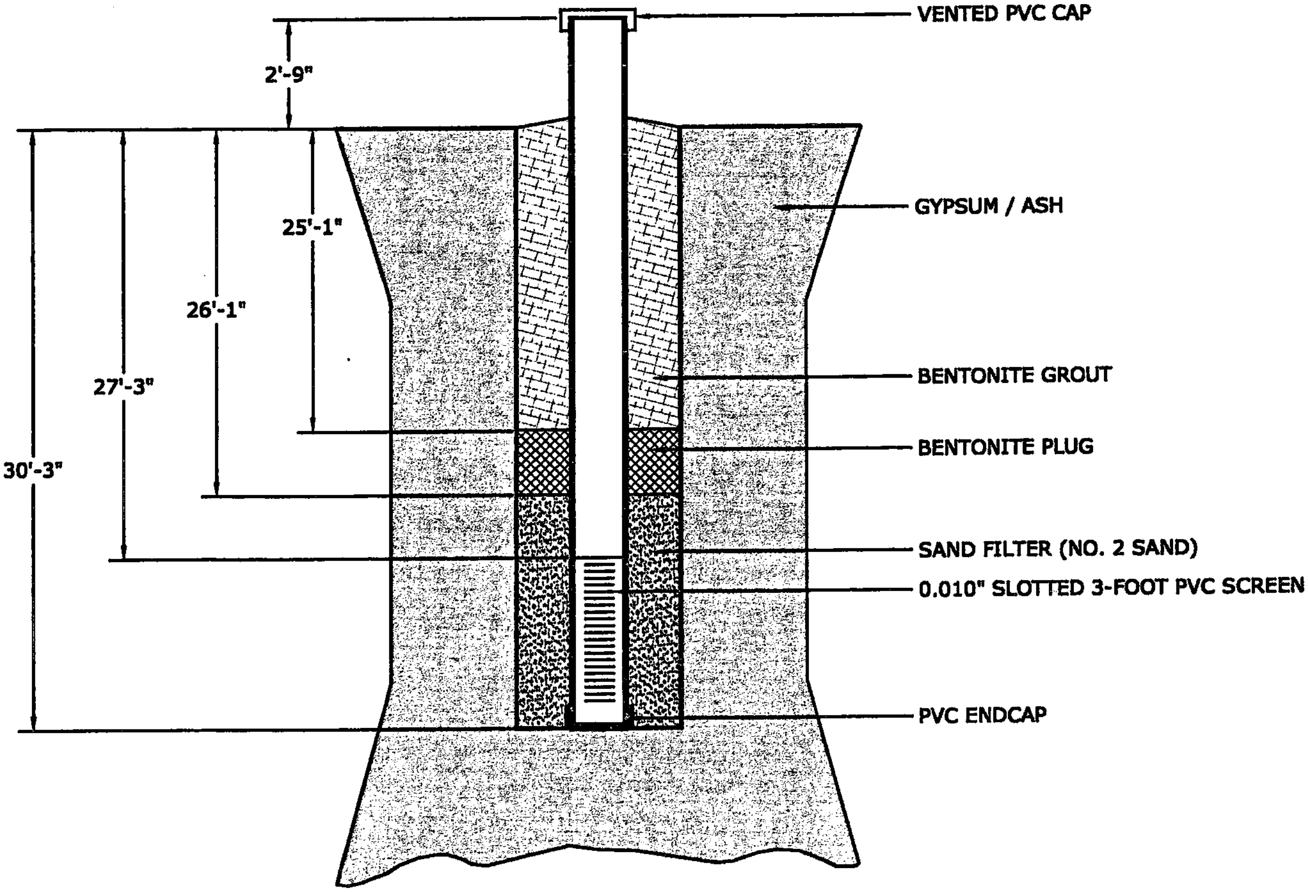
PIEZOMETER INSTALLATION RECORD

PIEZOMETER NUMBER PZ-3

INSTALLATION DATE 06/04/2004

TOTAL DEPTH 30' - 3"

RISER/SCREEN
MATERIAL SCHEDULE 40 PVC
DIAMETER 2.0"
SLOT SIZE 0.010"



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PIEZOMETER INSTALLATION RECORD TVA - WIDOWS CREEK FOSSIL PLANT STEVENSON, ALABAMA

COORDINATES: N xx° W xx°

DRAFTING BY:	PREPARED BY: HAB	CHECKED BY: CDT
JOB NUMBER: 3043041026/0001	DATE: JUNE 16, 2004	SCALE: NOT TO SCALE

PIEZOMETER INSTALLATION RECORD

PIEZOMETER NUMBER PZ-4

INSTALLATION DATE 06/08/2004

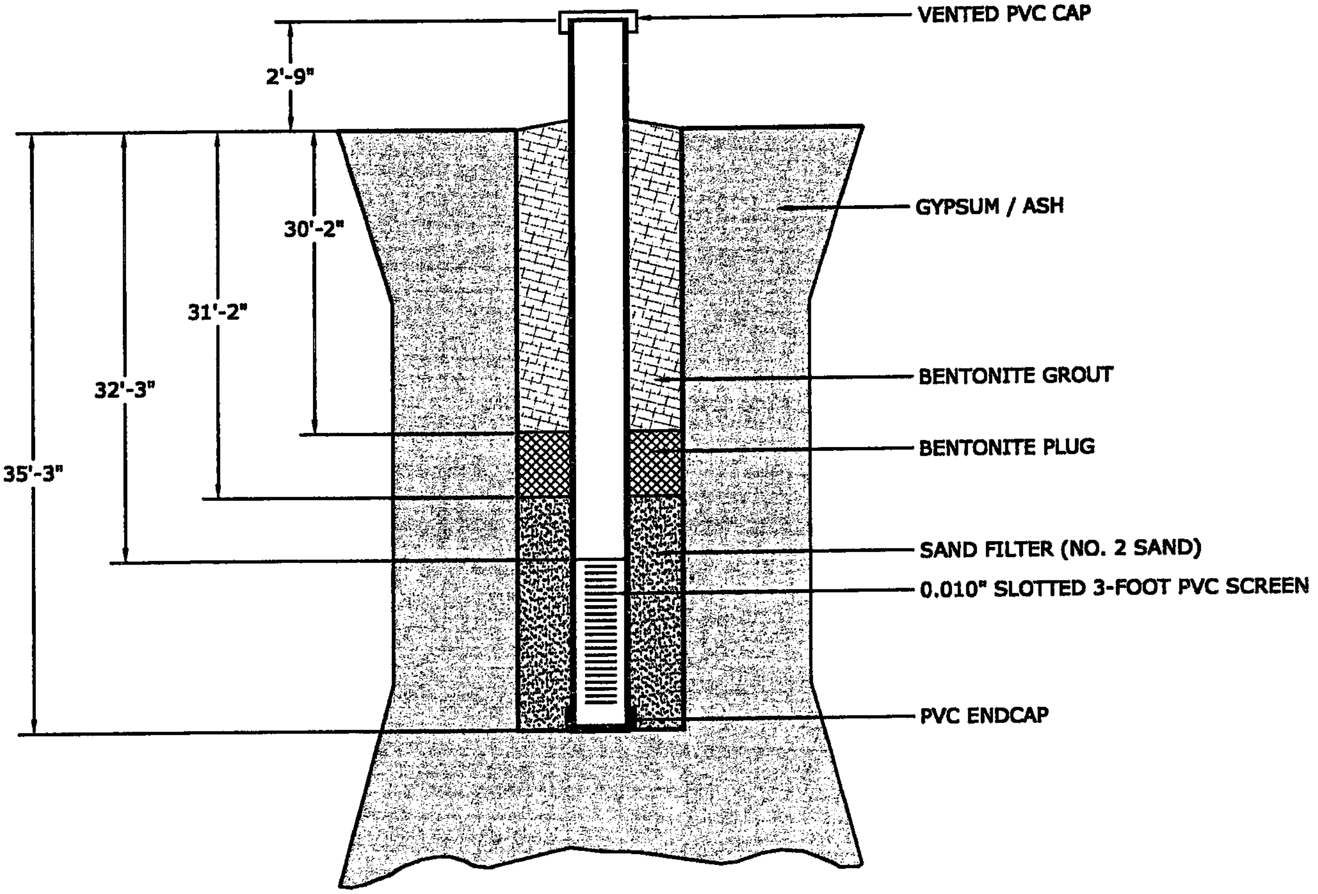
TOTAL DEPTH 35' - 3"

RISER/SCREEN

MATERIAL SCHEDULE 40 PVC

DIAMETER 2.0"

SLOT SIZE 0.010"



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PIEZOMETER INSTALLATION RECORD
TVA - WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

COORDINATES: N xx° W xx°

DRAFTING BY:	PREPARED BY: HAB	CHECKED BY: CDT
JOB NUMBER: 3043041026/0001	DATE: JUNE 16, 2004	SCALE: NOT TO SCALE

PIEZOMETER INSTALLATION RECORD

PIEZOMETER NUMBER PZ-5

INSTALLATION DATE 06/09/2004

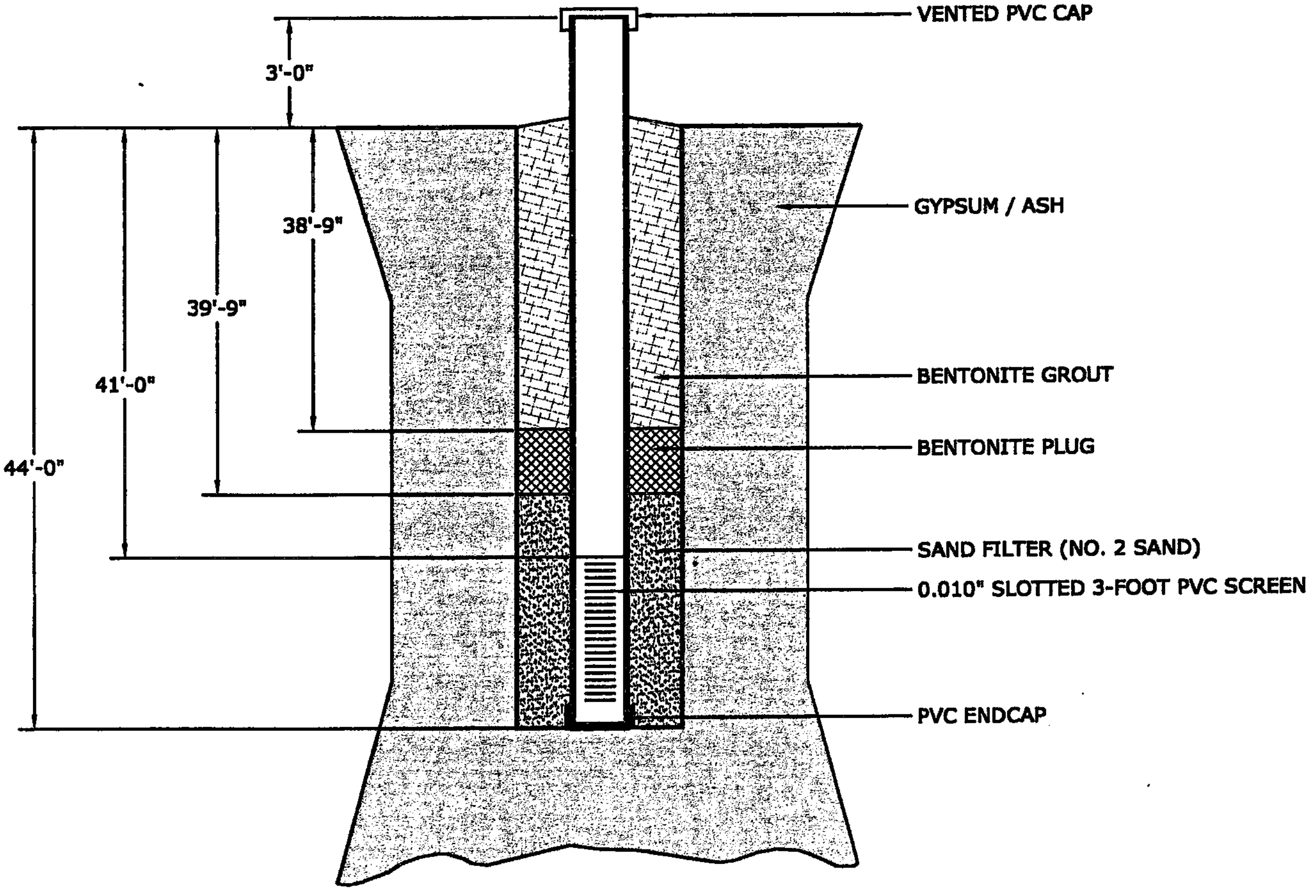
TOTAL DEPTH 44' - 0"

RISER/SCREEN

MATERIAL SCHEDULE 40 PVC

DIAMETER 2.0"

SLOT SIZE 0.010"



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PIEZOMETER INSTALLATION RECORD
TVA - WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

COORDINATES: N xx° W xx°

DRAFTING BY: RSB	PREPARED BY: HAB	CHECKED BY: CDT
JOB NUMBER: 3043041026/0001	DATE: JUNE 16, 2004	SCALE: NOT TO SCALE

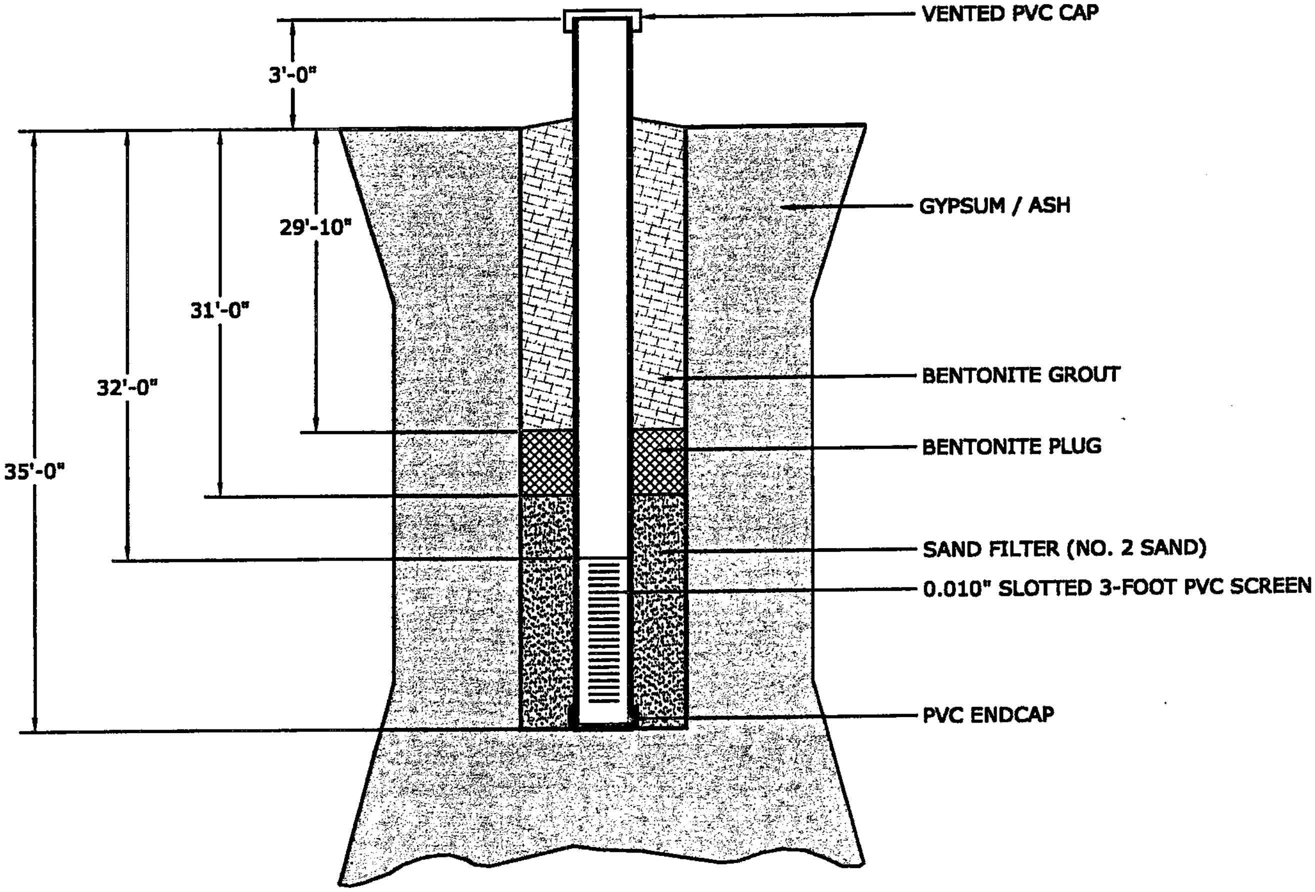
PIEZOMETER INSTALLATION RECORD

PIEZOMETER NUMBER PZ-6

INSTALLATION DATE 06/08/2004

TOTAL DEPTH 35' - 0"

RISER/SCREEN
MATERIAL SCHEDULE 40 PVC
DIAMETER 2.0"
SLOT SIZE 0.010"



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PIEZOMETER INSTALLATION RECORD
TVA - WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

COORDINATES: N xx° W xx°

DRAFTING BY:	PREPARED BY: HAB	CHECKED BY: CDT
JOB NUMBER: 3043041026/0001	DATE: JUNE 16, 2004	SCALE: NOT TO SCALE

PIEZOMETER INSTALLATION RECORD

PIEZOMETER NUMBER PZ-1S

INSTALLATION DATE 6/03/04

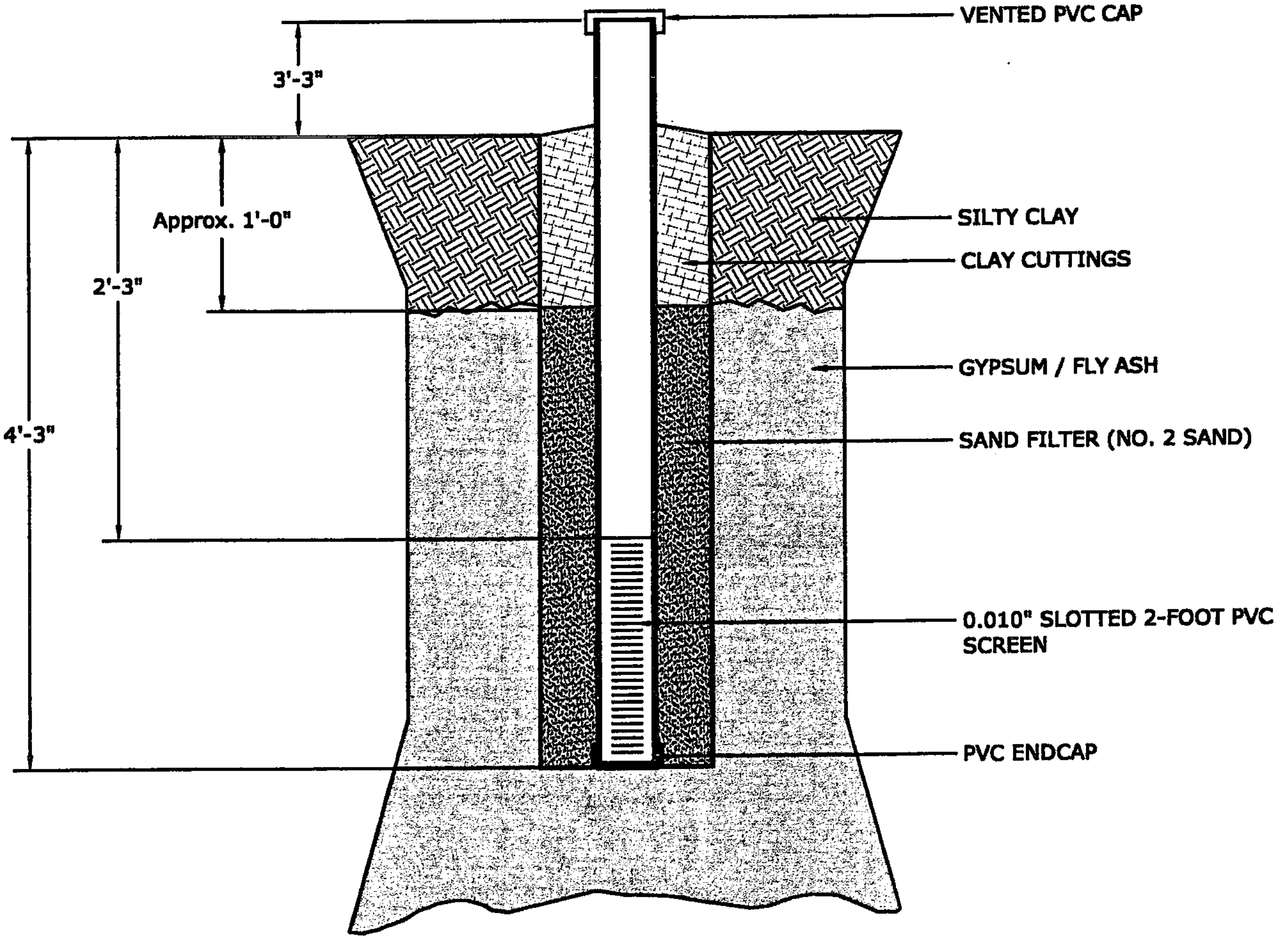
TOTAL DEPTH 4' - 3"

RISER/SCREEN

MATERIAL SCHEDULE 40 PVC

DIAMETER 2.0"

SLOT SIZE 0.010"



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Knoxville, Tennessee 37921-5904
865-588-8544 • Fax: 865-588-8026

PIEZOMETER INSTALLATION RECORD
TVA - WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

DRAFTING BY: RBB	PREPARED BY: HAB	CHECKED BY: CDT
JOB NUMBER: 3043041026/0001	DATE: JUNE 16, 2004	SCALE: NOT TO SCALE

COORDINATES: N xx° W xx°

PIEZOMETER INSTALLATION RECORD

PIEZOMETER NUMBER PZ-2S

INSTALLATION DATE 6/03/04

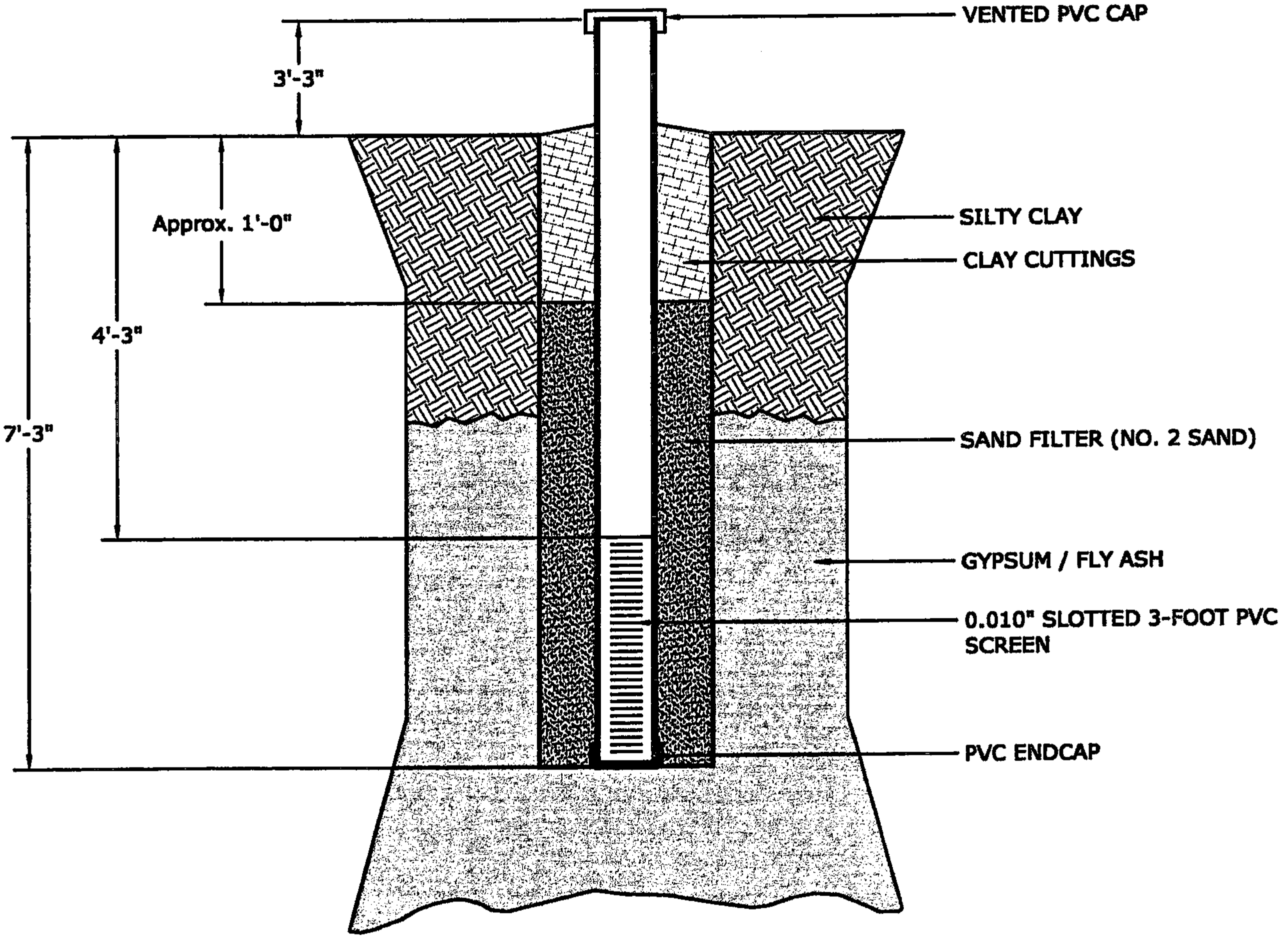
TOTAL DEPTH 7' - 3"

RISER/SCREEN

MATERIAL SCHEDULE 40 PVC

DIAMETER 2.0"

SLOT SIZE 0.010"



(NOT TO SCALE)

MACTEC

MACTEC Engineering and Consulting, Inc.
1725 Louisville Drive
Knoxville, Tennessee 37921-5904
865-588-8544 • Fax: 865-588-8026

PIEZOMETER INSTALLATION RECORD
TVA - WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

COORDINATES: N xx° W xx°

DRAFTING BY:	PREPARED BY: HAB	CHECKED BY: CDT
JOB NUMBER: 3043041026/0001	DATE: JUNE 16, 2004	SCALE: NOT TO SCALE

PIEZOMETER INSTALLATION RECORD

PIEZOMETER NUMBER PZ-4S

INSTALLATION DATE 6/04/04

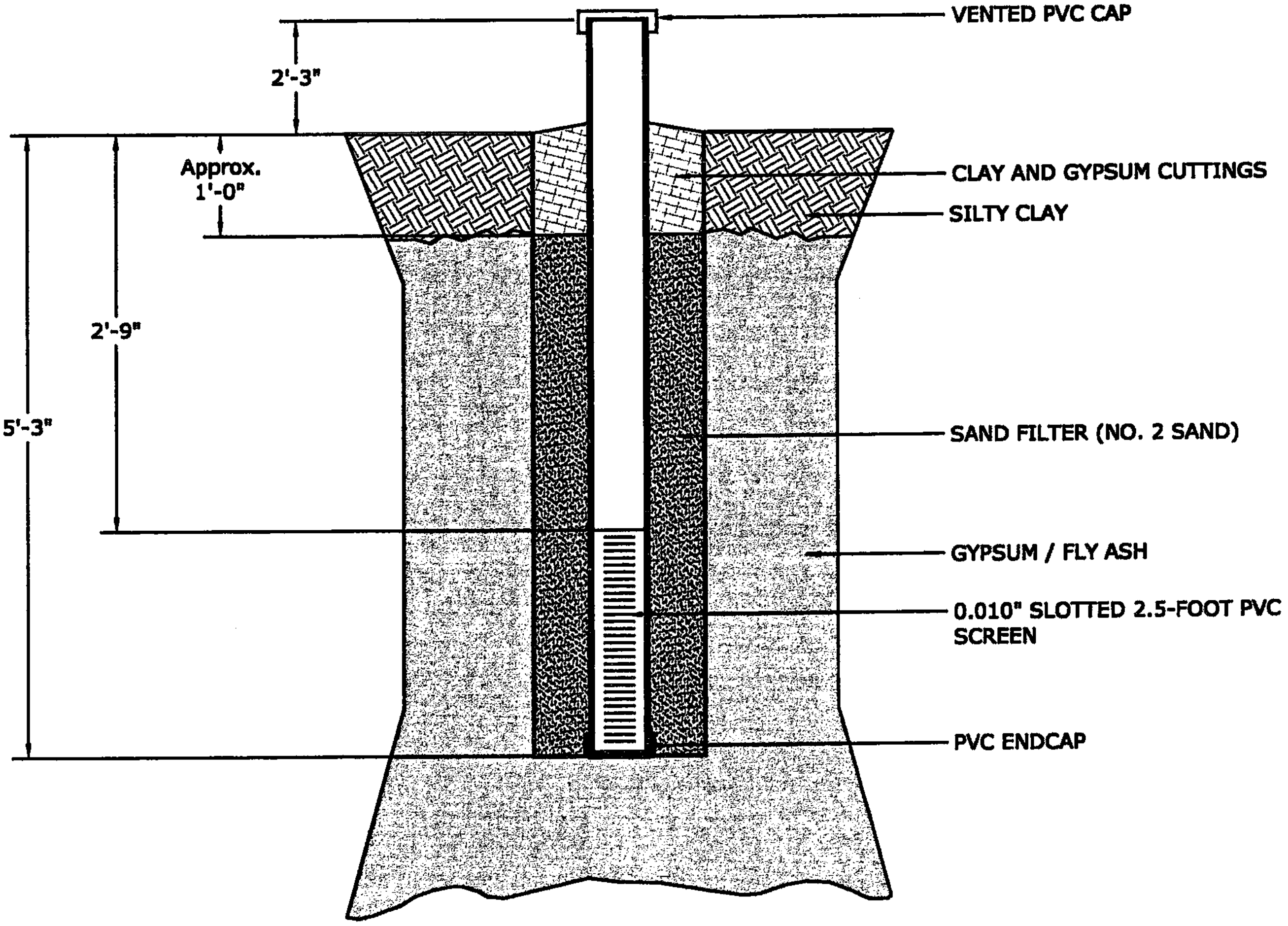
TOTAL DEPTH 5' - 3"

RISER/SCREEN

MATERIAL SCHEDULE 40 PVC

DIAMETER 2.0"

SLOT SIZE 0.010"



(NOT TO SCALE)

MACTEC

MACTEC Engineering and Consulting, Inc.
1725 Louisville Drive
Knoxville, Tennessee 37921-5904
865-588-8544 • Fax: 865-588-8026

PIEZOMETER INSTALLATION RECORD
TVA - WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

COORDINATES: N xx° W xx°

DRAFTING BY: RBB	PREPARED BY: HAB	CHECKED BY: CDT
JOB NUMBER: 3043041026/0001	DATE: JUNE 22, 2004	SCALE: NOT TO SCALE

PIEZOMETER INSTALLATION RECORD

PIEZOMETER NUMBER PZ-5S

INSTALLATION DATE 6/03/04

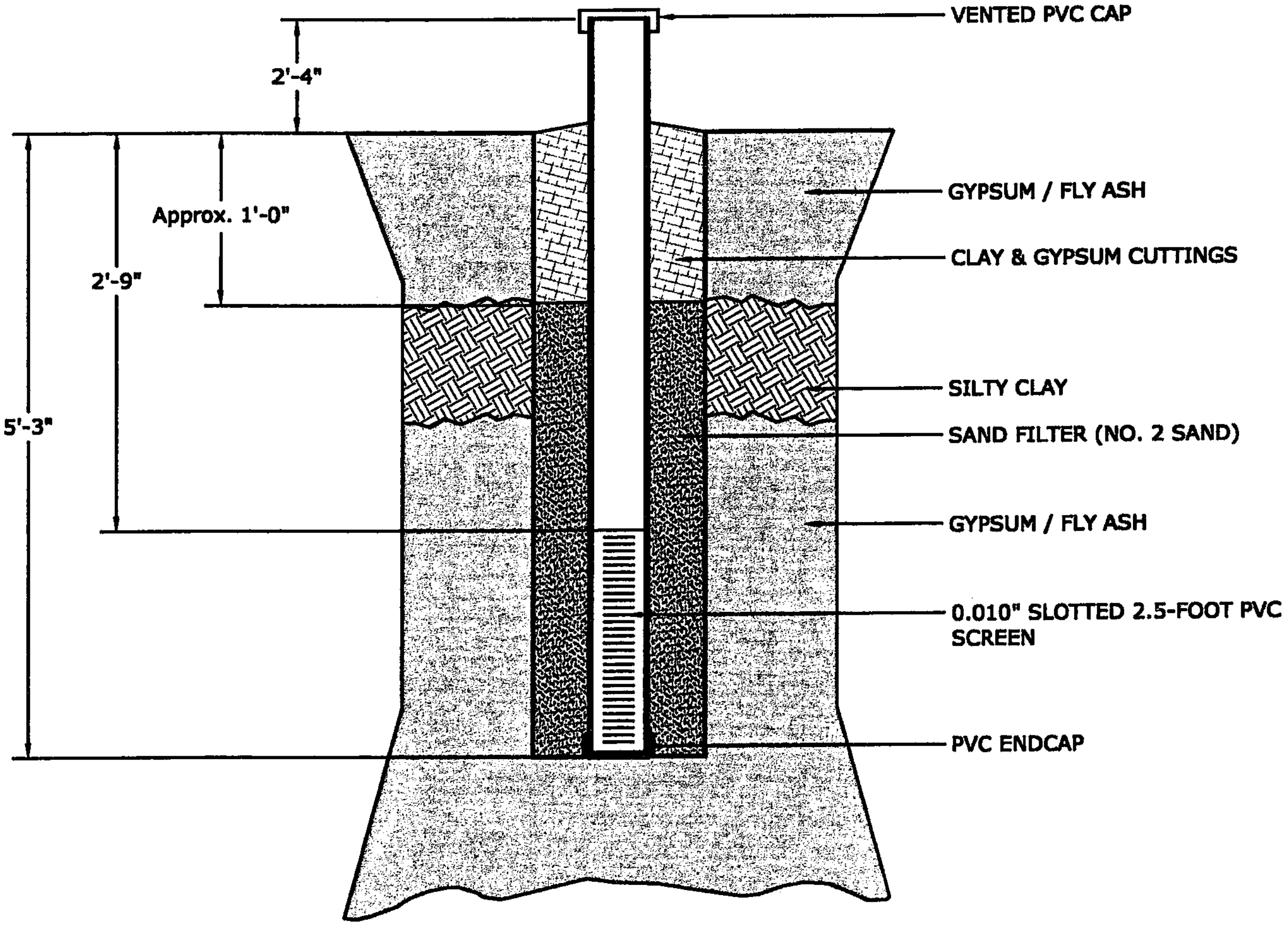
TOTAL DEPTH 5' - 3"

RISER/SCREEN

MATERIAL SCHEDULE 40 PVC

DIAMETER 2.0"

SLOT SIZE 0.010"



(NOT TO SCALE)

MACTEC

MACTEC Engineering and Consulting, Inc.
1725 Louisville Drive
Knoxville, Tennessee 37921-5904
865-588-8544 • Fax: 865-588-8026

PIEZOMETER INSTALLATION RECORD
TVA - WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

DRAFTING BY:	PREPARED BY: HAB	CHECKED BY: CDT
JOB NUMBER: 3043041026/0001	DATE: JUNE 18, 2004	SCALE: NOT TO SCALE

COORDINATES: N xx° W xx°

PIEZOMETER INSTALLATION RECORD

PIEZOMETER NUMBER PZ-6S

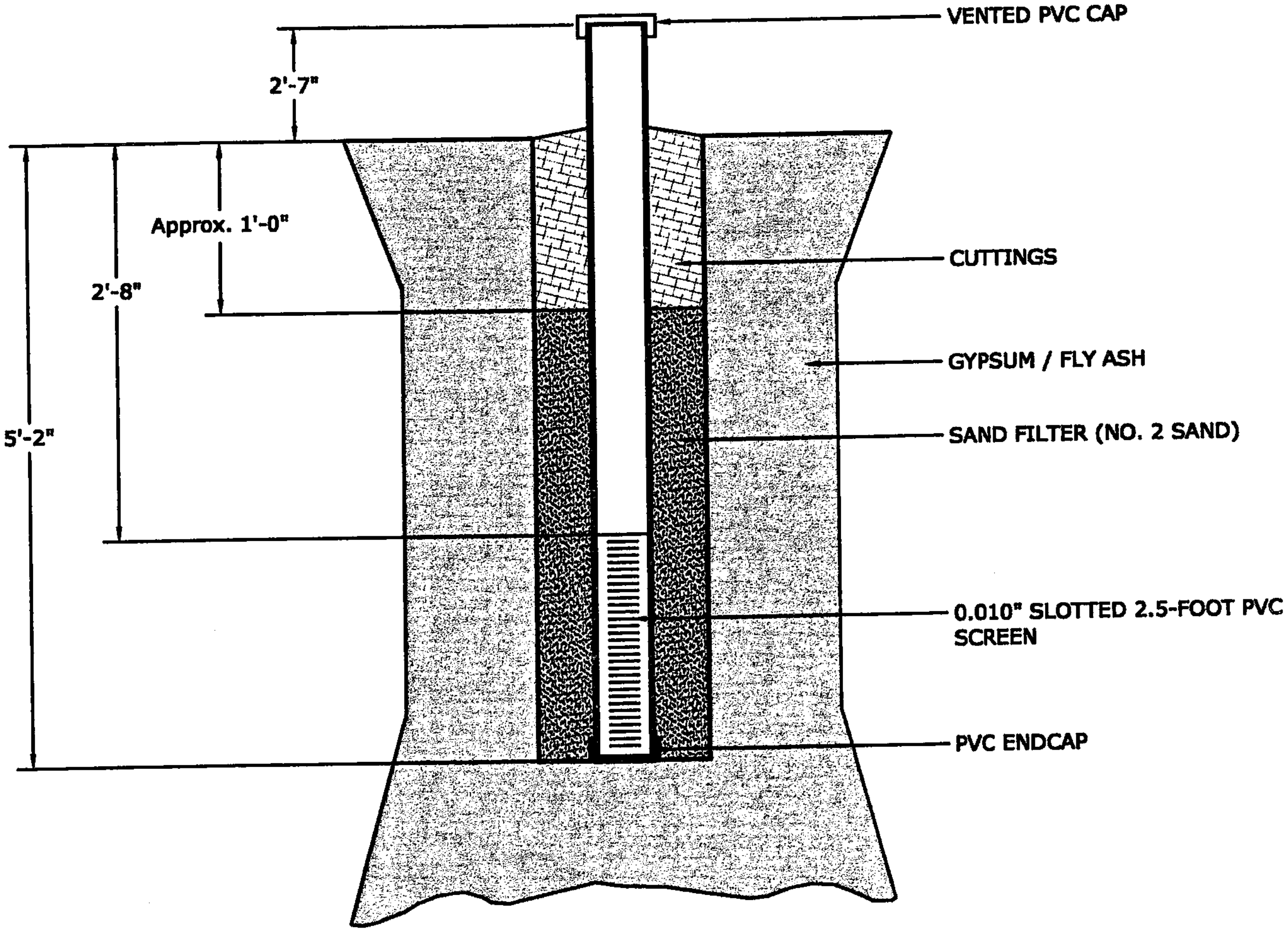
INSTALLATION DATE 6/04/04

TOTAL DEPTH 5' - 2"

RISER/SCREEN
MATERIAL SCHEDULE 40 PVC

DIAMETER 2.0"

SLOT SIZE 0.010"



(NOT TO SCALE)

MACTEC

MACTEC Engineering and Consulting, Inc.
1725 Louisville Drive
Knoxville, Tennessee 37921-5904
865-588-8544 • Fax: 865-588-8026

PIEZOMETER INSTALLATION RECORD
TVA - WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

DRAFTING BY:	PREPARED BY: HAB	CHECKED BY: CDT
JOB NUMBER: 3043041026/0001	DATE: JUNE 16, 2004	SCALE: NOT TO SCALE

COORDINATES: N xx° W xx°

APPENDIX D

WATER LEVEL DATA

Table D1
Water Level Data

Piezometer Number	Installation Date	Water Level Reading on 6/9/04 (Feet)	Water Level Reading on 6/11/04 (Feet)	Water Level Reading on 6/18/04 (Feet)
PZ-1	6/9/04	--	18.90	18.80
PZ-2	6/10/04	--	28.2	27.80
PZ-3	6/4/04	20.95	20.95	20.85
PZ-4	6/8/04	19.60	19.70	19.50
PZ-5	6/9/04	--	24.00	23.50
PZ-6	6/8/04	22.10	22.10	22.05
PZ-1S	6/3/04	4.20	--	4.25
PZ-2S	6/3/04	6.15	--	6.10
PZ-4S	6/4/04	5.95	--	5.95
PZ-5S	6/3/04	7.10	--	7.00
PZ-6S	6/4/04	4.75	--	4.60

Note: All readings were measured from the top of the PVC pipe.

Prepared By HAB Date 6/23/04 Checked By GJT Date 6/23/04

Appendix 2

Results of Chemical Analyses of Gypsum-Fly Ash Samples Performed by TVA Central Laboratories Services

Data Report Number: 40722-143717
Report of Results: Analytical

TENNESSEE VALLEY AUTHORITY
CENTRAL LABORATORIES SERVICES

1101 Market Street, PSC 1B-C
Chattanooga, Tennessee 37402-2801
Phone: (423) 876 - 4318 • Fax: (423) 876 - 4137

Shipping Address:
Chickamauga Power Service Center
North Side Chickamauga
Reservation
Chattanooga, Tennessee 37415

Customer Address: Ronald Powell
LP 2G-C
Phone Not Available
Fax : Not Available
E-Mail: Not Available

Location Code: WCF
Field ID: Widows Creek Fossil Plant
Sample Description: 04-056A-1
Shipping Ticket Number:
Plant Name: Widows Creek Fossil Plant

Sample ID: AE11212 **LRF ID:** 04070127
Matrix: **Reg:**
Date Collected: 06/25/2004
Time Collected: 0:00 CST
Date Received: 06/28/2004
Time Received: 8:48
Project Manager: Lisa D. Ortiz
TIIC No.:

Analyte	CAS Number	Result	Units	MDL[2]	Analysis Date	Analysis	Analyst	Method Reference
SO3 Percent	14265-45-3	0.10	%	0.01	07/16/2004	10:00	WMG	Titration
Calcium Percent	7440-70-2	20.98	%	0.01	07/15/2004	11:00	WMG	Titration
Magnesium Percent	7439-95-4	0.73	%	0.01	07/15/2004	11:05	WMG	Titration
Miscellaneous Test (Narrative)		L5262911.NT			07/16/2004	8:00	WMG	
%SO4 = 33.13								
%CO3 = 12.51								
Acid Insoluble		20.25	%	0.1	07/16/2004	14:00	WMG	Gravimetric

Sample Comments: None

---

[1] Chemical Abstracts Service Registry Number [2] Method Detection Limit

Data Report Number: 40722-143717
Report of Results: Analytical

TENNESSEE VALLEY AUTHORITY
CENTRAL LABORATORIES SERVICES

1101 Market Street, PSC 1B-C
Chattanooga, Tennessee 37402-2801
Phone: (423) 876 - 4318 • Fax: (423) 876 - 4137

Shipping Address:
Chickamauga Power Service Center
North Side Chickamauga
Reservation
Chattanooga, Tennessee 37415

Customer Address: Ronald Powell
LP 2G-C
Phone Not Available
Fax : Not Available
E-Mail: Not Available
Location Code: WCF
Field ID: Widows Creek Fossil Plant
Sample Description: 04-056A-2
Shipping Ticket Number:
Plant Name: Widows Creek Fossil Plant

Sample ID: AE11213 **LRF ID:** 04070127
Matrix: **Reg:**
Date Collected: 06/25/2004
Time Collected: 0:00 CST
Date Received: 06/28/2004
Time Received: 8:48
Project Manager: Lisa D. Ortiz
THC No.:

Analyte	CAS Number	Result	Units	MDL[2]	Analysis Date	Analysis	Analyst	Method Reference
SO3 Percent	14265-45-3	2.63	%	0.01	07/16/2004	10:05	WMG	Titration
Calcium Percent	7440-70-2	21.85	%	0.01	07/15/2004	11:10	WMG	Titration
Magnesium Percent	7439-95-4	0.36	%	0.01	07/15/2004	11:15	WMG	Titration
Miscellaneous Test (Narrative)		L5262927.NT			07/16/2004	8:10	WMG	
%SO4 = 32.63								
%CO3 = 13.20								
Acid Insoluble		20.25	%	0.1	07/16/2004	14:01	WMG	Gravimetric

Sample Comments: None

---

[1] Chemical Abstracts Service Registry Number [2] Method Detection Limit

Data Report Number: 40722-143717
Report of Results: Analytical

TENNESSEE VALLEY AUTHORITY
CENTRAL LABORATORIES SERVICES
1101 Market Street, PSC 1B-C
Chattanooga, Tennessee 37402-2801
Phone: (423) 876 - 4318 • Fax: (423) 876 - 4137

Shipping Address:
Chickamauga Power Service Center
North Side Chickamauga
Reservation
Chattanooga, Tennessee 37415

Customer Address: Ronald Powell
LP 2G-C
Phone Not Available
Fax : Not Available
E-Mail: Not Available

Location Code: WCF

Field ID: Widows Creek Fossil Plant

Sample Description: 04-056A-3

Shipping Ticket Number:

Plant Name: Widows Creek Fossil Plant

Sample ID: AE11214 **LRF ID:** 04070127

Matrix: **Reg:**

Date Collected: 06/25/2004

Time Collected: 0:00 CST

Date Received: 06/28/2004

Time Received: 8:48

Project Manager: Lisa D. Ortiz

TIIC No.:

Analyte	CAS Number	Result	Units	MDL[2]	Analysis Date	Analysis	Analyst	Method Reference
SO3 Percent	14265-45-3	0.34	%	0.01	07/16/2004	10:10	WMG	Titration
Calcium Percent	7440-70-2	24.31	%	0.01	07/15/2004	11:20	WMG	Titration
Magnesium Percent	7439-95-4	0.71	%	0.01	07/15/2004	11:25	WMG	Titration
Miscellaneous Test (Narrative)		L5262940.NT			07/16/2004	8:20	WMG	
%SO4 = 24.73 %CO3 = 22.70								
Acid Insoluble		18.36	%	0.1	07/16/2004	14:02	WMG	Gravimetric

Sample Comments: None

---

[1] Chemical Abstracts Service Registry Number [2] Method Detection Limit

Data Report Number: 40722-143717
Report of Results: Analytical

TENNESSEE VALLEY AUTHORITY
CENTRAL LABORATORIES SERVICES

1101 Market Street, PSC 1B-C
Chattanooga, Tennessee 37402-2801
Phone: (423) 876 - 4318 • Fax: (423) 876 - 4137

Shipping Address:
Chickamauga Power Service Center
North Side Chickamauga
Reservation
Chattanooga, Tennessee 37415

Customer Address: Ronald Powell
LP 2G-C
Phone Not Available
Fax : Not Available
E-Mail: Not Available
Location Code: WCF
Field ID: Widows Creek Fossil Plant
Sample Description: 04-056A-4
Shipping Ticket Number:
Plant Name: Widows Creek Fossil Plant

Sample ID: AE11215 **LRF ID:** 04070127
Matrix: **Reg:**
Date Collected: 06/25/2004
Time Collected: 0:00 CST
Date Received: 06/28/2004
Time Received: 8:48
Project Manager: Lisa D. Ortiz
THC No.:

Analyte	CAS Number	Result	Units	MDL²	Analysis Date	Analysis	Analyst	Method Reference
SO3 Percent	14265-45-3	0.23	%	0.01	07/16/2004	10:15	WMG	Titration
Calcium Percent	7440-70-2	29.47	%	0.01	07/15/2004	11:30	WMG	Titration
Magnesium Percent	7439-95-4	0.71	%	0.01	07/15/2004	11:35	WMG	Titration
Miscellaneous Test (Narrative)		L5262954.NT			07/16/2004	8:30	WMG	
%SO4 = 16.47 %CO3 = 35.59								
Acid Insoluble		11.63	%	0.1	07/16/2004	14:03	WMG	Gravimetric

Sample Comments: None

---

¹ Chemical Abstracts Service Registry Number ² Method Detection Limit

Data Report Number: 40722-143717
Report of Results: Analytical

TENNESSEE VALLEY AUTHORITY
CENTRAL LABORATORIES SERVICES

1101 Market Street, PSC 1B-C
Chattanooga, Tennessee 37402-2801
Phone: (423) 876 - 4318 • Fax: (423) 876 - 4137

Shipping Address:
Chickamauga Power Service Center
North Side Chickamauga
Reservation
Chattanooga, Tennessee 37415

Customer Address: Ronald Powell
LP 2G-C
Phone Not Available
Fax : Not Available
E-Mail: Not Available
Location Code: WCF
Field ID: Widows Creek Fossil Plant
Sample Description: 04-056A-5
Shipping Ticket Number:
Plant Name: Widows Creek Fossil Plant

Sample ID: AE11216
LRF ID: 04070127
Matrix:
Reg:
Date Collected: 06/25/2004
Time Collected: 0:00 CST
Date Received: 06/28/2004
Time Received: 8:48
Project Manager: Lisa D. Ortiz
TIIC No.:

Analyte	CAS Number	Result	Units	MDL[2]	Analysis Date	Analysis	Analyst	Method Reference
SO3 Percent	14265-45-3	0.16	%	0.01	07/16/2004	10:20	WMG	Titration
Calcium Percent	7440-70-2	16.27	%	0.01	07/15/2004	11:40	WMG	Titration
Magnesium Percent	7439-95-4	0.86	%	0.01	07/15/2004	11:45	WMG	Titration
Miscellaneous Test (Narrative)		L5262967.NT			07/16/2004	8:40	WMG	
%SO4 = 21.02 %CO3 = 13.35								
Acid Insoluble		40.65	%	0.1	07/16/2004	14:04	WMG	Gravimetric

Sample Comments: None

---

[1] Chemical Abstracts Service Registry Number [2] Method Detection Limit

Data Report Number: 40722-143717
Report of Results: Analytical

TENNESSEE VALLEY AUTHORITY
CENTRAL LABORATORIES SERVICES
1101 Market Street, PSC 1B-C
Chattanooga, Tennessee 37402-2801
Phone: (423) 876 - 4318 • Fax: (423) 876 - 4137

Shipping Address:
Chickamauga Power Service Center
North Side Chickamauga
Reservation
Chattanooga, Tennessee 37415

Customer Address: Ronald Powell
LP 2G-C
Phone Not Available
Fax : Not Available
E-Mail: Not Available
Location Code: WCF
Field ID: Widows Creek Fossil Plant
Sample Description: 04-056A-6
Shipping Ticket Number:
Plant Name: Widows Creek Fossil Plant

Sample ID: AE11217 **LRF ID:** 04070127
Matrix: **Reg:**
Date Collected: 06/25/2004
Time Collected: 0:00 CST
Date Received: 06/28/2004
Time Received: 8:48
Project Manager: Lisa D. Ortiz
THC No.:

Analyte	CAS Number	Result	Units	MDL[2]	Analysis Date	Analysis	Analyst	Method Reference
SO3 Percent	14265-45-3	0.81	%	0.01	07/16/2004	10:25	WMG	Titration
Calcium Percent	7440-70-2	22.46	%	0.01	07/15/2004	11:50	WMG	Titration
Magnesium Percent	7439-95-4	0.71	%	0.01	07/15/2004	11:55	WMG	Titration
Miscellaneous Test (Narrative)		L5262978.NT			07/16/2004	8:50	WMG	
%SO4 = 29.81								
%CO3 = 16.75								
Acid Insoluble		19.25	%	0.1	07/16/2004	14:05	WMG	Gravimetric

Sample Comments: None

---

[1] Chemical Abstracts Service Registry Number [2] Method Detection Limit

Data Report Number: 40722-143717
Report of Results: Analytical

TENNESSEE VALLEY AUTHORITY
CENTRAL LABORATORIES SERVICES

1101 Market Street, PSC 1B-C
Chattanooga, Tennessee 37402-2801
Phone: (423) 876 - 4318 • Fax: (423) 876 - 4137

Shipping Address:
Chickamauga Power Service Center
North Side Chickamauga
Reservation
Chattanooga, Tennessee 37415

Customer Address: Ronald Powell
LP 2G-C
Phone Not Available
Fax : Not Available
E-Mail: Not Available
Location Code: WCF
Field ID: Widows Creek Fossil Plant
Sample Description: 04-056A-7
Shipping Ticket Number:
Plant Name: Widows Creek Fossil Plant

Sample ID: AE11218
LRF ID: 04070127
Matrix:
Reg:
Date Collected: 06/25/2004
Time Collected: 0:00 CST
Date Received: 06/28/2004
Time Received: 8:48
Project Manager: Lisa D. Ortiz
TIIC No.:

Analyte	CAS Number	Result	Units	MDL[2]	Analysis Date	Analysis	Analyst	Method Reference
SO3 Percent	14265-45-3	0.17	%	0.01	07/16/2004	10:30	WMG	Titration
Calcium Percent	7440-70-2	28.74	%	0.01	07/15/2004	12:00	WMG	Titration
Magnesium Percent	7439-95-4	1.20	%	0.01	07/15/2004	12:05	WMG	Titration
Miscellaneous Test (Narrative)		L5262991.NT			07/16/2004	9:00	WMG	
%SO4 = 16.66 %CO3 = 35.59								
Acid Insoluble		11.60	%	0.1	07/16/2004	14:06	WMG	Gravimetric

Sample Comments: None

---

[1] Chemical Abstracts Service Registry Number
[2] Method Detection Limit

Environmental Chemistry Laboratory data report number 040722-143717 was electronically approved using Labworks Enterprise Version 5.7, Build 255 on **07/19/2004 at 5:27:00 PM by Lisa D. Ortiz**

Vanessa L. Ramey, Lab Director
Lisa D. Ortiz, Department Manager
Randall L. Howell, Product Manager
Ricardo I. Gilbert, Senior Analytical Chemist

This report contains sample results for the following samples, Login Reference File number: 04070127

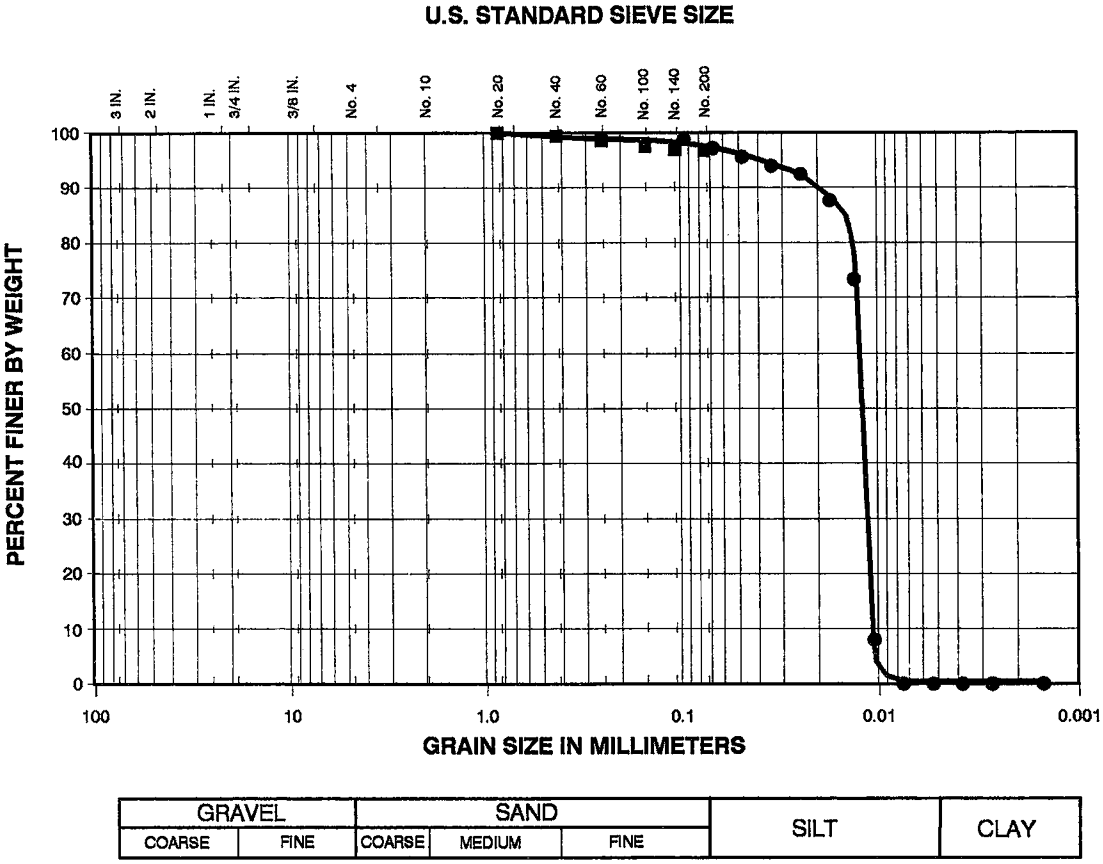
AE11212
AE11213
AE11214
AE11215
AE11216
AE11217
AE11218

---

[1] Chemical Abstracts Service Registry Number [2] Method Detection Limit

Appendix 3

Grain Size Distribution Curves for Widows Creek Gypsum-Fly Ash Deposits



SYMBOL	TEST METHOD
■	Sieve Analysis
●	Hydrometer Analysis

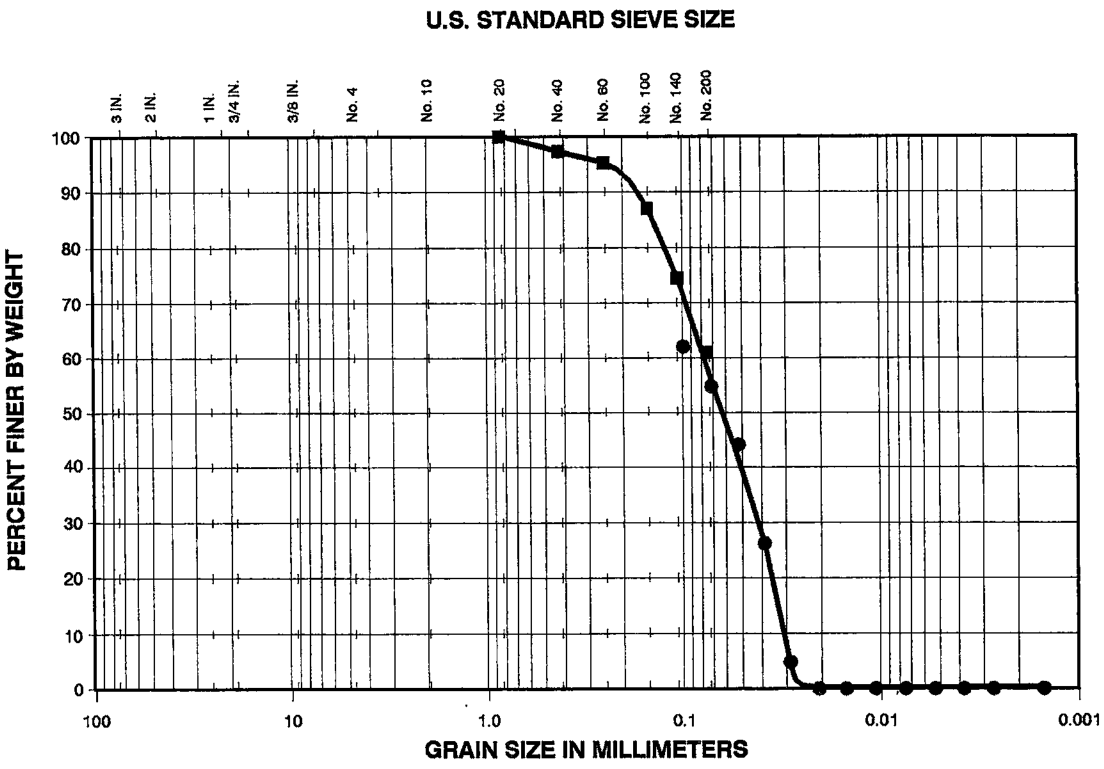
PARTICLE-SIZE DISTRIBUTION OF SAMPLE SPT-1, #7, 30.0 - 31.5 FT

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

GYPSUM-FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

DRAWN BY: NTD	CHECKED BY:	DATE: 08/02/04
FILE NO.: 04-056A	APPROVED BY:	FIGURE: A-3.1

TVA\04-056A\LAB\FIGURE\TVA1.DRW NTD



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

SYMBOL	TEST METHOD
■	Sieve Analysis
●	Hydrometer Analysis

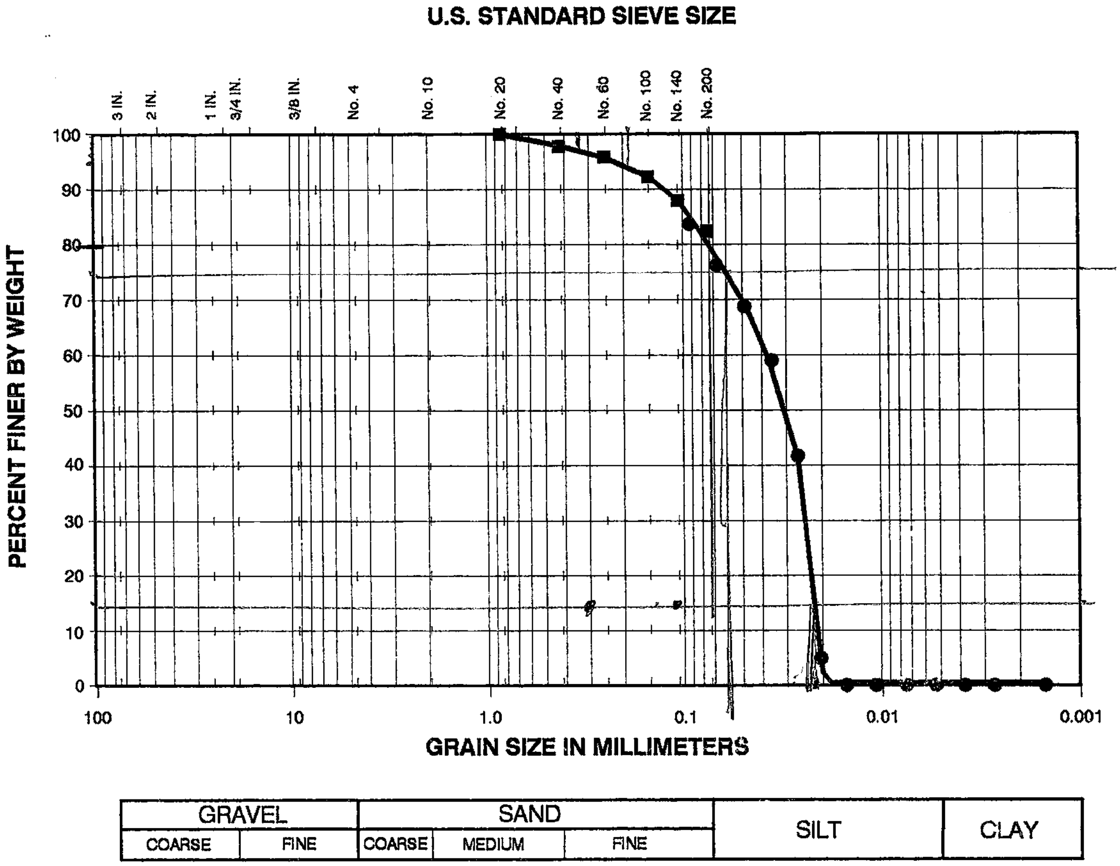
PARTICLE-SIZE DISTRIBUTION OF SAMPLE SPT-1, #9, 40.0 - 41.5 FT

Ardaman & Associates, Inc.
Geotechnical, Environmental and
Materials Consultants

GYPSUM-FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

DRAWN BY: NTD	CHECKED BY:	DATE: 08/02/04
FILE NO.: 04-056A	APPROVED BY:	FIGURE: A-3.2

TVA\04-056A\LAB\FIGURE\TVA2.DRW NTD



D_{85} = .06 mm

D_{15} = .022 mm

SYMBOL	TEST METHOD
■	Sieve Analysis
●	Hydrometer Analysis

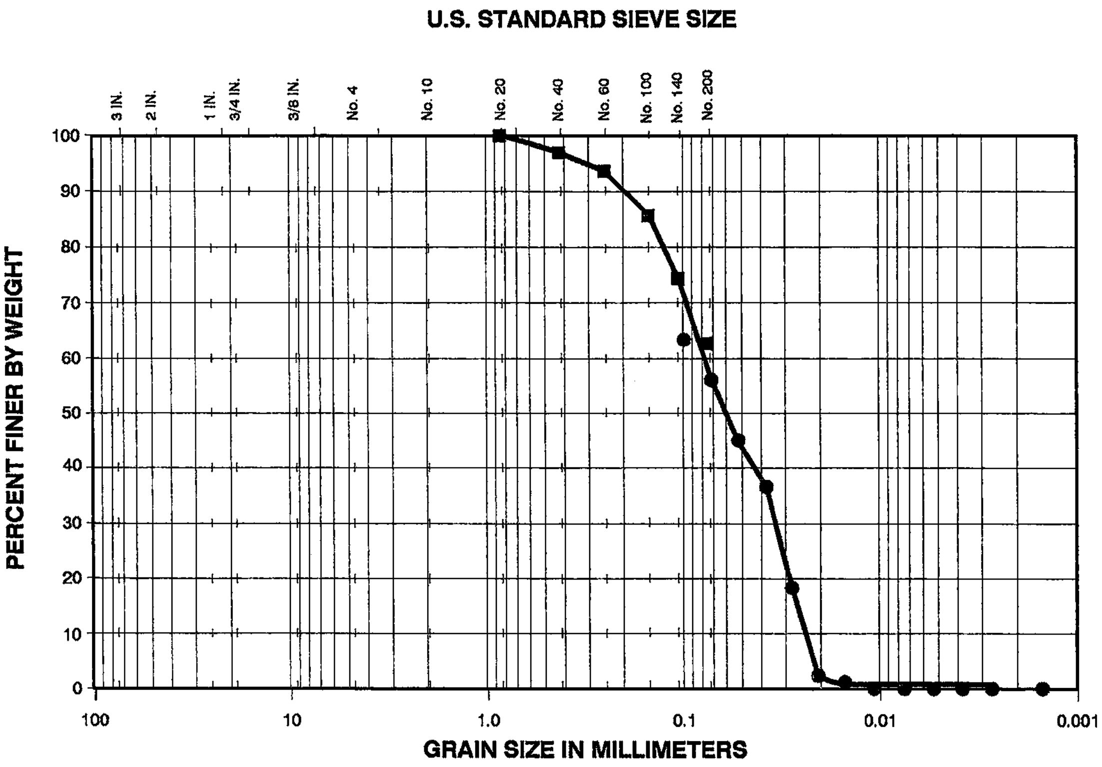
PARTICLE-SIZE DISTRIBUTION OF SAMPLE SPT-2, #5, 20.0 - 21.5 FT

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

GYPSUM-FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

DRAWN BY: NTD	CHECKED BY:	DATE: 08/02/04
FILE NO.: 04-056A	APPROVED BY:	FIGURE: A-3.3

TVA\04-056A\LAB\FIGURE\TVA3.DRW NTD



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

SYMBOL	TEST METHOD
■	Sieve Analysis
●	Hydrometer Analysis

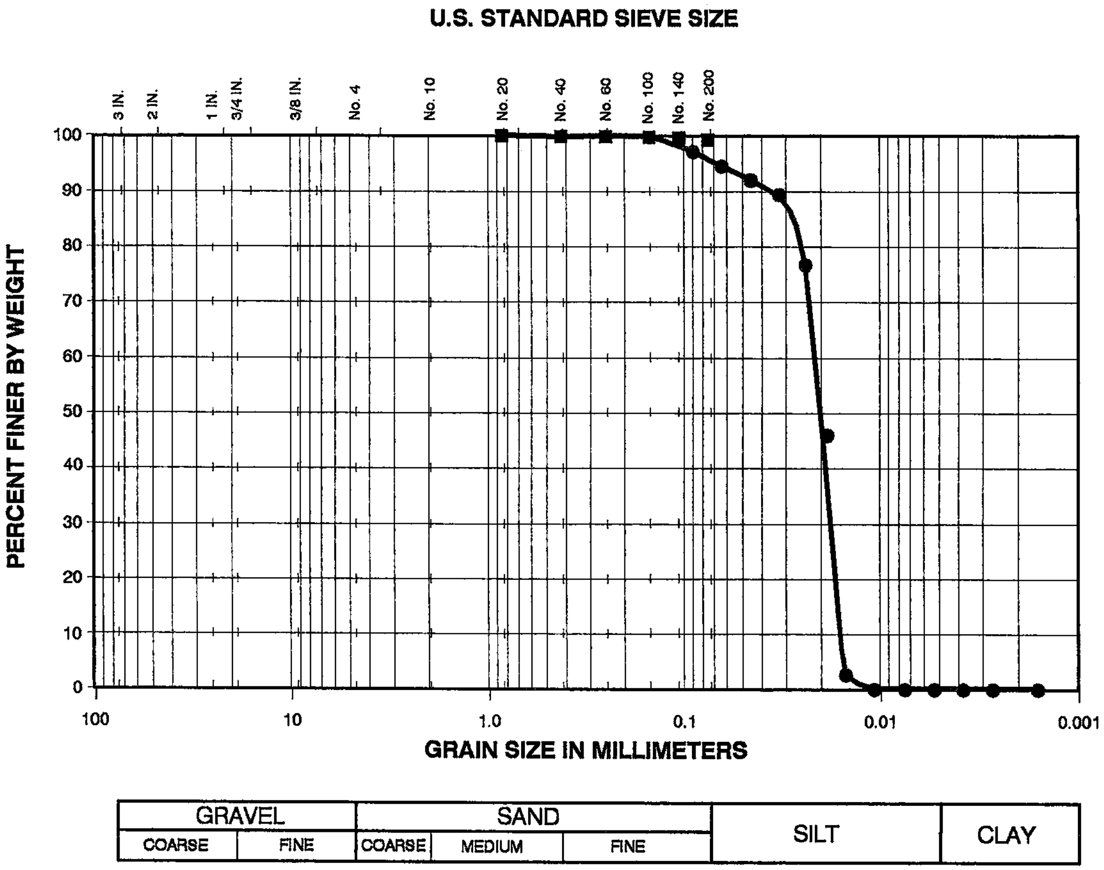
PARTICLE-SIZE DISTRIBUTION OF SAMPLE SPT-2, #6, 25.0 - 26.5 FT

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

GYPSUM-FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

DRAWN BY: NTD	CHECKED BY:	DATE: 08/02/04
FILE NO.: 04-056A	APPROVED BY:	FIGURE: A-3.4

TVA\04-056A\LAB\FIGURE\TVA4.DRW NTD



SYMBOL	TEST METHOD
■	Sieve Analysis
●	Hydrometer Analysis

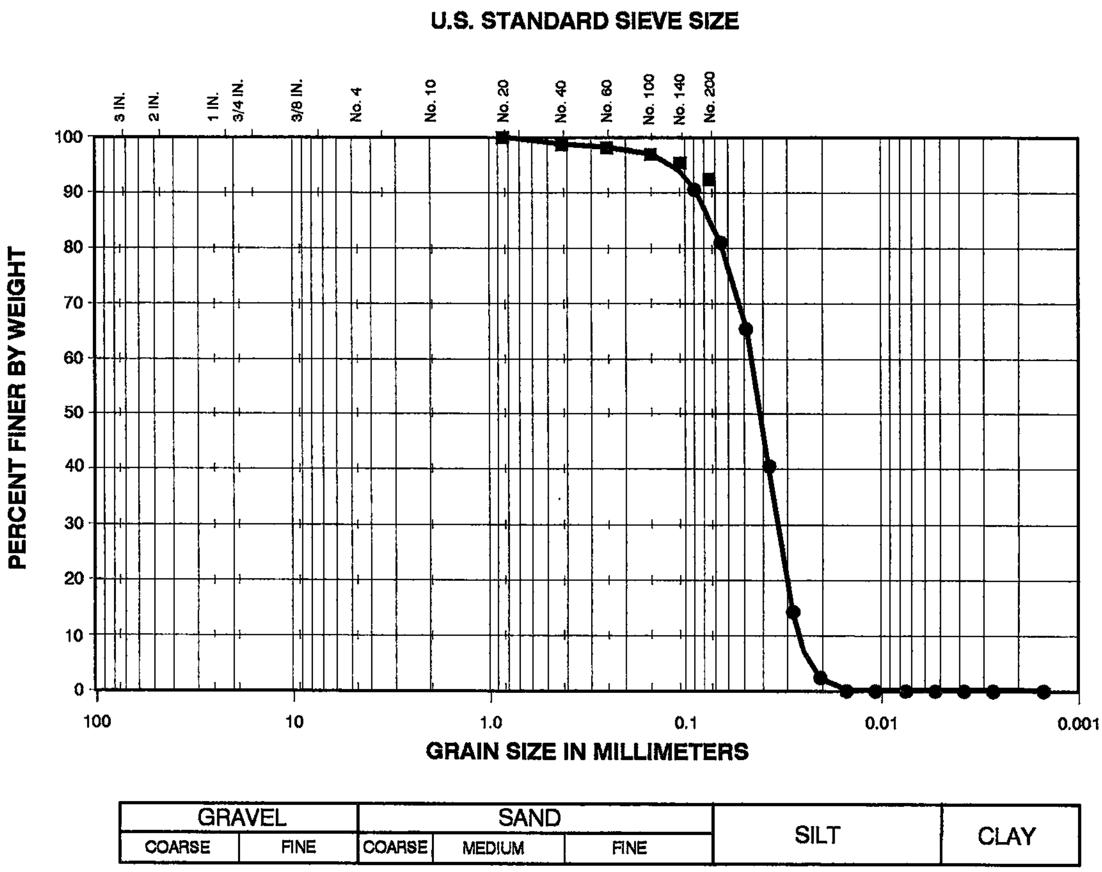
PARTICLE-SIZE DISTRIBUTION OF SAMPLE SPT-3, #5, 20.0 - 21.5 FT

Ardaman & Associates, Inc.
Geotechnical, Environmental and
Materials Consultants

GYPSUM-FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

DRAWN BY: NTD	CHECKED BY:	DATE: 08/02/04
FILE NO.: 04-056A	APPROVED BY:	FIGURE: A-3.5

TVA\04-056A\LAB\FIGURE\TVA5.DRW NTD



SYMBOL	TEST METHOD
■	Sieve Analysis
●	Hydrometer Analysis

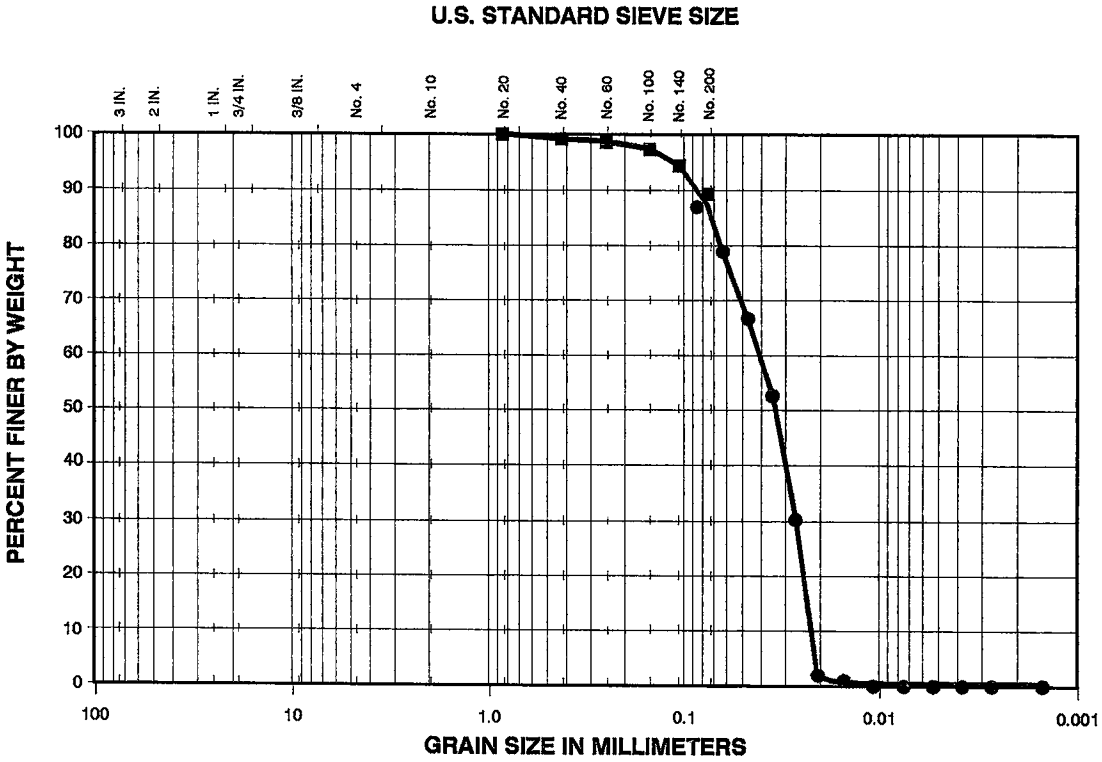
PARTICLE-SIZE DISTRIBUTION OF SAMPLE SPT-3, #6, 25.0 - 26.5 FT

Ardaman & Associates, Inc.
Geotechnical, Environmental and
Materials Consultants

GYPSUM-FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

DRAWN BY: NTD	CHECKED BY:	DATE: 08/02/04
FILE NO.: 04-056A	APPROVED BY:	FIGURE: A-3.6

TVA\04-056A\LAB\FIGURE\TVA6.DRW NTD



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

SYMBOL	TEST METHOD
■	Sieve Analysis
●	Hydrometer Analysis

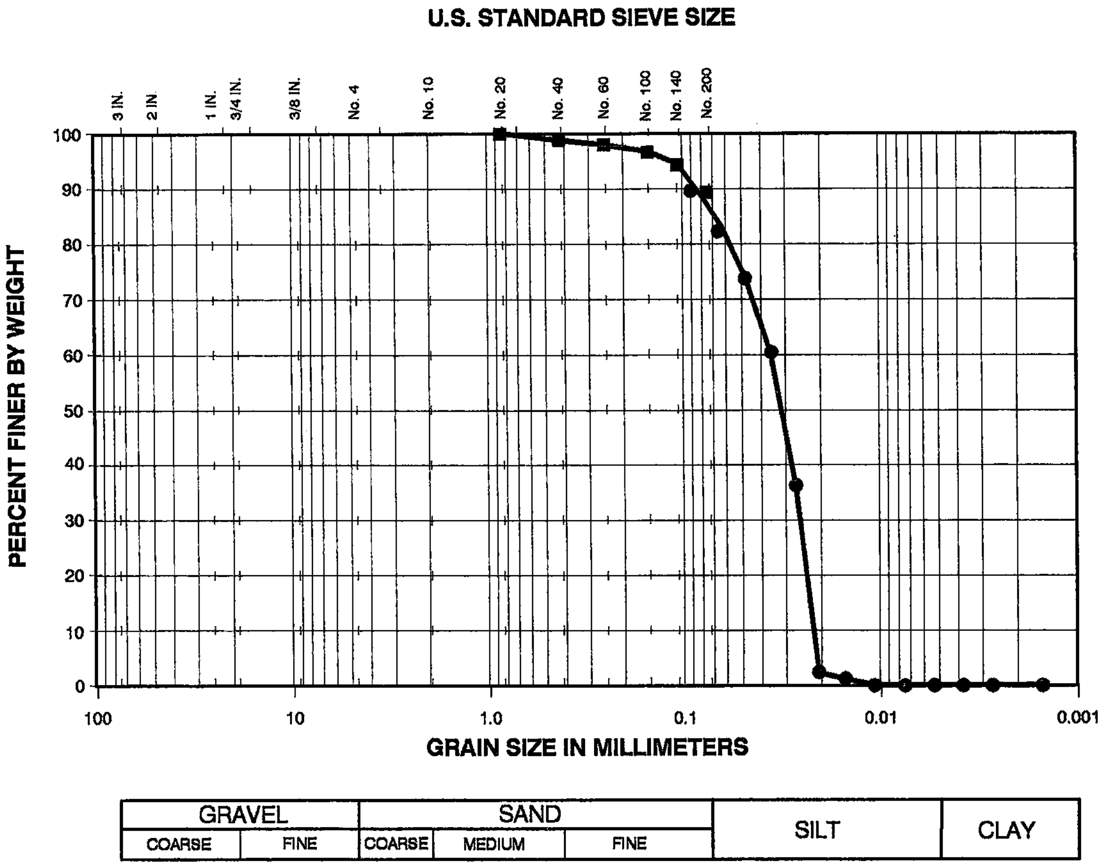
PARTICLE-SIZE DISTRIBUTION OF SAMPLE SPT-4, #5, 20.0 - 21.5 FT

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

GYPSUM-FLY ASH STORAGE FACILITY
TENNESSEE VALLEY AUTHORITY
WIDOWS CREEK FOSSIL PLANT
STEVENSON, ALABAMA

DRAWN BY: NTD	CHECKED BY:	DATE: 08/02/04
FILE NO.: 04-056A	APPROVED BY:	FIGURE: A-3.7

TVA\04-056A\LAB\FIGURE\TVA7.DRW NTD



SYMBOL	TEST METHOD
■	Sieve Analysis
●	Hydrometer Analysis

PARTICLE-SIZE DISTRIBUTION OF SAMPLE SPT-4, #6, 25.0 - 26.5 FT

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Materials Consultants

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STEVENSON, ALABAMA

DRAWN BY: NTD	CHECKED BY:	DATE: 08/02/04
FILE NO.: 04-056A	APPROVED BY:	FIGURE: A-3.8

TVA\04-056A\LAB\FIGURE\TVA8.DRW NTD

Appendix 4

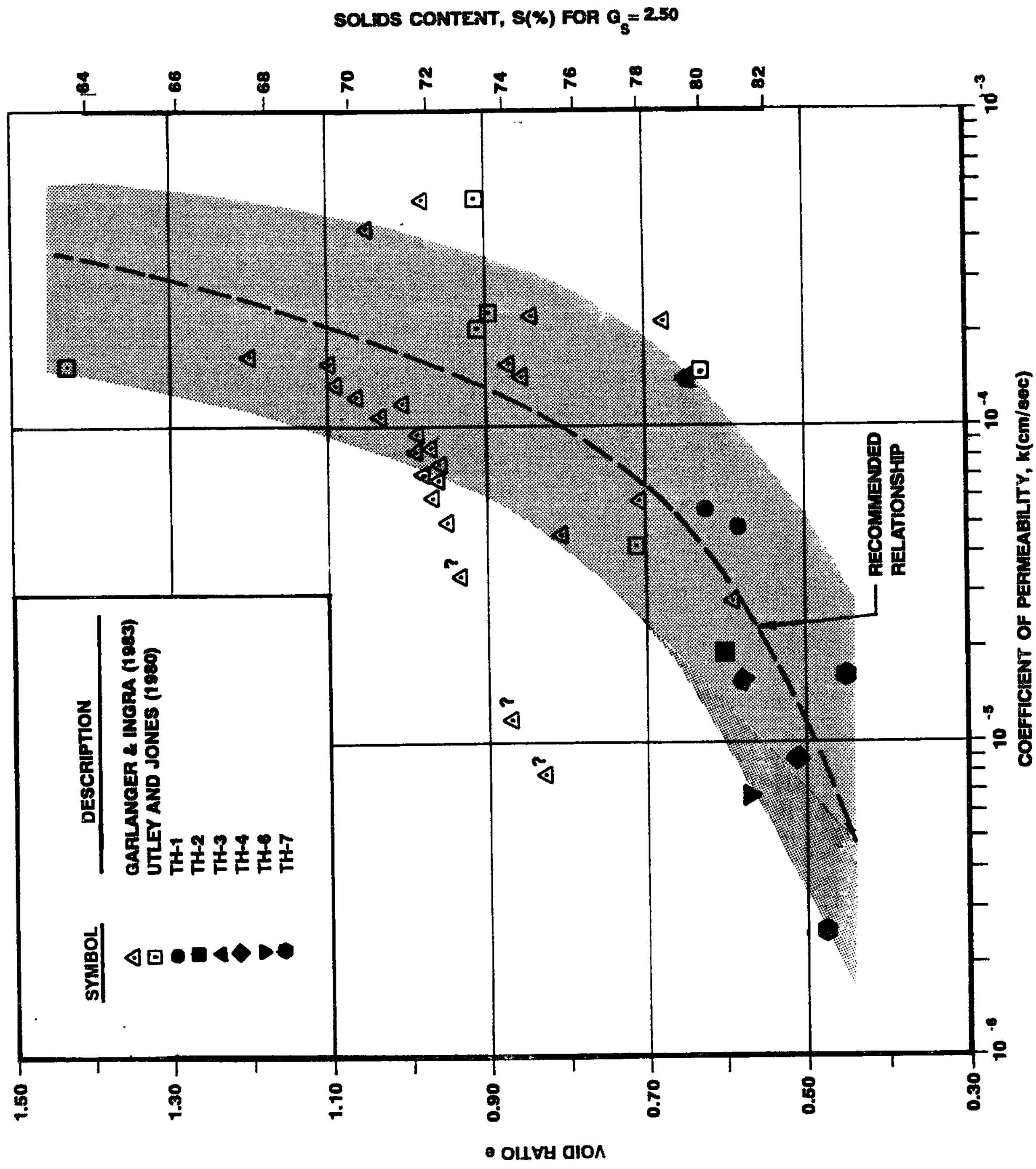
Summary of Permeability Test Results from Previous (1991) Study

Table 3.3

SUMMARY OF LABORATORY PERMEABILITY TEST RESULTS ON UNDISTURBED GYPSUM-FLYASH SAMPLES

Boring	Sample	Depth (feet)	Sample Center Elevation (MSL)	-200 (%)	Effective Confining Pressure $\bar{\sigma}_c$ (psf)	Initial Conditions				Final Conditions				Coefficient of Permeability k_v (cm/sec)
						Dry Density γ_d (lb/ft^3)	Moisture Content (%)	Void Ratio e*	Saturation S* (%)	Dry Density γ_d (lb/ft^3)	Moisture Content (%)	Void Ratio e*	Saturation S* (%)	
TH-1	US-1	4 - 6	638.4	99	500	90.8	25.4	0.72	88.4	95.8	25	0.63	99.5	$5.2x10^{-5}$
TH-1	US-3	14 - 16	628.4	93	500	95.4	23.1	0.64	90.9	98.6	22.8	0.58	97.9	$4.9x10^{-5}$
TH-2	US-3	33 - 34.25	616.9	84	1500	96.6	22.7	0.62	92.3	97.6	24	0.60	100.3	$1.9x10^{-5}$
TH-3	US-2	24 - 26	618.6	85	1000	94.9	26.1	0.64	101.3	94.9	24.5	0.64	95.1	$1.3x10^{-4}$
TH-4	US-1	6 - 8	633.4	98	500	93.8	23.9	0.66	90.1	104.1	20.3	0.50	101.9	$8.6x10^{-6}$
TH-4	US-3	14 - 16	624.9	99	1000	95.3	22.3	0.64	87.5	99.1	21.2	0.57	92.3	$1.4x10^{-5}$
TH-6	US-2	14 - 16	633.9	99	1000	96.3	23.5	0.62	94.8	99.2	21.7	0.57	94.7	$6.3x10^{-6}$
TH-7	US-1	10.5 - 12.5	627.1	99	500	98.0	19.5	0.59	82.4	105.2	20.5	0.48	106.1	$2.3x10^{-6}$
TH-7	US-3	18.5 - 20.5	619.1	97	1000	95.4	22.0	0.64	86.6	107.4	21	0.45	116.0	$1.6x10^{-5}$
Average				95		95.2	23.2	0.64	90.5	100.2	22.3	0.56	100.4	$3.3x10^{-5}$

* Based on a specific gravity of 2.50 for gypsum-flyash.



COEFFICIENT OF PERMEABILITY VS. VOID RATIO RELATIONSHIP FOR GYPSUM-FLYASH

Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

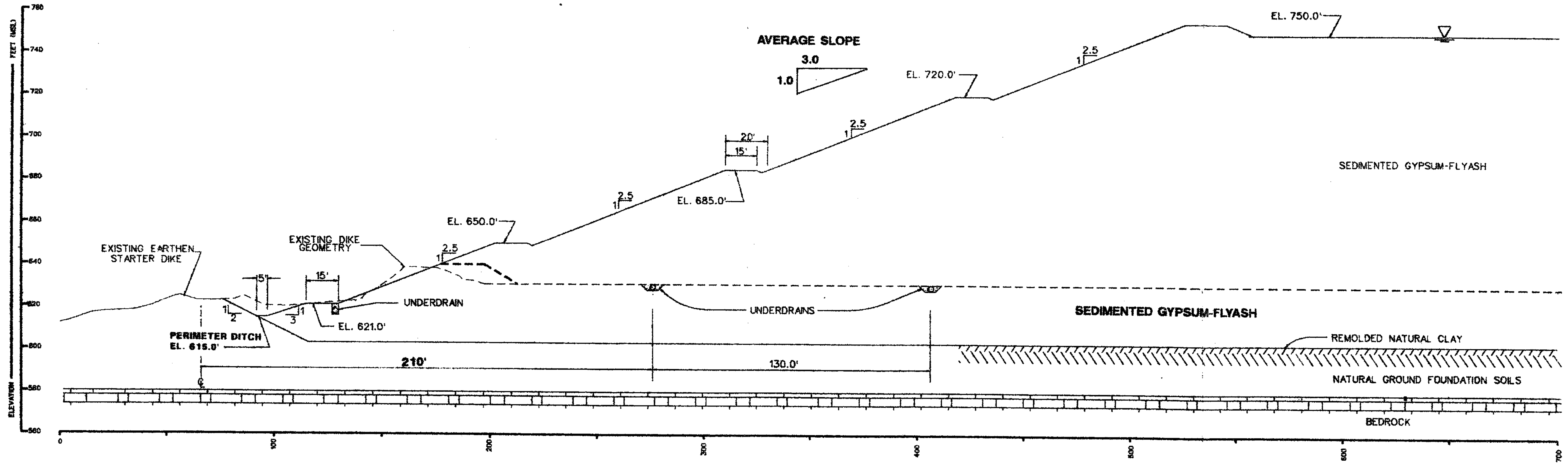
DRAWN BY: GRW	CHECKED BY: EJW	DATE: 8/1/91
FILE NO. 90-059	APPROVED BY John E. Garlanger	

N39695

FIGURE 4

Appendix 5

Design Slope Geometry and Stability Analysis from 1991 Engineering Evaluation



TYPICAL CROSS SECTION

SCALE: 1"=50'

CROSS SECTION 5-5 FOR CONCEPTUAL REMEDIAL PLAN FOR GYPSUM-FLYASH STACK

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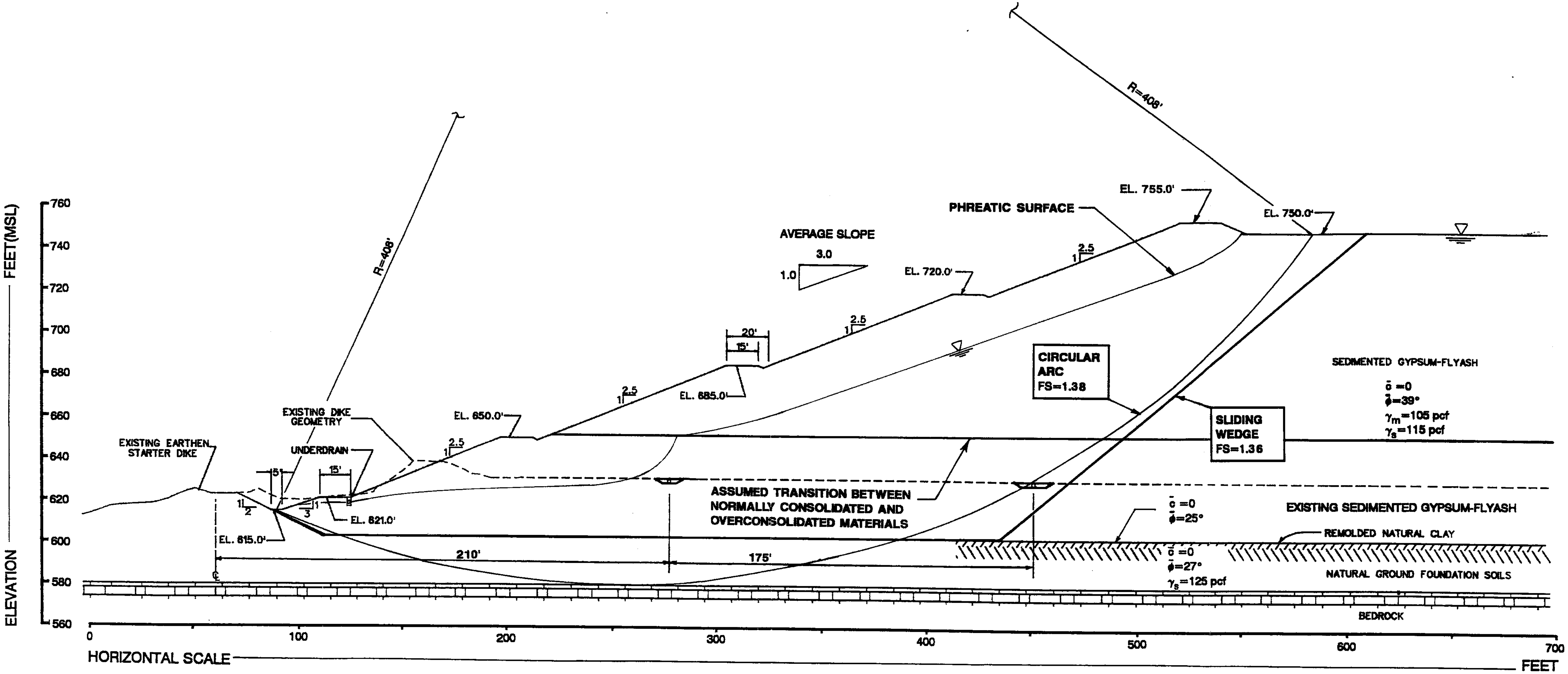
FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY	RDS	CHECKED BY	EJW	DATE	4/11/91
FILE NO.	90-059	APPROVED BY			

FIGURE 2

N39695



SECTION 5-5

SCALE: 1"=50'

STABILITY ANALYSIS FOR 2-LAYERED GYPSUM-FLYASH STACK

Ardaman & Associates, Inc.
Consulting Engineers in Soils, Hydrogeology, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

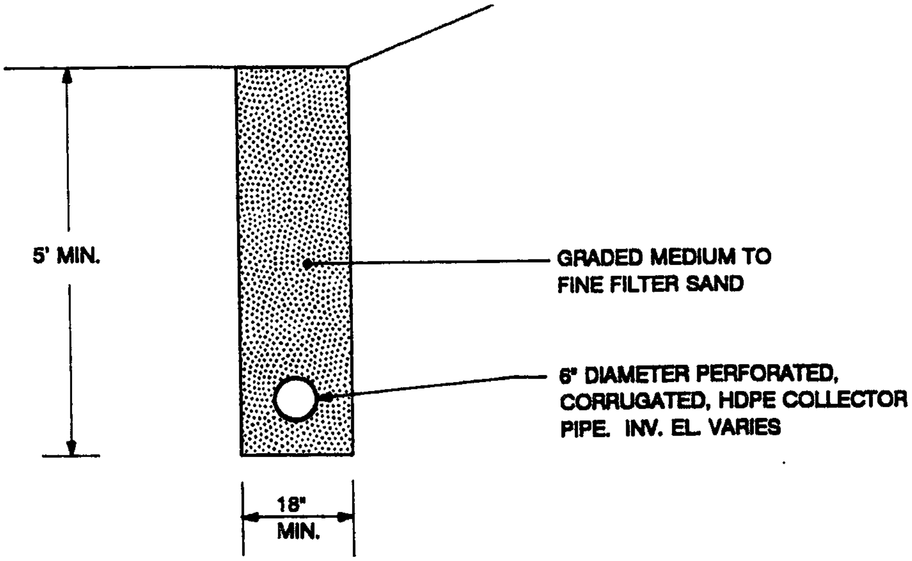
DRAWN BY: SEF	CHECKED BY: EJW	DATE: 8/1/91
FILE NO. 90-059	APPROVED BY:	

FIGURE 13

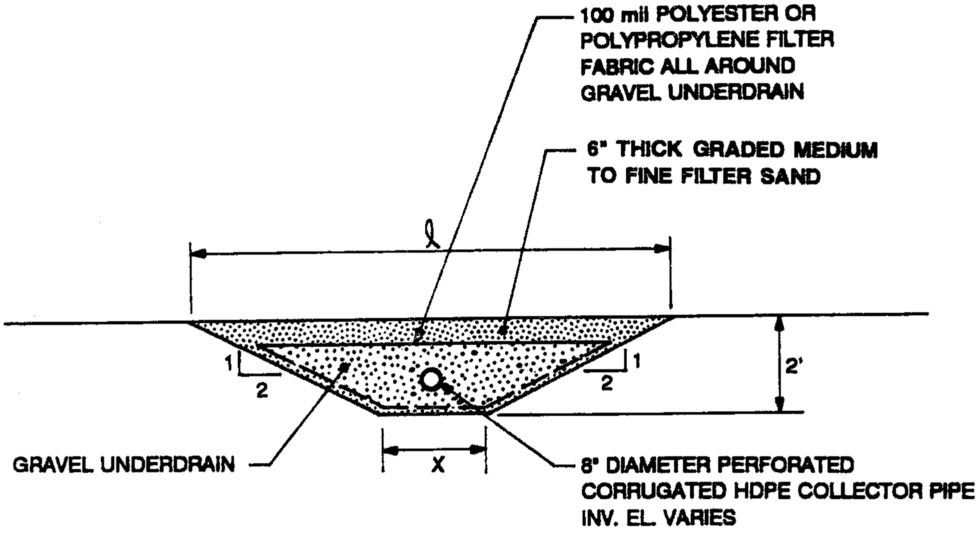
N36488

DRAIN TYPE "A"

NOT TO SCALE



DRAIN TYPES "B" AND "C"



DRAIN TYPE	ℓ (FEET)	X (FEET)
B	12	4
C	18	10

PRELIMINARY DRAIN DESIGN DETAILS

Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Materials Testing

FGD GYPSUM-FLYASH WASTE WET-STACKING DISPOSAL OPERATIONS
WIDOWS CREEK STEAM PLANT
STEVENSON, ALABAMA

DRAWN BY: KAG	CHECKED BY EAW	DATE: 8/1/91
FILE NO. 90-059	APPROVED BY	

FIGURE 14

April 30, 1991

PREPARED FOR:
TENNESSEE VALLEY AUTHORITY
FOSSIL & HYDRO ENGINEERING
1101 MARKET STREET
CHATTANOOGA, TN 37402-2801
AS REQUESTED BY: J.H. COULSON

WIDOWS CREEK STEAM PLANT
FORCED OXIDATION GYPSUM DRY STACKING - PHASE II
GEOTECHNICAL INVESTIGATION
DE-F19-392222

SL REPORT 30-02-0016A

VOLUME I

PREPARED BY:
Y.C. CHUNG

SINGLETON LABORATORIES
1413 TOPSIDE ROAD
LOUISVILLE, TENNESSEE 37777
615-970-2299/800-735-2299

TABLE OF CONTENTS

INTRODUCTION

Singleton Laboratories has completed a requested geotechnical investigation of Forced Oxidation Gypsum Dry Stacking - Phase II for Widows Creek Steam Plant. This investigation was conducted in general accordance with RTP No. DE-RTP-F19, dated November 10, 1990. A copy of the task proposal is enclosed in Appendix A. The purpose of the investigation is to:

1. Assess general subsurface soil conditions of the proposed forced oxidation dry stacking area.
2. Determine soil classification and engineering properties including shear strength, permeability, and consolidation of in-situ soils.
3. Determine soil classification and optimum compaction conditions of the borrow soils and their engineering properties including shear strength and permeability at the specified compaction conditions.
4. Estimate the volume of suitable borrow soils.

The investigation included the subsurface exploration and laboratory testing of foundation and borrow soils. The following report presents the activities and results of the investigation.

SITE INVESTIGATION

The field investigation was completed between December 19, 1990 and February 6, 1991. Borings included 23 split-spoon (SS), 16 power auger holes (PAH), and 7 undisturbed sampling locations in which a total of 650 lin ft was drilled. All borings were advanced by dry method with a CME-55 drill equipped with 3-1/4-in. hollow stem auger and AW drilling rods. Samplers used were the standard 2-in. split-spoon samplers, 6-in. flight augers, and 5-in. diameter thin-walled tubes. The site may be divided into two areas; one is the proposed dike area, and the other is borrow area which is located inside the proposed dike.

Proposed Dike Area

The 23 split-spoon borings in the proposed dike area consisted of 12 borings designated as SS-51 through SS-63 located along the dike, 6 borings designated as SS-64 through SS-70 located outside the dike, and 5 borings designated as SS-71 through SS-75 located inside the dike. For each split-spoon boring, Standard Penetration Tests (SPT) were performed and SPT samples were taken at 5-ft intervals to refusal. SPT tests were performed in accordance with American Society for Testing and Materials (ASTM) standard D 1586 in which a standard 1.4-in. id. and 2.0-in. od. split-spoon sampler is driven into the soil with a 140-lb hammer that free falls 30 inches. The standard penetration resistance of soil is defined as the number of blows required to drive the final foot. Coordinates and elevations of all borings investigated were tabulated and are enclosed in Appendix B. Field logs showing sampling depth, SPT blow counts (N values), moisture content, and soil classification are enclosed in Appendix C.

Seven (7) undisturbed borings designated as US-53, -55, -58, -60, -65, -66, and -73 were completed and a total of ten (10) 5-in. diameter undisturbed tube samples were obtained for laboratory testing. Upon completion of each split-spoon and undisturbed boring, the boring was backfilled with two bags of bentonite, then a mixture of bentonite and natural soils.

Overburden thickness of soils in the proposed dike ranged approximately from 4 to 22.5-ft with an average of 13.2-ft. Generally, the overburden soils were classified as brown to tan, lean to highly plastic clay of stiff to very stiff consistencies. SPT blow counts varied from 13 to 40 with an average of 21 for all the borings in the dike except boring SS-60 where soils of soft to medium consistencies were found at depths of about 5 and 20-ft. For the outside area surrounding the dike, refusals were encountered at depths ranging from 4.5 to 18.6-ft. The overburden soil was classified as a brown with grey mottled silty clay with thin lens of weathered chert.

Borrow Soils

The area inside the proposed dike was designated as a borrow area consisting of approximately 55 acres. Sixteen (16) auger borings were advanced to refusal. A boring location plan is enclosed in Figure 1. For each boring, bulk samples were taken at 5-ft intervals or soil changes. Refusal was encountered at depths ranging from 9.0 to 24.5-ft with an average of 16-ft. It is estimated that stripping topsoil will remove about 1.5-ft. Also, an additional 2.0-ft will not be recoverable where the top of rock is high; thus the average usable depth will be near 12-ft. Assuming 25 percent shrinkage the area could yield more than one-half million cubic yards of suitable fill needed.

Ground Water

Water level readings taken immediately and 24 hours after drilling showed the water table was located at or near the surface at most of the locations. Heavy precipitations prior to and during the period of sampling may have partially contributed to the high ground water table. The ground water table of each boring is shown in the enclosed field logs and ground water elevations are tabulated in Appendix C.

LABORATORY TESTING

Laboratory testing including moisture content (ASTM D 2216) and visual classification (ASTM D 2487) were made on all split-spoon samples, while Atterberg limits (ASTM D 4318) and grain-size analysis (ASTM D 422) were determined on representative samples of each soil type. Test results are shown in field logs in Appendix C. Undisturbed soil samples were tested individually for moisture content, unit weight, specific gravity (ASTM D 854), Atterberg limits, and grain-size distribution. Classification test results of undisturbed soils are summarized in Table 1. Moisture contents ranged from 14.6 to 31.1 percent with an average of 23.6 percent. Dry densities varied from 92.9 to 118.6 pcf with an average of 103.8 pcf. The soils were generally classified as lean to fat clay with some sand and gravel sizes of chert.

Unconsolidated-undrained (Q) and consolidated-undrained (R) triaxial shear, permeability, and consolidation tests were conducted on selected undisturbed samples representing each soil type and condition. R test samples were saturated, consolidated, then sheared with pore pressure measurements. Engineering test results are also summarized in Table 1. Under Q-test conditions, friction angles and cohesion ranged from 1.8 to 14.0 degrees and from 0.22 to 1.57 tsf, respectively. Under R-test conditions, apparent friction angles and cohesion ranged from 7.0 to 20.6 degrees and from 0.14 to 0.84 tsf, respectively, while effective friction angles and cohesion varied from 13.5 to 37.3 degrees and from zero to 0.46 tsf, respectively. Coefficients of permeability ranged from $1.8\text{x}10^{-6}$ to $3.5\text{x}10^{-6}$ cm/s. For the same soil type, the coefficient of vertical permeability is slightly higher than the horizontal permeability. The compression indices obtained from the 4 selected soil samples varied from 0.123 to 0.190.

Representative soil samples from the borrow area underwent index testing including grain-size analysis and Atterberg limits. Based on compaction test results, two soil classes were identified; Class I soil was classified as a lean clay, and Class II soil was classified as a fat clay. Standard compaction tests (ASTM D 698) yielded optimum moisture contents of 17.8 and 22.2 percent with corresponding maximum dry densities of 108.4 and 101.8 pcf for the Class I and II soils, respectively. Compaction curves developed for the two resulting soil classes and laboratory test data are enclosed in Appendix G. Samples from each class were tested for classification including grain-size and Atterberg limits and for triaxial shear strength under both Q (unconsolidated-undrained) and R (consolidated-undrained) test conditions. Samples for Q tests were compacted to 95 percent of maximum dry density at 3 percent wet of optimum moisture, while R-test samples were compacted to 95 percent of maximum dry density at 2 percent of optimum moisture. Samples for permeability were compacted to the same conditions as the R-tests. Test results of borrow soils are summarized in Table 2.

Under Q-test conditions, friction angles and cohesion are 6.7 degrees and 0.58 tsf for Class I soil and 5.3 degrees and 0.69 tsf for Class II soil. Under R-test conditions, apparent friction angles and cohesion are 14.9 degrees and 0.07 tsf for Class I soil and 12.2 degrees and 0.21 tsf for Class II soil, while effective friction angles and cohesion are 30.4 degrees and 0.04 tsf for Class I soil and 18.6 degrees and 0.24 tsf for Class II soil. Permeability test results indicate coefficients of both vertical and horizontal permeabilities are less than $1x10^{-7}$ cm/s at a density of 95 percent of maximum dry density.

SUMMARY

This investigation has shown the proposed dike site to be underlain by 4 to 22.5 ft of lean to fat clay. Overall, standard penetration testing has shown the foundation soil to be stiff to very stiff consistency although two isolated soil layers of medium consistency were encountered at boring SS-60. Shear strength tests indicate values of medium range. The in-situ soils were also shown to be of low compressibility and permeability.

For borrow soils, two soil classes were identified and the soils were classified as a lean clay for Class I and a fat clay for Class II. Compaction tests yielded optimum moisture contents of 17.8 and 22.2 percent with corresponding maximum dry densities of 108.4 and 101.8 pcf for Classes I and II, respectively. Both vertical and horizontal permeabilities of soil specimens compacted to 95 percent of maximum dry density with 2 percent dry of optimum moisture were determined to be less than 10^{-7} cm/s. Based on the assumptions of 55 acres and average usable depth of 12 ft, the borrow area should yield more than one-half million cubic yards of suitable fill.

WIDOWS CREEK STEAM PLANT
FORCED OXIDATION GYPSUM STACKING - PHASE II
GEOTECHNICAL INVESTIGATION
DE-F19-392222

Singleton Laboratories Report 30-02-0016A

					Grain-Size Analysis					Atterberg Limits				Triaxial Q		Sat Triaxial R				Coefficient of		
	Soil	Specific								Liquid	Plastic	Dry	Void	Undisturbed		Apparent		Effective		Permeability		Consolidation
	Symbol	Gravity	Nat Moist %	Sat	Gravel %	Sand %	Silt %	Clay %	D_{10} mm	Limit %	Index %	Density pcf	Ratio	ø deg	c tsf	ø deg	c tsf	ø deg	c tsf	K_h cm/sec	K_v cm/sec	Cc
Boring US-53, Surface El 635.7																						
(1) 630-7.630.0	ML/CL	2.73	21.8	95.3	0	21	32	47	--	49	20	104.9	0.626								1.4×10^{-7}	
(2) 622.7-622.0	CH	2.79	23.9	99.2	2	11	19	68	--	65	40	104.1	0.670								3.5×10^{-8}	
Boring US-55, Surface El 620.3																						
(1) 615.3-613.7	CH	2.75	31.1	100.0	6	7	9	78	--	84	55	93.2	0.841	1.8	1.12	7.0	0.64	13.5	0.46	4.8×10^{-7}	3.0×10^{-7}	0.172
Boring US-58, Surface El 607.6																						
(1) 602.6-601.0	CL	2.74/ 2.71	20.1	100.0	13	31	25	31	--	37	20	111.0	0.538								2.8×10^{-8}	
Boring US-60, Surface El 603.8																						
(1) 598.8-597.4	SC	2.73/ 2.79	14.6	91.2	26	50	7	17	.0009	46	25	118.6	0.436	7.5	0.22	20.3	0.14	37.3	0.00	3.8×10^{-7}	3.4×10^{-6}	0.136
(2) 591.3-589.8	CH	2.78	26.0	100.0	4	20	20	56	--	54	32	101.4	0.711	6.0	0.76	17.3	0.47	34.7	0.00	4.0×10^{-8}	2.5×10^{-8}	0.190
Boring US-65, Surface El 610.9																						
(1) 605.9-604.0	CH	2.80/ 2.75	27.7	92.5	12	24	19	45	--	53	28	98.9	0.766								5.8×10^{-7}	
Boring US-66, Surface El 610.9																						
(1) 602.9-602.2	GC	2.74/ 2.74	19.1	95.4	41	31	5	23	.0001	64	45	110.3	0.547								1.8×10^{-8}	
Boring US-73, Surface El 623.7																						
(1) 618.7-617.9	ML/CL	2.66	22.7	98.2	0	16	36	48	--	46	18	102.7	0.615	14.0	1.57	20.6	0.84	33.9	0.00	3.8×10^{-7}	3.5×10^{-6}	0.123
(2) 615.7-614.7	CH	2.74	29.0	94.8	0	2	8	90	--	85	57	92.7	0.839								2.8×10^{-8}	

WIDOWS CREEK FOSSIL PLANT
FORCED OXIDATION GYPSUM STACKING - PHASE II
DE-F19-392222

Singleton Laboratories Report 30-02-0016A

Table 2

BORROW SOIL CLASSES

Class	I	II
Symbol	CL	CH
Mechanical and Hydrometer Analysis		
Gravel, percent	0	0
Sand, percent	22	14
Silt, percent	30	24
Clay, percent	48	62
Atterberg Limits		
Liquid Limit, percent	43	56
Plastic Limit, percent	20	22
Plasticity Index, percent	23	34
Shrinkage Limit, percent	--	--
Standard Proctor Compaction		
Optimum Moisture, percent	17.8	22.2
Maximum Density, pcf	108.4	101.8
Penetration Resistance, psi	580	560

Shear Strength at: Remolded at 2% dry of optimum moisture and at 95% maximum unit weight.

		I	II
Triaxial R:	Apparent O, degrees	14.9	12.2
	Apparent C, tsf	0.07	0.21
	Effective O, degrees	30.4	18.6
	Effective C, tsf	0.04	0.24

Shear Strength at: Remolded at 3% wet of optimum moisture and at 95% maximum unit weight.

		I	II
Triaxial Q:	O, degrees	6.7	5.3
	C, tsf	0.58	0.69

Coefficient of Permeability: Remolded at 2% dry of optimum moisture and at 95 % of maximum unit weight.

	I	II
Vertical Permeability (Kv), cm/sec	2.5×10^{-8}	2.5×10^{-8}
Horizontal Permeability (Kh), cm/sec	3.8×10^{-8}	2.25×10^{-8}

WIDOWS CREEK STEAM PLANT

FORCED OXIDATION GYPSUM STACKING - PHASE II

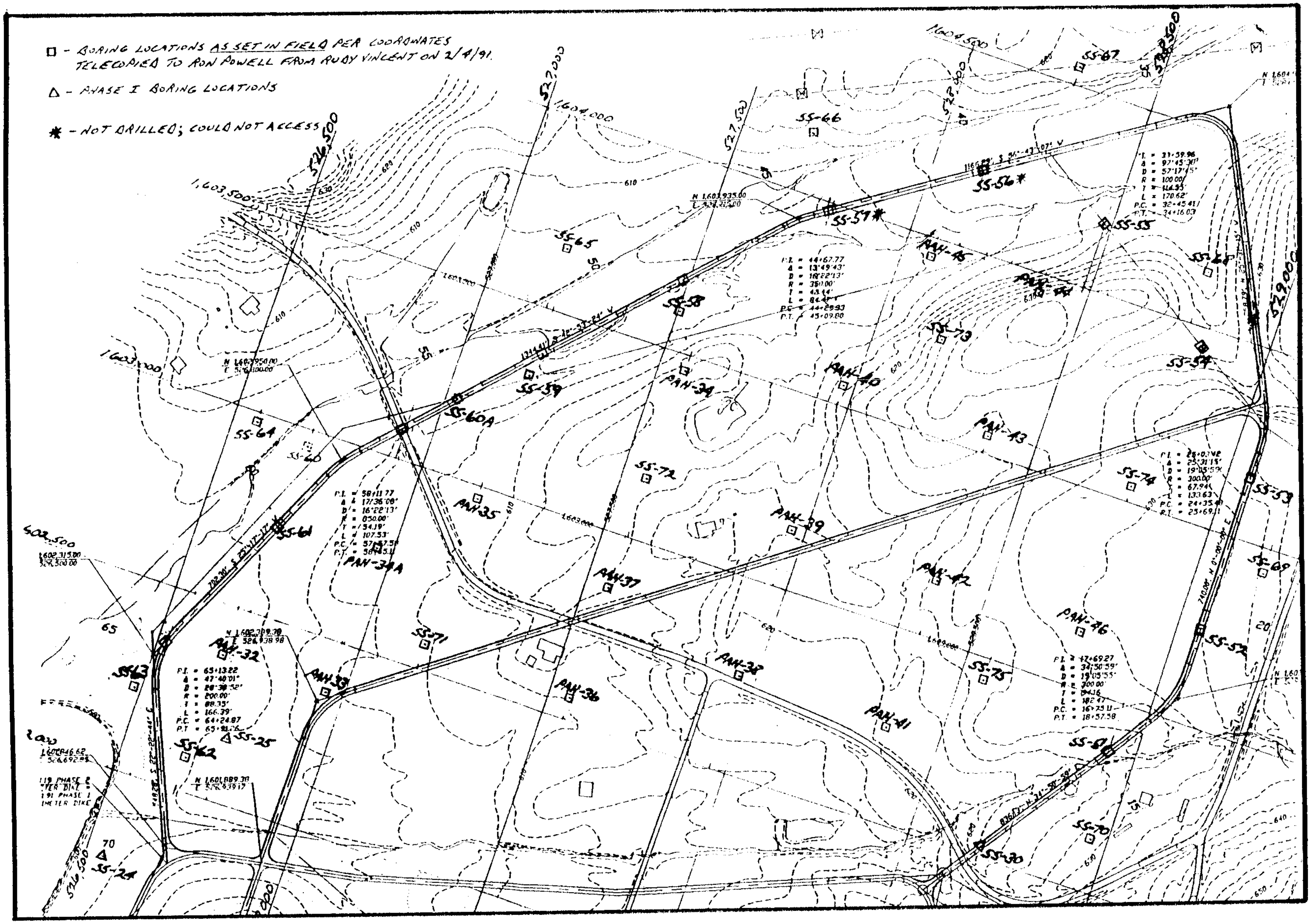


Figure 1

Boring Location Plan

WIDOWS CREEK STEAM PLANT
FORCED OXIDATION GYPSUM STACKING - PHASE II
GEOTECHNICAL INVESTIGATION
DE-F19-392222

Singleton Laboratories Report 30-02-0016A

APPENDIX A

TEST REQUEST

REQUEST FOR TASK PROPOSAL

DIGITAL ENGINEERING, INC. CONTRACT NO. TV-[illegible]

DATE: November 20 ~~2~~, 1990

RFP No. AE-RTA-F19

OPERATIONS: Power Engineering and Construction

DIVISION: Fossil and Hydro Engineering

DEPARTMENT: Civil

PROJECT: Widows Creek Fossil Plant

TASK SUBJECT: Forced Oxidation Gypsum Stacking - Phase II

	Name	Address	Telephone No.
PROJECT MANAGER:	Marvin Miller	BR 4N 49A-C	5947
TECHNICAL CONTACT:	Ron Powell	MR 3S 133D-C	8912

SCOPE OF WORK:
(Include sufficient detail to identify specific contractor responsibility; deliverables and schedule for delivery to TVA, quantity and TVA review requirements; and any special proposal information required from contractor. Use an attachment if additional space is required.)

See Attachments

Deloria T. Carter

Contract Administrator, Power Business Operations

11-28-90

Date

6622M

ATTACHMENT ____ Sheet 1 of 4

SOIL INVESTIGATION REQUEST

SUBJECT WIDOWS CREEK FOSSIL PLANT – FORCED OXIDATION GYPSUM STACKING – PHASE II

DNE SOIL SCHEDULE NO. N.A.

FIELD EXPLORATION

FOUNDATION OR IN SITU

SPT (D1586*)
No. of borings 25
Sampling interval: Continuous ____, 5' (max.) or each mat'l. change ✓,
or Other ____
Sample to: Top of rock ✓, Elev. ____, or Depth ____

UNDISTURBED SAMPLING (D1587)
No. borings 6±*, No. UD samples required ____
Sample each rep. soil type ✓, Sample each rep. soil condition ✓.
Est. depth ____, Contact GGEG ____, Other ____

PIEZOMETERS
No. required 2, See sketch LATER for details.
Reading schedule BY TVA
Special instructions LIST COSTS FOR PIEZOMETER INSTALLATIONS SEPARATELY IN COST ESTIMATE.

BORROW

Volume required (in-place) 125,000 C.Y. UNCLASSIFIED MTL. 345,000 C.Y. DIKE AND LINER MTL. C.Y., No. holes/acre ____

AUGER BORINGS (D1452) 15 TEST PITS N.A.
To top of rock ✓, or Elev. ____, or Depth ____, Other ____

JAR/BAG SAMPLING
Sample frequency ____
Sample each rep. soil type ✓
Other ____

GENERAL

Field classification (D2488): Each sample ✓, Other ____
Borings by: Dry procedures ✓, Drilling mud ____, Other ____
Borehole groundwater readings:
At completion of boring ____, 1 hr. ✓, 24 hr. ✓, Other ____
Special requirements for hole backfill USE EXCAVATED SOILS
Boring locations shown on attached DRAWING 10E217-01
Allowable boring offset from locations shown 5'
Survey required BY TVA Accuracy required 1.0' HORIZ., 0.1' VERT.
* Other instructions or requirements SINGLETON LABORATORIES WILL COORDINATE THE LOCATIONS OF THE UNDISTURBED BORINGS AND SAMPLING WITH THE FOSSIL AND HYDRO ENGINEERING (FHE) CIVIL GROUP, BASED ON THE INFORMATION FROM THE SPLIT-SPOON BORINGS.

*Applicable ASTM test designation or SME special laboratory procedure.

LAB TESTING

FOUNDATION or IN SITU	ASTM or SME Proc.	All Samples	Rep. Sample of Each Soil Type	Other
A. DISTURBED SAMPLES				
Classification	D2487		✓	
Moisture Content	D2216	✓		
Liquid Limit	D4318		✓	
Plastic Limit	D4318		✓	
Particle Size	D422		✓	To D10 ✓ or _____ mm
Specific Gravity	D854		✓	
Other				
Unused Sample Storage Requirements 9 MONTHS MIN. UNLESS OTHERWISE NOTIFIED				
B. UNDISTURBED SAMPLES				
Classification	D2487	✓		
Moisture Content	D2216	✓		
Liquid Limit	D4318	✓		
Plastic Limit	D4318	✓		
Particle Size	D422	✓		To D10 ✓ or _____ mm
Specific Gravity	D854	✓		
Unit Weight	SLP1/2	✓		
Permeability				
* Fine Grain	SLP3	✓		* HORIZ. AND VERT.
Granular	D2434			
Relative Density	D4253/4			
Consolidation	D2435		✓	Natural moisture _____, Saturated ✓, Max. load 16.0 TSF,
Swell or Settlement Potential	D4546			Cr reqd. _____ at load _____ TSF
Unconfined Compression	D2166			Degree of Sensitivity, St _____
Unconsolidated-Undrained (Q)	D2850		✓	
‡ Consolidated-Undrained (R)	SLP7		✓	Natural moisture _____, Saturated ✓, Pore pressure measurement ✓
Consolidated-Drained (S)				
Triaxial	SLP8			Natural moisture _____. Saturated _____
Direct Shear	D3080			Natural moisture _____. Submerged _____
Cyclic Triaxial Shear	SLP9			_____ TSF, Max. no. of cycles _____, Initial cyclic stress ratio _____
Resonant Column	D4015			Natural moisture _____. Saturated _____. _____ TSF, Initial stress (H:V) ratio _____
Unused Sample Storage Requirements 9 MONTHS MIN. UNLESS OTHERWISE NOTIFIED				

Other instructions or requirements FOR SPT BORINGS INSIDE PHASE II DIKES (NOS. 71 THRU 75), LAB SHALL PERFORM TESTS ON ONLY THE MATERIAL FROM 6 FEET ABOVE BEDROCK DOWN TO BEDROCK.

* PERFORM HORIZ. PERMEABILITY TEST ON ONE-HALF OF SAMPLES.

LAB TESTING (Continued)

BORROW SOILS	ASTM or SME Proc.	All Samples	Other
A. JAR SAMPLES			
Classification	D2487		
Moisture Content	D2216	✓	
Liquid Limit	D4318		
Plastic Limit	D4318		
Particle Size	D422		To D10 size ___ or ___ mm
B. SOIL CLASSES (BAG SAMPLES)		Each Soil Class	
Classification	D2487	✓	
Liquid Limit	D4318	✓	
Plastic Limit	D4318	✓	
Particle Size	D422	✓	To D10 size ✓ or ___ mm
Specific Gravity	D854	✓	
Moisture-Density (Compaction)			
Standard	D698	✓	Family of compaction control curves ✓
Modified	D1557		Family of compaction control curves ___
Moisture-penetration	SLP5	✓	
Relative Density	D4253/4		Granular soils only
		Each Soil Class	MOLDING CONDITIONS AND SPECIAL INSTRUCTIONS
Consolidation	D2435		___ % Compact, ___ % Wet of OMC, ___ % Dry of OMC, Max. load ___ TSF, Cr read ___ at load ___ TSF
Permeability			
* Fine Grain VERT.-EA. CLASS HORIZ.-½ OF CLASSES	SLP3	✓	95 % Compact, ___ % Wet of OMC, 2 % Dry of OMC
Granular	D2434		___ % Relative Density
Unconsolidated-Undrained(Q)	D2850	✓	95 % Compact, 3 % Wet of OMC, ___ % Dry of OMC
† Consolidated-Undrained (R)	SLP7	✓	95 % Compact, ___ % Wet of OMC, 2 % Dry of OMC, Saturate before shear ✓, Pore pressure measurement ✓
Consolidated-Drained (S)			
Triaxial	SLP8		___ % Compact, ___ % Wet of OMC, ___ % Dry of OMC, Saturate before shear ___
Direct Shear	D3080		___ % Compact, ___ % Wet of OMC, ___ % Dry of OMC, Submerge before shear ___
Cyclic Triaxial Shear	SLP9		___ % Compact, ___ % Wet of OMC, ___ % Dry of OMC, ___ TSF, Max. no. cycles ___, Initial cyclic stress ratio ___
Resonant Column	D4015		___ % Compact, ___ % Wet of OMC, ___ % Dry of OMC, ___ TSF, Initial stress (H:V) ratio ___
CBR	D1883		
Unused Sample Storage Requirements			

* Other instructions or requirements - IF PERMEABILITY OF 10^{-7} IS NOT OBTAINED AT 95% COMPACTION, TEST AT 98% COMPACTION.

† TABULATION OF $\bar{R}$ STRENGTH PARAMETERS ALSO REQUIRED.

Sheet 4 of 4

REPORT

Graphic Logs: SPT Borings ✓, Undisturbed Borings ✓, Auger Borings ✓, Indicate Groundwater ✓

Boring Location Plan ✓

Soil Profiles (Geologic Sections) ✓

Tabulation of SPT Sample Test Data ✓

Tabulation of Undisturbed Sample Test Data ✓

Plots of Test Data ✓

Advanced Information Requirements ______

Final Report: Due Date MARCH 5, 1991

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Account Number ______

GGEG Reviewer ______ Ext. ______

WIDOWS CREEK STEAM PLANT
FORCED OXIDATION GYPSUM STACKING - PHASE II
GEOTECHNICAL INVESTIGATION
DE-F19-392222

Singleton Laboratories Report 30-02-0016A

APPENDIX B

COORDINATES AND ELEVATIONS OF BORINGS

*

5 February 1991

TENNESSEE VALLEY AUTHORITY
MAPS & SURVEYS DEPARTMENT
ENGINEERING

RECEIVED
FEB 12 1991
SINGLETON LABORATORIES

WIDOWS CREEK STEAM PLANT
GYPSUM DRY STACK PHASE II
DRILL HOLES (PAH & SS)
** AS SET IN FIELD **
ADDENDUM

DATE OF SURVEY: 19 DECEMBER 1990
FILES: AG6, AG13

Designation	4th Order Ala. Mercator East Coordinates (Ft.)	4th Order Plant Grid Coordinates	4th Order Elevation (Feet)
PAH-32 (* *)	X= 526,670.0 Y= 1,602,372.2	E 79+45.9 N 32+71.9	601.9
PAH-33	X= 526,952.1 Y= 1,602,367.4	E 81+45.4 N 30+72.4	605.8
PAH-34 (Relocated)	X= 527,568.7 Y= 1,603,458.4	E 93+47.0 N 34+28.2	613.2
PAH-34A	X=526,958.3 Y=1,602,767.4	E 84+27.9 N 33+55.7	606.7
PAH-35 (Original AAH-34 Loc.)	X= 527,161.4 Y= 1,602,964.9	E 87+11.1 N 33+56.5	608.4
PAH-36	X= 527,554.9 Y= 1,602,558.4	E 87+11.5 N 27+90.7	609.7
PAH-37	X= 527,559.6 Y= 1,602,858.3	E 89+23.4 N 30+03.1	613.7
PAH-38	X= 527,958.0 Y= 1,602,752.4	E 91+36.2 N 26+50.1	618.1
PAH-39	X= 527,964.2 Y= 1,603,152.3	E 94+18.6 N 29+33.3	619.3
PAH-40	X= 527,970.2 Y= 1,603,552.3	E 97+00.9 N 32+16.7	617.2
PAH-41	X= 528,358.2 Y= 1,602,746.5	E 94+19.8 N 23+67.6	619.9
PAH-42	X= 528,363.8 Y= 1,603,146.4	E 97+01.8 N 26+51.2	624.0

WIDOWS CREEK STEAM PLANT
GYPSUM DRY STACK PHASE II
DRILL HOLES (PAH & SS)
** AS SET IN FIELD **
ADDENDUM

Designation	4th Order Ala. Mercator East Coordinates (Ft.)	4th Order Plant Grid Coordinates	4th Order Elevation (Feet)
PAH-43	X= 528,370.3 Y= 1,603,546.3	E 99+84.4 N 29+34.3	624.0
PAH-44	X= 528,376.1 Y= 1,603,946.3	E 102+66.6 N 32+17.8	629.5
PAH-45 (Relocated)	X= 528,076.0 Y= 1,603,950.8	E 100+54.0 N 34+29.6	611.5
PAH-46	X= 528,764.1 Y= 1,603,140.4	E 99+85.4 N 23+68.7	629.3
SS-24 Phase I Boring	X= 526,543.4 Y= 1,601,773.6	E 74+38.8 N 29+29.5	601.3
SS-25 Phase I Boring	X= 526,749.4 Y= 1,602,170.6	E 78+62.9 N 30+71.8	602.5
SS-30 Phase I Boring	X= 528,687.6 Y= 1,602,530.0	E 95+06.2 N 19+83.0	621.1
SS-51	X= 528,927.1 Y= 1,602,869.3	E 99+14.2 N 20+60.5	625.4
SS-52	X= 529,060.0 Y= 1,603,242.5	E 102+69.1 N 22+36.5	632.2
SS-53	X= 529,060.0 Y= 1,603,657.5	E 105+57.6 N 25+34.8	635.7
SS-54	X= 528,831.3 Y= 1,603,948.1	E 105+95.1 N 29+02.7	626.8
SS-55	X= 528,483.0 Y= 1,604,173.5	E 105+01.4 N 33+06.9	620.3
SS-56 Not drilled Could Not Access	X= 528,135.2 Y= 1,604,210.0	E 102+76.7 N 35+74.9	613.0

WIDOWS CREEK STEAM PLANT
GYPSUM DRY STACK PHASE II
DRILL HOLES (PAH & SS)
** AS SET IN FIELD **
ADDENDUM

Designation	4th Order Ala. Mercator East Coordinates (Ft.)	4th Order Plant Grid Coordinates	4th Order Elevation (Feet)
SS-57 Not drilled Could Not Access	X= 527,787.9 Y= 1,603,982.7	E 98+69.0 N 36+52.8	612.3
SS-58 (**)	X= 527,506.2 Y= 1,603,603.0	E 94+02.6 N 35+75.6	607.6
SS-59 (**)	X= 527,190.6 Y= 1,603,315.7	E 89+76.0 N 35+88.4	605.7
SS-60 (**)	X= 526,704.7 Y= 1,602,954.8	E 83+75.8 N 36+66.7	603.8
SS-60A	X=527,029.1 Y=1,603,196.6 (Original SS-60 Loc.)	E 87+77.1 N 36+15.1	605.4
SS-61 ~~(**)~~	X= 526,702.7 Y= 1,602,743.3	E 82+27.3 N 35+16.0	602.9
SS-62 (**)	X= 526,664.9 Y= 1,602,089.3	E 77+45.6 N 30+72.0	601.8
SS-63 (**)	X= 526,482.7 Y= 1,602,218.8	E 77+04.6 N 32+91.8	601.0
SS-64	X= 526,561.4 Y= 1,602,973.3	E 82+85.6 N 37+79.6	603.8
SS-65 Not Found in Field. Visually located by drill crew personnel.			
SS-66	X= 527,679.3 Y= 1,604,156.8	E 99+11.9 N 38+53.5	610.9
SS-67	X= 528,285.2 Y= 1,604,547.7	E 106+19.2 N 37+13.4	615.3
SS-68	X= 528,779.0 Y= 1,604,140.2	E 106+91.1 N 30+77.2	620.6
SS-69	X= 529,168.6 Y= 1,603,434.4	E 104+80.6 N 22+99.0	634.8

(**) = Relocated from theoretical position in the field due to high water.

WIDOWS CREEK STEAM PLANT
GYPSUM DRY STACK PHASE II
DRILL HOLES (PAH & SS)
** AS SET IN FIELD **
ADDENDUM

Designation	4th Order Ala. Mercator East Coordinates (Ft.)	4th Order Plant Grid Coordinates	4th Order Elevation (Feet)
SS-70	X= 528,956.5 Y= 1,602,637.2	E 97+74.0 N 18+73.2	629.3
SS-71	X= 527,155.5 Y= 1,602,564.8	E 84+28.8 N 30+72.9	607.5
SS-72	X= 527,564.1 Y= 1,603,158.3	E 91+35.1 N 32+15.7	612.9
SS-73	X= 528,173.1 Y= 1,603,749.2	E 99+83.7 N 32+17.2	623.7
SS-74	X= 528,770.2 Y= 1,603,540.4	E 102+67.8 N 26+52.1	628.7
SS-75	X= 528,561.3 Y= 1,602,943.3	E 97+02.6 N 23+68.0	624.7

APPENDIX C

FIELD LOGS AND WATER TABLE READING

SINGLETON LABORATORIES

SOIL PROFILE LEGEND AND SYMBOLS

Depth 1"=5'	El	SPT (N)	Log*	W	LL	PI	Gr	Description or Test Results
Boring Depth and Scale	Elevation	Blows Per Foot (SS Boring)	Lab Soil Type	Moisture Content	Liquid Limit	Plasticity Index	Soil Group Number	

Legend

Cl,etc	Soil Type (Unified Classification)
Mat'l	Notation of Soil Not Sampled (SS, PAH, HAH Logs)
(Core) Type	Bedrock (Note core if cored)
▽	Initial Water Table Reading
▼	24 h Water Table Reading
	Explanation of US Sampling Limits if Applicable

Under Description or Test Results		
Test	Engineering Test Results	
Q, R, $\bar{R}$, S	Friction Angle (degrees)	Cohesion (tsf)
UC	Unconfined Compressive Strength (tsf)	Sensitivity Ratio
C	Compression Index	Preconsolidation Pressure (tsf)
k	Coefficient of Permeability (cm/sec)	

Example:

Q 12.0 0.62 R 19.6 0.21 S 34.0 0
UC 4.0 2.6 C 0.72 2.0 k 5.6

Boring Symbols

SS - 2-in. od Split Spoon Boring
SPT - Standard Penetration Test Blows Per Foot With 2-in. Split Spoon
CPT - Cone Penetration Test
US - Undisturbed Sample Boring
PAH - Power Auger Hole
HAH - Hand Auger Hole
TP - Test Pit or Trench
V - Vane Shear
P - Piezometer

Soil Test Symbols

Q - Unconsolidated-Undrained Triaxial Compression
R - Consolidated-Undrained Triaxial Compression (Saturated)
$\bar{R}$ - Effective Consolidated-Undrained Triaxial Compression
R nat - Consolidated-Undrained Triaxial Compression (Natural Moisture)
S - Consolidated-Drained Direct Shear
UC - Unconfined Compression
C - Consolidation
k - Permeability

FLA

SINGLETON LABORATORIES

FIELD LOG ABBREVIATIONS

Typical Name	Abbreviation
Sandy gravel	sd gv
Silty gravel	si gv
Clayey gravel	cl gv
Sand	sd
Silty sand	si sd
Clayey sand	cl sd
Sandy silt	sd si
Clayey silt	cl si
Fat silt	ft si
Sandy clay	sd cl
Silty clay	si cl
Medium clay	md cl
Fat clay	ft cl
Cobble	cob
Blouder	bldr
Riprap	rr
Topsoil	ts

Name Modifiers

Clean	cln
Coarse	crs
Dirty	dty
Fine	fn
Organic	org
Poorly graded	pgd
Well graded	wgd
Degraded	degd

Gravel Shape

Angular	ang
Platy	plty
Round/Rounded	rd
Subangular	sb ang
Subrounded	sb rd

Lithology and Mineralogy	Abbreviation
Bedrock	br
Chert	cht
Dolomite	dol
Limestone	ls
Manganese	mn
Micaceous	mic
Pyrite	py
Quartz	qtz
Sandstone	ss
Shale	sh
Bentonite	bent
Hematite	hem

Color

Black	blk
Blue	blu
Brown	brn
Cream	crm
Dark	dk
Gray	gy
Green	grn
Light	lt
Maroon	mrn
Mottled	mott
Olive	olv
Pink	pk
Purple	pur
Red	r
Rust	rst
Tan	tn
White	wht
Yellow	yel

Structure	Abbreviation	Consistency	Abbreviation
Blocky	blky	Dense	dns
Fissured	fis	Firm	f
Homogeneous	homo	Hard	hd
Laminated	lam	Loose	lse
Saprolitic	sapr	Soft	s
Shaly	shly	Stiff	stf
Slickensided	slsid	Very Stiff	v stf
Stratified	strat		
Origin		**Moisture**	
Alluvial	all	Dry	d
Colluvial	coll	Moist	mst
Loess	lss	V Moist	v mst
Residual	resd	Wet	w

General Modifiers

Alternate/Alternating	alt	Layers	lyrs
Angle	∢	Low	l
Augering	augg	Material	mtl
Bottom Ash	ba	Medium	md
Coal	col	Mud	mud
Contaminated	cont	Original	orig
Dip	dp	Partings	prtgs
Disturbed	dstrb	Plastic	plstc
Debris	dbr	River	rvr
Discontinued	disc	Roots	rts
Drive	dr	Rough	rou
Dust	dst	Slow	sl
Elevation	el	Small	sm
Feet	ft	Spoil	sp
Fill	fl	Terraced	ter
Fiber	fbr	Thick	thk
Fly Ash	fa	Thin	thn
High/highly	h	Trace	tr
Horizontal	hor	Variable	var
Hydraulic	hyd	Vegetation	veg
Inch	in	Vertical	vert
Inclusion	inc	Weathered	wth
Incomplete Recovery	IR	With	w/
Interface	infa	Wood	wd

SUMMARY OF WATER TABLE READINGS

Boring	Surface Elevation	Initial Water Table Reading	24-Hr Water Table Reading
SS-51	620.0	607.0	612.0
SS-52	632.2	623.7	623.7
SS-53	635.7	dry	dry
SS-54	626.8	619.8	619.8
SS-55	620.3	dry	dry
SS-58	607.6	606.6	606.8
SS-59	605.7	604.7	605.2
SS-60	603.8	598.3	603.8
SS-60A	605.4	600.4	604.4
SS-61	602.9	595.0	601.9
SS-62	601.8	no reading	no reading
SS-63	601.0	588.0	600.0
SS-64	603.8	598.4	599.8
SS-65	605.0	599.5	599.5
SS-66	610.9	610.9	610.9
SS-67	615.3	605.3	607.3
SS-69	634.8	dry	dry
SS-70	629.3	624.8	624.8
SS-71	607.5	606.5	607.5
SS-72	612.9	602.9	607.4
SS-73	623.7	610.7	612.9
SS-74	628.7	616.2	617.7
SS-75	624.7	614.7	618.1

SUMMARY OF WATER TABLE READINGS

Boring	Surface Elevation	Initial Water Table Reading	24-Hr Water Table Reading
PAH-32	601.9	600.9	601.3
PAH-33	605.8	601.8	603.3
PAH-34	613.2	609.2	610.2
PAH-34A	606.7	594.2	594.2
PAH-35	608.4	596.4	599.4
PAH-36	609.7	596.7	609.1
PAH-37	613.7	607.7	610.7
PAH-38	618.1	605.6	dry
PAH-39	619.3	606.8	613.6
PAH-40	617.2	609.2	610.6
PAH-41	619.9	610.9	610.9
PAH-42	624.0	607.0	611.0
PAH-43	624.0	609.5	621.3
PAH-44	629.5	608.4	608.4
PAH-45	611.5	606.0	610.5
PAH-46	629.3	611.4	611.4

SINGLETON LABORATORIES

SOIL PROFILE (SPLIT-SPOON)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK FEATURE: PHASE II, ASH PIT
BORING: SS-51 STATION: RANGE: SURFACE EL: 620.0
DATE DRILLED: 2/1/91 TO PREPARED BY: ALH CHECKED BY: TAL

DEPTH ft.	EL 620	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
5	615	21	CH	23.6	54	31	4	BRN-TN W/GY MOTT FT CL, MST, COLL/ALL
				▼				
10	610	21	CL	18.4	45	27	1	BRN-TN W/GY MOTT FT CL W/WTH CHT GV to SI SD & WTH LS, MST, RESD
				▽				
15	605							REFUSAL
20	600							
25	595							
30	590							
35	585							

1''=5'

*Lab. Classif.

SINGLETON LABORATORIES

SOIL PROFILE (SPLIT-SPOON)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK
FEATURE: PHASE II, ASH PIT
BORING: SS-52 STATION:
RANGE:
SURFACE EL: 632.2
DATE DRILLED: 2/1/91 TO
PREPARED BY: ALM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
	630							
5		19	CL	23.3	45	27	1	BRN-TN FT CL, MST, RESD W/WTH CHT GV & BLK CONCRTN STAINS
	625							
			▼	▽				
10								REFUSAL
	620							
15								
	615							
20								
	610							
25								
	605							
30								
	600							
35								
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (SPLIT-SPOON)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK FEATURE: PHASE II, ASH PIT
BORING: SS-53 STATION: RANGE: SURFACE EL: 635.7
DATE DRILLED: 2/1/91 TO PREPARED BY: ALM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
	635							
5	630	25	CL	21.8	45	27	1	BRN-R BRN SI CL W/THN LENS MED CL, W/WTH CHT GV & BLK CONCRTN, D-MST, COLL/ALL
10	625	18	CL	22.0	45	27	1	BRN-TN W/GY MOTT FT CL, V PLSTC STF, HD, 10% <1/8" RD CHT GV & BLK CONCRTN, MST, COLL/ALL
15	620	25	CH	34.0	54	31	4	BRN W/DK GY MOTT FT CL, PLSTC, STF, MST, RESD, WTH LS
				▼ ▽				REFUSAL
20	615							
25	610							
30	605							
35								
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (SPLIT-SPOON)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK
FEATURE: PHASE II, ASH PIT
BORING: SS-54 STATION:
RANGE:
SURFACE EL: 626.8
DATE DRILLED: 2/1/91 TO
PREPARED BY: ALM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
	625							
5								
		15	CL	26.9 ▼ ▽	45	27	1	BRN-R BRN W/GY MOTT & BLK CONCRT FT CL W/SD DUE TO WTH CHT, MST-D
	620							
								REFUSAL.
10								
	615							
15								
	610							
20								
	605							
25								
	600							
30								
	595							
35								
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (SPLIT-SPOON)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK FEATURE: PHASE II, ASH PIT
BORING: SS-55 STATION: RANGE: SURFACE EL: 620.3
DATE DRILLED: 2/1/91 TO PREPARED BY: ALM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
	620							
5	615	20	CL	32.8	45	27	1	IR; BRN W/R&GY MOTT FT CL, MST, COLL/ALL, RD CHT GV, V HD, PLSTC
10	610	20	CL	23.3	45	27	1	BRN W/GY&R MOTT FT CL, MST-D, HD, PLSTC, RD CHT GV, BLK CONCRT STAINS, COLL/ALL
				▼ ▽				
15	605							REFUSAL, BEDROCK.
20	600							
25	595							
30	590							
35								

1''=5'

*Lab. Classif.

SINGLETON LABORATORIES

SOIL PROFILE (SPLIT-SPOON)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK
FEATURE: PHASE II, ASH PIT
BORING: SS-58
STATION:
RANGE:
SURFACE EL: 607.6
DATE DRILLED: 1/28/91 TO
PREPARED BY: ALM
CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
			▼▽					
	605							
5		17	CL	24.3	40	23	2	IR; BRN W/GY MOTT FT W/THIN LENS R BRN SI CL W/WTH CONCRTN FRAG (SD), MST, HD, STF, PLSTC
	600							
10		17	CL	30.1	38	20	5	IR; BRN W/KD GY MOTT FT CL, V MST, RESD/ALL, 20% WTH CHT GV & LS GV
	595							REFUSAL, BEDROCK.
15								
	590							
20								
	585							
25								
	580							
30								
	575							
35								
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (SPLIT-SPOON)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK
BORING: SS-59 STATION:
DATE DRILLED: 1/28/91 TO

FEATURE: PHASE II, ASH PIT
RANGE:
SURFACE EL: 605.7
PREPARED BY: Aisi CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
	605		▼	▽				
5	600	15	CL	14.6	45	27	1	IR; BRN-R BRN SI CL W/SD CHT & CONCRTN, 35% WTH CHT GV <1/8", MST, ALL
								REFUSAL, BEDROCK.
10	595							
15	590							
20	585							
25	580							
30	575							
35								
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (SPLIT-SPOON)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK
FEATURE: PHASE II, ASH PIT
BORING: SS-60 STATION:
RANGE:
SURFACE EL: 603.8
DATE DRILLED: 12/21/90 TO
PREPARED BY: ALM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W ▼	LL	PI	GR	FIELD DESCRIPTION
	600							
5								
		5	CL	▽18.1	45	27	1	IR;GY W/BRN MOTT MD SD CL W/30% <1/2" RD CHT'SS GV, W, COLL/ALL
	595							
10								
		15	CL	20.2	40	23	2	BRN/TN/GY/R FT CL, V PLSTC, V HD V STF, MST, RESD/ALL
	590							
15								
		14	CL	24.9	40	23	2	BRN W/R&GY MOTT FT CL, V HD, V PLSTC, V STF, MST, RESD, 10% CHT
	585							
20								
		8	CL	29.2	40	23	2	R&BRN W/GY MOTT FT CL, V HD, V STF, V PLSTC, MST-V MST, RESD
	580							REFUSAL, BEDROCK.
25								
	575							
30								
	570							
35								
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (SPLIT-SPOON)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK FEATURE: PHASE II, ASH PIT
BORING: SS-60A STATION: RANGE: SURFACE EL: 605.4
DATE DRILLED: 1/28/91 TO PREPARED BY: ALM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
	605			▼				
5	600	17	CL	▽ 22.6	38	20	5	IR; BRN&TN FT CL W/GY MOTT, MST ALL, BLK CONCRTN STAINS, THIN LENS OF R BRN SI CL/WTH CONCRTN
10	595	25	CL	18.5	38	20	5	BRN W/GY/TN/R BRN MOTT FT CL, MST-V MST, V PLSTC W/35% WTH CHT GV & BLK CONCRTN, ALL
15	590	21	CL	14.5	40	22	6	BRN W/GY MOTT FT CL, V HD, V STF &PLSTC, MST-V MST, RESD/ALL
								REFUSAL, BEDROCK.
20	585							
25	580							
30	575							
35								
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (SPLIT-SPOON)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK
FEATURE: PHASE II, ASH PIT
BORING: SS-61 STATION:
RANGE:
SURFACE EL: 602.9
DATE DRILLED: 12/21/90 TO
PREPARED BY: ALM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
				▼				
	600							
5								
		19	CL	19.9	40	23	2	IR; BRN-R BRN SD MED CL, 45% BLK IRON CONCRTN&RVR RD CHT GV, MST, COLL/ALL
	595			▽				
10								
		13	CL	19.2	38	20	5	IR; BRN&R BRN W/GY MOTT FT CL, V HD, V PLSTC, V STF, 20% <1/2" RD CHT GV, COLL/ALL, MST
	590							
								REFUSAL, BEDROCK.
15								
	585							
20								
	580							
25								
	575							
30								
	570							
35								
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (SPLIT-SPOON)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK FEATURE: PHASE II, ASH PIT
BORING: SS-62 STATION: RANGE: SURFACE EL: 601.8
DATE DRILLED: 12/19/90 TO 12/20/90 PREPARED BY: ALLi CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
	600							
5		40	CL	18.2	45	27	1	BRN&TN W/GY MOTT FT CL W/THIN LENS FT SD CL W/10% FRAG CHT&SS& Mg CONCRTN, COLL/ALL, MST
	595							
10		29	CL	19.5	45	27	1	BRN-TN W/30% BLK&BRN CONCRTN & STAINS, FT CL W/THIN LENS FT SD CL DUE TO CONCRTN, V HD, PLSTC, D, COLL/ALL
	590							
15								REFUSAL, BEDROCK.
	585							
20								
	580							
25								
	575							
30								
	570							
35								
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (SPLIT-SPOON)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK FEATURE: PHASE II, ASH PIT
BORING: SS-63 STATION: RANGE: SURFACE EL: 601.0
DATE DRILLED: 1/25/91 TO PREPARED BY: ALM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
	600			▼				
5								
	595	35	CL	11.7	45	27	1	IR; BRN GV MED CL W/40% <1/8" WTH CHT GV & BLK Mg CONCRTN, D
10								
	590	21	CL	18.1	45	27	1	IR; BRN W/GY MOTT FT CL, HD, STF MST W/5% CHT GV & BLK CONCRTN
				▽				
15								REFUSAL, BEDROCK.
	585							
20								
	580							
25								
	575							
30								
	570							
35								
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (SPLIT-SPOON)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK
FEATURE: PHASE II, ASH PIT
BORING: SS-64
STATION:
RANGE:
SURFACE EL: 603.8
DATE DRILLED: 2/4/91 TO
PREPARED BY: ALM
CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
	600							
5		29	CL	18.4	45	27	1	BRN WTH CT GV, SD CL W/SM WTH CHT, BLK WTH CONCRTN, MST, COLL/ALL
	595							
10		23	CL	20.0	45	27	1	BRN W/GY MOTT FT CL W/THIN LENS SD (WTH RK), MST-D, W/35% SUB AND RD COLL/RESD
	590							
15								REFUSAL
	585							
20								
	580							
25								
	575							
30								
	570							
35								
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (SPLIT-SPOON)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK
FEATURE: PHASE II, ASH PIT
BORING: SS-65
STATION:
RANGE:
SURFACE EL: 605.0
DATE DRILLED: 2/5/91 TO
PREPARED BY: ALM
CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
	605							
		13	CL	20.2	40	22	6	GY W/BRN MOTT SI CL W/LENS MED CL ALSO LENS WTH CHT, SS OR CONCRTN FOR SD BANDS, W, COL/ALL
5	600			▼ ▽				NO RECOVERY
		30	CL	17.1	38	20	5	GY W/BRN MOTT FT CL W/SD WTH CHT GV, V MST W, RESD, ANG CHT FRAG
10	595							REFUSAL
15	590							
20	585							
25	580							
30	575							
35	570							
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (SPLIT-SPOON)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK
FEATURE: PHASE II, ASH PIT
BORING: SS-66 STATION:
RANGE:
SURFACE EL: 610.9
DATE DRILLED: 2/4/91 TO
PREPARED BY: ALM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	▼ W ▽	LL	PI	GR	FIELD DESCRIPTION
	610							
5	605	14	CL	17.7	38	20	5	BRN SD MED CL W/GY MOTT MED CL W/HD SD (35% CHT GV), BLK CONCRT COLL/ALL, MST
10	600	11	CL	20.3	46	27	3	IR; BRN W/GY MOTT FR SD CL W/20% WTH CHT GV, SB ANG RD, MST, COLL/RESD
15	595	11	CL	26.8	46	27	3	IR; MST BRN W/GY MOTT FT CL, V HD, V PLSTC, COLL/ALL, <10% RD CHT GV
20	590							REFUSAL
25	585							
30	580							
35								
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (SPLIT-SPOON)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK
FEATURE: PHASE II, ASH PIT
BORING: SS-67
STATION:
RANGE:
SURFACE EL: 615.3
DATE DRILLED: 2/4/91 TO
PREPARED BY: ALM
CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
	615							
5	610	14	CL CH	13.6 15.5	45 54	27 31	1 4	IR; 5.0-5.3: MST BRN & GY SD CL W/15% WTH CHT, COLL/ALL 5.3-5.8: MST-V MST GY & BRN MED CL W/THIN LENS SD CL, COLL/ALL
				▼				
				▽				
10	605	16	CH	27.6	54	31	4	IR; BRN W/GY MOTT FT CL, V HD, V PLSTC, MST, RESD/COLL
15	600	20	CL	27.4	46	27	3	BRN W/BLU GY MOTT, V FT CL, V HD V PLSTC W/THIN LENS FT SD CL W/WTH CHT GV, MST, RESD/COLL
								REFUSAL
20	595							
25	590							
30	585							
35								
1''=5'								

*Lab. Classif.

SINGLETON LABORATORIES

SOIL PROFILE (SPLIT-SPOON)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK FEATURE: PHASE II, ASH PIT
BORING: SS-69 STATION: RANGE: SURFACE EL: 634.8
DATE DRILLED: 2/1/91 TO PREPARED BY: ALM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
5	630	10	CL	28.6	45	27	1	BRN W/GY MOTT FT CL, MST, CHT GV COLL/ALL
10	625	16	CL	18.9	45	27	1	BRN W/GY (LS) FT CL W/SD (WTH CHT&LS), MST, RESD
				▼ ▽				
								REFUSAL
15	620							
20	615							
25	610							
30	605							
35	600							
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (SPLIT-SPOON)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK FEATURE: PHASE II, ASH PIT
BORING: SS-70 STATION: RANGE: SURFACE EL: 629.3
DATE DRILLED: 2/6/91 TO PREPARED BY: ALM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
5	625	50+	CL	▼▽15.0	45	27	1	BRN-TN FT CL, MST W/20-30% CHT GV ≤1/8"->1.375, V PLSTC
								REFUSAL
10	620							
15	615							
20	610							
25	605							
30	600							
35	595							
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (SPLIT-SPOON)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK FEATURE: PHASE II, ASH PIT
BORING: SS-71 STATION: RANGE: SURFACE EL: 607.5
DATE DRILLED: 12/20/90 TO PREPARED BY: ALM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	▼ W	LL	PI	GR	FIELD DESCRIPTION
				▽				
	605							
5		6		16.8 16.9				5.0-5.5: CONCRTN LYR W/ SD SI or SI SD, 60% CONCRTN, BLK & BRN, V MST, COLL/ALL 5.5-6.0: BRN & GY SI CL W/THIN LENS SD MATRL, EX W, ALL/COLL
	600							
10		18		19.7 20.9				10.0-10.5: FT CL W/40% BLK & BRN CONCRTN, BRN & TN W/GY MOTT SOIL W/THIN LENS SD CL MST, COLL/ALL 10.5-10.9: BRN W/GY MOTT FT CL W/<5% CONCRTN, MST, V HD & PLSTC, COLL/ALL
	595							
15		6	CH	44.7	69	40	1	BRN W/BLU GY FT CL, V HD & PLSTC MST-V MST, RESD
	590							
20								REFUSAL
	585							
25								
	580							
30								
	575							
35								
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (SPLIT-SPOON)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK FEATURE: PHASE II, ASH PIT
BORING: SS-72 STATION: RANGE: SURFACE EL: 612.9
DATE DRILLED: 1/28/91 TO 1/29/91 PREPARED BY: ALM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
	610							
5		31		▼ 16.4				IR; TN/YEL/GY MED CL-BRN/R WTH CONCRTN THAT TEXTURE TO SI CL, MST-D, COLL/ALL
	605							
10		13		▽ 19.6				IR; BRN&TN FT CL W/BLK/R CONCRTN WTH (SI CL), MST, ALL/COLL
	600							
15		10	CH	40.7	69	40	1	BRN W/GY MOTT FT CL, V PLSTC, STF, V MST, RESD/COLL
	595							
20								REFUSAL
	590							
25								
	585							
30								
	580							
35								
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (SPLIT-SPOON)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK FEATURE: PHASE II, ASH PIT
BORING: SS-73 STATION: RANGE: SURFACE EL: 623.7
DATE DRILLED: 1/31/91 TO PREPARED BY: ALM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
	620							
5		26		22.5				BRN W/R MOTT MED CL, MST, RESD W/ANG CHT 1/8-1/2", WTH CHT GV
	615							
10		15		▼ 25.3				IR; TN&BRN W/R&GY MOTT FT CL, V PLSTC&HD, MST RESD W/SD
				▽				
	610							
15		20		30.2				BRN W/TN-GY-R BRN MOTT FT CL, HD, PLSTC, MST, RESD
	605							
20		21	CH	32.3 42.6	69	40	1	20.0-20.5: BRN W/GY MOTT FT CL, MST, <5% CHT GV, RESD 20.5-20.9: BRN W/R BRN&BLK MOTT SI CL W/SD (WTH CHT GV) RESD 25-30% CHT GV & WTH BR, .10 GY WTH LS
	600							
25								REFUSAL
	595							
30								
	590							
35								
1''=5'								

* Lab. Classif.

SINGLETON LABORATORIES

SOIL PROFILE (SPLIT-SPOON)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK
FEATURE: PHASE II, ASH PIT
BORING: SS-74
STATION:
RANGE:
SURFACE EL: 628.7
DATE DRILLED: 2/1/91 TO
PREPARED BY: ALM
CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
	625							
5		16		27.2				TN SI MOTT CL W/SD
	620							
10		22	CH	▼ 20.7	52	31	2	BRN W/GY MOTT FT CL W/SD (WTH CHT GV), HD, STF, MST, ALL/COLL
				▽				
	615							REFUSAL
15								
	610							
20								
	605							
25								
	600							
30								
	595							
35								

1''=5'

* Lab. Classif.

SINGLETON LABORATORIES

SOIL PROFILE (SPLIT-SPOON)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK FEATURE: PHASE II, ASH PIT
BORING: SS-75 STATION: RANGE: SURFACE EL: 624.7
DATE DRILLED: 1/29/91 TO PREPARED BY: ALM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	FIELD DESCRIPTION
5	620	12		▼ 18.8				IR; YEL&TN W/BRN MOTT MED CL W/THIN LENS SI CL, BLK&BRN BLK&BRN CONCRTN, MST, ALL/COLL
10	615	16	CH	▽ 22.0	52	31	2	IR; R BRN&GY FT CL W/BLK CONCRTN MST, ALL/COLL
15	610	50+		33.2				15.0-15.5: BRN FT CL, V MST, PLSTC, RESD 15.5-15.7: HI WTH LS W/SI CL, V W, RESD
								REFUSAL
20	605							
25	600							
30	595							
35	590							
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (UNDISTURBED)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK FEATURE: PHASE II, ASH PIT
BORING: US-53 STATION: RANGE: SURFACE EL: 635.7
DATE DRILLED: 2/6/91 TO PREPARED BY: ALM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	DESCRIPTION (ENGINEERING TEST RESULTS)
	635							
5	630		ML/CL	21.8	49	30		LT BRN SI CL, MST, V F
10	625							
			CH	23.9	65	40		LT BRN&TN SI CL, MST, F
15	620							DISCONTINUED.
20	615							
25	610							
30	605							
35								
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (UNDISTURBED)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK FEATURE: PHASE II, ASH PIT
BORING: US-55 STATION: RANGE: SURFACE EL: 620.3
DATE DRILLED: 2/6/91 TO PREPARED BY: ACM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	DESCRIPTION (ENGINEERING TEST RESULTS)
	620							
5	615							
			CL	31.1	84	55		LT BRN CL MIX W/4% GV, MST, F
								DISCONTINUED.
10	610							
15	605							
20	600							
25	595							
30	590							
35								
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (UNDISTURBED)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK FEATURE: PHASE II, ASH PIT
BORING: US-58 STATION: RANGE: SURFACE EL: 607.6
DATE DRILLED: 2/5/91 TO PREPARED BY: ALM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	DESCRIPTION (ENGINEERING TEST RESULTS)
	605							
5								
			CL	20.1	37	20		LT-DK BRN CL GV ±25%, MST, F
	600							
								DISCONTINUED.
10								
	595							
15								
	590							
20								
	585							
25								
	580							
30								
	575							
35								
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (UNDISTURBED)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK FEATURE: PHASE II, ASH PIT
BORING: US-60 STATION: RANGE: SURFACE EL: 603.8
DATE DRILLED: 2/5/91 TO 2/6/91 PREPARED BY: ALM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	DESCRIPTION (ENGINEERING TEST RESULTS)
	600							
5			CS	14.6	46	25		LT BRN CL MIX W/30% GV, MST, F
	595							
10								
			CH	26.0	54	32		DK BRN CL MIX W/25% GV, MST, F
	590							
15								DISCONTINUED.
	585							
20								
	580							
25								
	575							
30								
	570							
35								
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (UNDISTURBED)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK
FEATURE: PHASE II, ASH PIT
BORING: US-65 STATION:
RANGE:
SURFACE EL: 610.9
DATE DRILLED: 2/5/91 TO
PREPARED BY: ALM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	DESCRIPTION (ENGINEERING TEST RESULTS)
	610							
5			CH	27.7	53	28		MOTT GY/BRN/BLK CL MIX W/25% CHT
	605							
								DISCONTINUED.
10								
	600							
15								
	595							
20								
	590							
25								
	585							
30								
	580							
35								
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (UNDISTURBED)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK FEATURE: PHASE II, ASH PIT
BORING: US-66 STATION: RANGE: SURFACE EL: 610.9
DATE DRILLED: 2/6/91 TO PREPARED BY: ALM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	DESCRIPTION (ENGINEERING TEST RESULTS)
	610							
5								
	605							
			GC	19.1	64	15		BRN GV CL MIX W/±40% GV
10								
	600							DISCONTINUED.
15								
	595							
20								
	590							
25								
	585							
30								
	580							
35								

1''=5'

*Lab. Classif.

SINGLETON LABORATORIES

SOIL PROFILE (UNDISTURBED)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK FEATURE: PHASE II, ASH PIT
BORING: US-73 STATION: RANGE: SURFACE EL: 623.7
DATE DRILLED: 2/5/91 TO PREPARED BY: ALM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	GR	DESCRIPTION (ENGINEERING TEST RESULTS)
	620							
5			ML/CL	22.7	46	18		BRN-TN SI CL, MST, F
	615		CH	29.0	85	57		BRN-TN SI CL, MST F
10								DISCONTINUED.
	610							
15								
	605							
20								
	600							
25								
	595							
30								
	590							
35								
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (POWER AUGER HOLE)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK FEATURE: PHASE II, ASH PIT
BORING: PAH-32 STATION: RANGE: SURFACE EL: 601.9
DATE DRILLED: 1/24/91 TO PREPARED BY: ALM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	SO CL	FIELD DESCRIPTION
			▼▽					
	600							
			CL	18.1	44	26	1	BRN FT CL W/<5% CHT GV, MST to V MST
5								
	595		CL	20.2	44	26	1	BRN-DK BRN MED CL W/LENS FT CL W/20% WTH CHT GV, MST
10								
	590		CL	24.9	44	26	1	BRN/TN/GY W, V PLSTC, V HD FT CL
			CL	29.2	44	26	1	WTH BR, BRN-DK BRN MED CL-SI CL V W W/WTH CHT & CaCo3
15								
								REFUSAL, BEDROCK
	585							
20								
	580							
25								
	575							
30								
	570							
35								
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (POWER AUGER HOLE)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK FEATURE: PHASE II, ASH PIT
BORING: PAH-33 STATION: RANGE: SURFACE EL: 605.8
DATE DRILLED: 1/24/91 TO PREPARED BY: ALM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	SO CL	FIELD DESCRIPTION
	605							
			CL ▼	▽ 18.4	41	19	2	LT R FT CL, STF, HD
5	600							
			CL	20	41	19	2	BLK-DK BRN MED/FT CL W/30% CHT GV, D
10	595							
			CL	25	41	19	2	DK BRN FT CL, D
15	590							
			CL	28.5	44	26	1	BRN FT CL, MST
20	585							
								NO SAMPLE; WTH BR W/WTR TABLE, W
25	580							
								DISCONTINUED.
30	575							
35								
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (POWER AUGER HOLE)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK
FEATURE: PHASE II, ASH PIT
BORING: PAH-34 STATION:
RANGE:
SURFACE EL: 613.2
DATE DRILLED: 1/25/91 TO
PREPARED BY:
CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	SO CL	FIELD DESCRIPTION
								BRN-R BRN MED CL
	610		CL ▼	16.4 ▽	41	19	2	
5								
	605		CL	19.7	41	19	2	DK BRN W/LT BLK MED CL W/20% WTH CHT GV, MST
10								
	600		CL	20.7	44	26	1	TN/BRN FT CL, V PLSTC, MST, STF
15								
	595		CL	40.7	44	26	1	WTH BR; TN/BRN FT CL, V PLSTC, MST, STF
20								REFUSAL, BEDROCK
	590							
25								
	585							
30								
	580							
35								
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (POWER AUGER HOLE)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK FEATURE: PHASE II, ASH PIT
BORING: PAH-34A STATION: RANGE: SURFACE EL: 606.7
DATE DRILLED: 2/1/91 TO PREPARED BY: ALM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	SO CL	FIELD DESCRIPTION
								TS
	605		CH	21.1	52	31	3	R BRN SI CL, MST, COLL/ALL
5			CH	20.0	52	31	3	BRN FT CL, MST, COLL/ALL
	600							
10			CH	25.0	59	37	4	BRN FT CL, MST, RESD W/CHT GV & LS FRAG
	595							
				▼ ▽				DISCONTINUED.
15								
	590							
20								
	585							
25								
	580							
30								
	575							
35								
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (POWER AUGER HOLE)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK FEATURE: PHASE II, ASH PIT
BORING: PAH-35 STATION: RANGE: SURFACE EL: 608.4
DATE DRILLED: 1/25/91 TO PREPARED BY: Acm CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	SO CL	FIELD DESCRIPTION
			CL	17.0	44	26	1	BRN/YEL BRN SI CL, V MST, COLL/ALL
	605							
5								
	600		CL	20.1	▼41	19	2	BRN W/TN MOTT FT CL, V PLSTC STF MST, RESD/COLL
10								
					▽			— — — — — — — —
	595							REFUSAL, LIMESTONE
15								
	590							
20								
	585							
25								
	580							
30								
	575							
35								
1''=5'		* Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (POWER AUGER HOLE)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK
FEATURE: PHASE II, ASH PIT
BORING: PAH-36
STATION:
RANGE:
SURFACE EL: 609.7
DATE DRILLED: 1/24/91 TO
PREPARED BY: ALM
CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	SO CL	FIELD DESCRIPTION
					▼			
			CL	17.0	44	26	1	BRN-TN SI CL W/<2% CHT GV W/MG CONCRTN, W
5	605							
			CL	20.7	44	26	1	BRN-R BRN FT CL, V MST
10	600							
			CL	25.1	▽44	26	1	BRN-TN FT CL, W, V STF, HD WTH ROCK
15	595							REFUSAL, BEDROCK
20	590							
25	585							
30	580							
35	575							
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (POWER AUGER HOLE)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK FEATURE: PHASE II, ASH PIT
BORING: PAH-37 STATION: RANGE: SURFACE EL: 613.7
DATE DRILLED: 1/29/91 TO PREPARED BY: ALM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	SO CL	FIELD DESCRIPTION
			CH	▼22.8	52	31	3	R BRN W/BRN MOTT SI CL, MST- V MST, COLL, 10% <1/8" WTH CHT
	610							
5								
				▽				
			CH	22.3	52	31	3	BRN-TN FT CL, <2% CHT, D, V HD PLSTC, COLL/ALL
	605							
10								
	600		CH	24.7	59	37	4	BRNTN FT CL, No CHT only CONCRTN V PLSTC, V HD, COLL/RESD
15								
			CH	28.9	59	37	4	BRN FT CL W/THIN LENS MED CL, MST, PLSTC, RESD/COLL
	595		CH	35.5	59	37	4	BRN FT CL, V MST-W, V PLSTC RESD
20								
								DISCONTINUED.
	590							
25								
	585							
30								
	580							
35								
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (POWER AUGER HOLE)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK
FEATURE: PHASE II, ASH PIT
BORING: PAH-38
STATION:
RANGE:
SURFACE EL: 618.1
DATE DRILLED: 1/29/91 TO
PREPARED BY: ALM
CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	SO CL	FIELD DESCRIPTION
	615		CL	18.6	41	19	2	TN/BRN SI CL W/SD, MST, COLL/ALL
5								
	610		CL	21.1	41	19	2	TN W/GY MOTT SI CL, MST, COL/ALL
10								
	605		CH	▽30.1	52	31	3	TN W/ GY MOTT MED CL W/CHT GV V MST, RESD/COLL
15								REFUSAL.
	600							
20								
	595							
25								
	590							
30								
	585							
35								
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (POWER AUGER HOLE)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK FEATURE: PHASE II, ASH PIT
BORING: PAH 39 STATION: RANGE: SURFACE EL: 619.3
DATE DRILLED: 1/29/91 TO PREPARED BY: ALM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	SO CL	FIELD DESCRIPTION
								TS
			CL	20.6	41	19	2	TN/BRN SI CL W/CONCRTN & STAINS MST, COLL/ALL
5	615							
				▼				
			CH	24.1	52	31	3	TN SI CL W/ MED CL W/CONCRTN & STAINS, MST, COLL/ALL
10	610							
			CH	34.1	52	31	3	TN FT CL W/CHT & LS FRAG
15	605			▽				
								REFUSAL, BEDROCK.
20	600							
25	595							
30	590							
35	585							

1''=5'

*Lab. Classif.

SINGLETON LABORATORIES

SOIL PROFILE (POWER AUGER HOLE)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK FEATURE: PHASE II, ASH PIT
BORING: PAH-40 STATION: RANGE: SURFACE EL: 617.2
DATE DRILLED: 1/30/91 TO 1/31/91 PREPARED BY: ALM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	SO CL	FIELD DESCRIPTION
								TS
	615		CL	19.6	41	19	2	R BRN-BRN SI CL W/SD CONCRTN, MST, COLL, 5% <1/8" CHT GV
5								
					▼			
	610		CL	19.7	▽41	19	2	R BRN SI CL W/MED CL LENS, MST, CHT GV 1/8"-1/2", COLL
10								
	605							
			CL	25.1	41	19	2	BRN FT CL W/ANG CHT GV, PLSTC, RESD/COLL
15								
	600							
			CH	29.2	59	37	4	BRN FT CL, V PLSTC & STF, RESD
20								
	595							
								REFUSAL, BEDROCK.
25								
	590							
30								
	585							
35								
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (POWER AUGER HOLE)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK
FEATURE: PHASE II, ASH PIT
BORING: PAH-41 STATION:
RANGE:
SURFACE EL: 619.9
DATE DRILLED: 1/29/91 TO
PREPARED BY: ALM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	SO CL	FIELD DESCRIPTION
			CH	23.0	59	37	4	BRN-TN FT CL, SLIGHTLY PLSTC, MST, COLL/ALL
5	615							
			CH	26.0	59	37	4	BRN/R BRN W/GY-TN MOTT, FT CL, HD, PLSTC, MST, COLL/RESD, 10-15% WTH CHT GV
10	610		▼ ▽					DISCONTINUED.
15	605							
20	600							
25	595							
30	590							
35	585							

1''=5'

*Lab. Classif.

SINGLETON LABORATORIES

SOIL PROFILE (POWER AUGER HOLE)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK
FEATURE: PHASE II, ASH PIT
BORING: PAH-42 STATION:
RANGE:
SURFACE EL: 624.0
DATE DRILLED: 1/29/91 TO
PREPARED BY: ALM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	SO CL	FIELD DESCRIPTION
			CL	18.9	41	19	2	BRN SI CL W/<10% CHT, MST, ALL/COLL
	620							
5								
			CL	22.9	41	19	2	R BRN MED CL, MST, COLL/ALL, <20% CHT GV
	615							
10								
			CH	33.0	52	31	3	TN/BRN FT CL W/CHT GV, MST, V PLSTC, RESD
				▼				
	610							
15			CH	33.0	52	31	3	BRN/DK BRN FT CL, D-MST, RESD/COLL, CHT&LS FRAG
				▽				
	605							REFUSAL
20								
	600							
25								
	595							
30								
	590							
35								
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (POWER AUGER HOLE)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK
FEATURE: PHASE II, ASH PIT
BORING: PAH-43
STATION:
RANGE:
SURFACE EL: 624.0
DATE DRILLED: 1/30/91 TO
PREPARED BY: ALM
CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	SO CL	FIELD DESCRIPTION
								TS
			CL	▼20.7	41	19	2	DK BRN/BLK W/TN MOTT SI CL W/WTH CHT GV, MST, COLL/ALL
	620							
5								
			CH	27.2	52	31	3	BRN/R BRN W/DK BRN <1.0 LAYER; R BRN/BRN FT CL, MST, COLL/RESD; DK BRN MED CL
	615							
10								
			CH	35.1	59	37	4	TN W/GY MOTT FT CL W/LS FRAG >1" MST RESD/COLL, PLSTC WAXY
	610							
15				▽				
								REFUSAL, BEDROCK.
	605							
20								
	600							
25								
	595							
30								
	590							
35								
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (POWER AUGER HOLE)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK FEATURE: PHASE II, ASH PIT
BORING: PAH-44 STATION: RANGE: SURFACE EL: 629.5
DATE DRILLED: 1/31/91 TO PREPARED BY: ALM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	SO CL	FIELD DESCRIPTION
								TS
5	625		CH	26.3	52	31	3	R BRN-DK R FT CL W/<1/4" ANG CHT GV, MST, RESD
10	620		CL	25.0	41	19	2	R BRN MED CL W/SD WTH CHT, MST, RESD
15	615		CH	33.0	52	31	3	BRN W/R MOTT FT CL, D, PLSTC & STF, RESD, 10% <1/8" WTH CHT GV
20	610		CH	40.1	59	37	4	DK BRN FT CL, MST-V MST, RESD W/15% WTH CHT & CONCRTN
			▼	▽				REFUSAL, BEDROCK.
25	605							
30	600							
35	595							
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (POWER AUGER HOLE)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK
FEATURE: PHASE II, ASH PIT
BORING: PAH-45 STATION:
RANGE:
SURFACE EL: 611.5
DATE DRILLED: 2/2/91 TO
PREPARED BY: ALM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	SO CL	FIELD DESCRIPTION
				▼				TS
	610							
			CH	31.6				BRN FT CL/MED CL, W
5								
				▽				
	605							
			CH	31.2				BRN FT CL W/CHT GV & WTH LS, W, PLSTC, STF
10								
	600							
								REFUSAL.
15								
	595							
20								
	590							
25								
	585							
30								
	580							
35								
1''=5'		*Lab. Classif.						

SINGLETON LABORATORIES

SOIL PROFILE (POWER AUGER HOLE)

SHEET 1 OF 1

PROJECT: WIDOWS CREEK FEATURE: PHASE II, ASH PIT
BORING: PAH-46 STATION: RANGE: SURFACE EL: 629.3
DATE DRILLED: 2/1/91 TO PREPARED BY: ALM CHECKED BY: TAL

DEPTH ft.	EL	SPT (N)	* LOG	W	LL	PI	SO CL	FIELD DESCRIPTION
								TS
			CH	21.0	52	31	3	R BRN SI CL W/WTH CHT GV, BLK RD CONCRTN, MST, COLL/ALL
	625							
5								
			CL	26.0	41	14	2	R BRN MED CL W/WTH CHT GV <1/4" BLK RD CONCRTN, MST, COLL/ALL
	620							
10								
			CH	33.3	59	37	4	BRN W/TN MOTT FT CL, V PLSTC, STF, D-MST, RESD/COLL, CHT GV
	615							
15								
			CH	40.7	59	37	4	BRN W/TN-GY MOTT FT CL, V PLSTC & STF, RESD, W/ANG CHT GV
				▼ ▽				
	610							
20								DISCONTINUED.
	605							
25								
	600							
30								
	595							
35								
1''=5'		*Lab. Classif.						

WIDOWS CREEK STEAM PLANT
FORCED OXIDATION GYPSUM STACKING - PHASE II
GEOTECHNICAL INVESTIGATION
DE-F19-392222

Singleton Laboratories Report 30-02-0016A

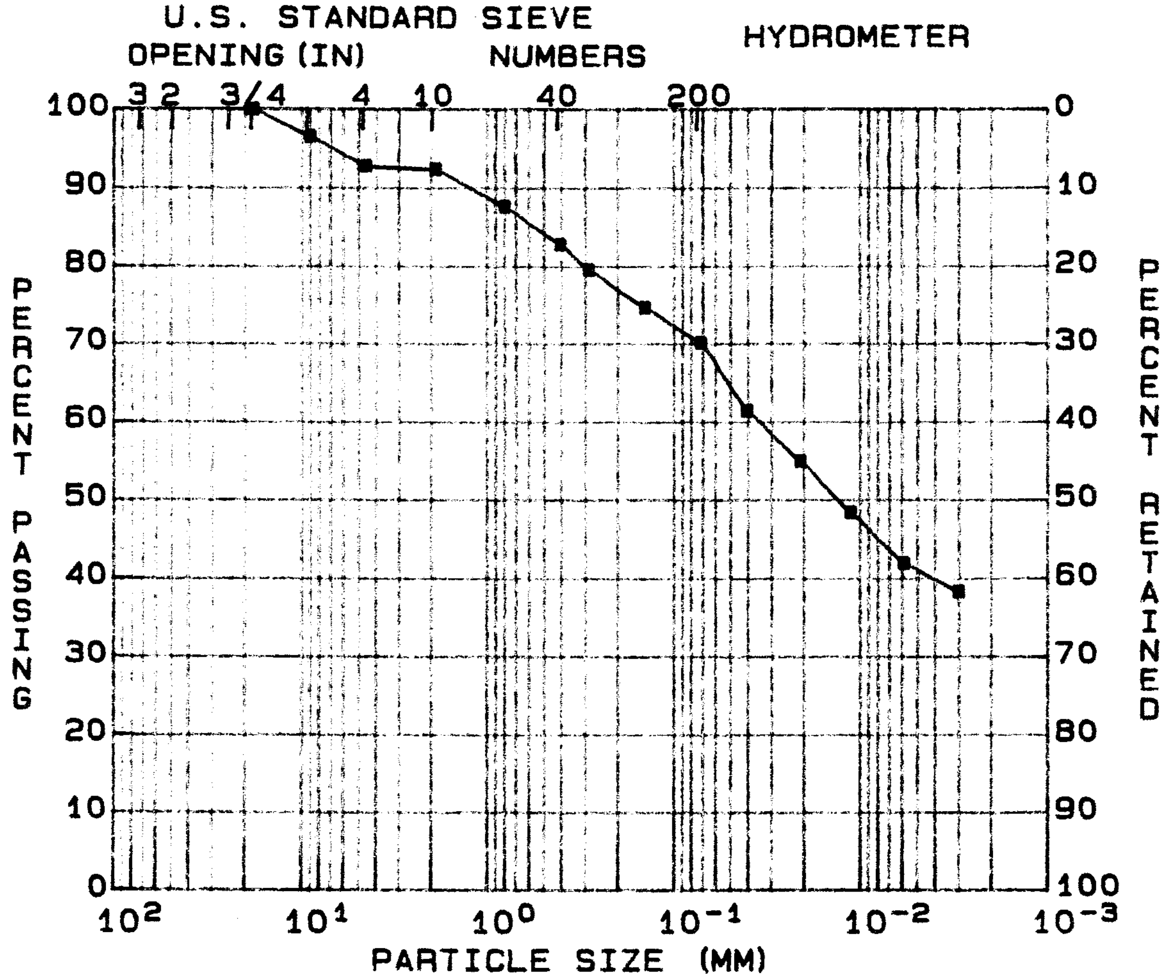
APPENDIX D

CLASSIFICATION TEST DATA FOR BORINGS SS-57 THROUGH 22-70

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK
FEATURE: DRY STACKING PH II
STATION:
RANGE :
PART :

BORING: SS-51 to 70
EL. :
SAMPLE: GR 1
DATE : 02-14-91



GRAVEL (%) = 6
SAND (%) = 23
SILT (%) = 29
CLAY (%) = 42

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= CL
MOISTURE (%) = --
SP. GR. = 2.77

L.L. (%) = 45
P.I. (%) = 27

DENSITY (pcf) = --
SATURATION (%) = --
VOID RATIO = --

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK
Feature: DRY STACKING PH II
Station:
Range :
Boring : SS-51 to 70

El. :
Sample: GR 1
Part :

FILE : 21
TESTED BY : TAL/CBE
Computed By:MHD
Checked By : TAL
Report Date:02-14-91

Specific Gravity = 2.772
Flask No. = 17.00
Temp.(deg.c.) = 21.30
Soil Wt.(gm) = 50.00
Total Wt.(gm) =706.33

Moisture Determination
Dry Wt.+Tare(gm)= 809.80
Tare Wt(gm) = 105.20

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 87.00
Dry Wt.+Tare(gm)= 85.60
Tare Wt(gm) = 38.80
Moisture(%) = 2.99

Liquid Limit
Blows = 25.00
Wet Wt.(gm) = 11.84
Dry Wt.(gm) = 9.40
Tare Wt.(gm) = 4.00
Liquid Limit(%) = 45.19
Plasticity Index= 26.81

Plastic Limit
Wet Wt.(gm) = 12.09
Dry Wt.(gm) = 10.80
Tare Wt.(gm) = 3.78
Plastic Limit(%)= 18.38

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 704.6

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	0.0	100.0	19.0500
3/8 in.	17.1	97.6	9.5300
NO.4	44.1	93.7	4.7500
NO.10	47.3	93.3	2.0000
NO.20	2.5	88.5	0.8500
NO.40	5.1	83.5	0.4250
NO.50	6.8	80.2	0.3000
NO.100	9.4	75.2	0.1500
NO.200	11.8	70.6	0.0750

Air Dry Weight(gm)= 50.00
Corrected Weight(gm)= 48.55

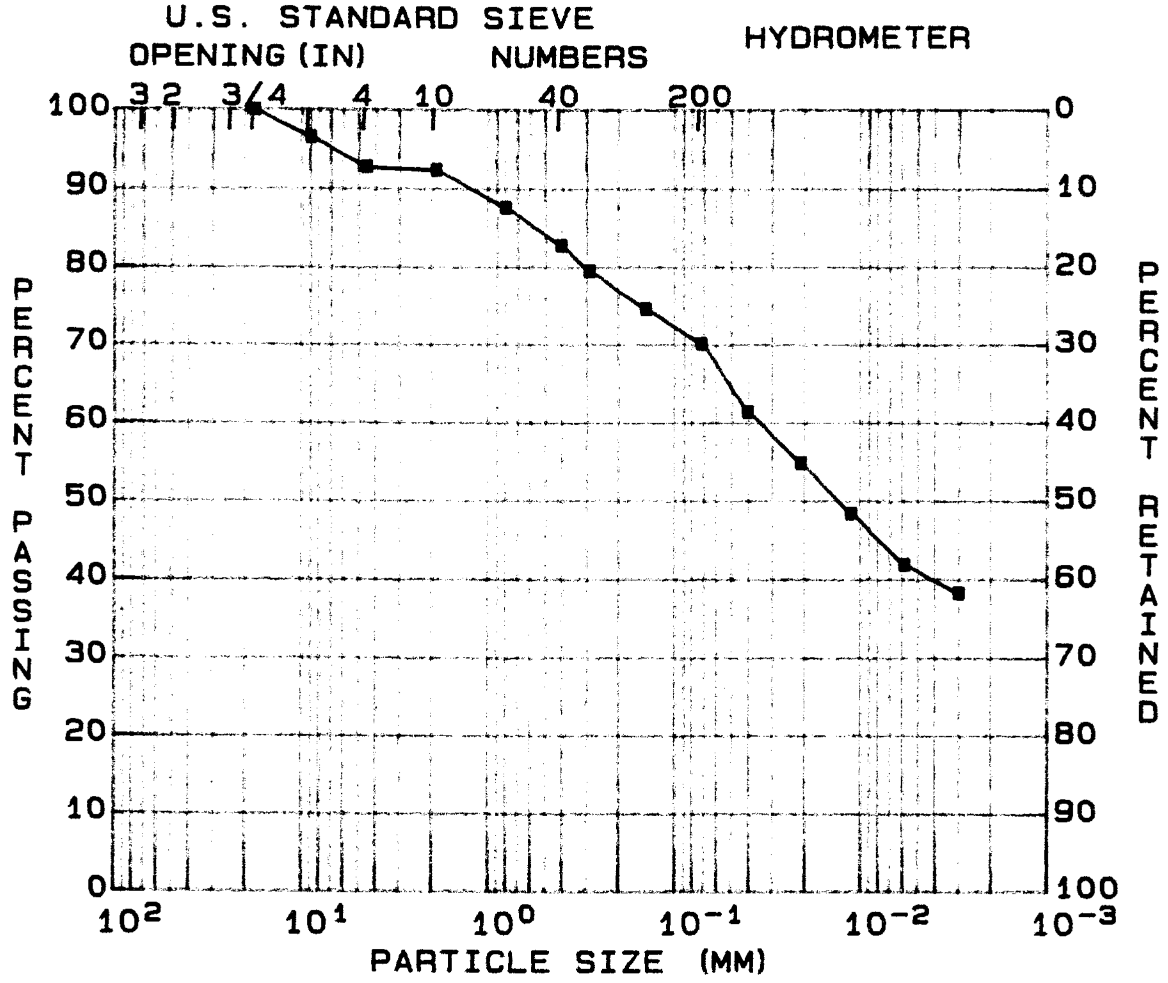
Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	16.6	41.0	8.0	61.8	0.0421
4 min.	16.6	37.5	8.0	55.2	0.0217
15 min.	16.6	34.0	8.0	48.7	0.0115
1 hour	16.3	31.0	8.5	42.1	0.0059
4 hours	16.3	29.0	8.5	38.4	0.0030

Soil Symbol= CL (Inorganic sandy clay of medium plasticity)
Gravel(%)= 6 Sand(%)=23 Silt(%)= 29 Clay(%)= 42

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK
FEATURE: DRY STACKING PH II
STATION:
RANGE :
PART :

BORING: SS-51 to 70
EL. :
SAMPLE: GR 1
DATE : 02-14-91



GRAVEL (%) = 6
SAND (%) = 23
SILT (%) = 29
CLAY (%) = 42

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= CL
MOISTURE (%) = --
SP. GR. = 2.77

L.L. (%) = 46
P.I. (%) = 27

DENSITY (pcf) = --
SATURATION (%) = --
VOID RATIO = --

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK
Feature: DRY STACKING PH II
Station:
Range :
Boring : SS-51 to 70

El. :
Sample: GR 1
Part :

FILE : 22
TESTED BY : TAL/CBE
Computed By:MHD
Checked By : TAL
Report Date:02-14-91

Specific Gravity = 2.772
Flask No. = 17.00
Soil Wt.(gm) = 50.00
Temp.(deg.c.) = 21.30
Total Wt.(gm) =706.33

Moisture Determination
Dry Wt.+Tare(gm)= 809.80
Tare Wt(gm) = 105.20

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 87.00
Tare Wt(gm) = 38.80
Dry Wt.+Tare(gm)= 85.60
Moisture(%) = 2.99

Liquid Limit
Blows = 26.00
Wet Wt.(gm) = 16.99
Dry Wt.(gm) = 12.97
Tare Wt.(gm) = 4.15
Liquid Limit(%) = 45.79
Plasticity Index= 27.42

Plastic Limit
Wet Wt.(gm) = 12.09
Dry Wt.(gm) = 10.80
Tare Wt.(gm) = 3.78
Plastic Limit(%)= 18.38

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 704.6

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	0.0	100.0	19.0500
3/8 in.	17.1	97.6	9.5300
NO.4	44.1	93.7	4.7500
NO.10	47.3	93.3	2.0000
NO.20	2.5	88.5	0.8500
NO.40	5.1	83.5	0.4250
NO.50	6.8	80.2	0.3000
NO.100	9.4	75.2	0.1500
NO.200	11.8	70.6	0.0750

Air Dry Weight(gm)= 50.00
Corrected Weight(gm)= 48.55

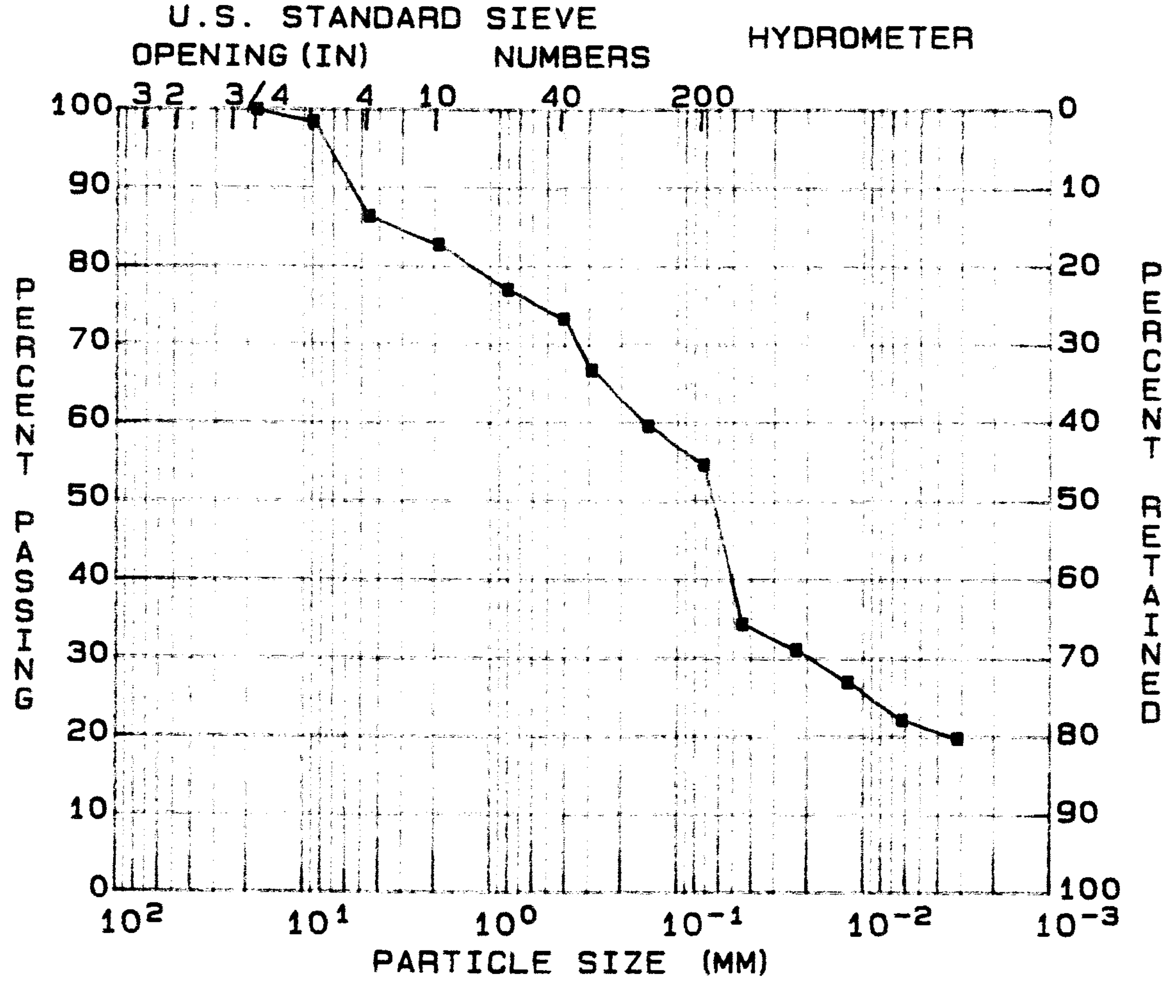
Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	16.6	41.0	8.0	61.8	0.0421
4 min.	16.6	37.5	8.0	55.2	0.0217
15 min.	16.6	34.0	8.0	48.7	0.0115
1 hour	16.3	31.0	8.5	42.1	0.0059
4 hours	16.3	29.0	8.5	38.4	0.0030

Soil Symbol= CL (Inorganic sandy clay of medium plasticity)
Gravel(%)= 6 Sand(%)=23 Silt(%)= 29 Clay(%)= 42

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK
FEATURE: DRY STACKING PH II
STATION:
RANGE :
PART :

BORING: SS-51 to 70
EL. :
SAMPLE: GR 2
DATE : 02-14-91



GRAVEL (%) = 13
SAND (%) = 32
SILT (%) = 34
CLAY (%) = 21

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= CL
MOISTURE (%) = --
SP. GR. = 2.80

L.L. (%) = 40
P.I. (%) = 23

DENSITY (pcf) = --
SATURATION (%) = --
VOID RATIO = --

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK
Feature: DRY STACKING PH II
Station:
Range :
Boring : SS-51 to 70

El. :
Sample: GR 2
Part :

FILE : 23
TESTED BY : TAL/CBE
Computed By:MHD
Checked By : TAL
Report Date:02-14-91

Specific Gravity = 2.795
Flask No. = 12.00
Soil Wt.(gm) = 50.00
Temp.(deg.c.) = 21.40
Total Wt.(gm) =706.38

Moisture Determination
Dry Wt.+Tare(gm)= 336.90
Tare Wt(gm) = 67.60

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 72.20
Tare Wt(gm) = 39.30
Dry Wt.+Tare(gm)= 71.50
Moisture(%) = 2.17

Liquid Limit
Blows = 28.00
Wet Wt.(gm) = 13.29
Dry Wt.(gm) = 10.62
Tare Wt.(gm) = 3.84
Liquid Limit(%) = 39.92
Plasticity Index= 22.53

Plastic Limit
Wet Wt.(gm) = 15.55
Dry Wt.(gm) = 13.86
Tare Wt.(gm) = 4.14

Plastic Limit(%)= 17.39

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 269.3

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	0.0	100.0	19.0500
3/8 in.	1.7	99.4	9.5300
NO.4	34.2	87.3	4.7500
NO.10	44.2	83.6	2.0000
NO.20	3.4	77.8	0.8500
NO.40	5.6	74.0	0.4250
NO.50	9.5	67.4	0.3000
NO.100	13.7	60.2	0.1500
NO.200	16.7	55.1	0.0750

Air Dry Weight(gm)= 50.00
Corrected Weight(gm)= 48.94

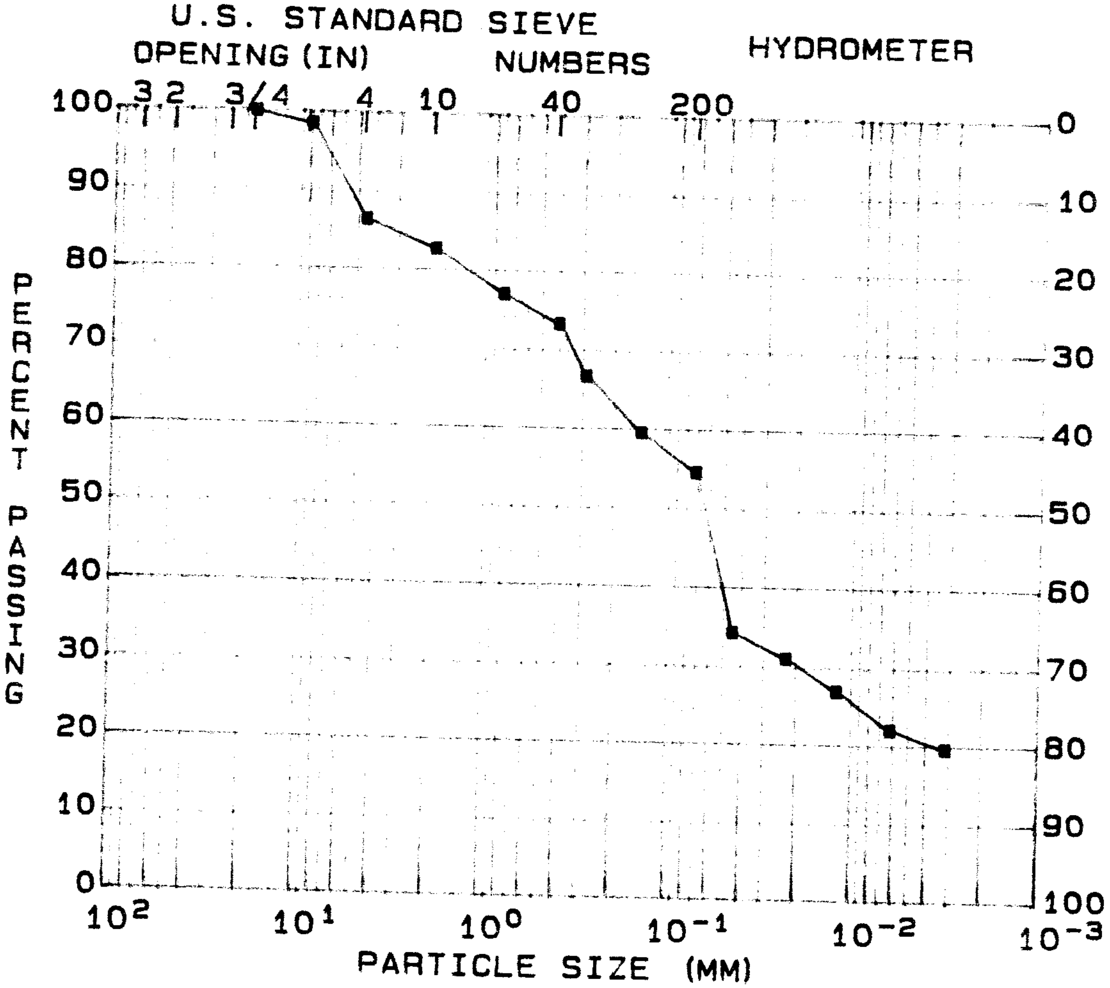
Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	16.6	29.0	8.0	34.8	0.0460
4 min.	16.6	27.0	8.0	31.5	0.0233
15 min.	16.6	24.5	8.0	27.3	0.0123
1 hour	16.3	22.0	8.5	22.4	0.0063
4 hours	16.3	20.5	8.5	19.9	0.0032

Soil Symbol= CL (inorganic gravelly clay of medium plasticity)
Gravel(%)=13 Sand(%)=32 Silt(%)= 34 Clay(%)= 21

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK
FEATURE: DRY STACKING PH II
STATION:
RANGE :
PART :

BORING: SS-51 to 70
EL. :
SAMPLE: GR 2
DATE : 02-14-91



GRAVEL (%) = 13
SAND (%) = 32
SILT (%) = 34
CLAY (%) = 21

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= CL
MOISTURE (%) = --
SP. GR. = 2.80

L.L. (%) = 40
P.I. (%) = 22

DENSITY (pcf) = --
SATURATION (%) = --
VOID RATIO = --

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK
Feature: DRY STACKING PH II
Station:
Range :
Boring : SS-51 to 70

El. :
Sample: GR 2
Part :

FILE : 24
TESTED BY : TAL/CBE
Computed By:MHD
Checked By : TAL
Report Date:02-14-91

Specific Gravity = 2.795
Flask No. = 12.00
Soil Wt.(gm) = 50.00
Temp.(deg.c.) = 21.40
Total Wt.(gm) =706.38

Moisture Determination
Dry Wt.+Tare(gm)= 336.90
Tare Wt(gm) = 67.60

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 72.20
Tare Wt(gm) = 39.30
Dry Wt.+Tare(gm)= 71.50
Moisture(%) = 2.17

Liquid Limit
Blows = 27.00
Wet Wt.(gm) = 15.29
Dry Wt.(gm) = 12.12
Tare Wt.(gm) = 4.09
Liquid Limit(%) = 39.84
Plasticity Index= 22.46

Plastic Limit
Wet Wt.(gm) = 15.55
Dry Wt.(gm) = 13.86
Tare Wt.(gm) = 4.14

Plastic Limit(%)= 17.39

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 269.3

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	0.0	100.0	19.0500
3/8 in.	1.7	99.4	9.5300
NO.4	34.2	87.3	4.7500
NO.10	44.2	83.6	2.0000
NO.20	3.4	77.8	0.8500
NO.40	5.6	74.0	0.4250
NO.50	9.5	67.4	0.3000
NO.100	13.7	60.2	0.1500
NO.200	16.7	55.1	0.0750

Air Dry Weight(gm)= 50.00
Corrected Weight(gm)= 48.94

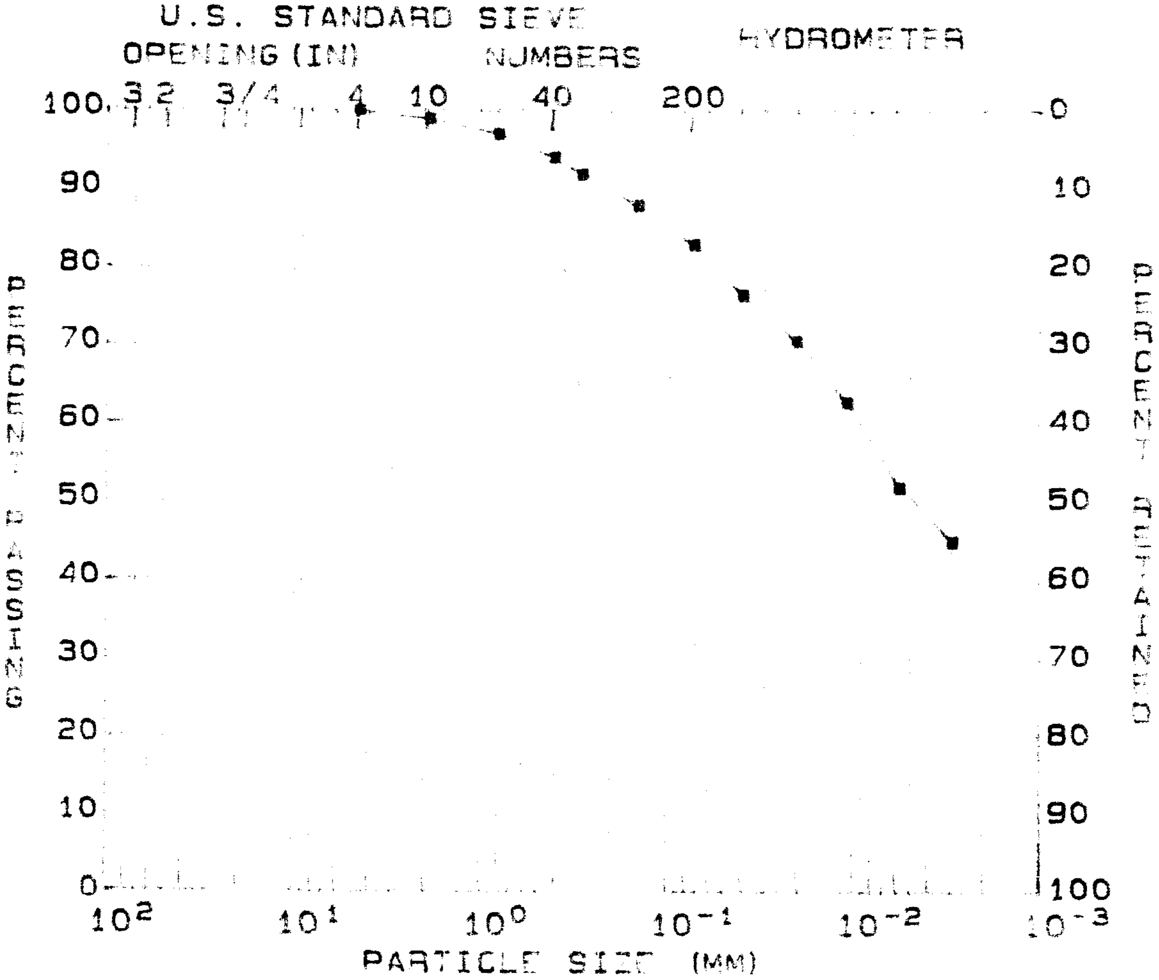
Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	16.6	29.0	8.0	34.8	0.0460
4 min.	16.6	27.0	8.0	31.5	0.0233
15 min.	16.6	24.5	8.0	27.3	0.0123
1 hour	16.3	22.0	8.5	22.4	0.0063
4 hours	16.3	20.5	8.5	19.9	0.0032

Soil Symbol= CL (Inorganic gravelly clay of medium plasticity)
Gravel(%)=13 Sand(%)=32 Silt(%)= 34 Clay(%)= 21

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK
FEATURE: DRY STACKING PH II
STATION:
RANGE :
PART :

BORING: SS-51 to 70
EL. :
SAMPLE: GR 3
DATE : 02-14-91



GRAVEL (%) = 0
SAND (%) = 17
SILT (%) = 33
CLAY (%) = 50

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF = --

SOIL SYMBOL = CL
MOISTURE (%) = --
SP. GR. = 2.75

L.L. (%) = 46
P.I. (%) = 27

DENSITY (pcf) = --
SATURATION (%) = --
VOID RATIO = --

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK FILE : 25
Feature: DRY STACKING PH II TESTED BY : TAL/CBE
Station: El. : Computed By:MHD
Range : Sample: GR 3 Checked By :TAL
Boring : SS-51 to 70 Part : Report Date:02-14-91

Specific Gravity = 2.746
Flask No. = 28.00 Temp.(deg.c.) = 21.40
Soil Wt.(gm) = 50.00 Total Wt.(gm) =701.74

Moisture Determination
Dry Wt.+Tare(gm)= 456.10 Tare Wt(gm) = 67.90

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 89.40 Dry Wt.+Tare(gm)= 88.40
Tare Wt(gm) = 38.80 Moisture(%) = 2.02

Liquid Limit
Blows = 24.00
Wet Wt.(gm) = 12.50
Dry Wt.(gm) = 9.82
Tare Wt.(gm) = 4.06
Liquid Limit(%) = 46.30
Plasticity Index= 27.42

Plastic Limit
Wet Wt.(gm) = 13.95
Dry Wt.(gm) = 12.36
Tare Wt.(gm) = 3.94
Plastic Limit(%)= 18.88

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 388.2

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	0.0	100.0	19.0500
3/8 in.	0.0	100.0	9.5300
NO.4	0.0	100.0	4.7500
NO.10	0.2	99.9	2.0000
NO.20	1.0	97.9	0.8500
NO.40	2.5	94.9	0.4250
NO.50	3.6	92.6	0.3000
NO.100	5.6	88.5	0.1500
NO.200	8.1	83.4	0.0750

Air Dry Weight(gm)= 50.00 Corrected Weight(gm)= 49.01

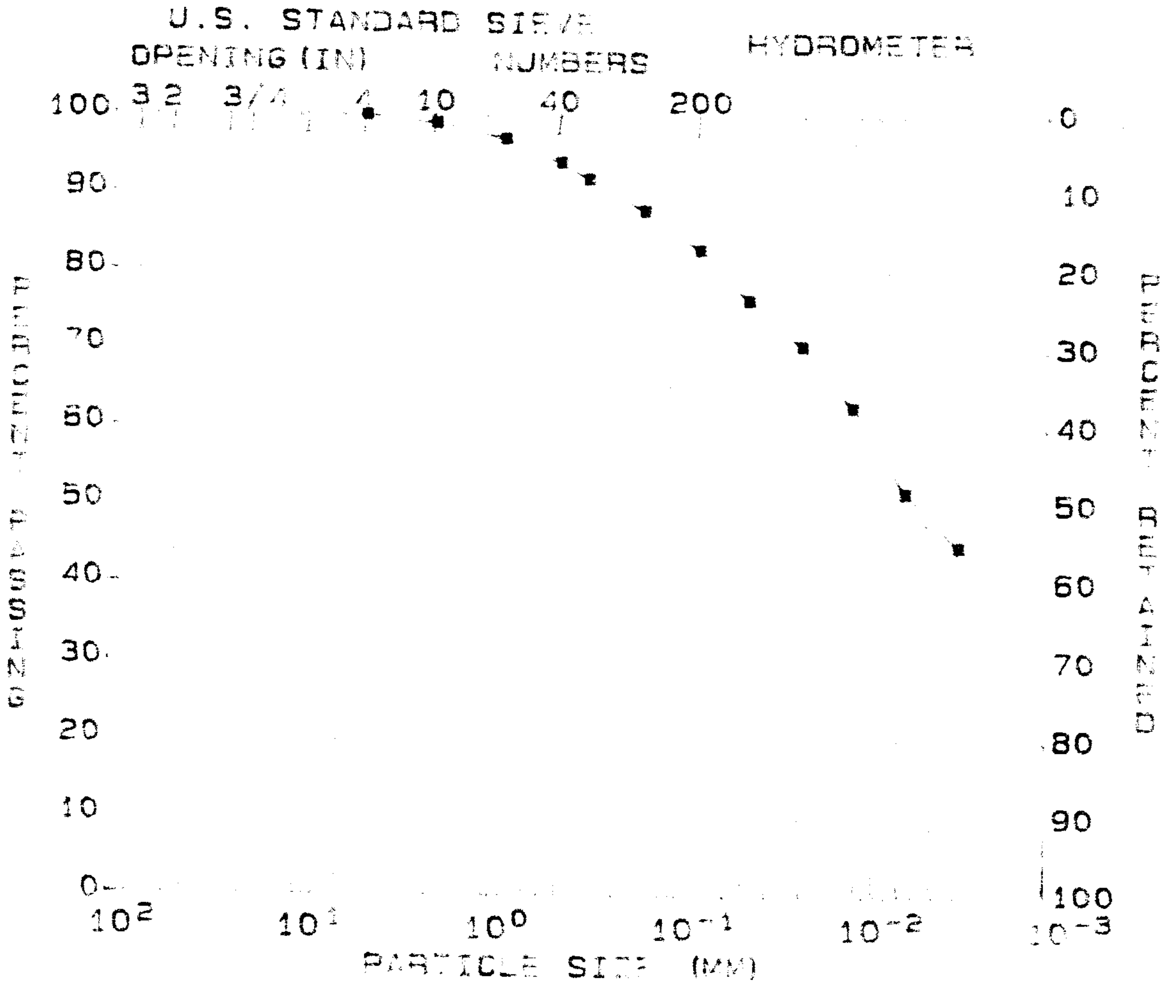
Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	16.6	46.5	8.0	76.9	0.0403
4 min.	16.6	43.5	8.0	70.9	0.0207
15 min.	16.6	39.5	8.0	62.9	0.0111
1 hour	16.3	34.5	8.5	51.9	0.0058
4 hours	16.3	31.0	8.5	44.9	0.0030

Soil Symbol= CL (Inorganic clay of medium plasticity)
Gravel(%)= 0 Sand(%)=17 Silt(%)= 33 Clay(%)= 50

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK
FEATURE: DRY STACKING PH II
STATION:
RANGE :
PART :

BORING: SS-51 to 70
EL. :
SAMPLE: GR 3
DATE : 02-14-91



GRAVEL (%) = 0
SAND (%) = 17
SILT (%) = 33
CLAY (%) = 50

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF = --

SOIL SYMBOL = CL
MOISTURE (%) = --
SP. GR. = 2.75

L.L. (%) = 47
P.I. (%) = 28

DENSITY (pcf) = --
SATURATION (%) = --
VOID RATIO = --

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK
Feature: DRY STACKING PH II
Station:
Range :
Boring : SS-51 to 70

El. :
Sample: GR 3
Part :

FILE : 26
TESTED BY : TAL/CBE
Computed By:MHD
Checked By : TAL
Report Date:02-14-91

Specific Gravity = 2.746
Flask No. = 28.00
Soil Wt.(gm) = 50.00
Temp.(deg.c.) = 21.40
Total Wt.(gm) =701.74

Moisture Determination
Dry Wt.+Tare(gm)= 456.10
Tare Wt(gm) = 67.90

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 89.40
Tare Wt(gm) = 38.80
Dry Wt.+Tare(gm)= 88.40
Moisture(%) = 2.02

Liquid Limit
Blows = 24.00
Wet Wt.(gm) = 15.82
Dry Wt.(gm) = 12.04
Tare Wt.(gm) = 4.05
Liquid Limit(%) = 47.08
Plasticity Index= 28.19

Plastic Limit
Wet Wt.(gm) = 13.95
Dry Wt.(gm) = 12.36
Tare Wt.(gm) = 3.94
Plastic Limit(%)= 18.88

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 388.2

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	0.0	100.0	19.0500
3/8 in.	0.0	100.0	9.5300
NO.4	0.0	100.0	4.7500
NO.10	0.2	99.9	2.0000
NO.20	1.0	97.9	0.8500
NO.40	2.5	94.9	0.4250
NO.50	3.6	92.6	0.3000
NO.100	5.6	88.5	0.1500
NO.200	8.1	83.4	0.0750

Air Dry Weight(gm)= 50.00
Corrected Weight(gm)= 49.01

Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	16.6	46.5	8.0	76.9	0.0403
4 min.	16.6	43.5	8.0	70.9	0.0207
15 min.	16.6	39.5	8.0	62.9	0.0111
1 hour	16.3	34.5	8.5	51.9	0.0058
4 hours	16.3	31.0	8.5	44.9	0.0030

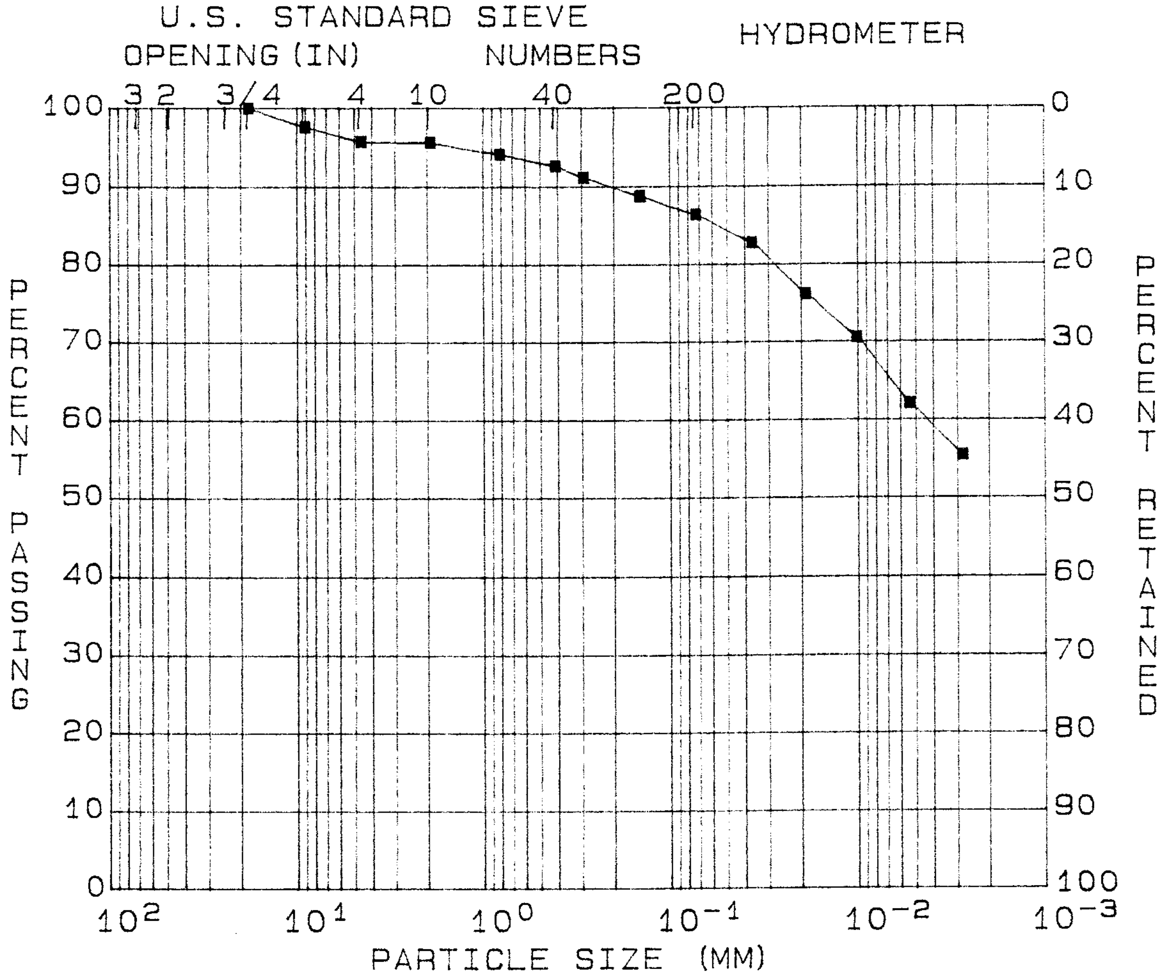
Soil Symbol= CL (Inorganic clay of medium plasticity)

Gravel(%)= 0 Sand(%)=17 Silt(%)= 33 Clay(%)= 50

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK
FEATURE: DRY STACKING PH II
STATION:
RANGE :
PART :

BORING: SS-51 to 70
EL. :
SAMPLE: GR 4
DATE : 02-14-91



GRAVEL (%) = 3
SAND (%) = 10
SILT (%) = 25
CLAY (%) = 62

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= CH
MOISTURE (%) = --
SP. GR. = 2.84

L.L. (%) = 54
P.I. (%) = 31

DENSITY (pcf) = --
SATURATION (%) = --
VOID RATIO = --

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK
Feature: DRY STACKING PH II
Station:
Range :
Boring : SS-51 to 70

El. :
Sample: GR 4
Part :

FILE : 27
TESTED BY : TAL/CBE
Computed By:MHD
Checked By : TAL
Report Date:02-14-91

Specific Gravity = 2.837
Flask No. = 33.00
Temp.(deg.c.) = 21.40
Soil Wt.(gm) = 50.00
Total Wt.(gm) =709.36

Moisture Determination
Dry Wt.+Tare(gm)= 593.50
Tare Wt(gm) = 105.20

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 87.50
Dry Wt.+Tare(gm)= 86.00
Tare Wt(gm) = 37.90
Moisture(%) = 3.12

Liquid Limit
Blows = 20.00
Wet Wt.(gm) = 11.68
Dry Wt.(gm) = 8.93
Tare Wt.(gm) = 3.94
Liquid Limit(%) = 53.65
Plasticity Index= 31.39

Plastic Limit
Wet Wt.(gm) = 17.08
Dry Wt.(gm) = 14.70
Tare Wt.(gm) = 4.01
Plastic Limit(%)= 22.26

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 488.3

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	0.0	100.0	19.0500
3/8 in.	7.5	98.5	9.5300
NO.4	16.7	96.6	4.7500
NO.10	17.9	96.3	2.0000
NO.20	0.8	94.7	0.8500
NO.40	1.6	93.2	0.4250
NO.50	2.4	91.6	0.3000
NO.100	3.6	89.2	0.1500
NO.200	4.8	86.8	0.0750

Air Dry Weight(gm)= 50.00
Corrected Weight(gm)= 48.49

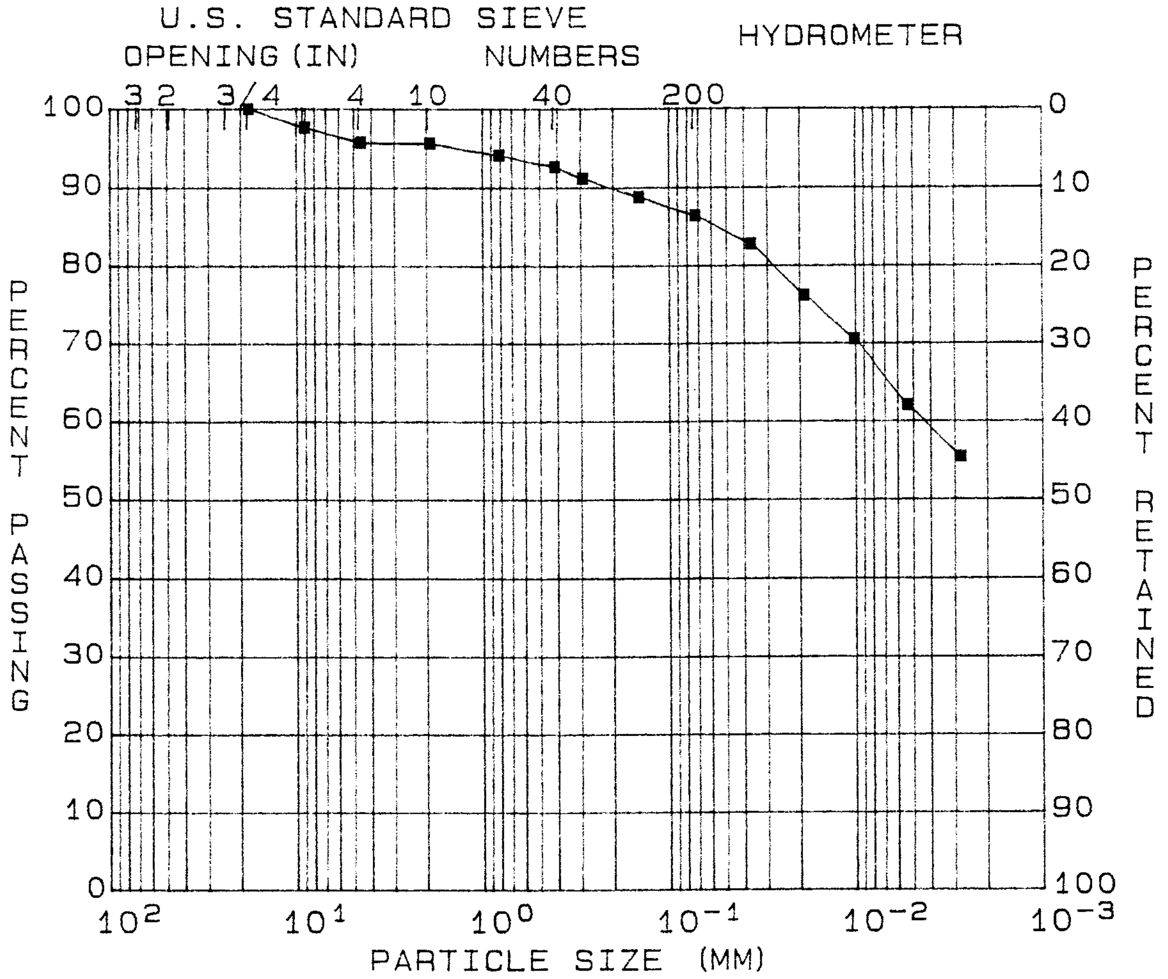
Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	16.6	51.5	8.0	83.1	0.0374
4 min.	16.6	48.0	8.0	76.4	0.0194
15 min.	16.6	45.0	8.0	70.7	0.0103
1 hour	16.3	41.0	8.5	62.1	0.0054
4 hours	16.3	37.5	8.5	55.4	0.0028

Soil Symbol= CH (Inorganic clay of high plasticity)
Gravel(%)= 3
Sand(%)=10
Silt(%)= 25
Clay(%)= 62

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK
FEATURE: DRY STACKING PH II
STATION:
RANGE :
PART :

BORING: SS-51 to 70
EL. :
SAMPLE: GR 4
DATE : 02-14-91



GRAVEL (%) = 3
SAND (%) = 10
SILT (%) = 25
CLAY (%) = 62

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= CH
MOISTURE (%) = --
SP. GR. = 2.84

L.L. (%) = 54
P.I. (%) = 32

DENSITY (pcf) = --
SATURATION (%) = --
VOID RATIO = --

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK		FILE : 28
Feature: DRY STACKING PH II		TESTED BY : TAL/CBE
Station:	El. :	Computed By:MHD
Range :	Sample: GR 4	Checked By : TAL
Boring : SS-51 to 70	Part :	Report Date:02-14-91

Specific Gravity = 2.837

Flask No.	= 33.00	Temp.(deg.c.)	= 21.40
Soil Wt.(gm)	= 50.00	Total Wt.(gm)	=709.36

Moisture Determination

Dry Wt.+Tare(gm)	= 593.50	Tare Wt(gm)	= 105.20

Hygroscopic Moisture

Wet Wt.+Tare(gm)	= 87.50	Dry Wt.+Tare(gm)	= 86.00
Tare Wt(gm)	= 37.90	Moisture(%)	= 3.12

Liquid Limit		Plastic Limit	
Blows	= 21.00	Wet Wt.(gm)	= 17.08
Wet Wt.(gm)	= 14.34	Dry Wt.(gm)	= 14.70
Dry Wt.(gm)	= 10.64	Tare Wt.(gm)	= 4.01
Tare Wt.(gm)	= 3.93		
Liquid Limit(%)	= 54.00	Plastic Limit(%)	= 22.26
Plasticity Index	= 31.74		

Sieve and Hydrometer Analysis

Total Dry Weight(gm) = 488.3

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	0.0	100.0	19.0500
3/8 in.	7.5	98.5	9.5300
NO.4	16.7	96.6	4.7500
NO.10	17.9	96.3	2.0000
NO.20	0.8	94.7	0.8500
NO.40	1.6	93.2	0.4250
NO.50	2.4	91.6	0.3000
NO.100	3.6	89.2	0.1500
NO.200	4.8	86.8	0.0750

Air Dry Weight(gm)= 50.00 Corrected Weight(gm)= 48.49

Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	16.6	51.5	8.0	83.1	0.0374
4 min.	16.6	48.0	8.0	76.4	0.0194
15 min.	16.6	45.0	8.0	70.7	0.0103
1 hour	16.3	41.0	8.5	62.1	0.0054
4 hours	16.3	37.5	8.5	55.4	0.0028

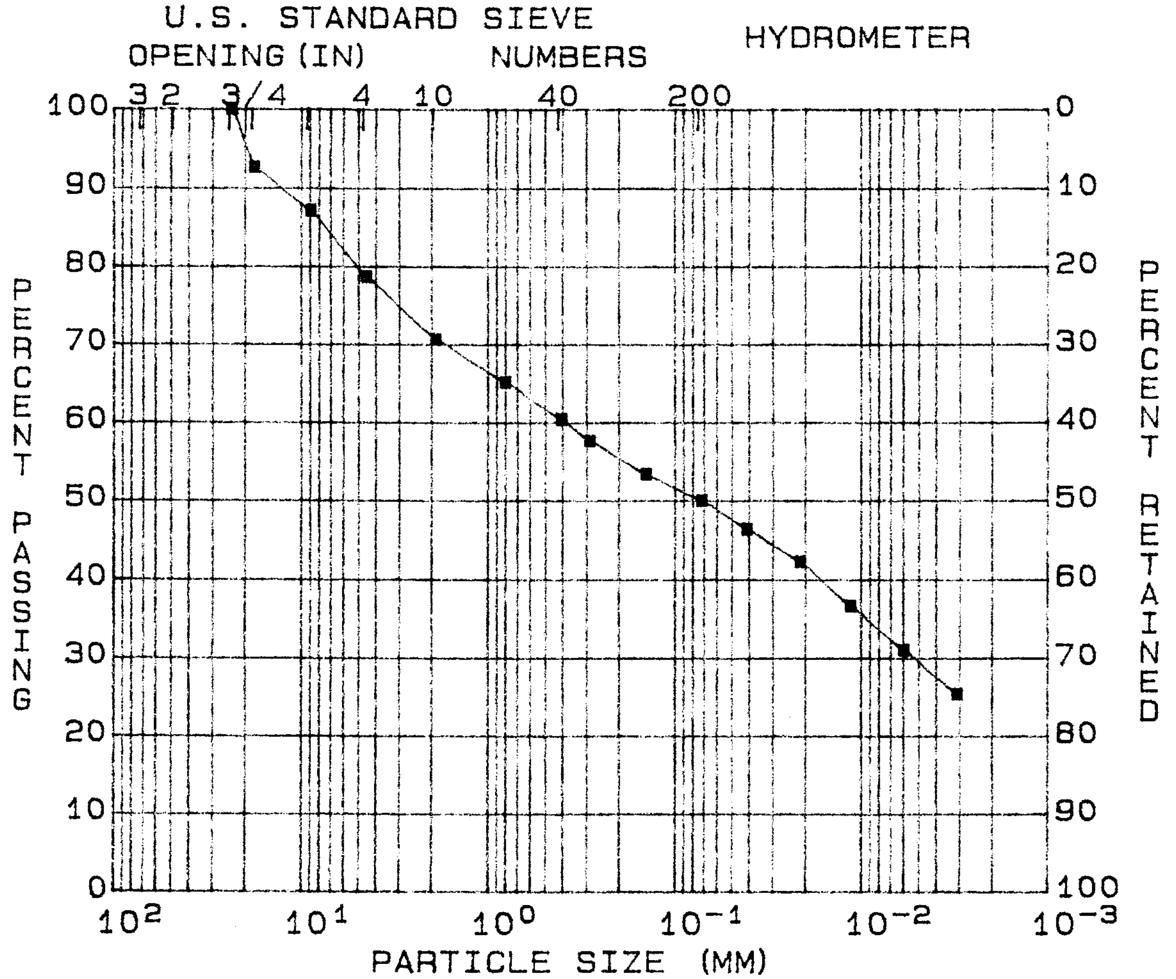
Soil Symbol= CH (Inorganic clay of high plasticity)

Gravel(%)= 3 Sand(%)=10 Silt(%)= 25 Clay(%)= 62

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK
FEATURE: DRY STACKING PH II
STATION:
RANGE :
PART :

BORING: SS-51 to 70
EL. :
SAMPLE: GR 5
DATE : 02-15-91



GRAVEL (%) = 21
SAND (%) = 29
SILT (%) = 21
CLAY (%) = 29

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= CL
MOISTURE (%) = --
SP. GR. = 2.76

L.L. (%) = 38
P.I. (%) = 20

DENSITY (pcf) = --
SATURATION (%) = --
VOID RATIO = --

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK
Feature: DRY STACKING PH II
Station:
Range :
Boring : SS-51 to 70

El. :
Sample: GR 5
Part :

FILE : 29
TESTED BY : TAL/CBE
Computed By:MHD
Checked By : TAL
Report Date:02-15-91

Specific Gravity = 2.762
Flask No. = 31.00 Temp.(deg.c.) = 21.50
Soil Wt.(gm) = 50.00 Total Wt.(gm) =710.63

Moisture Determination
Dry Wt.+Tare(gm)= 638.50 Tare Wt(gm) = 67.00

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 78.90 Dry Wt.+Tare(gm)= 78.20
Tare Wt(gm) = 39.50 Moisture(%) = 1.81

Liquid Limit
Blows = 20.00
Wet Wt.(gm) = 15.60
Dry Wt.(gm) = 12.28
Tare Wt.(gm) = 3.78
Liquid Limit(%) = 38.03
Plasticity Index= 20.35

Plastic Limit
Wet Wt.(gm) = 16.37
Dry Wt.(gm) = 14.51
Tare Wt.(gm) = 3.99
Plastic Limit(%)= 17.68

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 571.5

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	37.5	93.4	19.0500
3/8 in.	69.4	87.9	9.5300
NO.4	118.2	79.3	4.7500
NO.10	164.6	71.2	2.0000
NO.20	3.8	65.7	0.8500
NO.40	7.1	60.9	0.4250
NO.50	9.0	58.2	0.3000
NO.100	12.0	53.8	0.1500
NO.200	14.4	50.3	0.0750

Air Dry Weight(gm)= 50.00 Corrected Weight(gm)= 49.11

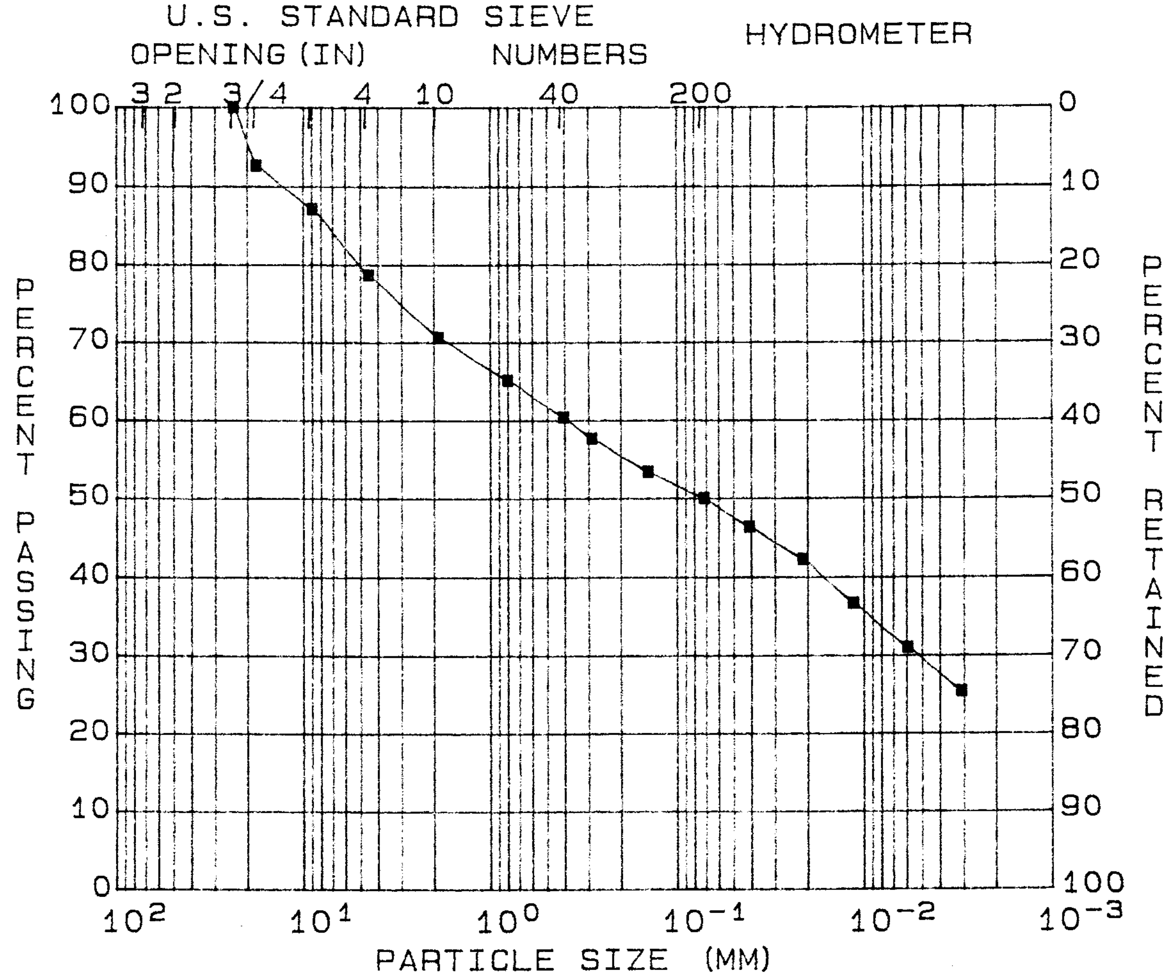
Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	16.6	41.0	8.0	46.7	0.0422
4 min.	16.6	38.0	8.0	42.4	0.0217
15 min.	16.6	34.0	8.0	36.8	0.0116
1 hour	16.3	30.5	8.5	31.1	0.0060
4 hours	16.3	26.5	8.5	25.5	0.0031

Soil Symbol= CL (Inorganic gravelly clay of medium plasticity)
Gravel(%)=21 Sand(%)=29 Silt(%)= 21 Clay(%)= 29

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK
FEATURE: DRY STACKING PH II
STATION:
RANGE :
PART :

BORING: SS-51 to 70
EL. :
SAMPLE: GR 5
DATE : 02-14-91



GRAVEL (%) = 21
SAND (%) = 29
SILT (%) = 21
CLAY (%) = 29

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= CL
MOISTURE (%) = --
SP. GR. = 2.76

L.L. (%) = 39
P.I. (%) = 21

DENSITY (pcf) = --
SATURATION (%) = --
VOID RATIO = --

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK
Feature: DRY STACKING PH II
Station:
Range :
Boring : SS-51 to 70

El. :
Sample: GR 5
Part :

FILE : 30
TESTED BY : TAL/CBE
Computed By:MHD
Checked By : TAL
Report Date:02-14-91

Specific Gravity = 2.762
Flask No. = 31.00
Soil Wt.(gm) = 50.00
Temp.(deg.c.) = 21.50
Total Wt.(gm) =710.63

Moisture Determination
Dry Wt.+Tare(gm)= 638.50
Tare Wt(gm) = 67.00

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 78.90
Tare Wt(gm) = 39.50
Dry Wt.+Tare(gm)= 78.20
Moisture(%) = 1.81

Liquid Limit
Blows = 21.00
Wet Wt.(gm) = 15.88
Dry Wt.(gm) = 12.55
Tare Wt.(gm) = 4.11
Liquid Limit(%) = 38.64
Plasticity Index= 20.96

Plastic Limit
Wet Wt.(gm) = 16.37
Dry Wt.(gm) = 14.51
Tare Wt.(gm) = 3.99
Plastic Limit(%)= 17.68

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 571.5

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	37.5	93.4	19.0500
3/8 in.	69.4	87.9	9.5300
NO.4	118.2	79.3	4.7500
NO.10	164.6	71.2	2.0000
NO.20	3.8	65.7	0.8500
NO.40	7.1	60.9	0.4250
NO.50	9.0	58.2	0.3000
NO.100	12.0	53.8	0.1500
NO.200	14.4	50.3	0.0750

Air Dry Weight(gm)= 50.00
Corrected Weight(gm)= 49.11

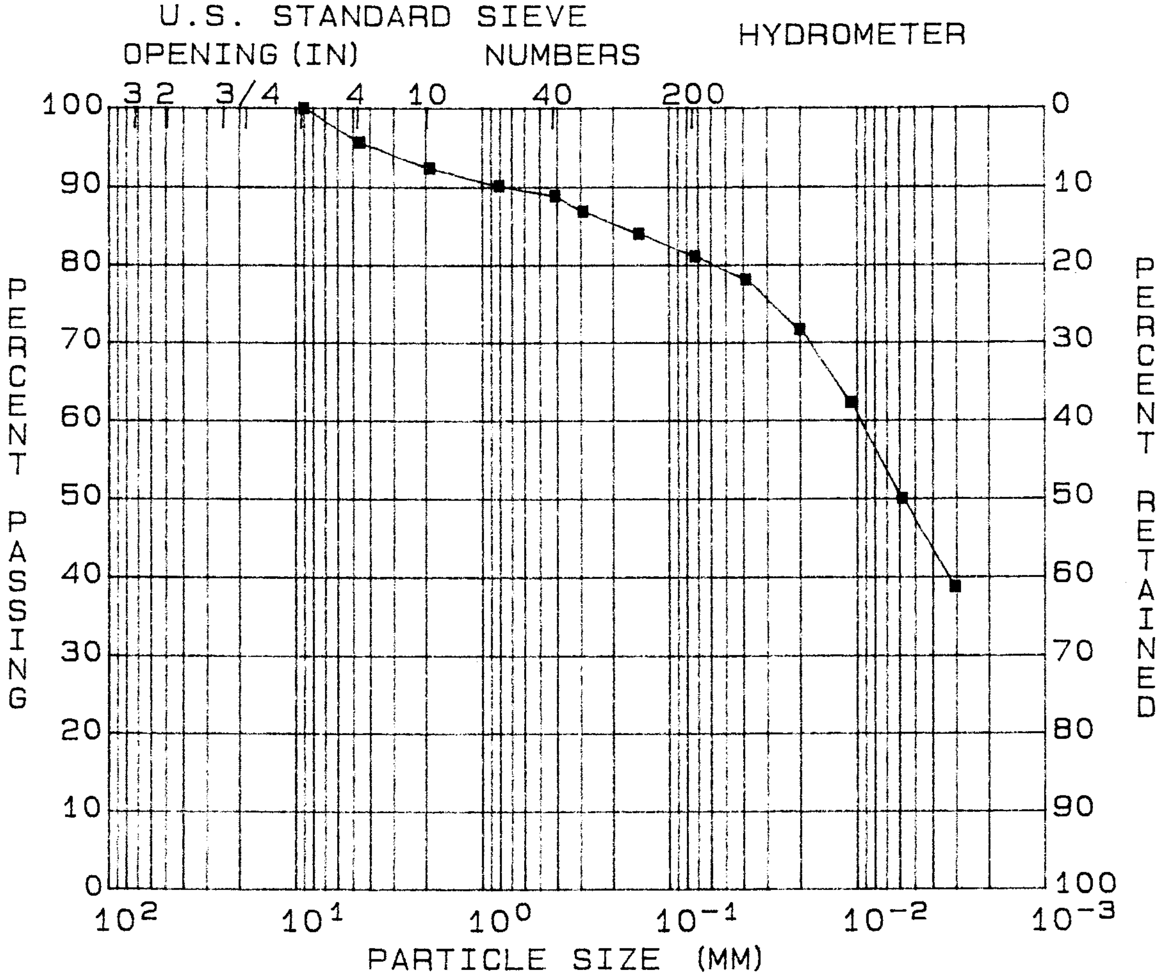
Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	16.6	41.0	8.0	46.7	0.0422
4 min.	16.6	38.0	8.0	42.4	0.0217
15 min.	16.6	34.0	8.0	36.8	0.0116
1 hour	16.3	30.5	8.5	31.1	0.0060
4 hours	16.3	26.5	8.5	25.5	0.0031

Soil Symbol= CL (Inorganic gravelly clay of medium plasticity)
Gravel(%)=21 Sand(%)=29 Silt(%)= 21 Clay(%)= 29

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK
FEATURE: DRY STACKING PH II
STATION:
RANGE :
PART :

BORING: SS-51 to 70
EL. :
SAMPLE: GR 6
DATE : 02-14-91



GRAVEL (%) = 4
SAND (%) = 15
SILT (%) = 34
CLAY (%) = 47

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= CL
MOISTURE (%) = --
SP. GR. = 2.72

L.L. (%) = 40
P.I. (%) = 22

DENSITY (pcf) = --
SATURATION (%) = --
VOID RATIO = --

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK FILE : 31
Feature: DRY STACKING PH II TESTED BY : TAL/CBE
Station: El. : Computed By:MHD
Range : Sample: GR 6 Checked By : TAL
Boring : SS-51 to 70 Part : Report Date:02-14-91

Specific Gravity = 2.715
Flask No. = 19.00 Temp.(deg.c.) = 21.30
Soil Wt.(gm) = 50.00 Total Wt.(gm) =712.72

Moisture Determination
Dry Wt.+Tare(gm)= 435.60 Tare Wt(gm) = 96.60

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 82.80 Dry Wt.+Tare(gm)= 81.50
Tare Wt(gm) = 39.40 Moisture(%) = 3.09

Liquid Limit
Blows = 21.00
Wet Wt.(gm) = 13.02
Dry Wt.(gm) = 10.41
Tare Wt.(gm) = 4.07
Liquid Limit(%) = 40.31
Plasticity Index= 22.21

Plastic Limit
Wet Wt.(gm) = 17.25
Dry Wt.(gm) = 15.23
Tare Wt.(gm) = 4.07
Plastic Limit(%)= 18.10

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 339

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	0.0	100.0	19.0500
3/8 in.	0.0	100.0	9.5300
NO.4	12.1	96.4	4.7500
NO.10	23.4	93.1	2.0000
NO.20	1.2	90.8	0.8500
NO.40	1.9	89.5	0.4250
NO.50	3.0	87.3	0.3000
NO.100	4.5	84.5	0.1500
NO.200	6.0	81.6	0.0750

Air Dry Weight(gm)= 50.00 Corrected Weight(gm)= 48.50

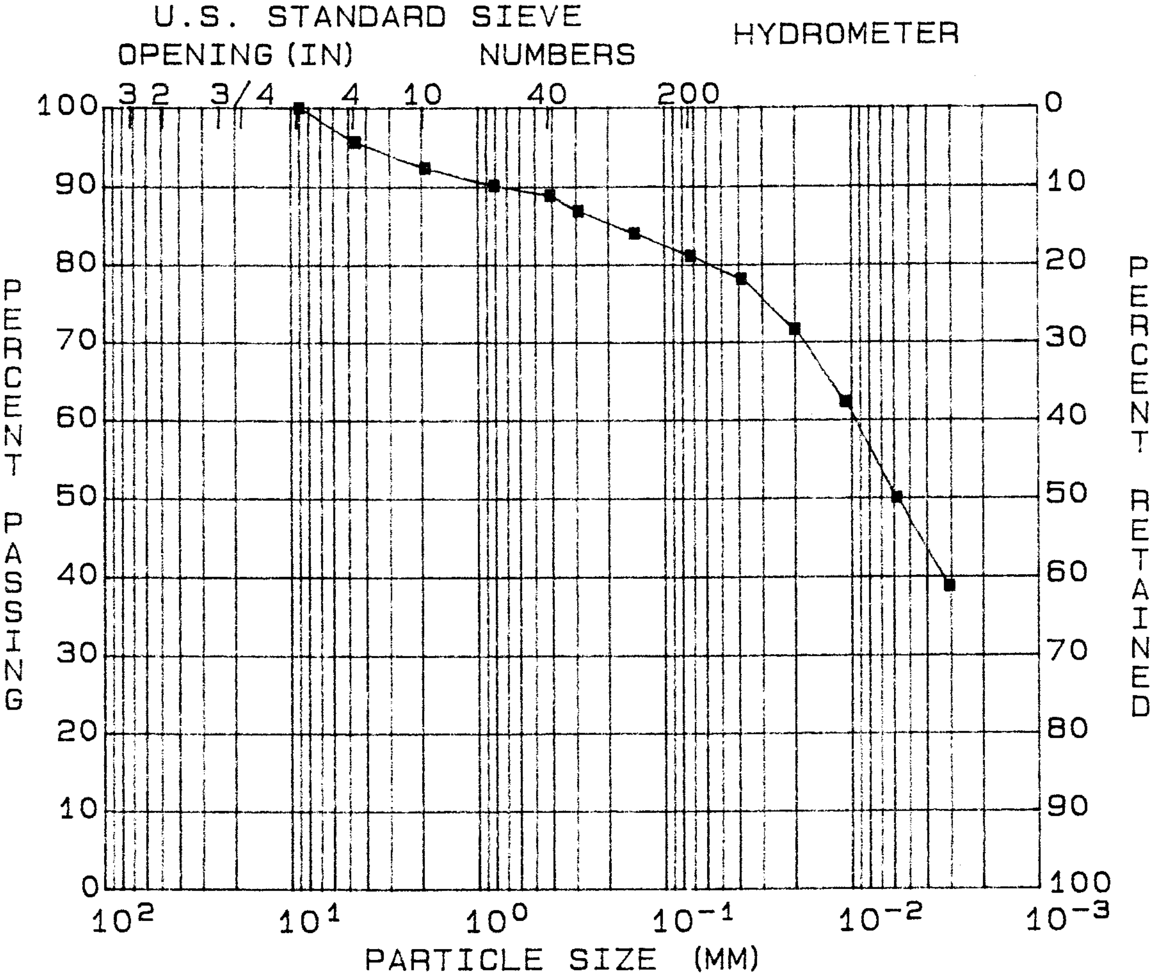
Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	16.6	49.5	8.0	78.5	0.0395
4 min.	16.6	46.0	8.0	71.9	0.0205
15 min.	16.6	41.0	8.0	62.4	0.0111
1 hour	16.3	35.0	8.5	50.1	0.0058
4 hours	16.3	29.0	8.5	38.8	0.0031

Soil Symbol= CL (Inorganic clay of medium plasticity)
Gravel(%)= 4 Sand(%)=15 Silt(%)= 34 Clay(%)= 47

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK
FEATURE: DRY STACKING PH II
STATION:
RANGE :
PART :

BORING: SS-51 to 70
EL. :
SAMPLE: GR 6
DATE : 02-14-91



GRAVEL (%) = 4
SAND (%) = 15
SILT (%) = 34
CLAY (%) = 47

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= CL
MOISTURE (%) = --
SP. GR. = 2.72

L.L. (%) = 40
P.I. (%) = 22

DENSITY (pcf) = --
SATURATION (%) = --
VOID RATIO = --

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK
Feature: DRY STACKING PH II
Station:
Range :
Boring : SS-51 to 70

El. :
Sample: GR 6
Part :

FILE : 32
TESTED BY : TAL/CBE
Computed By:MHD
Checked By : TA
Report Date:02-14-91

Specific Gravity = 2.715
Flask No. = 19.00
Temp.(deg.c.) = 21.30
Soil Wt.(gm) = 50.00
Total Wt.(gm) =712.72

Moisture Determination
Dry Wt.+Tare(gm)= 435.60
Tare Wt(gm) = 96.60

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 82.80
Dry Wt.+Tare(gm)= 81.50
Tare Wt(gm) = 39.40
Moisture(%) = 3.09

Liquid Limit
Blows = 20.00
Wet Wt.(gm) = 17.96
Dry Wt.(gm) = 13.90
Tare Wt.(gm) = 4.07
Liquid Limit(%) = 40.21
Plasticity Index= 22.11

Plastic Limit
Wet Wt.(gm) = 17.25
Dry Wt.(gm) = 15.23
Tare Wt.(gm) = 4.07
Plastic Limit(%)= 18.10

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 339

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	0.0	100.0	19.0500
3/8 in.	0.0	100.0	9.5300
NO.4	12.1	96.4	4.7500
NO.10	23.4	93.1	2.0000
NO.20	1.2	90.8	0.8500
NO.40	1.9	89.5	0.4250
NO.50	3.0	87.3	0.3000
NO.100	4.5	84.5	0.1500
NO.200	6.0	81.6	0.0750

Air Dry Weight(gm)= 50.00
Corrected Weight(gm)= 48.50

Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	16.6	49.5	8.0	78.5	0.0395
4 min.	16.6	46.0	8.0	71.9	0.0205
15 min.	16.6	41.0	8.0	62.4	0.0111
1 hour	16.3	35.0	8.5	50.1	0.0058
4 hours	16.3	29.0	8.5	38.8	0.0031

Soil Symbol= CL (Inorganic clay of medium plasticity)
Gravel(%)= 4
Sand(%)=15
Silt(%)= 34
Clay(%)= 47

WIDOWS CREEK STEAM PLANT
FORCED OXIDATION GYPSUM STACKING - PHASE II
GEOTECHNICAL INVESTIGATION
DE-F19-392222

Singleton Laboratories Report 30-02-0016A

APPENDIX E

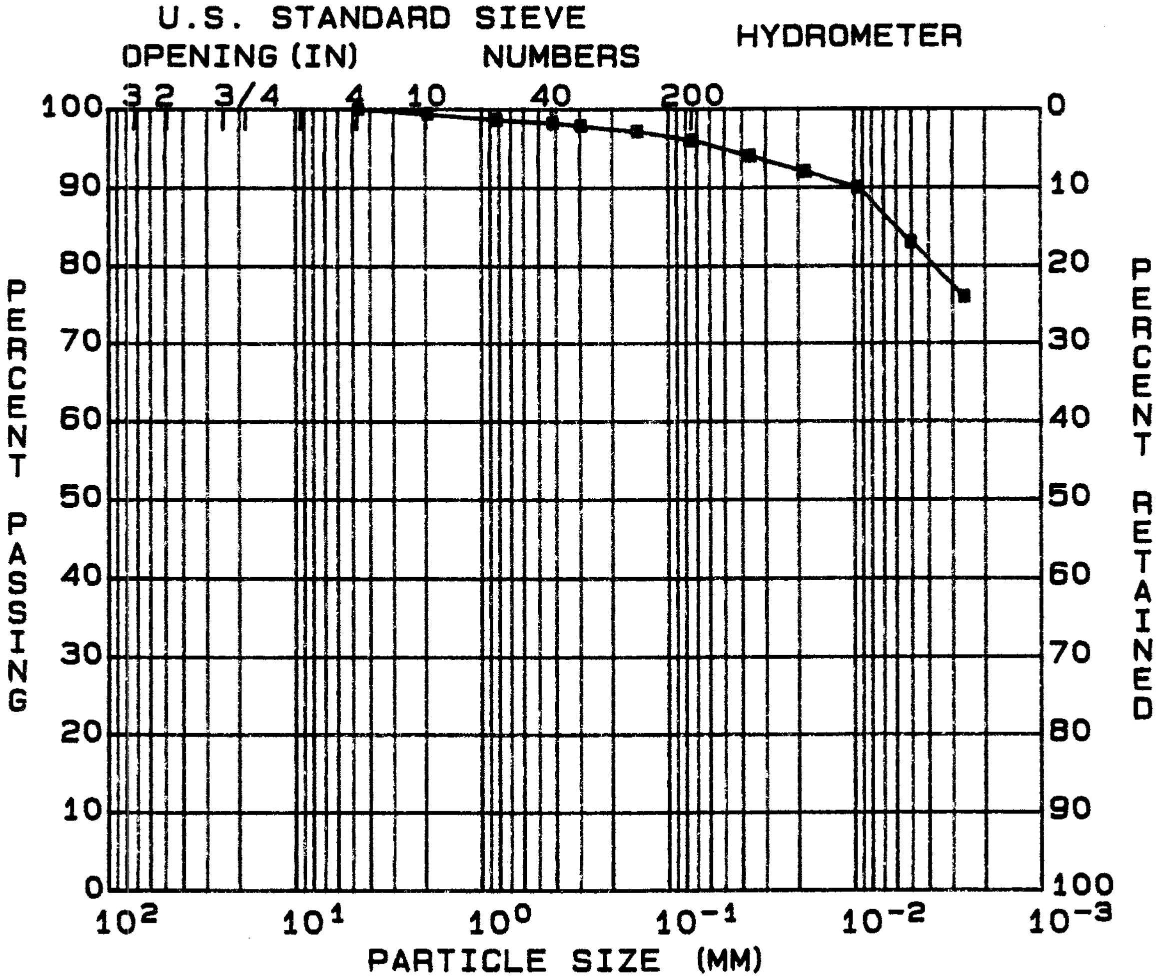
CLASSIFICATION TEST DATA FOR BORINGS SS-71 THROUGH SS-75

SINGLETON LABORATORIES
Knoxville, Tennessee

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK
FEATURE: DRY STACKING PH II
STATION:
RANGE :
PART : SS-71, 3A; SS-72, 3A

BORING: SS-71 to 75
EL. :
SAMPLE: GR 1
DATE : 02-14-91



GRAVEL (%) = 0
SAND (%) = 4
SILT (%) = 13
CLAY (%) = 83

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= CH
MOISTURE (%) = --
SP. GR. = 2.80

L.L. (%) = 69
P.I. (%) = 40

DENSITY (pcf) = --
SATURATION (%) = --
VOID RATIO = --

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK
FILE : 17
Feature: DRY STACKING PH II
TESTED BY : TAL/CBE
Station:
El. :
Computed By:MHD
Range :
Sample: GR 1
Checked By : TAL
Boring : SS-71 to 75
Part : SS-71,3A;SS-72,3A
Report Date:02-14-91

Specific Gravity = 2.801
Flask No. = 5.00
Temp.(deg.c.) = 21.30
Soil Wt.(gm) = 50.00
Total Wt.(gm) =705.17

Moisture Determination
Dry Wt.+Tare(gm)= 369.80
Tare Wt(gm) = 68.80

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 73.70
Dry Wt.+Tare(gm)= 72.50
Tare Wt(gm) = 38.00
Moisture(%) = 3.48

Liquid Limit
Blows = 23.00
Wet Wt.(gm) = 15.51
Dry Wt.(gm) = 10.79
Tare Wt.(gm) = 4.04
Liquid Limit(%) = 69.23
Plasticity Index= 40.22

Plastic Limit
Wet Wt.(gm) = 11.16
Dry Wt.(gm) = 9.57
Tare Wt.(gm) = 4.09
Plastic Limit(%)= 29.01

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 301

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	0.0	100.0	19.0500
3/8 in.	0.0	100.0	9.5300
NO.4	0.0	100.0	4.7500
NO.10	0.3	99.9	2.0000
NO.20	0.4	99.1	0.8500
NO.40	0.6	98.7	0.4250
NO.50	0.8	98.2	0.3000
NO.100	1.2	97.4	0.1500
NO.200	1.8	96.2	0.0750

Air Dry Weight(gm)= 50.00
Corrected Weight(gm)= 48.32

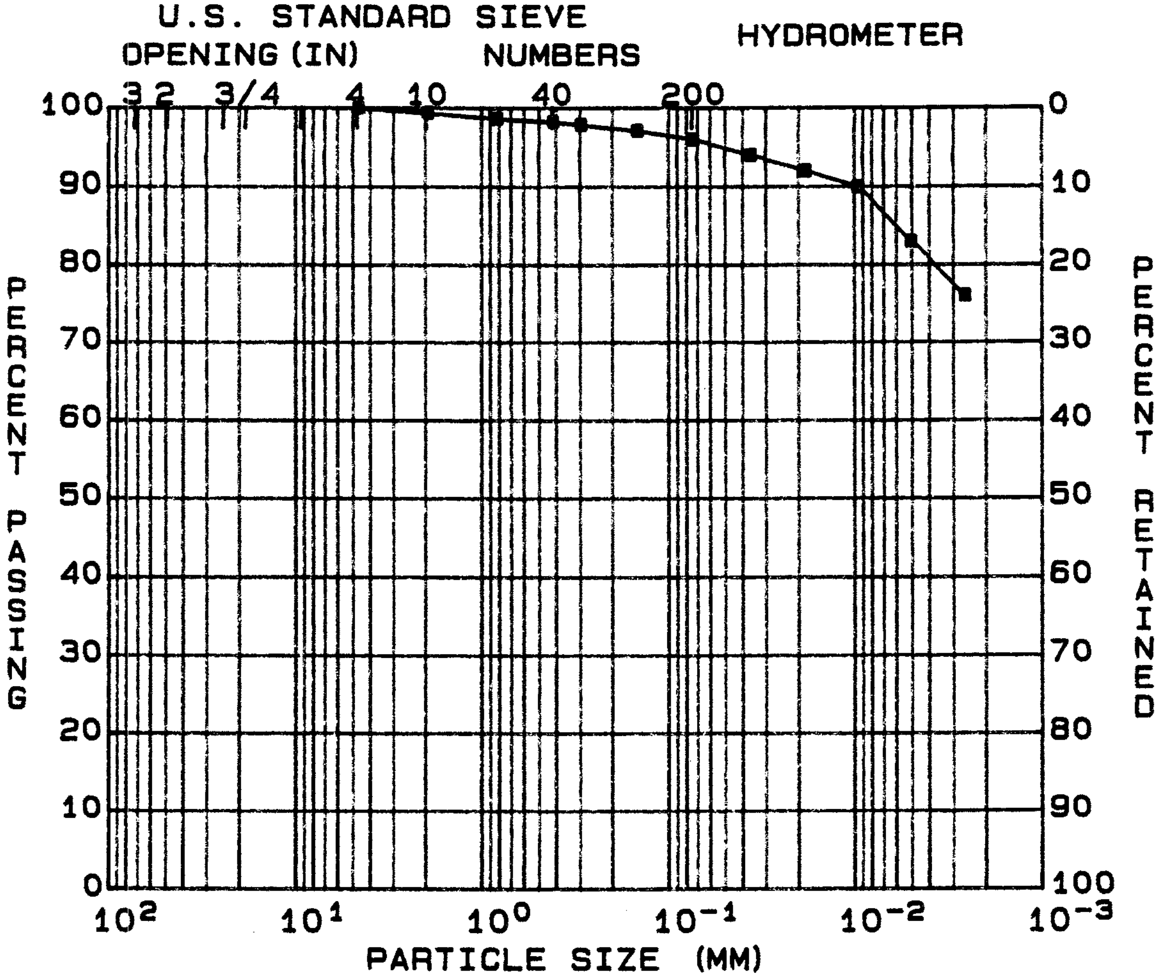
Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	16.6	55.0	8.0	94.1	0.0363
4 min.	16.6	54.0	8.0	92.1	0.0184
15 min.	16.6	53.0	8.0	90.1	0.0096
1 hour	16.3	50.0	8.5	83.1	0.0050
4 hours	16.3	46.5	8.5	76.1	0.0026

Soil Symbol= CH (Inorganic clay of high plasticity)
Gravel(%)= 0
Sand(%)= 4
Silt(%)= 13
Clay(%)= 83

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK
FEATURE: DRY STACKING PH II
STATION:
RANGE :
PART : SS-71, 3A; SS-72, 3A

BORING: SS-71 to 75
EL. :
SAMPLE: GR 1
DATE : 02-14-91



GRAVEL (%) = 0
SAND (%) = 4
SILT (%) = 13
CLAY (%) = 83

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= CH
MOISTURE (%) = --
SP. GR. = 2.80

L.L. (%) = 70
P.I. (%) = 41

DENSITY (pcf) = --
SATURATION (%) = --
VOID RATIO = --

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK
Feature: DRY STACKING PH II
Station:
Range :
Boring : SS-71 to 75

El. :
Sample: GR 1
Part : SS-71,3A;SS-72,3A

FILE : 18
TESTED BY : TAL/CBE
Computed By:MHD
Checked By : TAL
Report Date:02-14-91

Specific Gravity = 2.801
Flask No. = 5.00
Soil Wt.(gm) = 50.00
Temp.(deg.c.) = 21.30
Total Wt.(gm) =705.17

Moisture Determination
Dry Wt.+Tare(gm)= 369.80
Tare Wt(gm) = 68.80

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 73.70
Tare Wt(gm) = 38.00
Dry Wt.+Tare(gm)= 72.50
Moisture(%) = 3.48

Liquid Limit
Blows = 23.00
Wet Wt.(gm) = 15.85
Dry Wt.(gm) = 10.99
Tare Wt.(gm) = 4.10
Liquid Limit(%) = 69.83
Plasticity Index= 40.82

Plastic Limit
Wet Wt.(gm) = 11.16
Dry Wt.(gm) = 9.57
Tare Wt.(gm) = 4.09
Plastic Limit(%)= 29.01

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 301

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	0.0	100.0	19.0500
3/8 in.	0.0	100.0	9.5300
NO.4	0.0	100.0	4.7500
NO.10	0.3	99.9	2.0000
NO.20	0.4	99.1	0.8500
NO.40	0.6	98.7	0.4250
NO.50	0.8	98.2	0.3000
NO.100	1.2	97.4	0.1500
NO.200	1.8	96.2	0.0750

Air Dry Weight(gm)= 50.00
Corrected Weight(gm)= 48.32

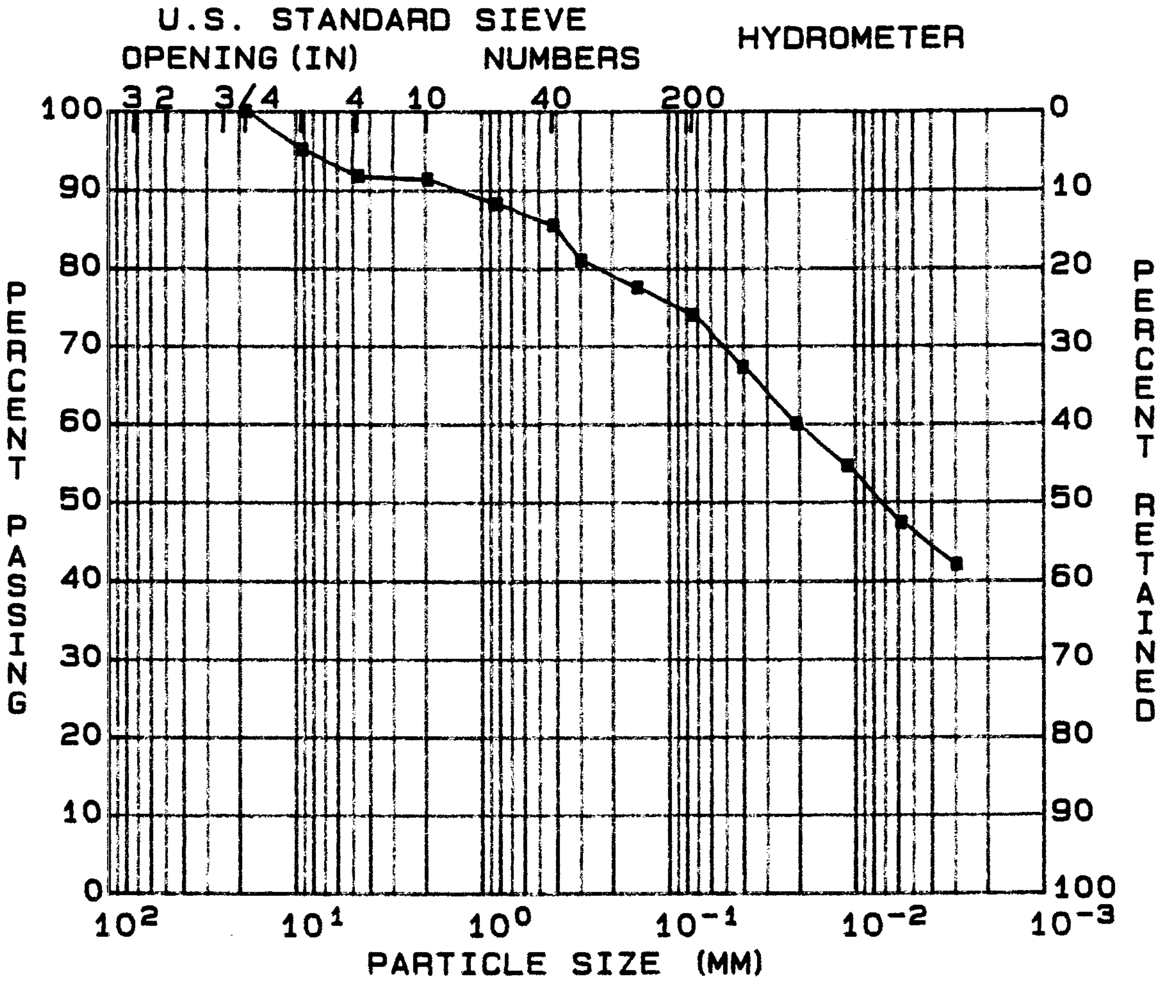
Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	16.6	55.0	8.0	94.1	0.0363
4 min.	16.6	54.0	8.0	92.1	0.0184
15 min.	16.6	53.0	8.0	90.1	0.0096
1 hour	16.3	50.0	8.5	83.1	0.0050
4 hours	16.3	46.5	8.5	76.1	0.0026

Soil Symbol= CH (inorganic clay of high plasticity)
Gravel(%)= 0 Sand(%)= 4 Silt(%)= 13 Clay(%)= 83

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK
FEATURE: DRY STACKING PH II
STATION:
RANGE :
PART : SS-74, 2A; SS-75, 2A

BORING: SS-71 to 75
EL. :
SAMPLE: GR 2
DATE : 02-14-91



GRAVEL (%) = 7
SAND (%) = 18
SILT (%) = 28
CLAY (%) = 47

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= CH
MOISTURE (%) = --
SP. GR. = 2.77

L.L. (%) = 52
P.I. (%) = 31

DENSITY (pcf) = --
SATURATION (%) = --
VOID RATIO = --

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK
FILE : 19
Feature: DRY STACKING PH II
TESTED BY : TAL/CBE
Station:
El. :
Computed By:MHD
Range :
Sample: GR 2
Checked By : TAL
Boring : SS-71 to 75
Part : SS-74,2A;SS-75,2A
Report Date:02-14-91

Specific Gravity = 2.772
Flask No. = 13.00
Temp.(deg.c.) = 21.20
Soil Wt.(gm) = 50.00
Total Wt.(gm) =705.55

Moisture Determination
Dry Wt.+Tare(gm)= 405.90
Tare Wt(gm) = 102.90

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 69.60
Dry Wt.+Tare(gm)= 69.00
Tare Wt(gm) = 38.00
Moisture(%) = 1.94

Liquid Limit
Blows = 23.00
Wet Wt.(gm) = 14.83
Dry Wt.(gm) = 11.12
Tare Wt.(gm) = 4.10
Liquid Limit(%) = 52.32
Plasticity Index= 31.49

Plastic Limit
Wet Wt.(gm) = 17.95
Dry Wt.(gm) = 15.51
Tare Wt.(gm) = 3.80
Plastic Limit(%)= 20.84

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 303

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	0.0	100.0	19.0500
3/8 in.	12.1	96.0	9.5300
NO.4	22.6	92.5	4.7500
NO.10	24.1	92.0	2.0000
NO.20	1.7	88.9	0.8500
NO.40	3.2	86.0	0.4250
NO.50	5.6	81.5	0.3000
NO.100	7.5	78.0	0.1500
NO.200	9.4	74.4	0.0750

Air Dry Weight(gm)= 50.00
Corrected Weight(gm)= 49.05

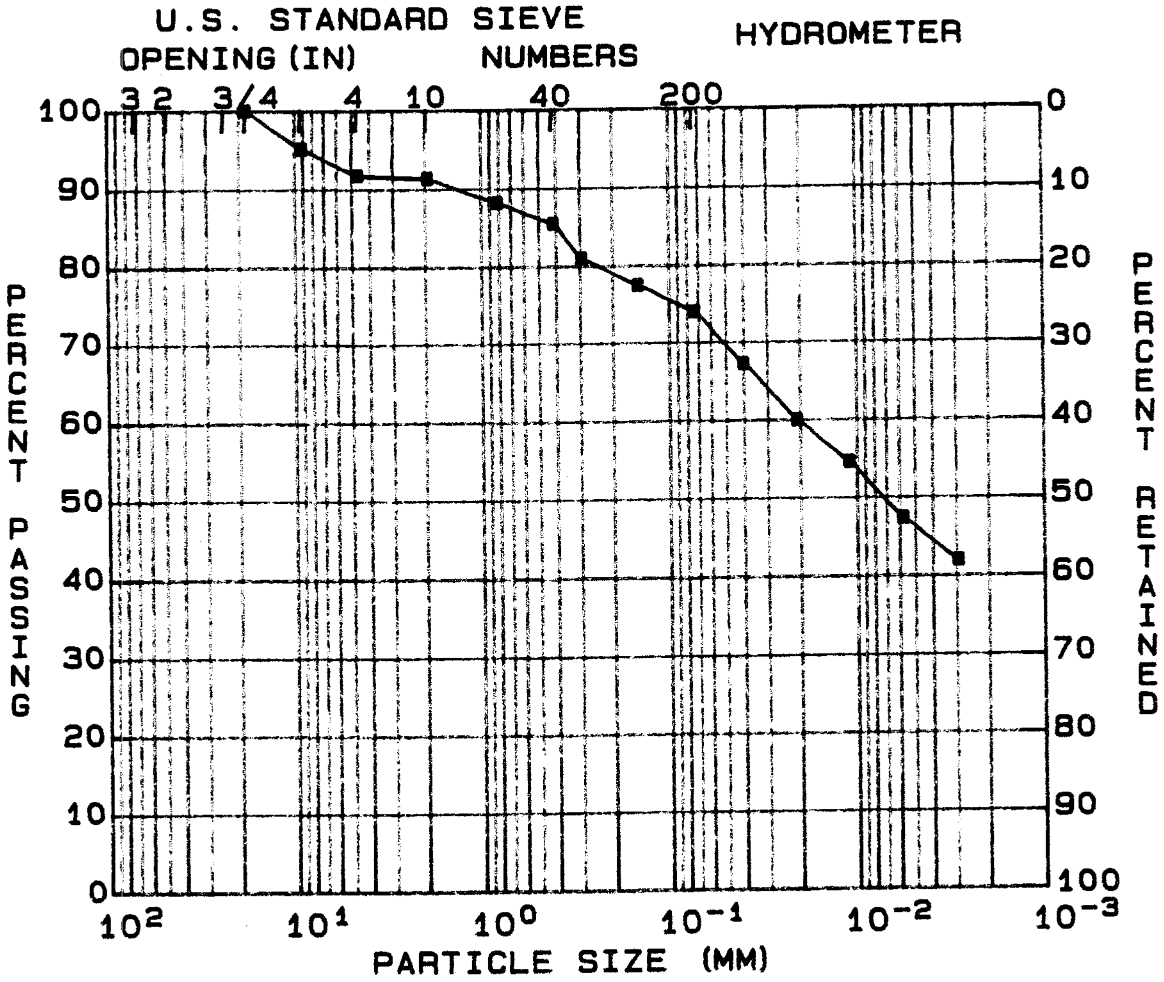
Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	16.6	45.0	8.0	67.6	0.0406
4 min.	16.6	41.0	8.0	60.3	0.0211
15 min.	16.6	38.0	8.0	54.8	0.0112
1 hour	16.3	34.5	8.5	47.5	0.0058
4 hours	16.3	31.5	8.5	42.0	0.0029

Soil Symbol= CH (Inorganic clay of high plasticity)
Gravel(%)= 7
Sand(%)=18
Silt(%)= 28
Clay(%)= 47

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK
FEATURE: DRY STACKING PH II
STATION:
RANGE :
PART : SS-74, 2A; SS-75, 2A

BORING: SS-71 to 75
EL. :
SAMPLE: GR 2
DATE : 02-14-91



GRAVEL (%) = 7
SAND (%) = 18
SILT (%) = 28
CLAY (%) = 47

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= CH
MOISTURE (%) = --
SP. GR. = 2.77

L.L. (%) = 52
P.I. (%) = 32

DENSITY (pcf) = --
SATURATION (%) = --
VOID RATIO = --

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK
Feature: DRY STACKING PH II
Station:
Range :
Boring : SS-71 to 75

El. :
Sample: GR 2
Part : SS-74,2A;SS-75,2A

FILE : 20
TESTED BY : TAL/CBE
Computed By:MHD
Checked By : TAL
Report Date:02-14-91

Specific Gravity = 2.772
Flask No. = 13.00
Soil Wt.(gm) = 50.00
Temp.(deg.c.) = 21.20
Total Wt.(gm) =705.55

Moisture Determination
Dry Wt.+Tare(gm)= 405.90
Tare Wt(gm) = 102.90

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 69.60
Tare Wt(gm) = 38.00
Dry Wt.+Tare(gm)= 69.00
Moisture(%) = 1.94

Liquid Limit
Blows = 24.00
Wet Wt.(gm) = 15.63
Dry Wt.(gm) = 11.62
Tare Wt.(gm) = 4.01
Liquid Limit(%) = 52.44
Plasticity Index= 31.60

Plastic Limit
Wet Wt.(gm) = 17.95
Dry Wt.(gm) = 15.51
Tare Wt.(gm) = 3.80
Plastic Limit(%)= 20.84

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 303

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	0.0	100.0	19.0500
3/8 in.	12.1	96.0	9.5300
NO.4	22.6	92.5	4.7500
NO.10	24.1	92.0	2.0000
NO.20	1.7	88.9	0.8500
NO.40	3.2	86.0	0.4250
NO.50	5.6	81.5	0.3000
NO.100	7.5	78.0	0.1500
NO.200	9.4	74.4	0.0750

Air Dry Weight(gm)= 50.00
Corrected Weight(gm)= 49.05

Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	16.6	45.0	8.0	67.6	0.0406
4 min.	16.6	41.0	8.0	60.3	0.0211
15 min.	16.6	38.0	8.0	54.8	0.0112
1 hour	16.3	34.5	8.5	47.5	0.0058
4 hours	16.3	31.5	8.5	42.0	0.0029

Soil Symbol= CH (Inorganic clay of high plasticity)
Gravel(%)= 7 Sand(%)=18 Silt(%)= 28 Clay(%)= 47

WIDOWS CREEK STEAM PLANT

FORCED OXIDATION GYPSUM STACKING - PHASE II

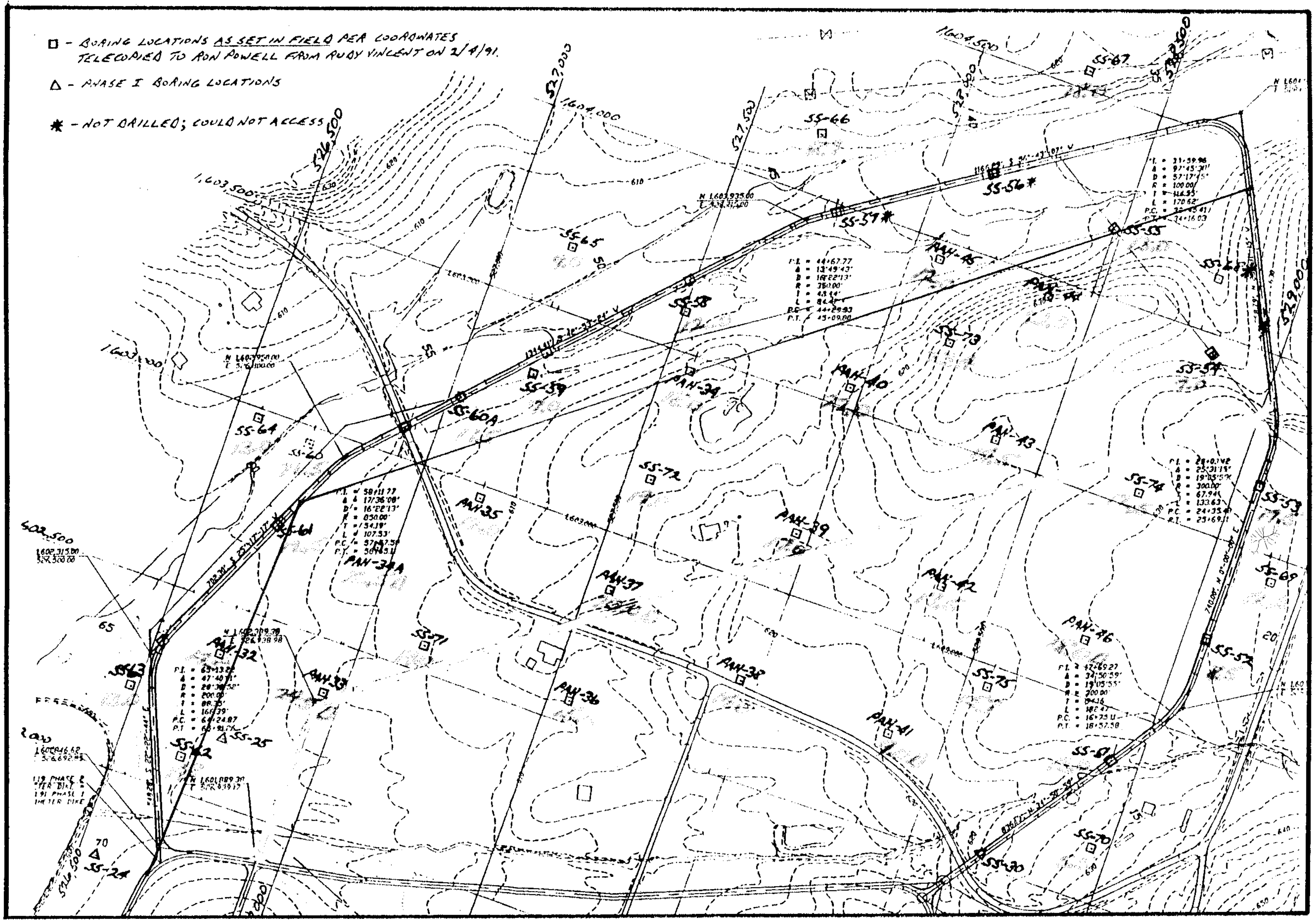


Figure 1

Boring Location Plan

April 30, 1991

PREPARED FOR:
TENNESSEE VALLEY AUTHORITY
FOSSIL & HYDRO ENGINEERING
1101 MARKET STREET
CHATTANOOGA, TN 37402-2801
AS REQUESTED BY: J.H. COULSON

WIDOWS CREEK STEAM PLANT
FORCED OXIDATION GYPSUM DRY STACKING - PHASE II
GEOTECHNICAL INVESTIGATION
DE-F19-392222

SL REPORT 30-02-0016A

VOLUME II

PREPARED BY:
Y.C. CHUNG

SINGLETON LABORATORIES
1413 TOPSIDE ROAD
LOUISVILLE, TENNESSEE 37777
615-970-2299/800-735-2299

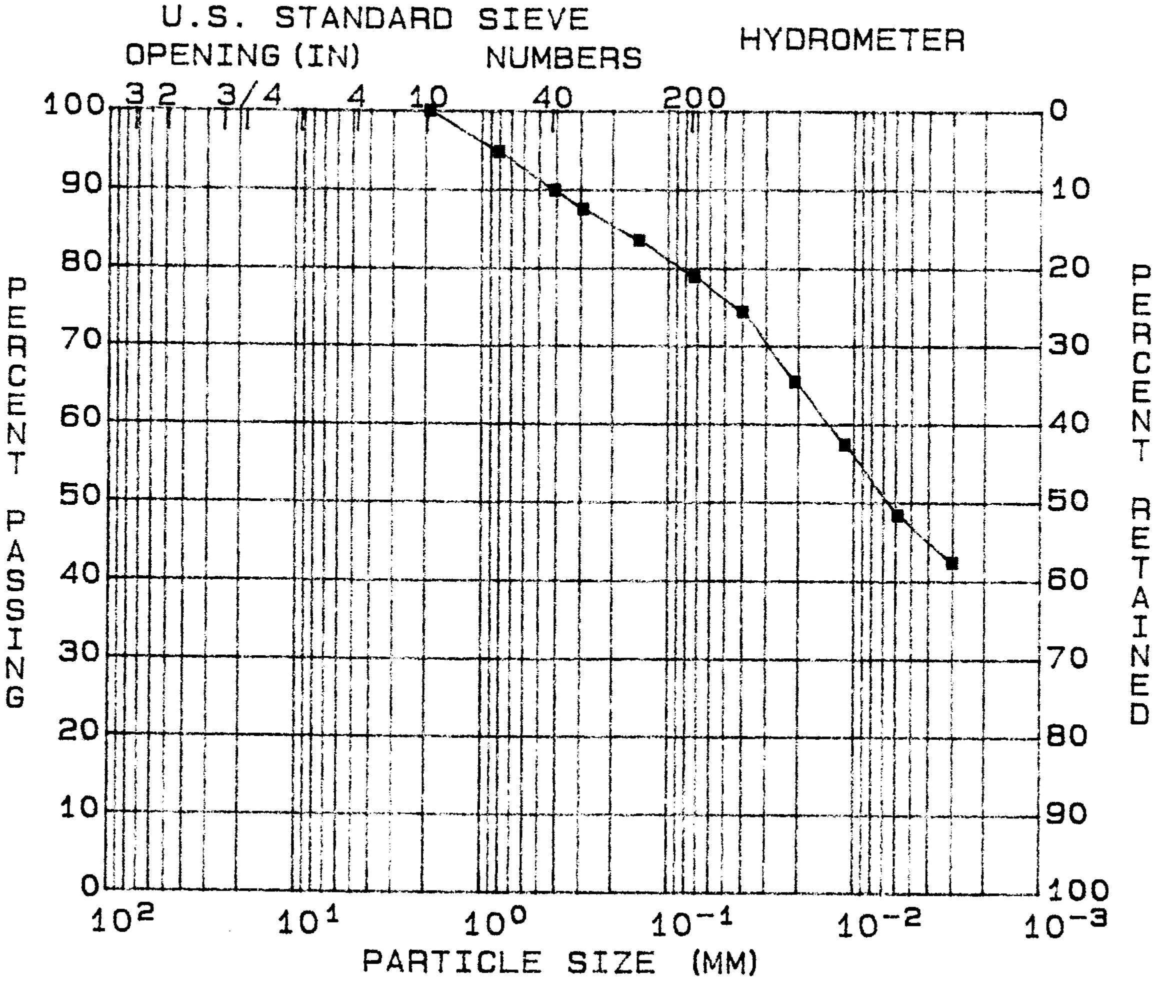
APPENDIX F

LABORATORY TEST DATA FOR UNDISTURBED SOILS

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STACKING PHS II
STATION:
RANGE :
PART : 2

BORING: US-53
EL. :
SAMPLE: 1
DATE : 02-22-91



GRAVEL (%) = 0
SAND (%) = 21
SILT (%) = 32
CLAY (%) = 47

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= ML/CL
MOISTURE (%) = 21.8
SP. GR. = 2.73

L.L. (%) = 49
P.I. (%) = 20

DENSITY (pcf) = 104.9
SATURATION (%) = 95.25
VOID RATIO = 0.626

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK SP
Feature: DRY STACKING PHS II
Station:
Range :
Boring : US-53

El. :
Sample: 1
Part : 2

FILE : 39
TESTED BY : GPB/CBE
Computed By:MHD
Checked By : TAC
Report Date:02-22-91

Specific Gravity = 2.733
Flask No. = 5.00
Temp.(deg.c.) = 21.00
Soil Wt.(gm) = 50.00
Total Wt.(gm) =704.76

Chunk Density
Wet Wt.+Tare(gm)= 157.5
Sample Wt.(gm) =2743.0
Dry Wt.+Tare(gm)= 136.5
Sa.+ Wt.(air) =2918.0
Tare Wt(gm) = 40.2
SA.+ PA. Wt(Water) =1382.0
Moisture(%) = 21.8
Density(pcf) =104.9
Void Ratio =0.626
Saturation(%) = 95.25

Moisture Determination
Dry Wt.+Tare(gm)= 258.70
Tare Wt(gm) = 67.60

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 83.80
Dry Wt.+Tare(gm)= 82.50
Tare Wt(gm) = 38.90
Moisture(%) = 2.98

Liquid Limit
Blows = 21.00
Wet Wt.(gm) = 13.52
Dry Wt.(gm) = 10.40
Tare Wt.(gm) = 4.11
Liquid Limit(%) = 48.58
Plasticity Index= 20.05

Plastic Limit
Wet Wt.(gm) = 16.26
Dry Wt.(gm) = 13.59
Tare Wt.(gm) = 4.23
Plastic Limit(%)= 28.53

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 191.1

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	0.0	100.0	19.0500
3/8 in.	0.0	100.0	9.5300
NO.4	0.0	100.0	4.7500
NO.10	0.0	100.0	2.0000
NO.20	2.1	95.7	0.8500
NO.40	4.5	90.7	0.4250
NO.50	5.7	88.3	0.3000
NO.100	7.7	84.1	0.1500
NO.200	10.0	79.4	0.0750

Air Dry Weight(gm)= 50.00
Corrected Weight(gm)= 48.55

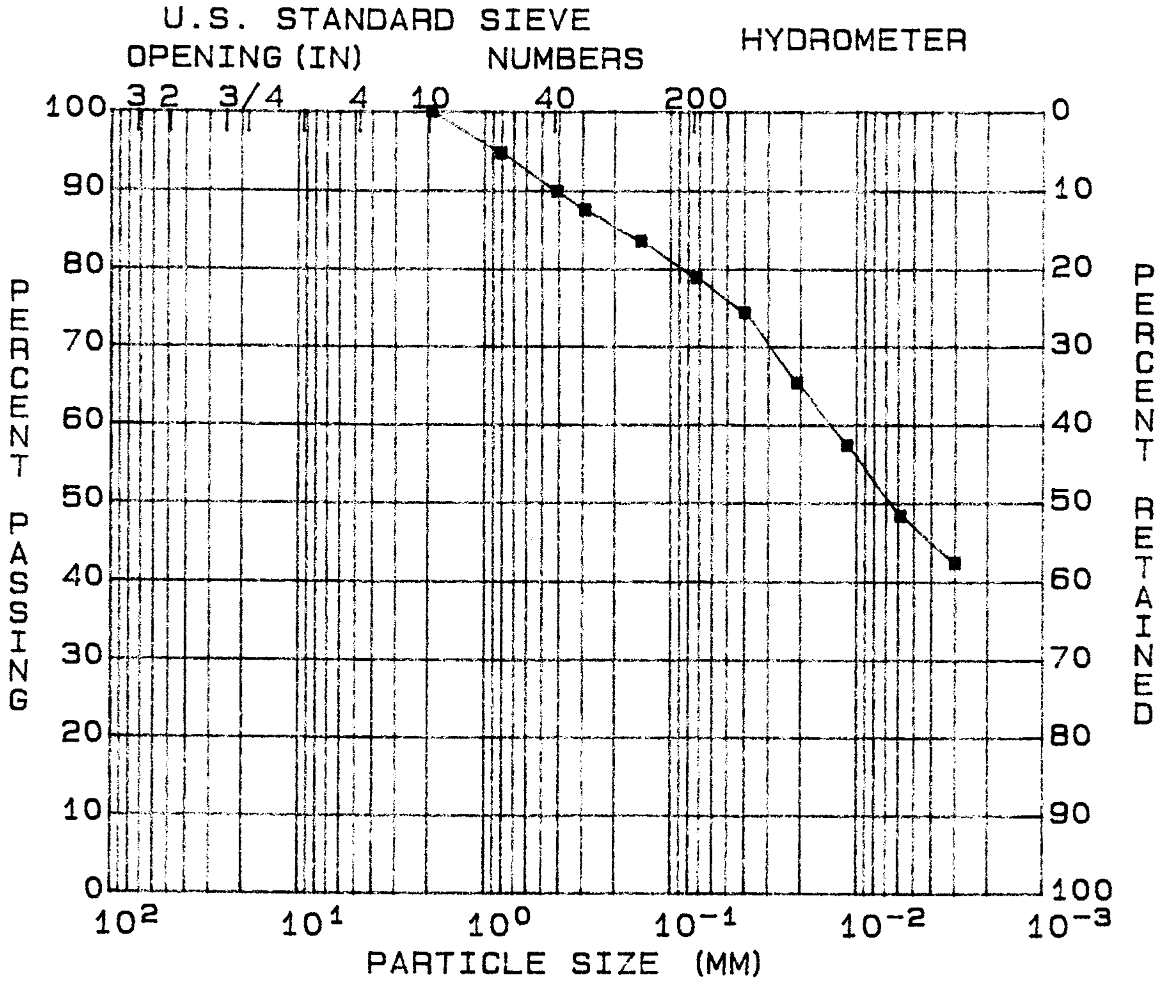
Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	18.1	43.0	6.0	74.8	0.0410
4 min.	18.1	38.5	6.0	65.7	0.0213
15 min.	18.1	34.5	6.0	57.6	0.0114
1 hour	18.1	30.0	6.0	48.5	0.0059
4 hours	18.3	27.0	6.0	42.5	0.0030

Soil Symbol= ML/CL (Inorganic sandy clayey silt)
Gravel(%)= 0
Sand(%)=21
Silt(%)= 32
Clay(%)= 47

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STACKING PHS II
STATION:
RANGE :
PART : 2

BORING: US-53
EL. :
SAMPLE: 1
DATE : 02-22-91



GRAVEL (%) = 0
SAND (%) = 21
SILT (%) = 32
CLAY (%) = 47

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= ML/CL
MOISTURE (%) = 21.8
SP. GR. = 2.73

L.L. (%) = 48
P.I. (%) = 20

DENSITY (pcf) = 104.9
SATURATION (%) = 95.25
VOID RATIO = 0.626

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK SP		FILE : 40
Feature: DRY STACKING PHS II		TESTED BY : GPB/CBE
Station:	El. :	Computed By:MHD
Range :	Sample: 1	Checked By : TAC
Boring : US-53	Part : 2	Report Date:02-22-91

Specific Gravity = 2.733
Flask No. = 5.00
Temp.(deg.c.) = 21.00
Soil Wt.(gm) = 50.00
Total Wt.(gm) =704.76

Chunk Density
Wet Wt.+Tare(gm)= 157.5
Sample Wt.(gm) =2743.0
Dry Wt.+Tare(gm)= 136.5
Sa.+ Wt.(air) =2918.0
Tare Wt(gm) = 40.2
SA.+ PA. Wt(Water) =1382.0
Moisture(%) = 21.8
Density(pcf) =104.9
Void Ratio =0.626
Saturation(%) = 95.25

Moisture Determination
Dry Wt.+Tare(gm)= 258.70
Tare Wt(gm) = 67.60

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 83.80
Dry Wt.+Tare(gm)= 82.50
Tare Wt(gm) = 38.90
Moisture(%) = 2.98

Liquid Limit
Blows = 20.00
Wet Wt.(gm) = 13.38
Dry Wt.(gm) = 10.25
Tare Wt.(gm) = 3.94
Liquid Limit(%) = 48.29
Plasticity Index= 19.77

Plastic Limit
Wet Wt.(gm) = 16.26
Dry Wt.(gm) = 13.59
Tare Wt.(gm) = 4.23
Plastic Limit(%)= 28.53

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 191.1

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	0.0	100.0	19.0500
3/8 in.	0.0	100.0	9.5300
NO.4	0.0	100.0	4.7500
NO.10	0.0	100.0	2.0000
NO.20	2.1	95.7	0.8500
NO.40	4.5	90.7	0.4250
NO.50	5.7	88.3	0.3000
NO.100	7.7	84.1	0.1500
NO.200	10.0	79.4	0.0750

Air Dry Weight(gm)= 50.00
Corrected Weight(gm)= 48.55

Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	18.1	43.0	6.0	74.8	0.0410
4 min.	18.1	38.5	6.0	65.7	0.0213
15 min.	18.1	34.5	6.0	57.6	0.0114
1 hour	18.1	30.0	6.0	48.5	0.0059
4 hours	18.3	27.0	6.0	42.5	0.0030

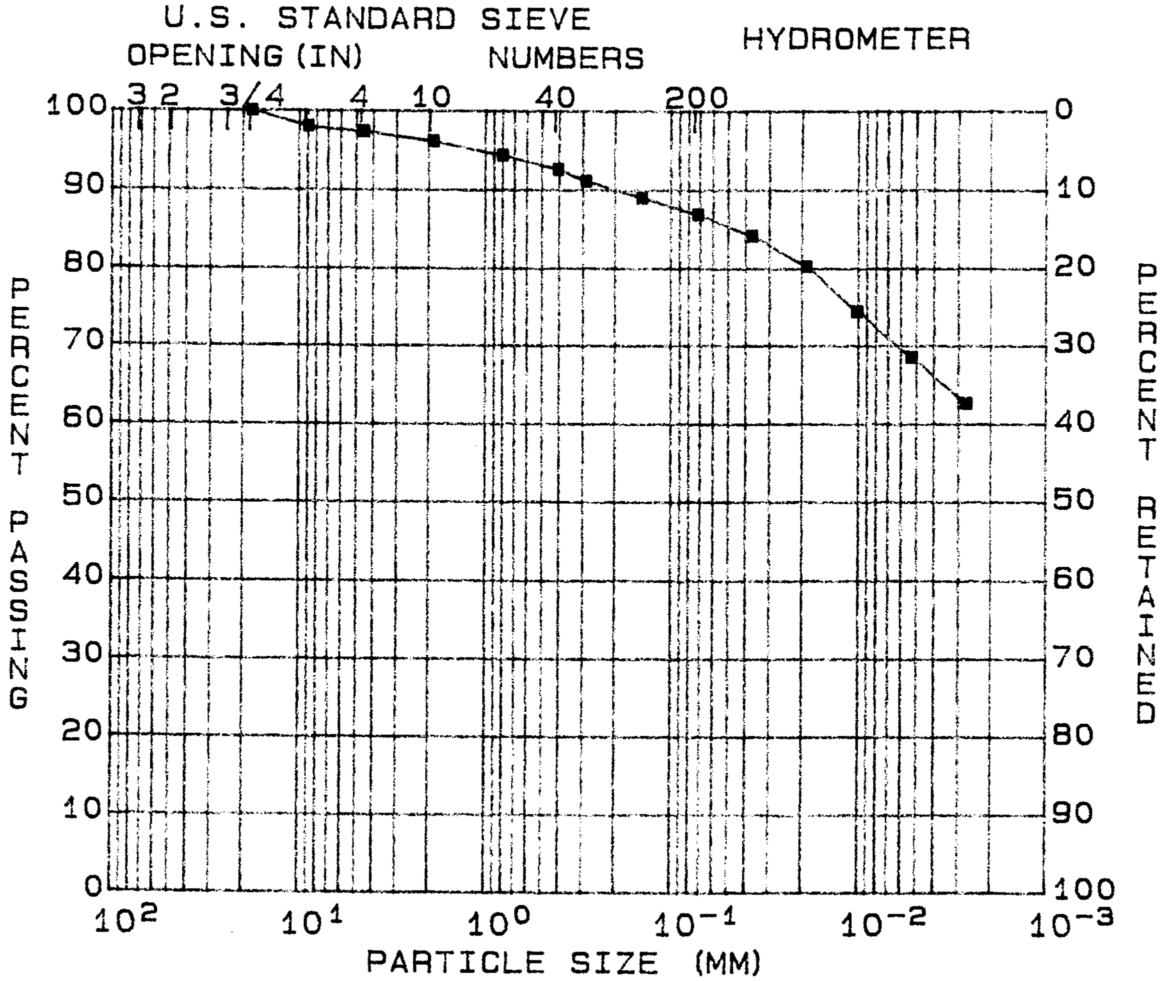
Soil Symbol= ML/CL (Inorganic sandy clayey silt)

Gravel(%)= 0 Sand(%)=21 Silt(%)= 32 Clay(%)= 47

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STACKING PHS II
STATION:
RANGE :
PART : 1

BORING: US-53
EL. :
SAMPLE: 2
DATE : 02-22-91



GRAVEL (%) = 2
SAND (%) = 11
SILT (%) = 19
CLAY (%) = 68

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= CH
MOISTURE (%) = 23.9
SP. GR. = 2.79

L.L. (%) = 65
P.I. (%) = 40

DENSITY (pcf) = 104.1
SATURATION (%) = 99.20
VOID RATIO = 0.670

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK SP
Feature: DRY STACKING PHS II
Station:
Range :
Boring : US-53

El. :
Sample: 2
Part : 1

FILE : 41
TESTED BY : GPB/CBE
Computed By:MHD
Checked By : TAL
Report Date:02-22-91

Specific Gravity = 2.786
Flask No. = 12.00
Soil Wt.(gm) = 50.00
Temp.(deg.c.) = 21.00
Total Wt.(gm) =706.36

Chunk Density
Wet Wt.+Tare(gm)= 170.4
Dry Wt.+Tare(gm)= 144.8
Tare Wt(gm) = 37.5
Moisture(%) = 23.9
Void Ratio =0.670
Sample Wt.(gm) =2555.0
Sa.+ Wt.(air) =2703.0
SA.+ PA. Wt(Water) =1300.0
Density(pcf) =104.1
Saturation(%) = 99.20

Moisture Determination
Dry Wt.+Tare(gm)= 455.70
Tare Wt(gm) = 105.30

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 88.70
Tare Wt(gm) = 37.30
Dry Wt.+Tare(gm)= 86.60
Moisture(%) = 4.26

Liquid Limit
Blows = 20.00
Wet Wt.(gm) = 12.40
Dry Wt.(gm) = 9.03
Tare Wt.(gm) = 3.96
Liquid Limit(%) = 64.71
Plasticity Index= 39.91

Plastic Limit
Wet Wt.(gm) = 14.84
Dry Wt.(gm) = 12.66
Tare Wt.(gm) = 3.87
Plastic Limit(%)= 24.80

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 350.4

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	0.0	100.0	19.0500
3/8 in.	4.6	98.7	9.5300
NO.4	7.2	97.9	4.7500
NO.10	11.6	96.7	2.0000
NO.20	0.9	94.9	0.8500
NO.40	1.8	93.1	0.4250
NO.50	2.6	91.4	0.3000
NO.100	3.7	89.2	0.1500
NO.200	4.8	87.0	0.0750

Air Dry Weight(gm)= 50.00
Corrected Weight(gm)= 47.96

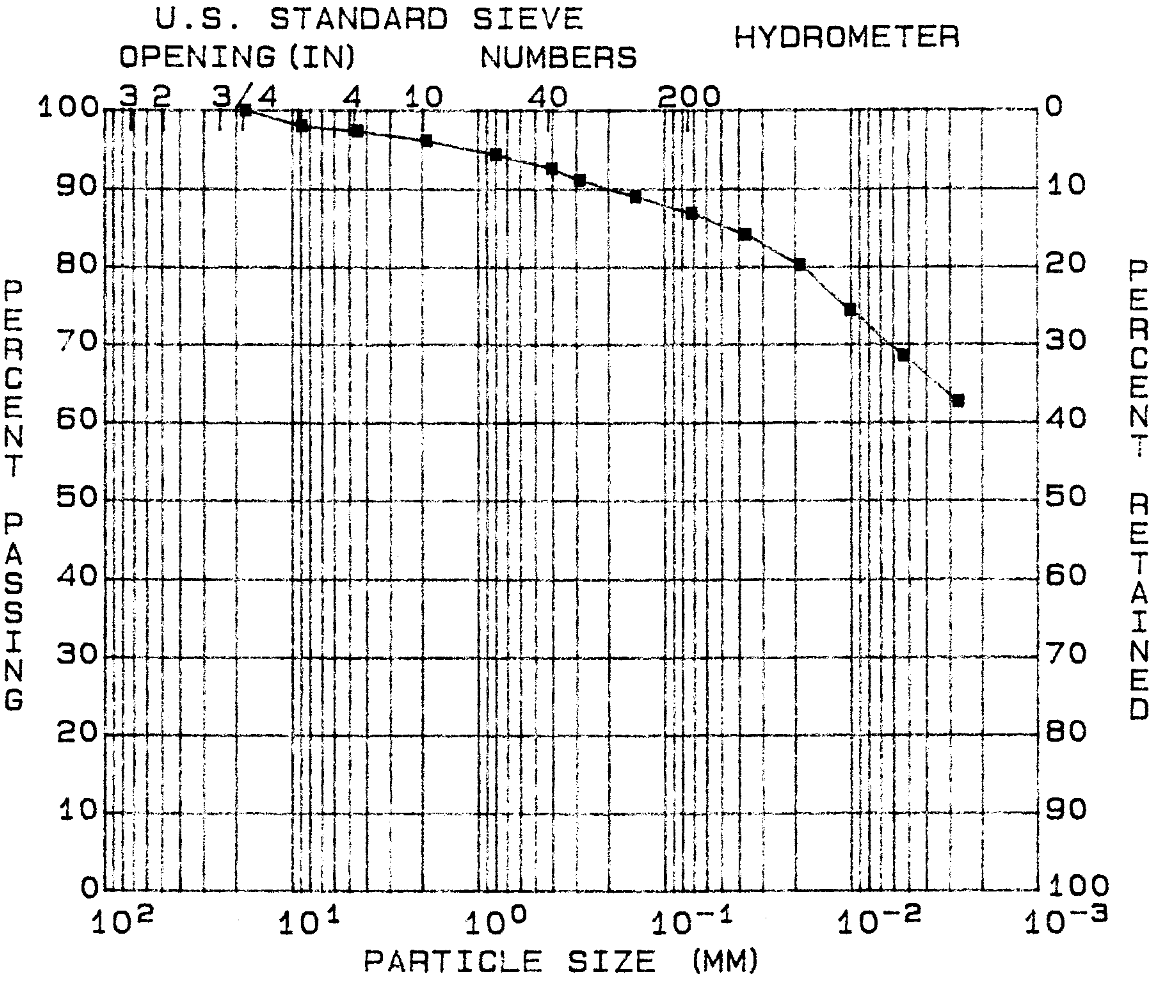
Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	18.1	49.0	6.0	84.2	0.0382
4 min.	18.1	47.0	6.0	80.3	0.0195
15 min.	18.1	44.0	6.0	74.4	0.0103
1 hour	18.1	41.0	6.0	68.5	0.0053
4 hours	18.3	38.0	6.0	62.7	0.0027

Soil Symbol= CH (Inorganic clay of high plasticity)
Gravel(%)= 2
Sand(%)=11
Silt(%)= 19
Clay(%)= 68

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STACKING PHS II
STATION:
RANGE :
PART : 1

BORING: US-53
EL. :
SAMPLE: 2
DATE : 02-22-91



GRAVEL (%) = 2
SAND (%) = 11
SILT (%) = 19
CLAY (%) = 68

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= CH
MOISTURE (%) = 23.9
SP. GR. = 2.79

L.L. (%) = 65
P.I. (%) = 40

DENSITY (pcf) = 104.1
SATURATION (%) = 99.20
VOID RATIO = 0.670

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK SP
Feature: DRY STACKING PHS II
Station:
Range :
Boring : US-53

El. :
Sample: 2
Part : 1

FILE : 42
TESTED BY : GPB/CBE
Computed By:MHD
Checked By : TAC
Report Date:02-22-91

Specific Gravity = 2.786
Flask No. = 12.00
Soil Wt.(gm) = 50.00
Temp.(deg.c.) = 21.00
Total Wt.(gm) =706.36

Chunk Density
Wet Wt.+Tare(gm)= 170.4
Dry Wt.+Tare(gm)= 144.8
Tare Wt(gm) = 37.5
Moisture(%) = 23.9
Void Ratio =0.670
Sample Wt.(gm) =2555.0
Sa.+ Wt.(air) =2703.0
SA.+ PA. Wt(Water) =1300.0
Density(pcf) =104.1
Saturation(%) = 99.20

Moisture Determination
Dry Wt.+Tare(gm)= 455.70
Tare Wt(gm) = 105.30

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 88.70
Tare Wt(gm) = 37.30
Dry Wt.+Tare(gm)= 86.60
Moisture(%) = 4.26

Liquid Limit
Blows = 21.00
Wet Wt.(gm) = 13.07
Dry Wt.(gm) = 9.40
Tare Wt.(gm) = 3.86
Liquid Limit(%) = 64.87
Plasticity Index= 40.07

Plastic Limit
Wet Wt.(gm) = 14.84
Dry Wt.(gm) = 12.66
Tare Wt.(gm) = 3.87
Plastic Limit(%)= 24.80

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 350.4

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	0.0	100.0	19.0500
3/8 in.	4.6	98.7	9.5300
NO.4	7.2	97.9	4.7500
NO.10	11.6	96.7	2.0000
NO.20	0.9	94.9	0.8500
NO.40	1.8	93.1	0.4250
NO.50	2.6	91.4	0.3000
NO.100	3.7	89.2	0.1500
NO.200	4.8	87.0	0.0750

Air Dry Weight(gm)= 50.00
Corrected Weight(gm)= 47.96

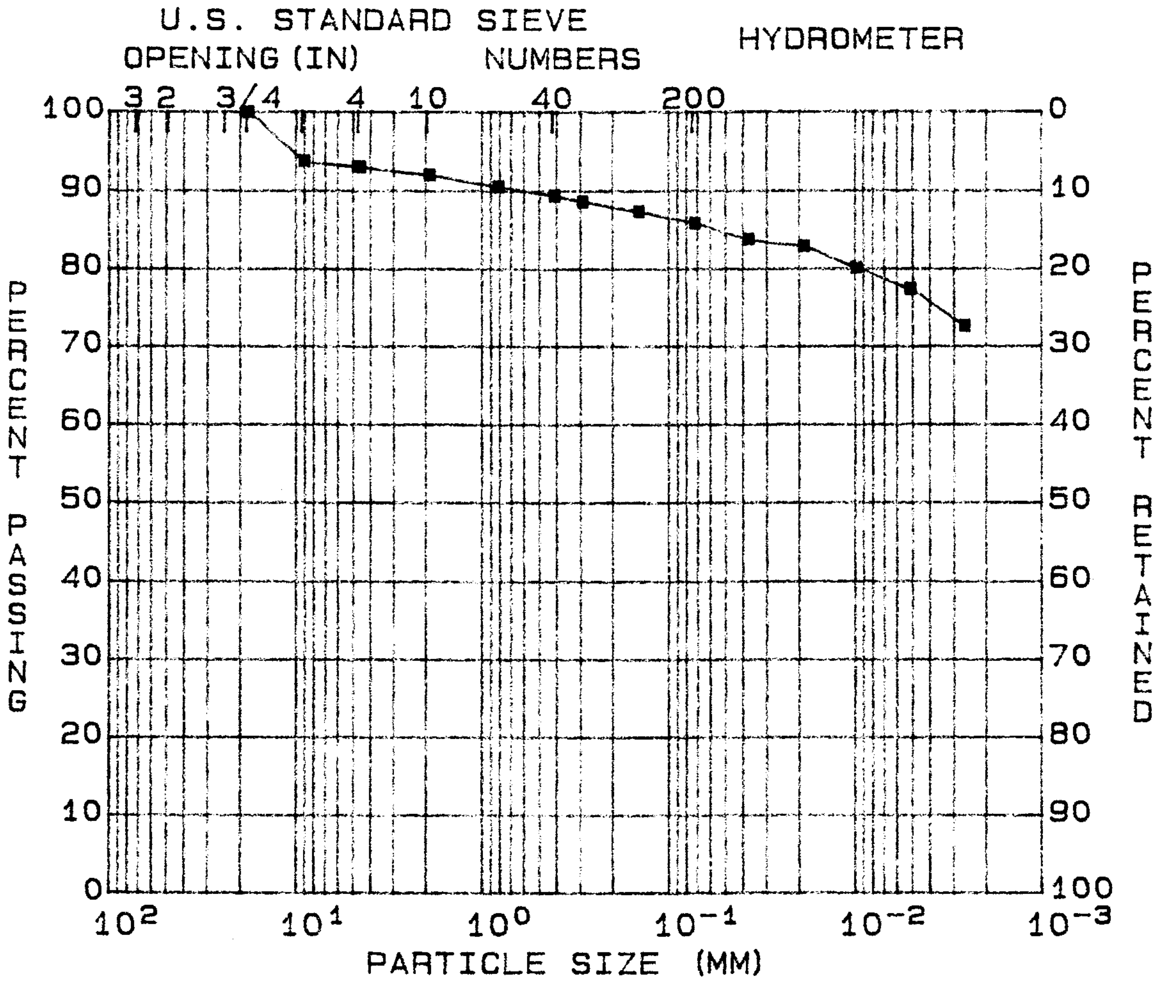
Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	18.1	49.0	6.0	84.2	0.0382
4 min.	18.1	47.0	6.0	80.3	0.0195
15 min.	18.1	44.0	6.0	74.4	0.0103
1 hour	18.1	41.0	6.0	68.5	0.0053
4 hours	18.3	38.0	6.0	62.7	0.0027

Soil Symbol= CH (inorganic clay of high plasticity)
Gravel(%)= 2 Sand(%)=11 Silt(%)= 19 Clay(%)= 68

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STACKING PHS II
STATION:
RANGE :
PART : 3

BORING: US-55
EL. :
SAMPLE: 1
DATE : 02-22-91



GRAVEL (%) = 6
SAND (%) = 7
SILT (%) = 9
CLAY (%) = 78

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= CH
MOISTURE (%) = 31.1
SP. GR. = 2.75

L.L. (%) = 84
P.I. (%) = 55

DENSITY (pcf) = 93.2
SATURATION (%) = 100.00
VOID RATIO = 0.841

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK SP
Feature: DRY STACKING PHS II
Station:
Range :
Boring : US-55

El. :
Sample: 1
Part : 3

FILE : 43
TESTED BY : GPB/CBE
Computed By:MHD
Checked By : TAL
Report Date:02-22-91

Specific Gravity = 2.749
Flask No. = 15.00 Temp.(deg.c.) = 21.00
Soil Wt.(gm) = 50.00 Total Wt.(gm) =709.87

Chunk Density
Wet Wt.+Tare(gm)= 123.8 Sample Wt.(gm) =2667.0
Dry Wt.+Tare(gm)= 103.5 Sa.+ Wt.(air) =2852.0
Tare Wt(gm) = 38.3 SA.+ PA. Wt(Water) =1282.0
Moisture(%) = 31.1 Density(pcf) = 93.2
Void Ratio =0.841 Saturation(%) =100.00

Moisture Determination
Dry Wt.+Tare(gm)= 285.60 Tare Wt(gm) = 102.90

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 71.00 Dry Wt.+Tare(gm)= 69.40
Tare Wt(gm) = 39.10 Moisture(%) = 5.28

Liquid Limit
Blows = 23.00
Wet Wt.(gm) = 14.29
Dry Wt.(gm) = 9.46
Tare Wt.(gm) = 3.78
Liquid Limit(%) = 84.19
Plasticity Index= 54.92

Plastic Limit
Wet Wt.(gm) = 12.60
Dry Wt.(gm) = 10.63
Tare Wt.(gm) = 3.90

Plastic Limit(%)= 29.27

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 182.7

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	0.0	100.0	19.0500
3/8 in.	9.9	94.6	9.5300
NO.4	11.3	93.8	4.7500
NO.10	13.2	92.8	2.0000
NO.20	0.8	91.2	0.8500
NO.40	1.4	90.0	0.4250
NO.50	1.8	89.3	0.3000
NO.100	2.5	87.9	0.1500
NO.200	3.3	86.3	0.0750

Air Dry Weight(gm)= 50.00 Corrected Weight(gm)= 47.49

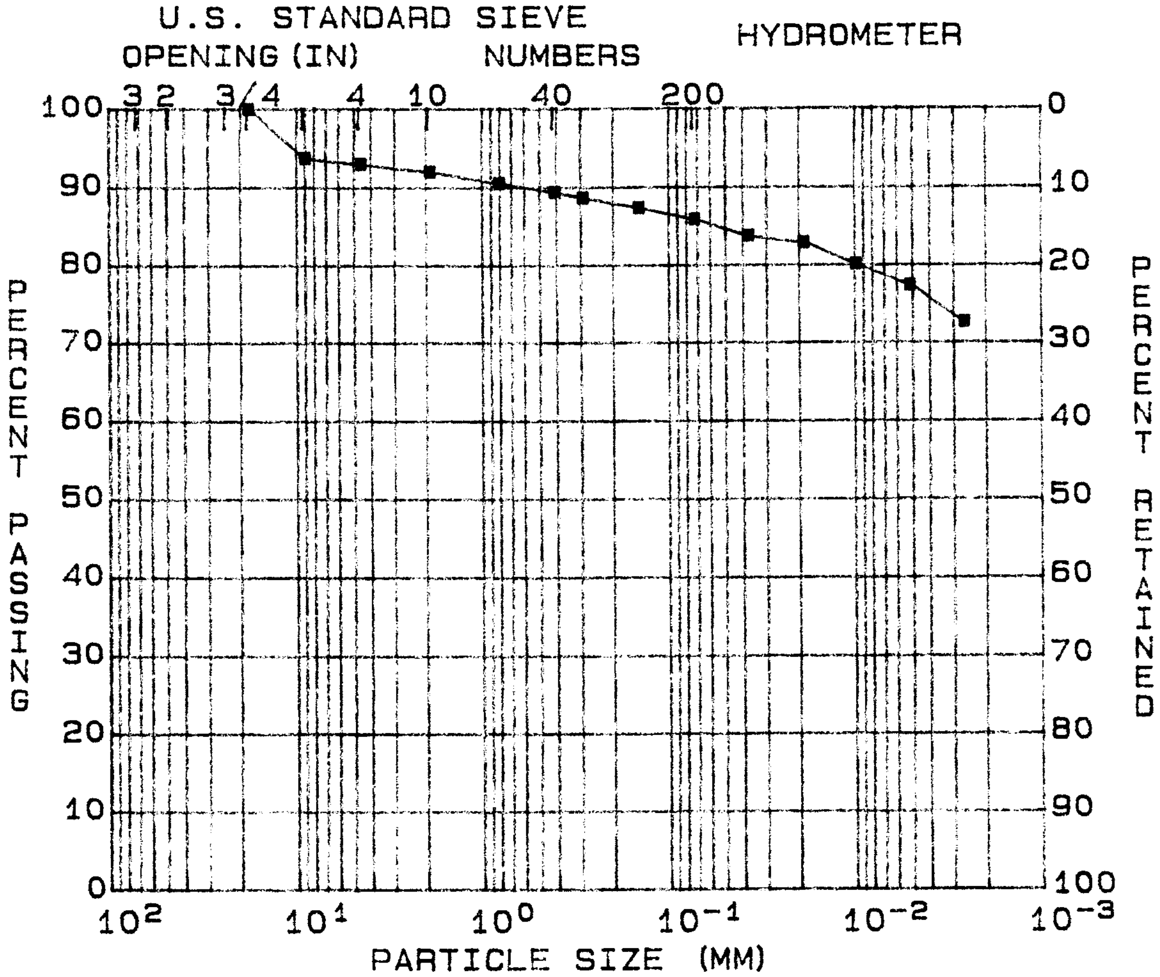
Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	18.1	50.0	6.0	84.1	0.0382
4 min.	18.1	49.5	6.0	83.2	0.0192
15 min.	18.1	48.0	6.0	80.3	0.0101
1 hour	18.1	46.5	6.0	77.4	0.0051
4 hours	18.3	44.0	6.0	72.7	0.0026

Soil Symbol= CH (Inorganic clay of high plasticity)
Gravel(%)= 6 Sand(%)= 7 Silt(%)= 9 Clay(%)= 78

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STACKING PHS II
STATION:
RANGE :
PART : 3

BORING: US-55
EL. :
SAMPLE: 1
DATE : 02-22-91



GRAVEL (%) = 6
SAND (%) = 7
SILT (%) = 9
CLAY (%) = 78

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= CH
MOISTURE (%) = 31.1
SP. GR. = 2.75

L.L. (%) = 85
P.I. (%) = 55

DENSITY (pcf) = 93.2
SATURATION (%) = 100.00
VOID RATIO = 0.841

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK SP		FILE : 44
Feature: DRY STACKING PHS II		TESTED BY : GPB/CBE
Station:	El. :	Computed By:MHD
Range :	Sample: 1	Checked By : TAC
Boring : US-55	Part : 3	Report Date:02-22-91

Specific Gravity = 2.749

Flask No. = 15.00	Temp.(deg.c.) = 21.00
Soil Wt.(gm) = 50.00	Total Wt.(gm) =709.87

Chunk Density

Wet Wt.+Tare(gm)= 123.8	Sample Wt.(gm) =2667.0
Dry Wt.+Tare(gm)= 103.5	Sa.+ Wt.(air) =2852.0
Tare Wt(gm) = 38.3	SA.+ PA. Wt(Water) =1282.0
Moisture(%) = 31.1	Density(pcf) = 93.2
Void Ratio =0.841	Saturation(%) =100.00

Moisture Determination

Dry Wt.+Tare(gm)= 285.60	Tare Wt(gm) = 102.90

Hygroscopic Moisture

Wet Wt.+Tare(gm)= 71.00	Dry Wt.+Tare(gm)= 69.40
Tare Wt(gm) = 39.10	Moisture(%) = 5.28

Liquid Limit	Plastic Limit
Blows = 24.00	Wet Wt.(gm) = 12.60
Wet Wt.(gm) = 13.28	Dry Wt.(gm) = 10.63
Dry Wt.(gm) = 8.96	Tare Wt.(gm) = 3.90
Tare Wt.(gm) = 3.88	
Liquid Limit(%) = 84.62	Plastic Limit(%)= 29.27
Plasticity Index= 55.35	

Sieve and Hydrometer Analysis

Total Dry Weight(gm) = 182.7

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	0.0	100.0	19.0500
3/8 in.	9.9	94.6	9.5300
NO.4	11.3	93.8	4.7500
NO.10	13.2	92.8	2.0000
NO.20	0.8	91.2	0.8500
NO.40	1.4	90.0	0.4250
NO.50	1.8	89.3	0.3000
NO.100	2.5	87.9	0.1500
NO.200	3.3	86.3	0.0750

Air Dry Weight(gm)= 50.00 Corrected Weight(gm)= 47.49

Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	18.1	50.0	6.0	84.1	0.0382
4 min.	18.1	49.5	6.0	83.2	0.0192
15 min.	18.1	48.0	6.0	80.3	0.0101
1 hour	18.1	46.5	6.0	77.4	0.0051
4 hours	18.3	44.0	6.0	72.7	0.0026

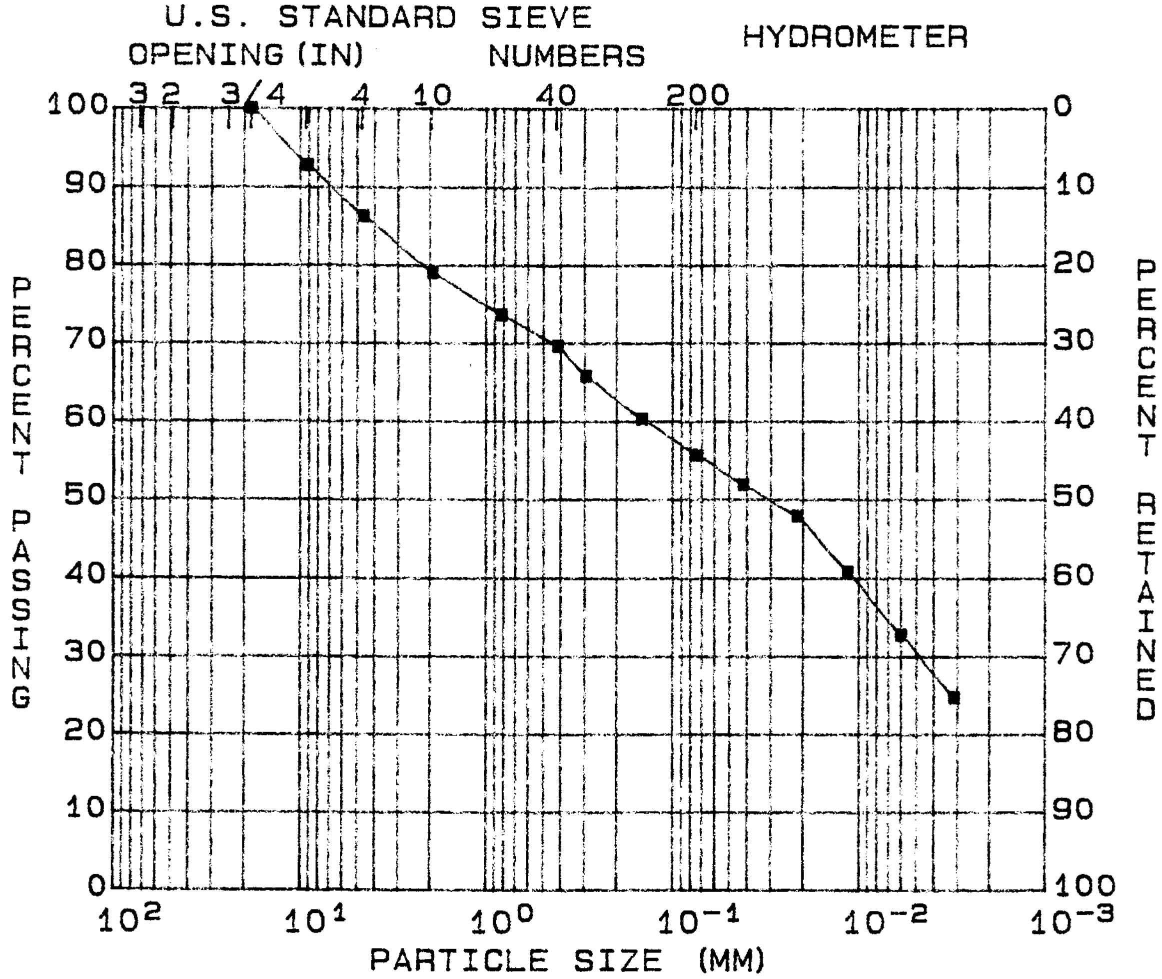
Soil Symbol= CH (Inorganic clay of high plasticity)

Gravel(%)= 6 Sand(%)= 7 Silt(%)= 9 Clay(%)= 78

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STACKING PHS II
STATION:
RANGE :
PART : 3

BORING: US-58
EL. :
SAMPLE: 1
DATE : 02-22-91



GRAVEL (%) = 13
SAND (%) = 31
SILT (%) = 25
CLAY (%) = 31

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= CL
MOISTURE (%) = 20.1
SP. GR. = 2.74

L.L. (%) = 37
P.I. (%) = 20

DENSITY (pcf) = 111.0
SATURATION (%) = 100.00
VOID RATIO = 0.538

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK SP
Feature: DRY STACKING PHS II
Station:
Range :
Boring : US-58

El. :
Sample: 1
Part : 3

FILE : 45
TESTED BY : GPB/CBE
Computed By:MHD
Checked By : TA
Report Date:02-22-91

Specific Gravity = 2.737
Flask No. = 16.00
Soil Wt.(gm) = 50.00
Temp.(deg.c.) = 21.00
Total Wt.(gm) =707.94

Chunk Density
Wet Wt.+Tare(gm)= 155.7
Dry Wt.+Tare(gm)= 136.2
Tare Wt(gm) = 39.1
Moisture(%) = 20.1
Void Ratio =0.538
Sample Wt.(gm) =2951.0
Sa.+ Wt.(air) =3137.0
SA.+ PA. Wt(Water) =1547.0
Density(pcf) =111.0
Saturation(%) =100.00

Moisture Determination
Dry Wt.+Tare(gm)= 606.20
Tare Wt(gm) = 105.30

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 95.10
Tare Wt(gm) = 39.80
Dry Wt.+Tare(gm)= 93.70
Moisture(%) = 2.60

Liquid Limit
Blows = 23.00
Wet Wt.(gm) = 14.14
Dry Wt.(gm) = 11.35
Tare Wt.(gm) = 3.90
Liquid Limit(%) = 37.08
Plasticity Index= 20.06

Plastic Limit
Wet Wt.(gm) = 16.05
Dry Wt.(gm) = 14.29
Tare Wt.(gm) = 3.95
Plastic Limit(%)= 17.02

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 500.9

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	0.0	100.0	19.0500
3/8 in.	32.8	93.5	9.5300
NO.4	65.9	86.8	4.7500
NO.10	102.8	79.5	2.0000
NO.20	3.3	74.1	0.8500
NO.40	5.8	70.0	0.4250
NO.50	8.2	66.1	0.3000
NO.100	11.6	60.6	0.1500
NO.200	14.5	55.8	0.0750

Air Dry Weight(gm)= 50.00
Corrected Weight(gm)= 48.73

Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	18.1	38.5	6.0	52.0	0.0426
4 min.	18.1	36.0	6.0	48.0	0.0218
15 min.	18.1	31.5	6.0	40.8	0.0116
1 hour	18.1	26.5	6.0	32.8	0.0060
4 hours	18.3	21.5	6.0	24.8	0.0031

Soil Symbol= CL (Inorganic gravelly clay of medium plasticity)
Gravel(%)=13
Sand(%)=31
Silt(%)= 25
Clay(%)= 31

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK SP
Feature: DRY STACKING PHS II
Station:
Range :
Boring : US-58

El. :
Sample: 1
Part : 3

FILE : 51
TESTED BY : GPB/CBE
Computed By:MHD
Checked By :
Report Date:02-22-91

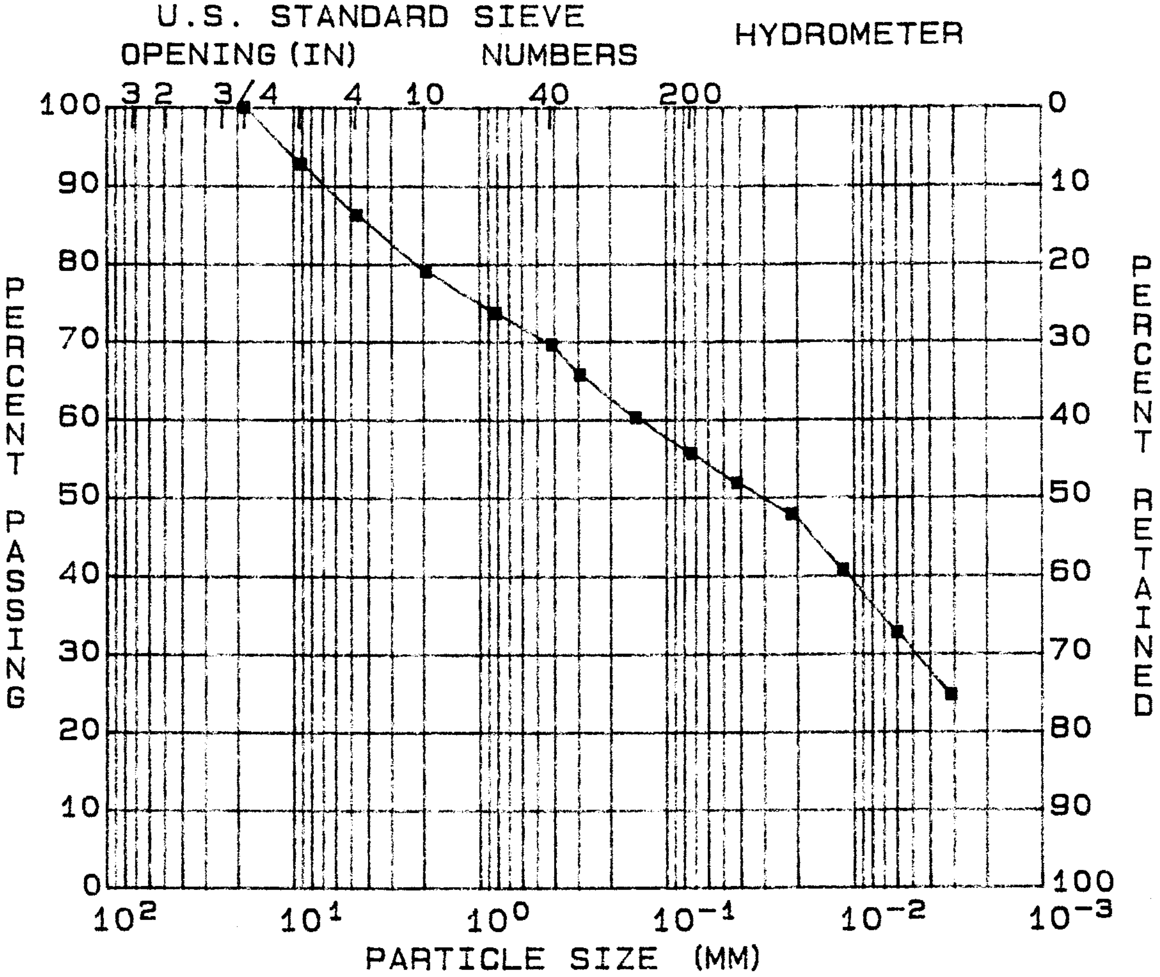
Specific Gravity = 2.711
Flask No. = 22.00
Soil Wt.(gm) = 35.00
Temp.(deg.c.) = 21.00
Total Wt.(gm) =699.00

Chunk Density
Wet Wt.+Tare(gm)= 155.7
Dry Wt.+Tare(gm)= 136.2
Tare Wt(gm) = 39.1
Moisture(%) = 20.1
Void Ratio =0.524
Sample Wt.(gm) =2951.0
Sa.+ Wt.(air) =3137.0
SA.+ PA. Wt(Water) =1547.0
Density(pcf) =111.0
Saturation(%) =100.00

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STACKING PHS II
STATION:
RANGE :
PART : 3

BORING: US-58
EL. :
SAMPLE: 1
DATE : 02-22-91



GRAVEL (%) = 13
SAND (%) = 31
SILT (%) = 25
CLAY (%) = 31

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= CL
MOISTURE (%) = 20.1
SP. GR. = 2.74

L.L. (%) = 37
P.I. (%) = 20

DENSITY (pcf) = 111.0
SATURATION (%) = 100.00
VOID RATIO = 0.538

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK SP FILE : 46
Feature: DRY STACKING PHS II TESTED BY : GPB/CBE
Station: El. : Computed By:MHD
Range : Sample: 1 Checked By : TAC
Boring : US-58 Part : 3 Report Date:02-22-91

Specific Gravity = 2.737
Flask No. = 16.00 Temp.(deg.c.) = 21.00
Soil Wt.(gm) = 50.00 Total Wt.(gm) =707.94

Chunk Density
Wet Wt.+Tare(gm)= 155.7 Sample Wt.(gm) =2951.0
Dry Wt.+Tare(gm)= 136.2 Sa.+ Wt.(air) =3137.0
Tare Wt(gm) = 39.1 SA.+ PA. Wt(Water) =1547.0
Moisture(%) = 20.1 Density(pcf) =111.0
Void Ratio =0.538 Saturation(%) =100.00

Moisture Determination
Dry Wt.+Tare(gm)= 606.20 Tare Wt(gm) = 105.30

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 95.10 Dry Wt.+Tare(gm)= 93.70
Tare Wt(gm) = 39.80 Moisture(%) = 2.60

Liquid Limit
Blows = 22.00
Wet Wt.(gm) = 15.62
Dry Wt.(gm) = 12.40
Tare Wt.(gm) = 3.90
Liquid Limit(%) = 37.31
Plasticity Index= 20.28

Plastic Limit
Wet Wt.(gm) = 16.05
Dry Wt.(gm) = 14.29
Tare Wt.(gm) = 3.95
Plastic Limit(%)= 17.02

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 500.9

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	0.0	100.0	19.0500
3/8 in.	32.8	93.5	9.5300
NO.4	65.9	86.8	4.7500
NO.10	102.8	79.5	2.0000
NO.20	3.3	74.1	0.8500
NO.40	5.8	70.0	0.4250
NO.50	8.2	66.1	0.3000
NO.100	11.6	60.6	0.1500
NO.200	14.5	55.8	0.0750

Air Dry Weight(gm)= 50.00 Corrected Weight(gm)= 48.73

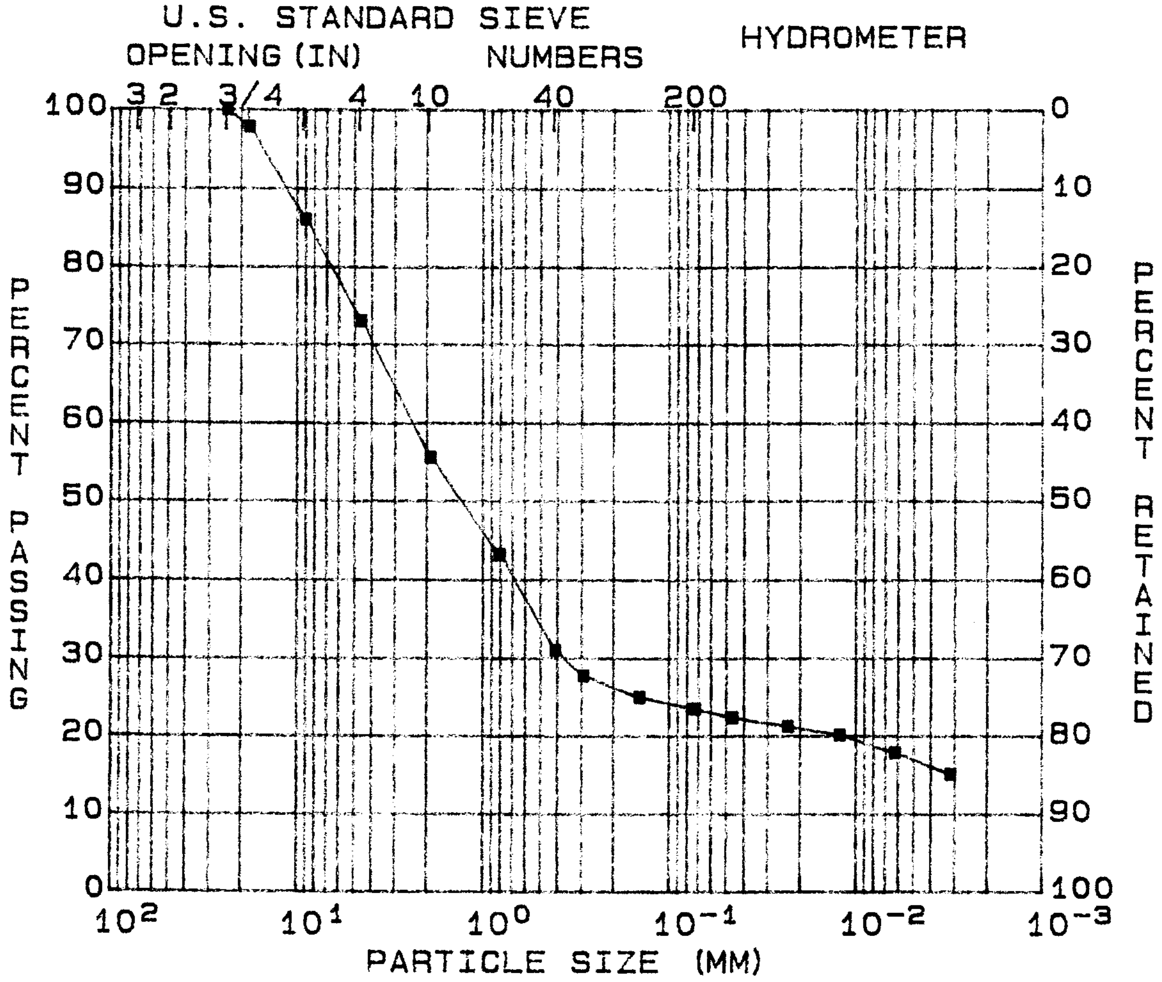
Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	18.1	38.5	6.0	52.0	0.0426
4 min.	18.1	36.0	6.0	48.0	0.0218
15 min.	18.1	31.5	6.0	40.8	0.0116
1 hour	18.1	26.5	6.0	32.8	0.0060
4 hours	18.3	21.5	6.0	24.8	0.0031

Soil Symbol= CL (Inorganic gravelly clay of medium plasticity)
Gravel(%)=13 Sand(%)=31 Silt(%)= 25 Clay(%)= 31

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STACKING PHS II
STATION:
RANGE :
PART : 2

BORING: US-60
EL. :
SAMPLE: 1
DATE : 02-22-91



GRAVEL (%) = 26
SAND (%) = 50
SILT (%) = 7
CLAY (%) = 17

D10 (MM) = 0.0009
D30 (MM) = 0.3653
D60 (MM) = 2.4364
COEF UNIF> 100

SOIL SYMBOL= SC
MOISTURE (%) = 14.6
SP. GR. = 2.73

L.L. (%) = 46
P.I. (%) = 25

DENSITY (pcf) = 118.6
SATURATION (%) = 91.23
VOID RATIO = 0.436

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK SP
Feature: DRY STACKING PHS II
Station:
Range :
Boring : US-60

El. :
Sample: 1
Part : 2

FILE : 47
TESTED BY : GPB/CBE
Computed By:MHD
Checked By : TA
Report Date:02-22-91

Specific Gravity = 2.729
Flask No. = 23.00
Soil Wt.(gm) = 50.00
Temp.(deg.c.) = 21.00
Total Wt.(gm) =707.34

Chunk Density
Wet Wt.+Tare(gm)= 176.4
Dry Wt.+Tare(gm)= 159.0
Tare Wt(gm) = 39.6
Moisture(%) = 14.6
Void Ratio =0.436
Sample Wt.(gm) =2970.0
Sa.+ Wt.(air) =3157.0
SA.+ PA. Wt(Water) =1583.0
Density(pcf) =118.6
Saturation(%) = 91.23

Moisture Determination
Dry Wt.+Tare(gm)= 786.10
Tare Wt(gm) = 104.00

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 90.80
Tare Wt(gm) = 40.00
Dry Wt.+Tare(gm)= 89.60
Moisture(%) = 2.42

Liquid Limit
Blows = 26.00
Wet Wt.(gm) = 14.18
Dry Wt.(gm) = 10.98
Tare Wt.(gm) = 3.94
Liquid Limit(%) = 45.67
Plasticity Index= 25.28

Plastic Limit
Wet Wt.(gm) = 16.26
Dry Wt.(gm) = 14.15
Tare Wt.(gm) = 3.80
Plastic Limit(%)= 20.39

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 682.1

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	11.0	98.4	19.0500
3/8 in.	91.4	86.6	9.5300
NO.4	180.3	73.6	4.7500
NO.10	300.2	56.0	2.0000
NO.20	10.8	43.6	0.8500
NO.40	21.4	31.4	0.4250
NO.50	24.3	28.1	0.3000
NO.100	26.7	25.4	0.1500
NO.200	28.1	23.8	0.0750

Air Dry Weight(gm)= 50.00
Corrected Weight(gm)= 48.82

Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	18.1	26.0	6.0	22.5	0.0470
4 min.	18.1	25.0	6.0	21.4	0.0237
15 min.	18.1	24.0	6.0	20.3	0.0123
1 hour	18.1	22.0	6.0	18.0	0.0062
4 hours	18.3	19.5	6.0	15.2	0.0032

Soil Symbol= SC (Clayey sand)
D10(mm) =0.0009 D30(mm)= 0.3653 D60(mm)= 2.4364
Gravel(%)=26 Sand(%)=50 Silt(%)= 7 Clay(%)= 17

Singleton Laboratories
General Classification Tests

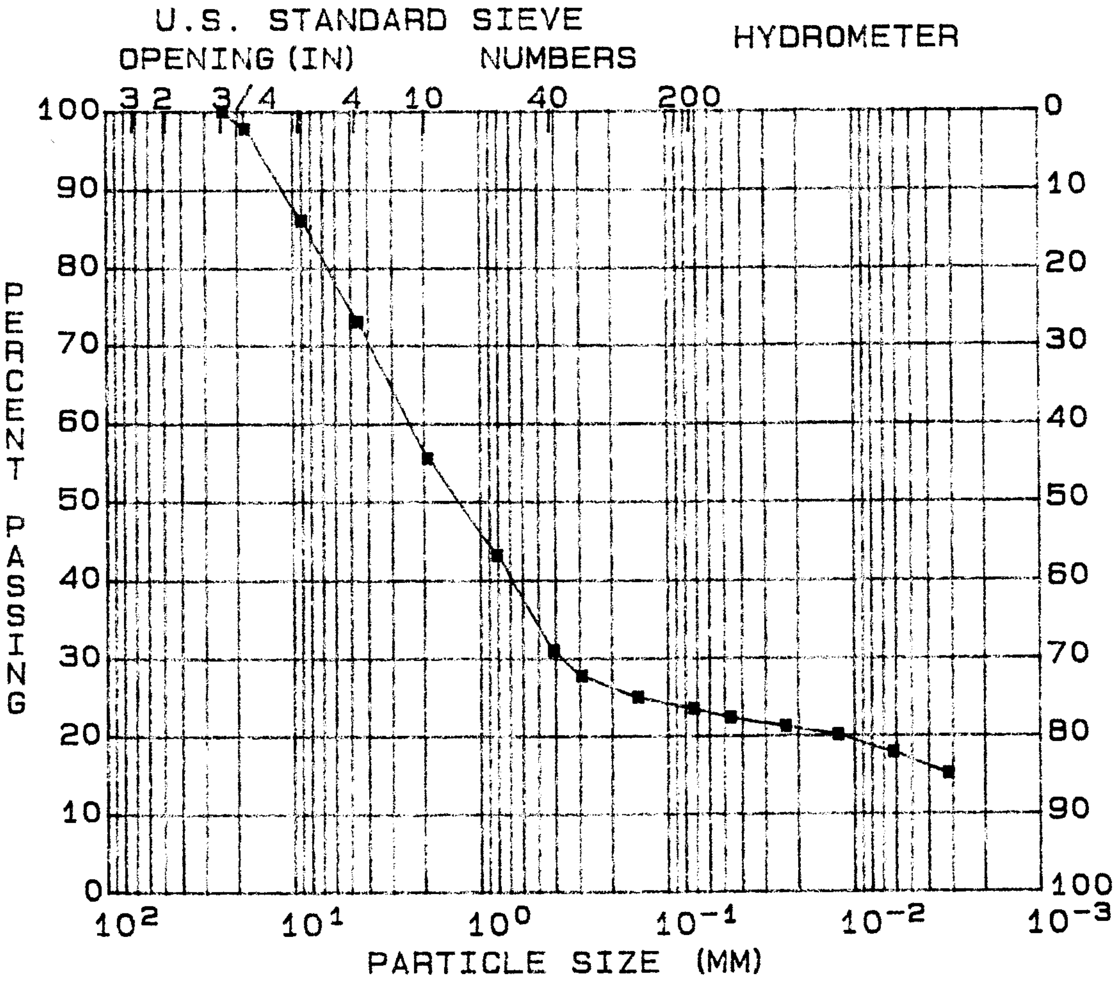
Project: WIDOWS CREEK SP
FILE : 52
Feature: DRY STACKING PHS II
TESTED BY : GPB/CBE
Station:
El. :
Computed By:MHD
Range :
Sample: 1
Checked By : TAL
Boring : US-60
Part : 2
Report Date:02-22-91

Specific Gravity = 2.794
Flask No. = 24.00
Temp.(deg.c.) = 21.00
Soil Wt.(gm) = 25.00
Total Wt.(gm) =692.00
Chunk Density
Wet Wt.+Tare(gm)= 176.4
Sample Wt.(gm) =2970.0
Dry Wt.+Tare(gm)= 159.0
Sa.+ Wt.(air) =3157.0
Tare Wt(gm) = 39.6
SA.+ PA. Wt(Water) =1583.0
Moisture(%) = 14.6
Density(pcf) =118.6
Void Ratio =0.470
Saturation(%) = 86.63

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STACKING PHS II
STATION:
RANGE :
PART : 2

BORING: US-60
EL. :
SAMPLE: 1
DATE : 02-22-91



GRAVEL (%) = 26
SAND (%) = 50
SILT (%) = 7
CLAY (%) = 17

D10 (MM) = 0.0009
D30 (MM) = 0.3653
D60 (MM) = 2.4364
COEF UNIF> 100

SOIL SYMBOL= SC
MOISTURE (%) = 14.6
SP. GR. = 2.73

L.L. (%) = 45
P.I. (%) = 24

DENSITY (pcf) = 118.6
SATURATION (%) = 91.23
VOID RATIO = 0.436

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK SP
Feature: DRY STACKING PHS II
Station:
Range :
Boring : US-60

El. :
Sample: 1
Part : 2

FILE : 48
TESTED BY : GPB/CBE
Computed By:MHD
Checked By : TAL
Report Date:02-22-91

Specific Gravity = 2.729
Flask No. = 23.00
Soil Wt.(gm) = 50.00
Temp.(deg.c.) = 21.00
Total Wt.(gm) =707.34

Chunk Density
Wet Wt.+Tare(gm)= 176.4
Dry Wt.+Tare(gm)= 159.0
Tare Wt(gm) = 39.6
Moisture(%) = 14.6
Void Ratio =0.436
Sample Wt.(gm) =2970.0
Sa.+ Wt.(air) =3157.0
SA.+ PA. Wt(Water) =1583.0
Density(pcf) =118.6
Saturation(%) = 91.23

Moisture Determination
Dry Wt.+Tare(gm)= 786.10
Tare Wt(gm) = 104.00

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 90.80
Tare Wt(gm) = 40.00
Dry Wt.+Tare(gm)= 89.60
Moisture(%) = 2.42

Liquid Limit
Blows = 26.00
Wet Wt.(gm) = 14.02
Dry Wt.(gm) = 10.88
Tare Wt.(gm) = 3.82
Liquid Limit(%) = 44.69
Plasticity Index= 24.30

Plastic Limit
Wet Wt.(gm) = 16.26
Dry Wt.(gm) = 14.15
Tare Wt.(gm) = 3.80
Plastic Limit(%)= 20.39

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 682.1

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	11.0	98.4	19.0500
3/8 in.	91.4	86.6	9.5300
NO.4	180.3	73.6	4.7500
NO.10	300.2	56.0	2.0000
NO.20	10.8	43.6	0.8500
NO.40	21.4	31.4	0.4250
NO.50	24.3	28.1	0.3000
NO.100	26.7	25.4	0.1500
NO.200	28.1	23.8	0.0750

Air Dry Weight(gm)= 50.00
Corrected Weight(gm)= 48.82

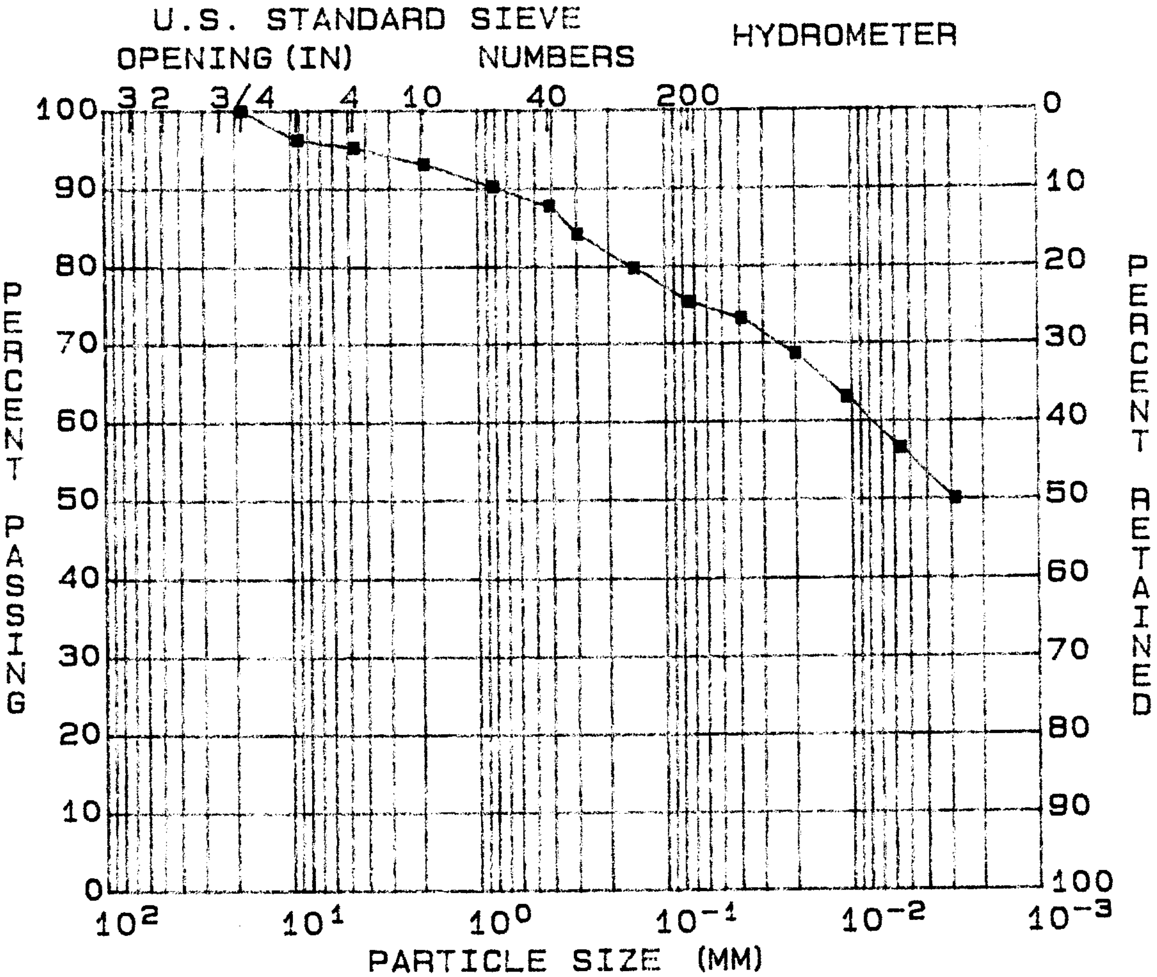
Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	18.1	26.0	6.0	22.5	0.0470
4 min.	18.1	25.0	6.0	21.4	0.0237
15 min.	18.1	24.0	6.0	20.3	0.0123
1 hour	18.1	22.0	6.0	18.0	0.0062
4 hours	18.3	19.5	6.0	15.2	0.0032

Soil Symbol= SC (Clayey sand)
D10(mm) =0.0009
D30(mm)= 0.3653
D60(mm)= 2.4364
Gravel(%)=26
Sand(%)=50
Silt(%)= 7
Clay(%)= 17

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STACKING PHS II
STATION:
RANGE :
PART : all

BORING: US-60
EL. :
SAMPLE: 2
DATE : 02-22-91



GRAVEL (%) = 4
SAND (%) = 20
SILT (%) = 20
CLAY (%) = 56

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= CH
MOISTURE (%) = 26.0
SP. GR. = 2.78

L.L. (%) = 54
P.I. (%) = 32

DENSITY (pcf) = 101.4
SATURATION (%) = 100.00
VOID RATIO = 0.711

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK SP
FILE : 49
Feature: DRY STACKING PHS II
TESTED BY : GPB/CBE
Station:
El. :
Computed By:MHD
Range :
Sample: 2
Checked By : TAL
Boring : US-60
Part : all
Report Date:02-22-91

Specific Gravity = 2.780
Flask No. = 31.00
Temp.(deg.c.) = 21.00
Soil Wt.(gm) = 50.00
Total Wt.(gm) =710.80

Chunk Density
Wet Wt.+Tare(gm)= 178.2
Sample Wt.(gm) =2670.0
Dry Wt.+Tare(gm)= 149.4
Sa.+ Wt.(air) =2850.0
Tare Wt(gm) = 38.8
SA.+ PA. Wt(Water) =1344.0
Moisture(%) = 26.0
Density(pcf) =101.4
Void Ratio =0.711
Saturation(%) =100.00

Moisture Determination
Dry Wt.+Tare(gm)= 548.90
Tare Wt(gm) = 105.30

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 90.70
Dry Wt.+Tare(gm)= 89.00
Tare Wt(gm) = 40.10
Moisture(%) = 3.48

Liquid Limit
Blows = 30.00
Wet Wt.(gm) = 12.79
Dry Wt.(gm) = 9.65
Tare Wt.(gm) = 3.71
Liquid Limit(%) = 54.03
Plasticity Index= 32.43

Plastic Limit
Wet Wt.(gm) = 16.45
Dry Wt.(gm) = 14.21
Tare Wt.(gm) = 3.84
Plastic Limit(%)= 21.60

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 443.6001

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	0.0	100.0	19.0500
3/8 in.	12.9	97.1	9.5300
NO.4	17.4	96.1	4.7500
NO.10	27.1	93.9	2.0000
NO.20	1.5	91.0	0.8500
NO.40	2.8	88.5	0.4250
NO.50	4.7	84.8	0.3000
NO.100	7.0	80.3	0.1500
NO.200	9.3	75.8	0.0750

Air Dry Weight(gm)= 50.00
Corrected Weight(gm)= 48.32

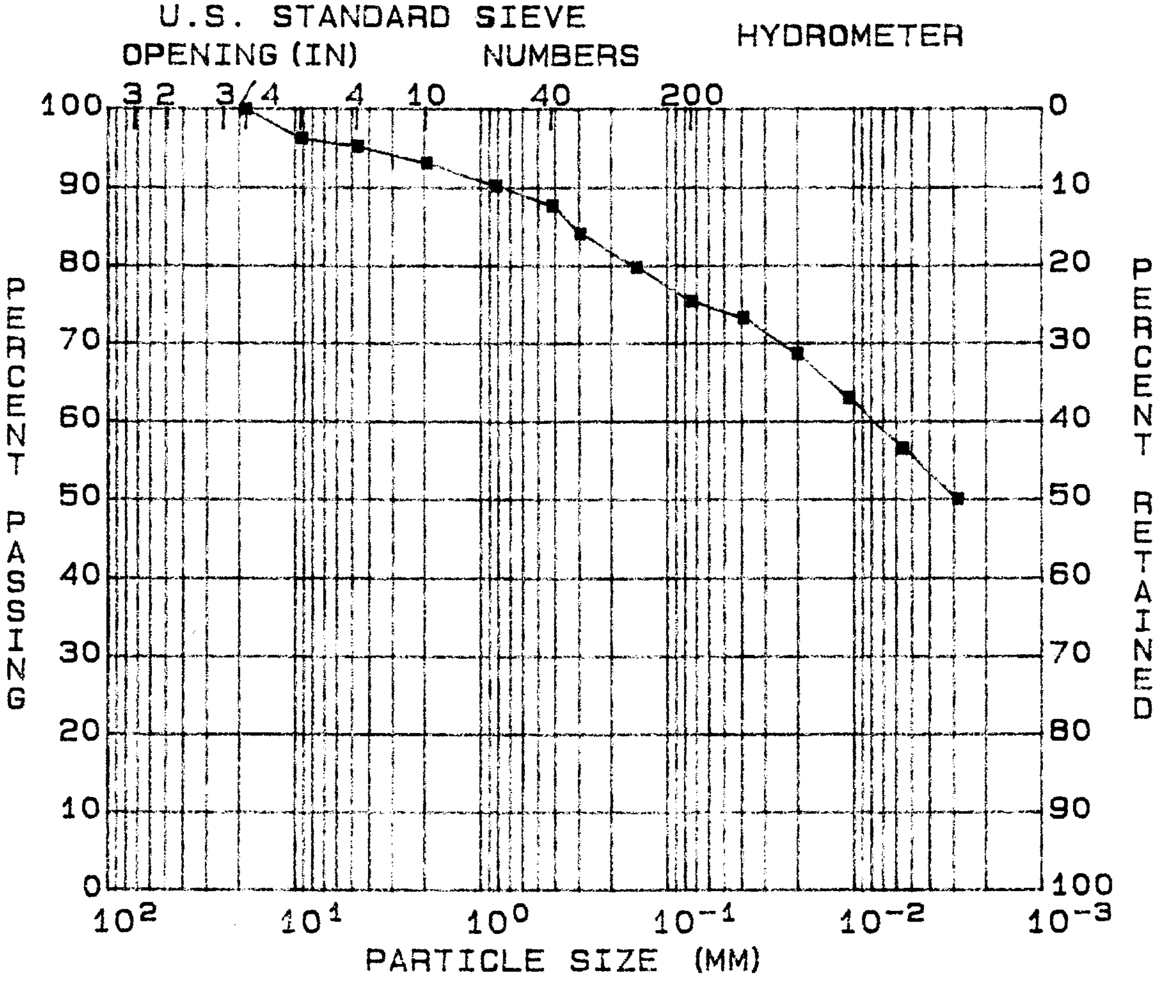
Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	18.1	45.0	6.0	73.7	0.0398
4 min.	18.1	42.5	6.0	69.0	0.0203
15 min.	18.1	39.5	6.0	63.3	0.0108
1 hour	18.1	36.0	6.0	56.7	0.0055
4 hours	18.3	32.5	6.0	50.1	0.0028

Soil Symbol= CH (Inorganic sandy clay of high plasticity)
Gravel(%)= 4
Sand(%)=20
Silt(%)= 20
Clay(%)= 56

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STACKING PHS II
STATION:
RANGE :
PART : all

BORING: US-60
EL. :
SAMPLE: 2
DATE : 02-22-91



GRAVEL (%) = 4
SAND (%) = 20
SILT (%) = 20
CLAY (%) = 56

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= CH
MOISTURE (%) = 26.0
SP. GR. = 2.78

L.L. (%) = 55
P.I. (%) = 33

DENSITY (pcf) = 101.4
SATURATION (%) = 100.00
VOID RATIO = 0.711

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK SP
Feature: DRY STACKING PHS II
Station:
Range :
Boring : US-60

El. :
Sample: 2
Part : all

FILE : 50
TESTED BY : GPB/CBE
Computed By:MHD
Checked By : TAL
Report Date:02-22-91

Specific Gravity = 2.780
Flask No. = 31.00
Temp.(deg.c.) = 21.00
Soil Wt.(gm) = 50.00
Total Wt.(gm) =710.80

Chunk Density
Wet Wt.+Tare(gm)= 178.2
Sample Wt.(gm) =2670.0
Dry Wt.+Tare(gm)= 149.4
Sa.+ Wt.(air) =2850.0
Tare Wt(gm) = 38.8
SA.+ PA. Wt(Water) =1344.0
Moisture(%) = 26.0
Density(pcf) =101.4
Void Ratio =0.711
Saturation(%) =100.00

Moisture Determination
Dry Wt.+Tare(gm)= 548.90
Tare Wt(gm) = 105.30

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 90.70
Dry Wt.+Tare(gm)= 89.00
Tare Wt(gm) = 40.10
Moisture(%) = 3.48

Liquid Limit
Blows = 30.00
Wet Wt.(gm) = 15.81
Dry Wt.(gm) = 11.65
Tare Wt.(gm) = 3.90
Liquid Limit(%) = 54.86
Plasticity Index= 33.26

Plastic Limit
Wet Wt.(gm) = 16.45
Dry Wt.(gm) = 14.21
Tare Wt.(gm) = 3.84

Plastic Limit(%)= 21.60

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 443.6001

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	0.0	100.0	19.0500
3/8 in.	12.9	97.1	9.5300
NO.4	17.4	96.1	4.7500
NO.10	27.1	93.9	2.0000
NO.20	1.5	91.0	0.8500
NO.40	2.8	88.5	0.4250
NO.50	4.7	84.8	0.3000
NO.100	7.0	80.3	0.1500
NO.200	9.3	75.8	0.0750

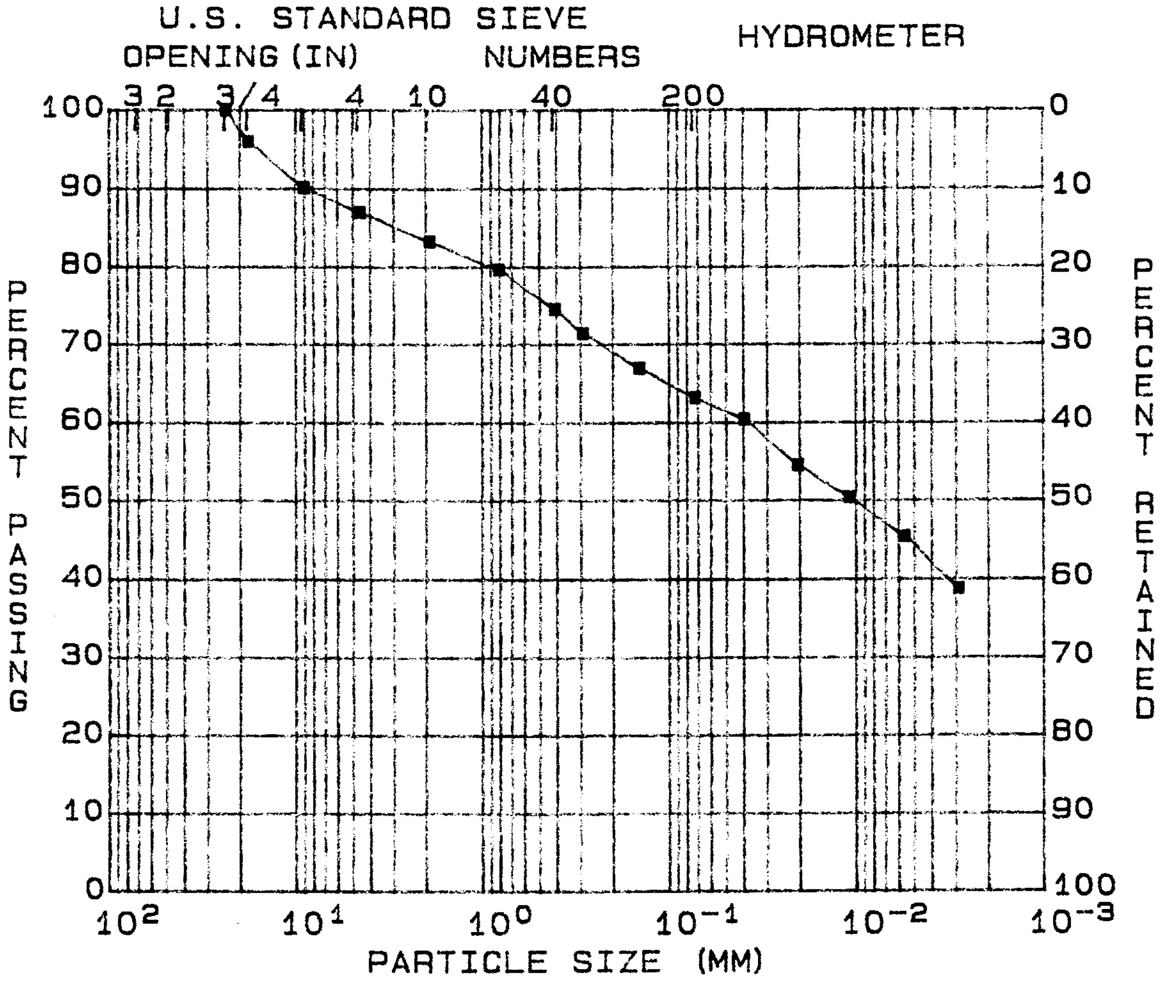
Air Dry Weight(gm)= 50.00
Corrected Weight(gm)= 48.32

Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	18.1	45.0	6.0	73.7	0.0398
4 min.	18.1	42.5	6.0	69.0	0.0203
15 min.	18.1	39.5	6.0	63.3	0.0108
1 hour	18.1	36.0	6.0	56.7	0.0055
4 hours	18.3	32.5	6.0	50.1	0.0028

Soil Symbol= CH (Inorganic sandy clay of high plasticity)
Gravel(%)= 4
Sand(%)=20
Silt(%)= 20
Clay(%)= 56

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT:	WIDOWS CREEK SP	BORING:	US-65
FEATURE:	DRY STACKING PHS II	EL. :	
STATION:		SAMPLE:	1
RANGE :		DATE :	02-22-91
PART :	3		



GRAVEL (%) = 12
SAND (%) = 24
SILT (%) = 19
CLAY (%) = 45

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= CH
MOISTURE (%) = --
SP. GR. = 2.80

L.L. (%) = 53
P.I. (%) = 28

DENSITY (pcf) = --
SATURATION (%) = --
VOID RATIO = --

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK SP
Feature: DRY STACKING PHS II
Station:
Range :
Boring : US-65

El. :
Sample: 1
Part : 3

FILE : 54
TESTED BY : GPB/CBE
Computed By:MHD
Checked By : TAL
Report Date:02-22-91

Specific Gravity = 2.805
Flask No. = 33.00
Soil Wt.(gm) = 50.00
Temp.(deg.c.) = 21.00
Total Wt.(gm) =709.20

Moisture Determination
Dry Wt.+Tare(gm)= 502.00
Tare Wt(gm) = 67.90

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 89.90
Tare Wt(gm) = 39.20
Dry Wt.+Tare(gm)= 88.00
Moisture(%) = 3.89

Liquid Limit
Blows = 28.00
Wet Wt.(gm) = 14.99
Dry Wt.(gm) = 11.21
Tare Wt.(gm) = 4.02
Liquid Limit(%) = 53.29
Plasticity Index= 28.23

Plastic Limit
Wet Wt.(gm) = 18.13
Dry Wt.(gm) = 15.33
Tare Wt.(gm) = 4.16
Plastic Limit(%)= 25.07

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 434.1

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	13.6	96.9	19.0500
3/8 in.	39.4	90.9	9.5300
NO.4	53.0	87.8	4.7500
NO.10	69.8	83.9	2.0000
NO.20	2.1	80.3	0.8500
NO.40	5.1	75.0	0.4250
NO.50	6.9	71.9	0.3000
NO.100	9.5	67.4	0.1500
NO.200	11.7	63.5	0.0750

Air Dry Weight(gm)= 50.00
Corrected Weight(gm)= 48.13

Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	18.1	42.0	6.0	60.7	0.0406
4 min.	18.1	38.5	6.0	54.8	0.0209
15 min.	18.1	36.0	6.0	50.6	0.0110
1 hour	18.1	33.0	6.0	45.6	0.0056
4 hours	18.3	29.0	6.0	38.8	0.0029

Soil Symbol= CH (Inorganic gravelly clay of high plasticity)
Gravel(%)=12 Sand(%)=24 Silt(%)= 19 Clay(%)= 45

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK SP
Feature: DRY STACKING PHS II
Station:
Range :
Boring : US-65

El. :
Sample: 1
Part : 3

FILE : 53
TESTED BY : GPB/CBE
Computed By:MHD
Checked By : TA
Report Date:02-22-91

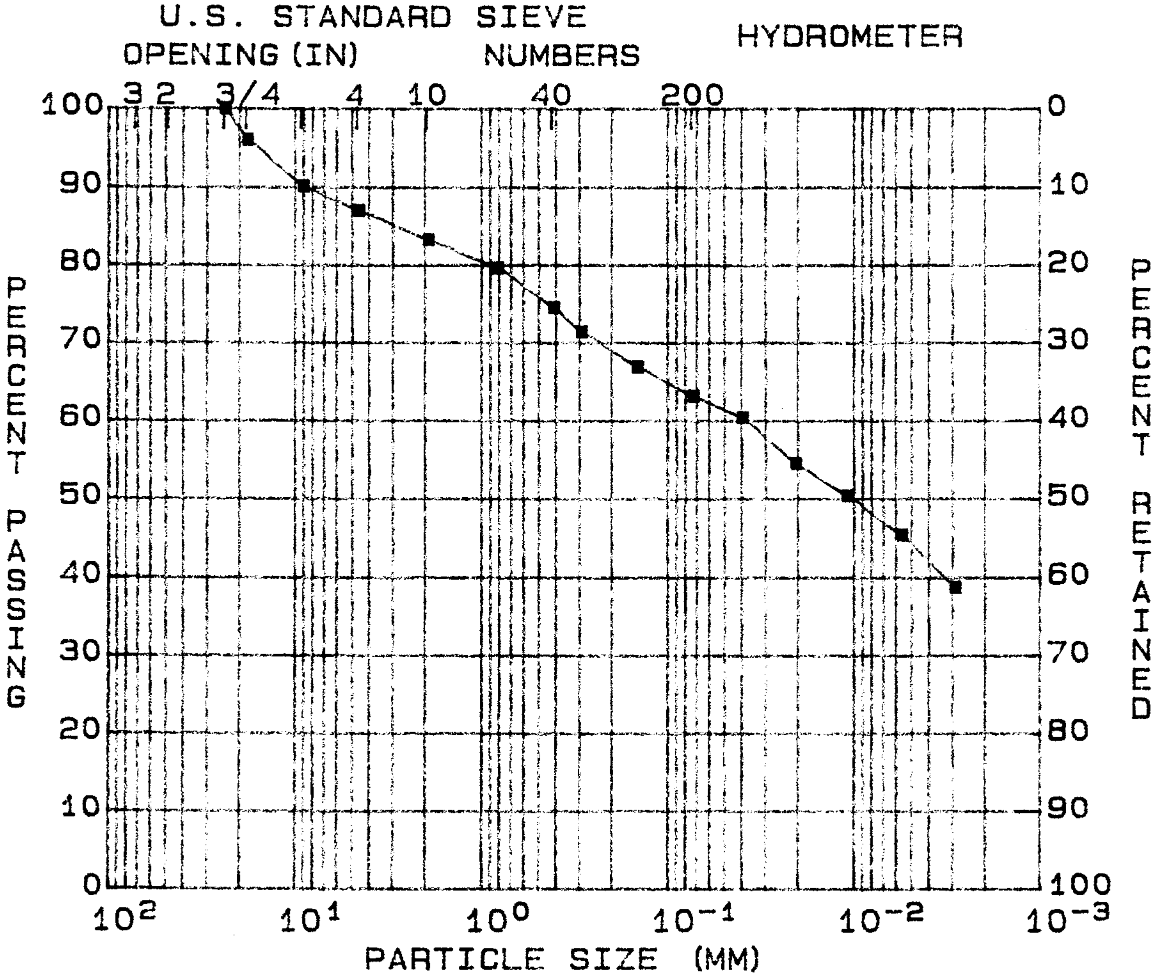
Specific Gravity = 2.749

Flask No. = 34.00
Soil Wt.(gm) = 50.00
Temp.(deg.c.) = 21.00
Total Wt.(gm) =710.54

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STACKING PHS II
STATION:
RANGE :
PART : 3

BORING: US-65
EL. :
SAMPLE: 1
DATE : 02-22-91



GRAVEL (%) = 12
SAND (%) = 24
SILT (%) = 19
CLAY (%) = 45

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= CH
MOISTURE (%) = --
SP. GR. = 2.80

L.L. (%) = 53
P.I. (%) = 28

DENSITY (pcf) = --
SATURATION (%) = --
VOID RATIO = --

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK SP
Feature: DRY STACKING PHS II
Station:
Range :
Boring : US-65

El. :
Sample: 1
Part : 3

FILE : 53
TESTED BY : GPB/CBE
Computed By:MHD
Checked By : TAC
Report Date:02-22-91

Specific Gravity = 2.805
Flask No. = 33.00
Temp.(deg.c.) = 21.00
Soil Wt.(gm) = 50.00
Total Wt.(gm) =709.20

Moisture Determination
Dry Wt.+Tare(gm)= 502.00
Tare Wt(gm) = 67.90

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 89.90
Dry Wt.+Tare(gm)= 88.00
Tare Wt(gm) = 39.20
Moisture(%) = 3.89

Liquid Limit
Blows = 28.00
Wet Wt.(gm) = 17.37
Dry Wt.(gm) = 12.76
Tare Wt.(gm) = 4.00
Liquid Limit(%) = 53.35
Plasticity Index= 28.28

Plastic Limit
Wet Wt.(gm) = 18.13
Dry Wt.(gm) = 15.33
Tare Wt.(gm) = 4.16
Plastic Limit(%)= 25.07

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 434.1

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	13.6	96.9	19.0500
3/8 in.	39.4	90.9	9.5300
NO.4	53.0	87.8	4.7500
NO.10	69.8	83.9	2.0000
NO.20	2.1	80.3	0.8500
NO.40	5.1	75.0	0.4250
NO.50	6.9	71.9	0.3000
NO.100	9.5	67.4	0.1500
NO.200	11.7	63.5	0.0750

Air Dry Weight(gm)= 50.00
Corrected Weight(gm)= 48.13

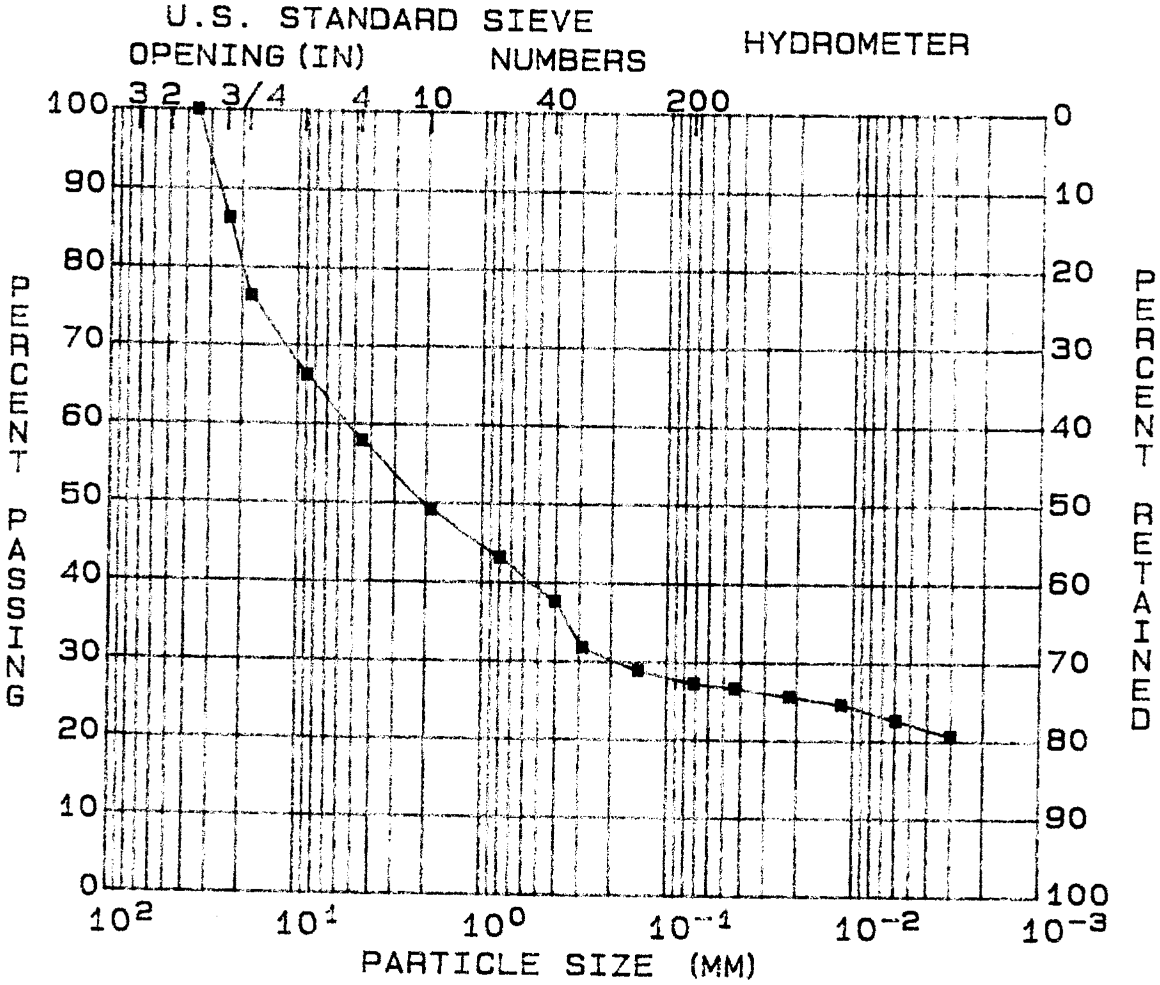
Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	18.1	42.0	6.0	60.7	0.0406
4 min.	18.1	38.5	6.0	54.8	0.0209
15 min.	18.1	36.0	6.0	50.6	0.0110
1 hour	18.1	33.0	6.0	45.6	0.0056
4 hours	18.3	29.0	6.0	38.8	0.0029

Soil Symbol= CH (inorganic gravelly clay of high plasticity)
Gravel(%)=12 Sand(%)=24 Silt(%)= 19 Clay(%)= 45

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STACKING PHS II
STATION:
RANGE :
PART : 1

BORING: US-66
EL. :
SAMPLE: 1
DATE : 02-22-91



GRAVEL (%) = 41
SAND (%) = 31
SILT (%) = 5
CLAY (%) = 23

D10 (MM) = 0.0001
D30 (MM) = 0.1806
D60 (MM) = 5.3796
COEF UNIF> 100

SOIL SYMBOL= GC
MOISTURE (%) = 19.1
SP. GR. = 2.74

L.L. (%) = 64
P.I. (%) = 45

DENSITY (pcf) = 110.3
SATURATION (%) = 95.37
VOID RATIO = 0.547

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK SP
Feature: DRY STACKING PHS II
Station:
Range :
Boring : US-66

El. :
Sample: 1
Part : 1

FILE : 55
TESTED BY : GPB/CBE
Computed By:MHD
Checked By : TAL
Report Date:02-22-91

Specific Gravity = 2.647
Flask No. = 17.00
Soil Wt.(gm) = 15.00
Temp.(deg.c.) = 21.00
Total Wt.(gm) =683.73

Chunk Density
Wet Wt.+Tare(gm)= 169.7
Dry Wt.+Tare(gm)= 148.6
Tare Wt(gm) = 38.0
Moisture(%) = 19.1
Void Ratio =0.497
Sample Wt.(gm) =3020.0
Sa.+ Wt.(air) =3227.0
SA.+ PA. Wt(Water) =1560.0
Density(pcf) =110.3
Saturation(%) =100.00

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK SP
Feature: DRY STACKING PHS II
Station:
Range :
Boring : US-66

El. :
Sample: 1
Part : 1

FILE : 56
TESTED BY : GPB/CBE
Computed By:MHD
Checked By : TAL
Report Date:02-22-91

Specific Gravity = 2.736
Flask No. = 35.00
Soil Wt.(gm) = 50.00
Temp.(deg.c.) = 21.00
Total Wt.(gm) =711.00

Chunk Density
Wet Wt.+Tare(gm)= 169.7
Dry Wt.+Tare(gm)= 148.6
Tare Wt(gm) = 38.0
Moisture(%) = 19.1
Void Ratio =0.547
Sample Wt.(gm) =3020.0
Sa.+ Wt.(air) =3227.0
SA.+ PA. Wt(Water) =1560.0
Density(pcf) =110.3
Saturation(%) = 95.37

Moisture Determination
Dry Wt.+Tare(gm)= 695.00
Tare Wt(gm) = 67.40

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 90.00
Tare Wt(gm) = 39.30
Dry Wt.+Tare(gm)= 88.20
Moisture(%) = 3.68

Liquid Limit
Blows = 28.00
Wet Wt.(gm) = 13.37
Dry Wt.(gm) = 9.80
Tare Wt.(gm) = 4.14
Liquid Limit(%) = 63.94
Plasticity Index= 44.54

Plastic Limit
Wet Wt.(gm) = 17.97
Dry Wt.(gm) = 15.70
Tare Wt.(gm) = 4.00
Plastic Limit(%)= 19.40

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 627.6

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	81.3	87.0	25.4000
3/4 in.	144.5	77.0	19.0500
3/8 in.	208.5	66.8	9.5300
NO.4	260.3	58.5	4.7500
NO.10	315.6	49.7	2.0000
NO.20	5.9	43.6	0.8500
NO.40	11.3	38.1	0.4250
NO.50	17.0	32.2	0.3000
NO.100	19.9	29.2	0.1500
NO.200	21.5	27.5	0.0750

Air Dry Weight(gm)= 50.00
Corrected Weight(gm)= 48.22

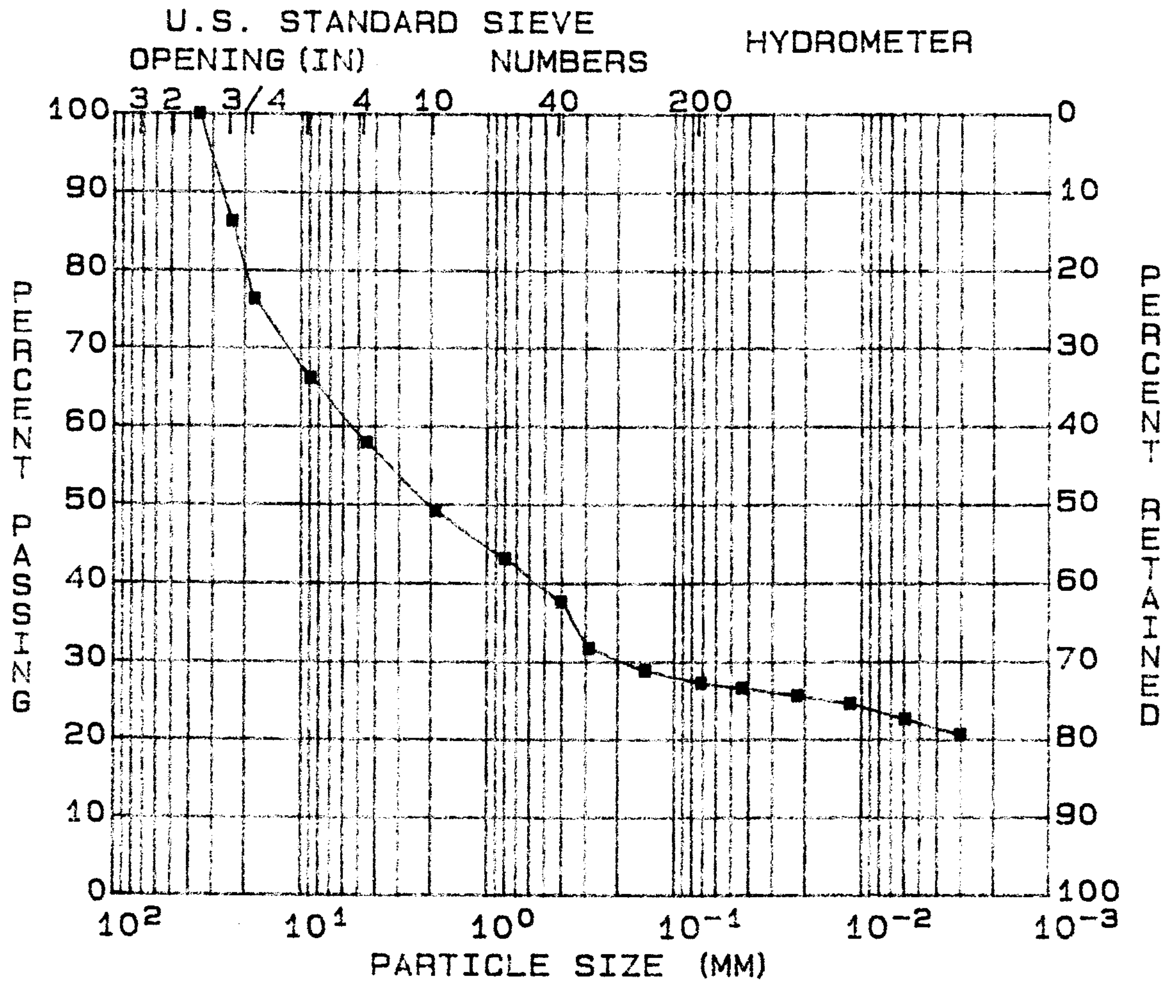
Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	18.1	32.5	6.0	26.8	0.0447
4 min.	18.1	31.5	6.0	25.8	0.0225
15 min.	18.1	30.5	6.0	24.8	0.0117
1 hour	18.1	28.5	6.0	22.8	0.0059
4 hours	18.3	26.5	6.0	20.7	0.0030

Soil Symbol= GC (Sandy clayey gravel)
D10(mm) =0.0001
D30(mm)= 0.1806
D60(mm)= 5.3796
Gravel(%)=41
Sand(%)=31
Silt(%)= 5
Clay(%)= 23

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STACKING PHS II
STATION:
RANGE :
PART : 1

BORING: US-66
EL. :
SAMPLE: 1
DATE : 02-22-91



GRAVEL (%) = 41
SAND (%) = 31
SILT (%) = 5
CLAY (%) = 23

D10 (MM) = 0.0001
D30 (MM) = 0.1806
D60 (MM) = 5.3796
COEF UNIF> 100

SOIL SYMBOL= GC
MOISTURE (%) = 19.1
SP. GR. = 2.74

L.L. (%) = 65
P.I. (%) = 46

DENSITY (pcf) = 110.3
SATURATION (%) = 95.37
VOID RATIO = 0.547

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK SP		FILE : 55
Feature: DRY STACKING PHS II		TESTED BY : GPB/CBE
Station:	El. :	Computed By:MHD
Range :	Sample: 1	Checked By : TAL
Boring : US-66	Part : 1	Report Date:02-22-91

Specific Gravity = 2.736

Flask No.	= 35.00	Temp.(deg.c.)	= 21.00
Soil Wt.(gm)	= 50.00	Total Wt.(gm)	=711.00

Chunk Density

Wet Wt.+Tare(gm)	= 169.7	Sample Wt.(gm)	=3020.0
Dry Wt.+Tare(gm)	= 148.6	Sa.+ Wt.(air)	=3227.0
Tare Wt(gm)	= 38.0	SA.+ PA. Wt(Water)	=1560.0
Moisture(%)	= 19.1	Density(pcf)	=110.3
Void Ratio	=0.547	Saturation(%)	= 95.37

Moisture Determination

Dry Wt.+Tare(gm)	= 695.00	Tare Wt(gm)	= 67.40

Hygroscopic Moisture

Wet Wt.+Tare(gm)	= 90.00	Dry Wt.+Tare(gm)	= 88.20
Tare Wt(gm)	= 39.30	Moisture(%)	= 3.68

Liquid Limit		Plastic Limit	
Blows	= 28.00	Wet Wt.(gm)	= 17.97
Wet Wt.(gm)	= 13.60	Dry Wt.(gm)	= 15.70
Dry Wt.(gm)	= 9.85	Tare Wt.(gm)	= 4.00
Tare Wt.(gm)	= 4.00		
Liquid Limit(%)	= 64.98	Plastic Limit(%)	= 19.40
Plasticity Index	= 45.58		

Sieve and Hydrometer Analysis

Total Dry Weight(gm) = 627.6

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	81.3	87.0	25.4000
3/4 in.	144.5	77.0	19.0500
3/8 in.	208.5	66.8	9.5300
NO.4	260.3	58.5	4.7500
NO.10	315.6	49.7	2.0000
NO.20	5.9	43.6	0.8500
NO.40	11.3	38.1	0.4250
NO.50	17.0	32.2	0.3000
NO.100	19.9	29.2	0.1500
NO.200	21.5	27.5	0.0750

Air Dry Weight(gm)= 50.00 Corrected Weight(gm)= 48.22

Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	18.1	32.5	6.0	26.8	0.0447
4 min.	18.1	31.5	6.0	25.8	0.0225
15 min.	18.1	30.5	6.0	24.8	0.0117
1 hour	18.1	28.5	6.0	22.8	0.0059
4 hours	18.3	26.5	6.0	20.7	0.0030

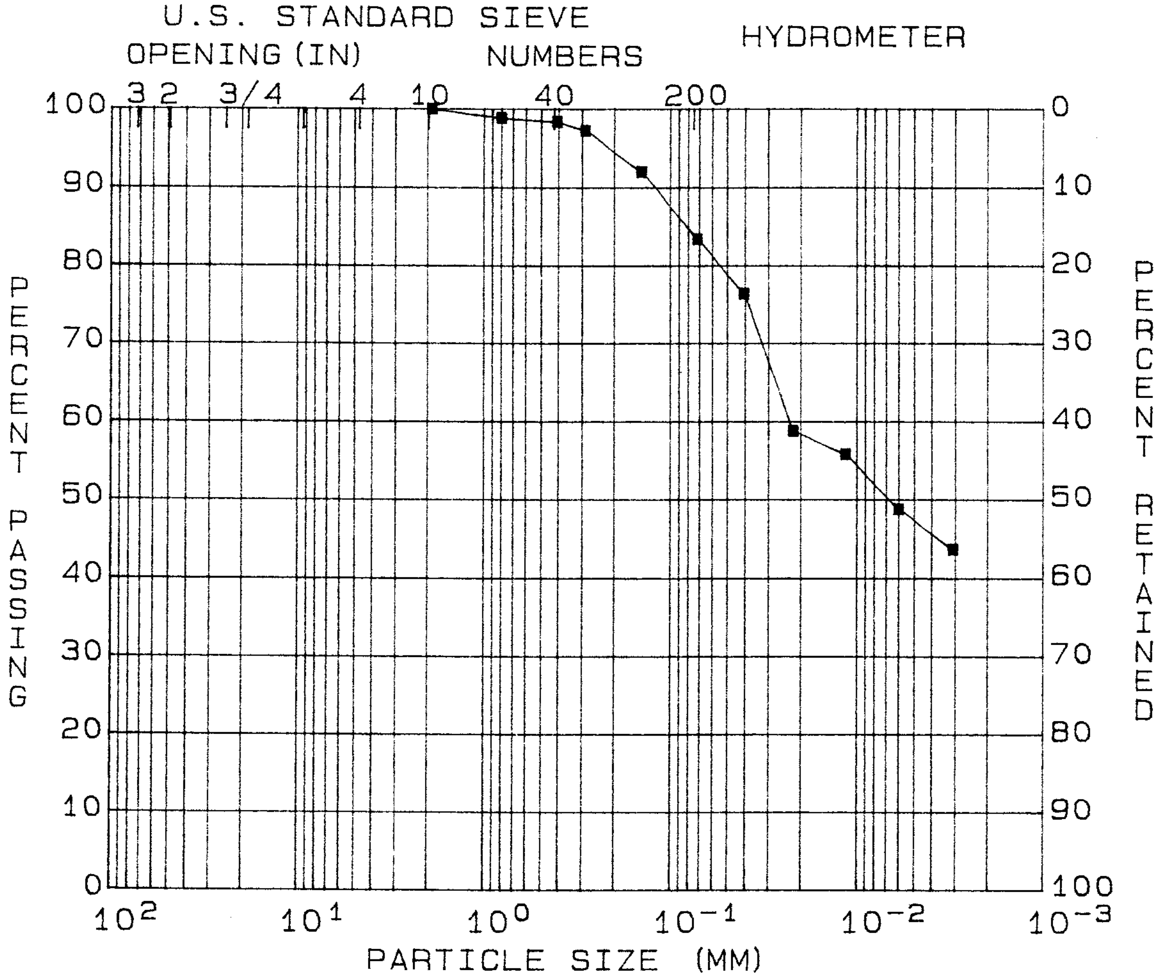
Soil Symbol= GC (Sandy clayey gravel)

D10(mm) =0.0001	D30(mm)= 0.1806	D60(mm)= 5.3796	
Gravel(%)=41	Sand(%)=31	Silt(%)= 5	Clay(%)= 23

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STACKING PHS II
STATION:
RANGE :
PART : 1

BORING: US-73
EL. :
SAMPLE: 1
DATE : 02-26-91



GRAVEL (%) = 0
SAND (%) = 16
SILT (%) = 36
CLAY (%) = 48

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= ML/CL
MOISTURE (%) = 22.7
SP. GR. = 2.66

L.L. (%) = 46
P.I. (%) = 18

DENSITY (pcf) = 102.7
SATURATION (%) = 98.21
VOID RATIO = 0.615

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK SP
Feature: DRY STACKING PHS II
Station:
Range :
Boring : US-73

El. :
Sample: 1
Part : 1

FILE : 59
TESTED BY : TAL/CBE
Computed By:MHD
Checked By : TAL
Report Date:02-26-91

Specific Gravity = 2.659
Flask No. = 9.00
Soil Wt.(gm) = 50.00
Temp.(deg.c.) = 18.70
Total Wt.(gm) =707.40

Chunk Density
Wet Wt.+Tare(gm)= 146.8
Dry Wt.+Tare(gm)= 126.8
Tare Wt(gm) = 38.8
Moisture(%) = 22.7
Void Ratio =0.615
Sample Wt.(gm) =2370.0
Sa.+ Wt.(air) =2546.0
SA.+ PA. Wt(Water) =1175.0
Density(pcf) =102.7
Saturation(%) = 98.21

Moisture Determination
Dry Wt.+Tare(gm)= 341.50
Tare Wt(gm) = 68.80

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 76.90
Tare Wt(gm) = 38.00
Dry Wt.+Tare(gm)= 75.70
Moisture(%) = 3.18

Liquid Limit
Blows = 22.00
Wet Wt.(gm) = 12.65
Dry Wt.(gm) = 9.92
Tare Wt.(gm) = 4.07
Liquid Limit(%) = 45.96
Plasticity Index= 18.04

Plastic Limit
Wet Wt.(gm) = 15.20
Dry Wt.(gm) = 12.76
Tare Wt.(gm) = 4.02
Plastic Limit(%)= 27.92

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 272.7

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	0.0	100.0	19.0500
3/8 in.	0.0	100.0	9.5300
NO.4	0.0	100.0	4.7500
NO.10	0.0	100.0	2.0000
NO.20	0.2	99.6	0.8500
NO.40	0.5	99.0	0.4250
NO.50	1.1	97.7	0.3000
NO.100	3.7	92.4	0.1500
NO.200	7.9	83.7	0.0750

Air Dry Weight(gm)= 50.00
Corrected Weight(gm)= 48.46

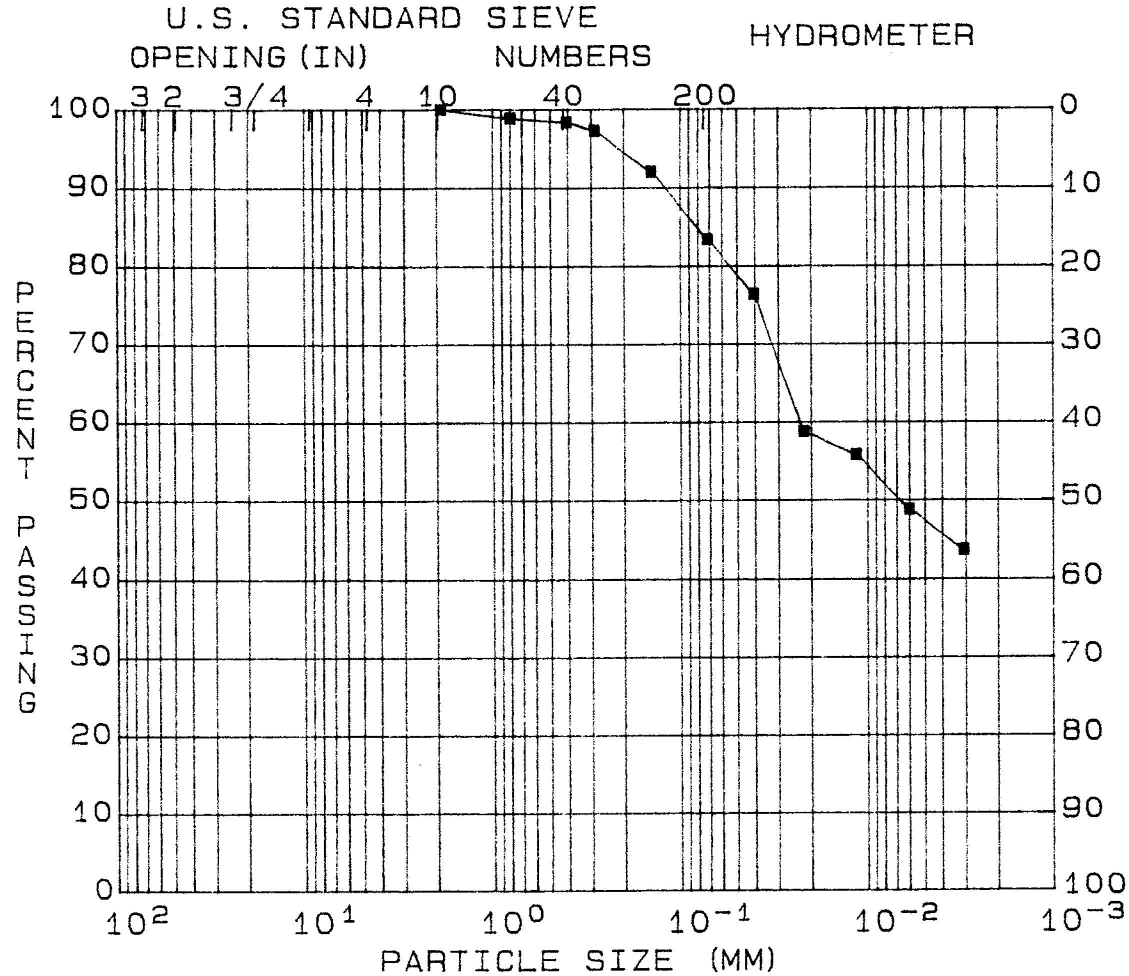
Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	17.0	44.2	7.0	76.6	0.0421
4 min.	17.0	35.6	7.0	58.9	0.0227
15 min.	17.0	34.0	6.9	55.8	0.0118
1 hour	17.0	30.6	6.9	48.8	0.0061
4 hours	17.2	28.0	6.8	43.7	0.0031

Soil Symbol= ML/CL (Inorganic clayey silt)
Gravel(%)= 0
Sand(%)=16
Silt(%)= 36
Clay(%)= 48

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STACKING PHS II
STATION:
RANGE :
PART : 1

BORING: US-73
EL. :
SAMPLE: 1
DATE : 02-26-91



GRAVEL (%) = 0
SAND (%) = 16
SILT (%) = 36
CLAY (%) = 48

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= ML/CL
MOISTURE (%) = 22.7
SP. GR. = 2.66

L.L. (%) = 46
P.I. (%) = 18

DENSITY (pcf) = 102.7
SATURATION (%) = 98.21
VOID RATIO = 0.615

REMARKS:

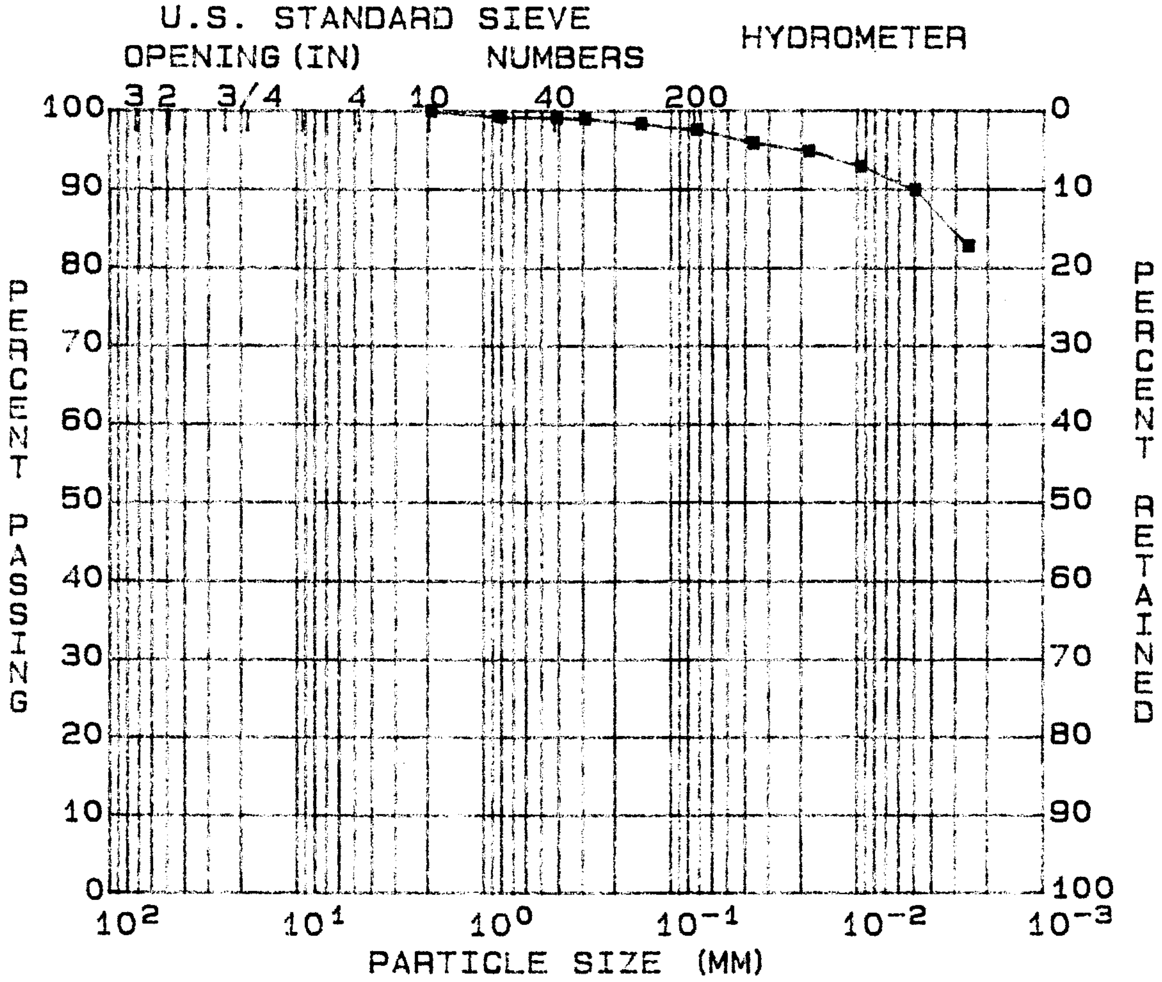
Singleton Laboratories
General Classification Tests

```
Project: WIDOWS CREEK SP                                   FILE : 60
Feature: DRY STACKING PHS II                               TESTED BY : TAL/CBE
Station:                        El.   :                    Computed By:MHD
Range  :                        Sample: 1                  Checked By : TAL
Boring : US-73                  Part  : 1                  Report Date:02-26-91

Specific Gravity =  2.659
 Flask No.       =  9.00         Temp.(deg.c.)    = 18.70
 Soil Wt.(gm)    = 50.00         Total Wt.(gm)    =707.40
Chunk Density
 Wet Wt.+Tare(gm)= 146.8         Sample Wt.(gm)      =2370.0
 Dry Wt.+Tare(gm)= 126.8         Sa.+ Wt.(air)       =2546.0
 Tare Wt(gm)     =  38.8         SA.+ PA. Wt(Water) =1175.0
 Moisture(%)     = 22.7          Density(pcf)     =102.7
 Void Ratio      =0.615          Saturation(%)    = 98.21
Moisture Determination
 Dry Wt.+Tare(gm)=  341.50       Tare Wt(gm)      =  68.80
Hygroscopic Moisture
 Wet Wt.+Tare(gm)=   76.90       Dry Wt.+Tare(gm)=  75.70
 Tare Wt(gm)     =   38.00       Moisture(%)     =   3.18
Liquid Limit                      Plastic Limit
 Blows           = 22.00            Wet Wt.(gm)      = 15.20
 Wet Wt.(gm)     = 15.54            Dry Wt.(gm)      = 12.76
 Dry Wt.(gm)     = 11.86            Tare Wt.(gm)     =  4.02
 Tare Wt.(gm)    =  4.03
 Liquid Limit(%) = 46.28            Plastic Limit(%)= 27.92
 Plasticity Index= 18.37
Sieve and Hydrometer Analysis
 Total Dry Weight(gm) = 272.7
 Sieve     Wt.Ret.    % Pass.    Size(mm)
 3   in.     0.0      100.0      76.2000
 2   in.     0.0      100.0      50.8000
 1.5 in.     0.0      100.0      38.1000
 1   in.     0.0      100.0      25.4000
 3/4 in.     0.0      100.0      19.0500
 3/8 in.     0.0      100.0       9.5300
 NO.4        0.0      100.0       4.7500
 NO.10       0.0      100.0       2.0000
 NO.20       0.2       99.6       0.8500
 NO.40       0.5       99.0       0.4250
 NO.50       1.1       97.7       0.3000
 NO.100      3.7       92.4       0.1500
 NO.200      7.9       83.7       0.0750
 Air Dry Weight(gm)= 50.00       Corrected Weight(gm)= 48.46
 Time        Temp.     Hyd.Rdg    Corr      % Pass    Size(mm)
 1 min.      17.0       44.2      7.0       76.6      0.0421
 4 min.      17.0       35.6      7.0       58.9      0.0227
 15 min.     17.0       34.0      6.9       55.8      0.0118
 1 hour      17.0       30.6      6.9       48.8      0.0061
 4 hours     17.2       28.0      6.8       43.7      0.0031

 Soil Symbol= ML/CL (Inorganic clayey silt)
 Gravel(%)= 0         Sand(%)=16          Silt(%)= 36          Clay(%)= 48
```

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STACKING PHS II
STATION:
RANGE :
PART : 2

BORING: US-73
EL. :
SAMPLE: 2
DATE : 02-22-91



GRAVEL (%) = 0
SAND (%) = 2
SILT (%) = 8
CLAY (%) = 90

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= CH
MOISTURE (%) = 29.0
SP. GR. = 2.74

L.L. (%) = 85
P.I. (%) = 57

DENSITY (pcf) = 92.9
SATURATION (%) = 94.78
VOID RATIO = 0.839

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK SP
Feature: DRY STACKING PHS II
Station:
Range :
Boring : US-73

El. :
Sample: 2
Part : 2

FILE : 57
TESTED BY : GPB/CBE
Computed By:MHD
Checked By : TA
Report Date:02-22-91

Specific Gravity = 2.738
Flask No. = 28.00
Soil Wt.(gm) = 50.00
Temp.(deg.c.) = 21.00
Total Wt.(gm) =701.73

Chunk Density
Wet Wt.+Tare(gm)= 133.2
Dry Wt.+Tare(gm)= 112.1
Tare Wt(gm) = 39.4
Moisture(%) = 29.0
Void Ratio =0.839
Sample Wt.(gm) =3108.0
Sa.+ Wt.(air) =3291.0
SA.+ PA. Wt(Water) =1468.0
Density(pcf) = 92.9
Saturation(%) = 94.78

Moisture Determination
Dry Wt.+Tare(gm)= 357.40
Tare Wt(gm) = 107.60

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 72.40
Tare Wt(gm) = 38.40
Dry Wt.+Tare(gm)= 71.00
Moisture(%) = 4.29

Liquid Limit
Blows = 22.00
Wet Wt.(gm) = 14.14
Dry Wt.(gm) = 9.46
Tare Wt.(gm) = 4.03
Liquid Limit(%) = 84.88
Plasticity Index= 56.87

Plastic Limit
Wet Wt.(gm) = 15.56
Dry Wt.(gm) = 13.02
Tare Wt.(gm) = 3.95
Plastic Limit(%)= 28.00

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 249.8

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	0.0	100.0	19.0500
3/8 in.	0.0	100.0	9.5300
NO.4	0.0	100.0	4.7500
NO.10	0.0	100.0	2.0000
NO.20	0.1	99.8	0.8500
NO.40	0.2	99.6	0.4250
NO.50	0.3	99.4	0.3000
NO.100	0.6	98.7	0.1500
NO.200	1.0	97.9	0.0750

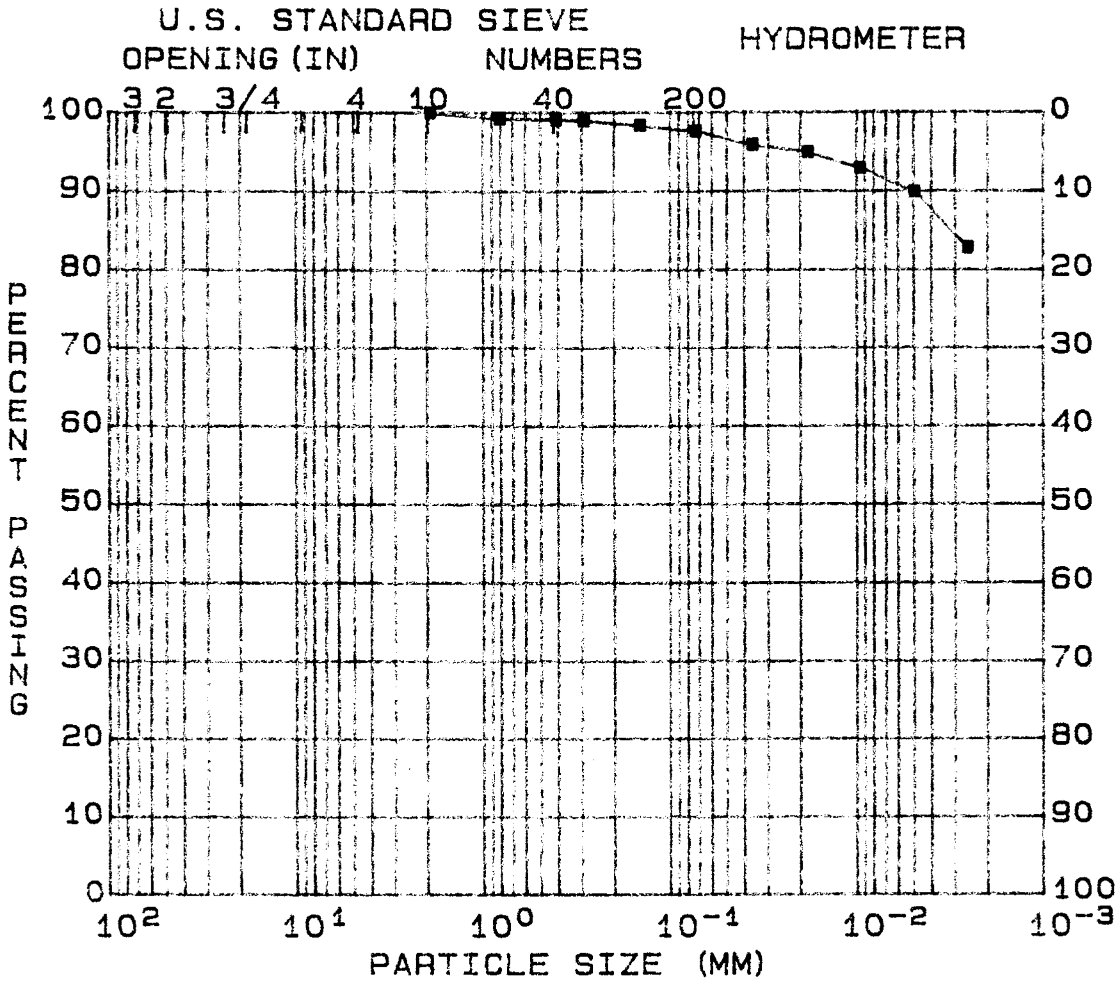
Air Dry Weight(gm)= 50.00
Corrected Weight(gm)= 47.94

Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	18.1	53.0	6.0	96.2	0.0371
4 min.	18.1	52.5	6.0	95.1	0.0187
15 min.	18.1	51.5	6.0	93.1	0.0097
1 hour	18.1	50.0	6.0	90.0	0.0049
4 hours	18.3	46.5	6.0	82.9	0.0026

Soil Symbol= CH (Inorganic clay of high plasticity)
Gravel(%)= 0
Sand(%)= 2
Silt(%)= 8
Clay(%)= 90

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT:	WIDOWS CREEK SP	BORING:	US-73
FEATURE:	DRY STACKING PHS II	EL. :	
STATION:		SAMPLE:	2
RANGE :		DATE :	02-22-91
PART :	2		



GRAVEL (%) = 0
SAND (%) = 2
SILT (%) = 8
CLAY (%) = 90

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= CH
MOISTURE (%) = 29.0
SP. GR. = 2.74

L.L. (%) = 85
P.I. (%) = 57

DENSITY (pcf) = 92.9
SATURATION (%) = 94.78
VOID RATIO = 0.839

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK SP
Feature: DRY STACKING PHS II
Station:
Range :
Boring : US-73

El. :
Sample: 2
Part : 2

FILE : 58
TESTED BY : GPB/CBE
Computed By:MHD
Checked By : TAL
Report Date:02-22-91

Specific Gravity = 2.738
Flask No. = 28.00 Temp.(deg.c.) = 21.00
Soil Wt.(gm) = 50.00 Total Wt.(gm) =701.73

Chunk Density
Wet Wt.+Tare(gm)= 133.2 Sample Wt.(gm) =3108.0
Dry Wt.+Tare(gm)= 112.1 Sa.+ Wt.(air) =3291.0
Tare Wt(gm) = 39.4 SA.+ PA. Wt(Water) =1468.0
Moisture(%) = 29.0 Density(pcf) = 92.9
Void Ratio =0.839 Saturation(%) = 94.78

Moisture Determination
Dry Wt.+Tare(gm)= 357.40 Tare Wt(gm) = 107.60

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 72.40 Dry Wt.+Tare(gm)= 71.00
Tare Wt(gm) = 38.40 Moisture(%) = 4.29

Liquid Limit
Blows = 22.00
Wet Wt.(gm) = 13.14
Dry Wt.(gm) = 8.94
Tare Wt.(gm) = 4.05
Liquid Limit(%) = 84.58
Plasticity Index= 56.58

Plastic Limit
Wet Wt.(gm) = 15.56
Dry Wt.(gm) = 13.02
Tare Wt.(gm) = 3.95

Plastic Limit(%)= 28.00

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 249.8

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	0.0	100.0	19.0500
3/8 in.	0.0	100.0	9.5300
NO.4	0.0	100.0	4.7500
NO.10	0.0	100.0	2.0000
NO.20	0.1	99.8	0.8500
NO.40	0.2	99.6	0.4250
NO.50	0.3	99.4	0.3000
NO.100	0.6	98.7	0.1500
NO.200	1.0	97.9	0.0750

Air Dry Weight(gm)= 50.00 Corrected Weight(gm)= 47.94

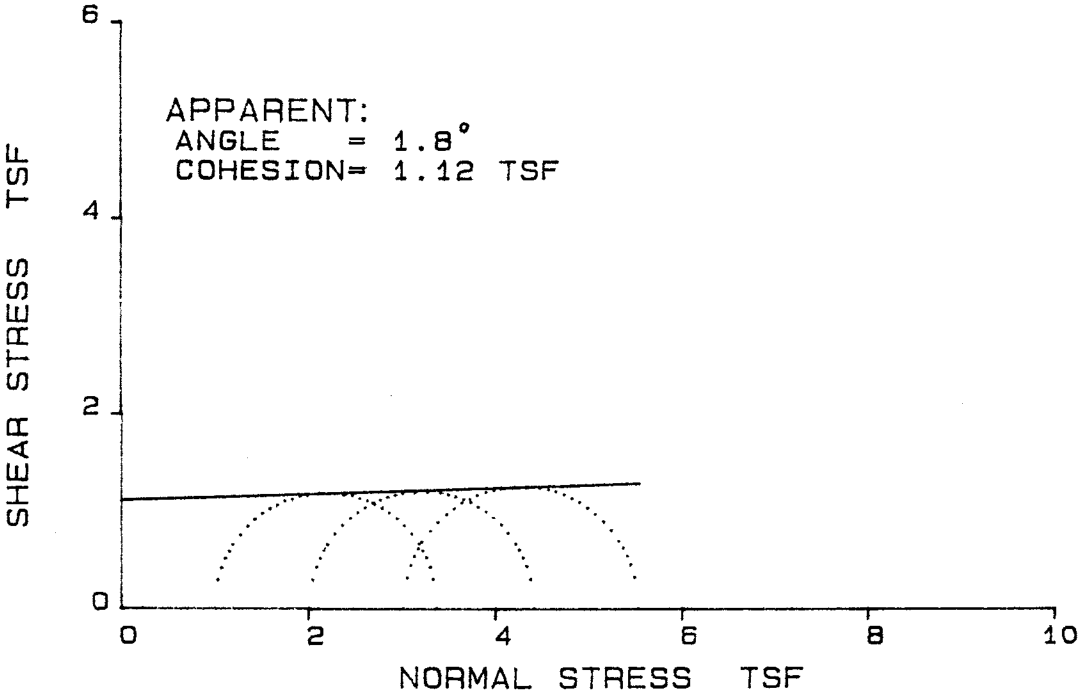
Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	18.1	53.0	6.0	96.2	0.0371
4 min.	18.1	52.5	6.0	95.1	0.0187
15 min.	18.1	51.5	6.0	93.1	0.0097
1 hour	18.1	50.0	6.0	90.0	0.0049
4 hours	18.3	46.5	6.0	82.9	0.0026

Soil Symbol= CH (Inorganic clay of high plasticity)
Gravel(%)= 0 Sand(%)= 2 Silt(%)= 8 Clay(%)= 90

SINGLETON LABORATORIES
UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (Q) TEST

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STKG PHS II
STATION:
RANGE :
BORING : US-55

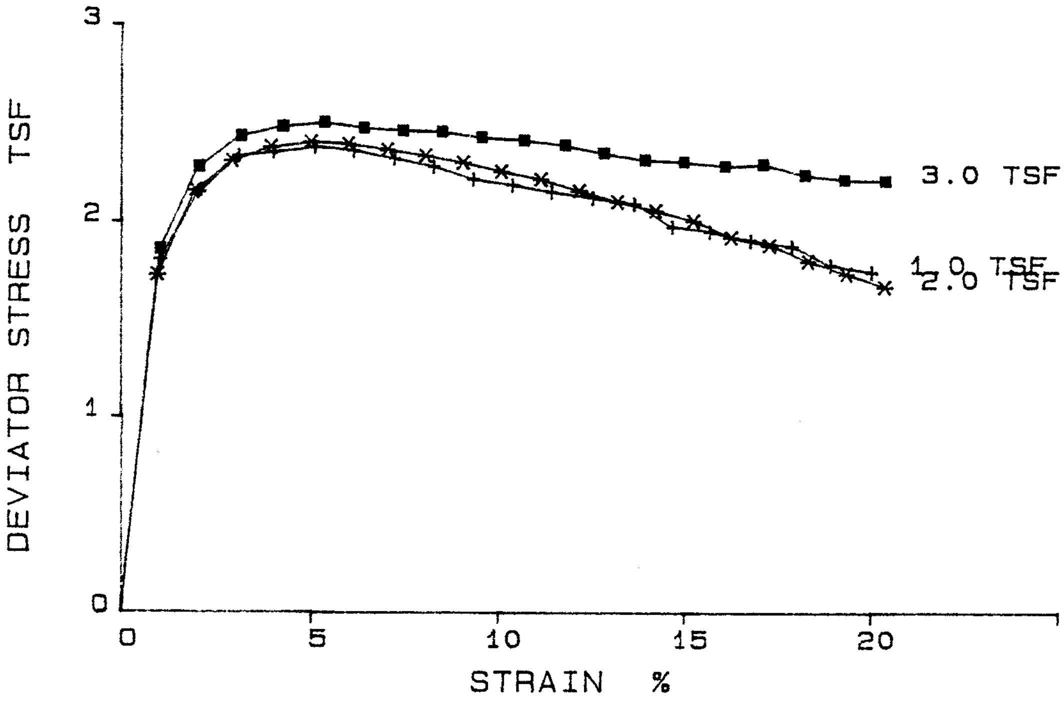
EL. : 614.5-614.1
SAMPLE : 1
PART : 3
SOIL SYM: CH
DATE : 02-26-91



REMARKS:

SINGLETON LABORATORIES
UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (Q) TEST

PROJECT:	WIDOWS CREEK SP	EL.	: 614.5-614.1
FEATURE:	DRY STKG PHS II	SAMPLE	: 1
STATION:		PART	: 3
RANGE :		SOIL SYM:	CH
BORING :	US-55	DATE	: 02-26-91



REMARKS:

Singleton Laboratories
Unconsolidated Undrained Triaxial Compression (Q) Test

Project: WIDOWS CREEK SP		File : 50
Feature: DRY STACKING PHS II		Tested By : CBE
Station:	El. : 614.5-614.1	Computed By: MHD
Range :	Sample: 1	Checked By : GPB
Boring : US-55	Part : 3	Report Date: 02-26-91

Soil Symbol= CH	L.L.(%)= 84	P.I.(%) = 55
Sp. Gr. = 2.75	D10(mm)= 0	

Specimen Number	1	2	3	4
Initial:				
Moisture Content(%)	24.9	26.9	26.1	0.0
Dry Density(pcf)	97.9	96.2	96.1	0.0
Void Ratio	0.753	0.784	0.787	0.000
Saturation(%)	91.0	94.3	91.1	0.0
Before Shearing:				
Moisture(%) (after satur.)	--	--	--	--
Saturation(%)	--	--	--	--
Moisture(%) (after cons.)	--	--	--	--
Void Ratio (after cons.)	--	--	--	--
Final Moisture Content(%)	25.1	26.8	25.8	0.0
Minor Principal Stress(tsf)	1.01	2.02	3.02	0.00
Major Principal Stress(tsf)	3.40	4.43	5.54	0.00
Eff. Minor Prin Stress (tsf)	--	--	--	--
Eff. Major Prin Stress (tsf)	--	--	--	--
Time to Failure(min)	5	5	5	0
Rate of Strain(%/min)	1.03	1.01	1.07	0.00
Specimen Height(in.)	3.08	3.08	3.08	0.00
Specimen Dia (in.)	1.40	1.40	1.40	0.00

	Max Deviator Stress		Max Eff Stress Ratio	
Shear Strength	Deg	c(tsf)	Deg	c(tsf)
Apparent	1.8	1.12		
Effective	--	--		

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Remark:

Singleton Laboratories
Unconsolidated Undrained Triaxial Compression (Q) Test

Project: WIDOWS CREEK SP
Feature: DRY STACKING PHS II
Station:
Range :
Boring : US-55

El. : 614.5-614.1
Sample: 1
Part : 3

File : 49
Tested By : CBE
Computed By: MHD
Checked By : GPB
Report Date: 02-26-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	166.0	151.4	189.8
Dry Wt. and Tare(gm)=	140.5	121.2	159.4
Wt. of Tare(gm) =	39.2	0.0	38.2
Moisture(%) =	25.2	24.9	25.1

Test Conditions and Constants:

Proving Ring No. = 2423
Proving Ring Constant:
Slope Const. = 1
Intercept = 0
Confining Pres.(psi) = 14
Initial Pore Pre(psi)= 0

Tube No. = 5
Sample Volume (cc) = 77.249
Sample Height(in.) = 3.077
Specific Gravity = 2.75
Consolidation(in.) = 0
Initial P.R. Rdg = 4

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Strain (%)	e1 - e3 (tsf)
1	0.031	43.0	1.01	1.81
2	0.062	50.8	2.01	2.16
3	0.095	55.4	3.09	2.34
4	0.124	56.4	4.03	2.36
5	0.158	57.6	5.13	2.39
6	0.190	57.8	6.17	2.37
7	0.224	57.6	7.28	2.34
8	0.257	57.4	8.35	2.30
9	0.290	56.6	9.42	2.24
10	0.323	56.6	10.50	2.21
11	0.356	56.4	11.57	2.18
12	0.390	56.4	12.67	2.15
13	0.424	56.4	13.78	2.12
14	0.456	54.2	14.82	2.01
15	0.488	54.2	15.86	1.99
16	0.522	53.8	16.96	1.94
17	0.556	53.8	18.07	1.92
18	0.588	52.0	19.11	1.82
19	0.622	51.8	20.21	1.79

Initial:
Moisture(%) = 24.9
Density(pcf)= 97.9

Void Ratio =0.753
Saturation(%)= 91.0

Minor Prin. Stress(tsf) =1.01
Major Prin. Stress(tsf) = 3.40

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Singleton Laboratories
Unconsolidated Undrained Triaxial Compression (Q) Test

Project: WIDOWS CREEK SP
Feature: DRY STACKING PHS II
Station:
Range :
Boring : US-55

El. : 614.5-614.1
Sample: 1
Part : 3

File : 49
Tested By : CBE
Computed By: MHD
Checked By : GPB
Report Date: 02-26-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	163.4	151.1	189.2
Dry Wt. and Tare(gm)=	136.4	119.1	157.3
Wt. of Tare(gm) =	38.3	0.0	38.2
Moisture(%) =	27.5	26.9	26.8

Test Conditions and Constants:

Proving Ring No. = 2423
Proving Ring Constant:
Slope Const. = 1
Intercept = 0
Confining Pres.(psi) = 28
Initial Pore Pre(psi)= 0

Tube No. = 5
Sample Volume (cc) = 77.249
Sample Height(in.) = 3.077
Specific Gravity = 2.75
Consolidation(in.) = 0
Initial P.R. Rdg = 10.8

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Strain (%)	e1 - e3 (tsf)
1	0.029	48.0	0.94	1.73
2	0.060	57.8	1.95	2.17
3	0.090	61.6	2.92	2.32
4	0.122	63.8	3.96	2.39
5	0.155	65.0	5.04	2.42
6	0.186	65.4	6.04	2.41
7	0.219	65.4	7.12	2.38
8	0.251	65.4	8.16	2.36
9	0.282	65.2	9.16	2.32
10	0.314	64.8	10.20	2.28
11	0.347	64.6	11.28	2.24
12	0.379	63.8	12.32	2.18
13	0.411	63.2	13.36	2.13
14	0.443	62.8	14.40	2.09
15	0.475	62.2	15.44	2.04
16	0.507	60.7	16.48	1.96
17	0.539	60.4	17.52	1.92
18	0.571	59.0	18.56	1.84
19	0.603	58.0	19.60	1.78
20	0.635	57.0	20.64	1.72

Initial:
Moisture(%) = 26.9
Density(pcf)= 96.2

Void Ratio =0.784
Saturation(%)= 94.3

Minor Prin. Stress(tsf) =2.02

Major Prin. Stress(tsf) = 4.43

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Singleton Laboratories
Unconsolidated Undrained Triaxial Compression (Q) Test

Project: WIDOWS CREEK SP
Feature: DRY STACKING PHS II
Station:
Range :
Boring : US-55

El. : 614.5-614.1
Sample: 1
Part : 3

File : 49
Tested By : CBE
Computed By: MHD
Checked By : GPB
Report Date: 02-26-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	156.1	149.9	186.8
Dry Wt. and Tare(gm)=	133.2	118.9	156.1
Wt. of Tare(gm) =	38.3	0.0	37.2
Moisture(%) =	24.1	26.1	25.8

Test Conditions and Constants:

Proving Ring No. = 2423
Proving Ring Constant:
Slope Const. = 1
Intercept = 0
Confining Pres.(psi) = 42
Initial Pore Pre(psi)= 0

Tube No. = 5
Sample Volume (cc) = 77.249
Sample Height(in.) = 3.077
Specific Gravity = 2.75
Consolidation(in.) = 0
Initial P.R. Rdg = 16.8

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Strain (%)	e1 - e3 (tsf)
1	0.031	56.8	1.01	1.86
2	0.062	66.4	2.01	2.28
3	0.096	70.4	3.12	2.44
4	0.130	72.2	4.22	2.49
5	0.164	73.4	5.33	2.52
6	0.197	73.4	6.40	2.49
7	0.230	73.8	7.47	2.48
8	0.263	74.4	8.55	2.48
9	0.296	74.4	9.62	2.45
10	0.331	74.8	10.76	2.43
11	0.365	75.0	11.86	2.41
12	0.397	74.8	12.90	2.37
13	0.431	74.8	14.01	2.34
14	0.464	75.4	15.08	2.34
15	0.499	75.8	16.22	2.32
16	0.531	76.8	17.26	2.33
17	0.565	76.2	18.36	2.28
18	0.598	76.4	19.43	2.26
19	0.632	77.2	20.54	2.26

Initial:
Moisture(%) = 26.1
Density(pcf)= 96.1

Void Ratio =0.787
Saturation(%)= 91.1

Minor Prin. Stress(tsf) =3.02

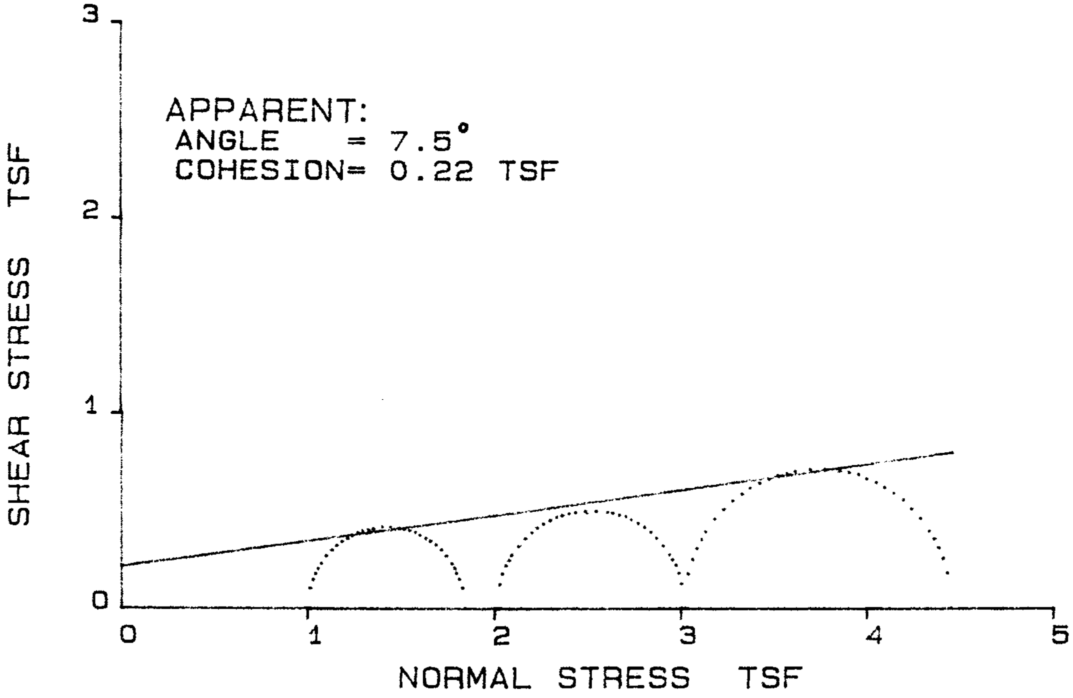
Major Prin. Stress(tsf) = 5.54

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

SINGLETON LABORATORIES
UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (Q) TEST

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STKG PHS II
STATION:
RANGE :
BORING : US-60

EL. : 598.4-597.9
SAMPLE : 1
PART : 2
SOIL SYM: SC
DATE : 02-27-91

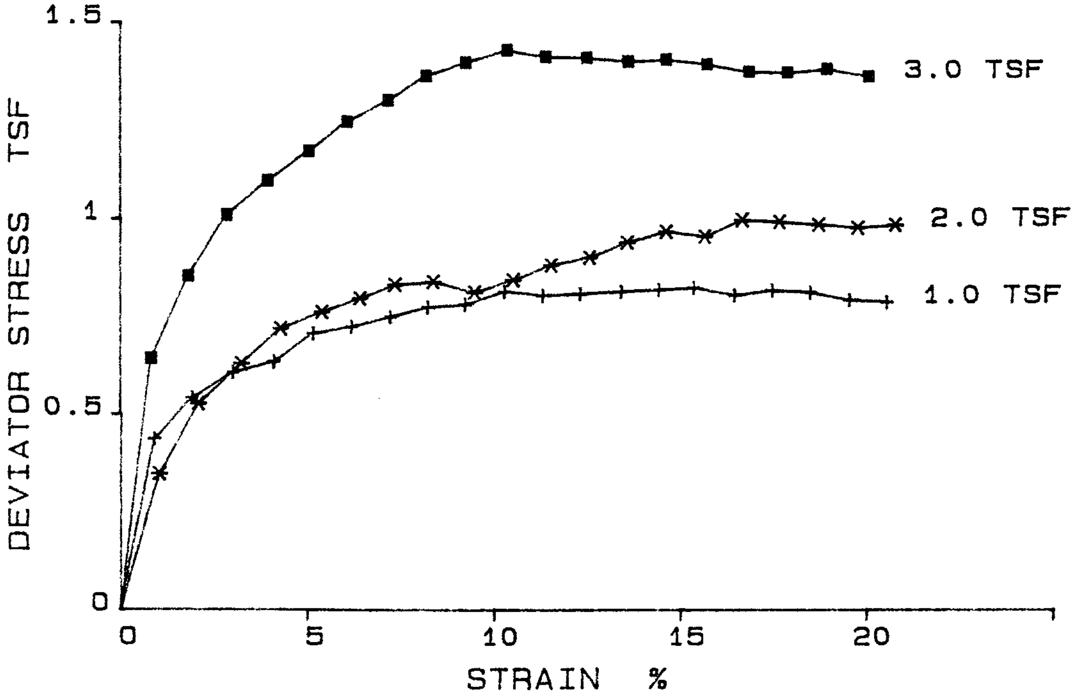


REMARKS: 40% REMOLDED

SINGLETON LABORATORIES
UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (Q) TEST

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STKG PHS II
STATION:
RANGE :
BORING : US-60

EL. : 598.4-597.9
SAMPLE : 1
PART : 2
SOIL SYM: SC
DATE : 02-27-91



REMARKS: 40% REMOLDED

Singleton Laboratories
UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION(Q) TEST

Project: WIDOWS CREEK SP
Feature: DRY STKG PHS II
Station:
Range :
Boring : US-60

El. : 598.4-597.9
Sample: 1
Part : 2

File : 1
Tested By : CBE
Computed By: MHD
Checked By : GPB
Report Date: 02-27-91

Soil Symbol= SC
Sp. Gr. = 2.73
L.L.(%)= 46
D10(mm)= .0009
P.I.(%) = 25

Specimen Number	1	2	3	4
Initial:				
Moisture Content(%)	18.4	19.1	17.9	0.0
Dry Density(pcf)	111.4	110.4	110.7	0.0
Void Ratio	0.530	0.544	0.539	0.000
Saturation(%)	94.9	95.9	90.5	0.0
Before Shearing:				
Moisture(%) (after satur.)	--	--	--	--
Saturation(%)	--	--	--	--
Moisture(%) (after cons.)	--	--	--	--
Void Ratio (after cons.)	--	--	--	--
Final Moisture Content(%)	18.0	19.0	17.7	0.0
Minor Principal Stress(tsf)	1.01	2.02	3.02	0.00
Major Principal Stress(tsf)	1.85	3.03	4.46	0.00
Eff. Minor Prin Stress (tsf)	--	--	--	--
Eff. Major Prin Stress (tsf)	--	--	--	--
Time to Failure(min)	15	16	10	0
Rate of Strain(%/min)	1.04	1.06	1.04	0.00
Specimen Height(in.)	3.08	3.08	3.08	0.00
Specimen Dia (in.)	1.40	1.40	1.40	0.00

	Max Deviator Stress		Max Eff Stress Ratio	
Shear Strength	Deg	c(tsf)	Deg	c(tsf)
Apparent	7.5	0.22		
Effective	--	--		

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Remark: 40% REMOLDED

Singleton Laboratories
UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION(Q) TEST

Project: WIDOWS CREEK SP
Feature: DRY STKG PHS II
Station:
Range :
Boring : US-60

El. : 598.4-597.9
Sample: 1
Part : 2

File : 50
Tested By : CBE
Computed By: MHD
Checked By : GPB
Report Date: 02-27-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	200.6	163.2	201.7
Dry Wt. and Tare(gm)=	171.2	137.8	176.9
Wt. of Tare(gm) =	38.9	0.0	39.1
Moisture(%) =	22.2	18.4	18.0

Test Conditions and Constants:

Proving Ring No. = 2423
Proving Ring Constant:
Slope Const. = 1
Intercept = 0
Confining Pres.(psi) = 14
Initial Pore Pre(psi)= 0

Tube No. = 5
Sample Volume (cc) = 77.249
Sample Height(in.) = 3.077
Specific Gravity = 2.73
Consolidation(in.) = 0
Initial P.R. Rdg = 5

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Strain (%)	e1 - e3 (tsf)
1	0.028	14.4	0.91	0.44
2	0.059	16.8	1.92	0.54
3	0.093	18.4	3.02	0.61
4	0.127	19.2	4.13	0.64
5	0.160	21.0	5.20	0.71
6	0.192	21.6	6.24	0.73
7	0.225	22.4	7.31	0.76
8	0.256	23.2	8.32	0.78
9	0.287	23.6	9.33	0.79
10	0.320	24.6	10.40	0.83
11	0.352	24.6	11.44	0.82
12	0.383	25.0	12.45	0.82
13	0.417	25.4	13.55	0.83
14	0.448	25.8	14.56	0.84
15	0.478	26.2	15.53	0.84
16	0.512	26.0	16.64	0.82
17	0.543	26.6	17.65	0.84
18	0.575	26.8	18.69	0.83
19	0.608	26.6	19.76	0.81
20	0.639	26.8	20.77	0.81

Initial:
Moisture(%) = 18.4
Density(pcf)=111.4

Void Ratio =0.530
Saturation(%)= 94.9

Minor Prin. Stress(tsf) =1.01

Major Prin. Stress(tsf) = 1.85

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Singleton Laboratories
UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION(Q) TEST

Project: WIDOWS CREEK SP
Feature: DRY STKG PHS II
Station:
Range :
Boring : US-60

El. : 598.4-597.9
Sample: 1
Part : 2

File : 50
Tested By : CBE
Computed By: MHD
Checked By : GAB
Report Date: 02-27-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	174.1	162.7	201.1
Dry Wt. and Tare(gm)=	151.5	136.6	175.1
Wt. of Tare(gm) =	38.5	0.0	38.5
Moisture(%) =	20.0	19.1	19.0

Test Conditions and Constants:

Proving Ring No. = 2515
Proving Ring Constant:
Slope Const. = 1
Intercept = 0
Confining Pres.(psi) = 28
Initial Pore Pre(psi)= 0

Tube No. = 5
Sample Volume (cc) = 77.249
Sample Height(in.) = 3.077
Specific Gravity = 2.73
Consolidation(in.) = 0
Initial P.R. Rdg = 15.1

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Strain (%)	e1 - e3 (tsf)
1	0.032	22.6	1.04	0.35
2	0.065	26.6	2.11	0.53
3	0.101	29.0	3.28	0.63
4	0.134	31.2	4.35	0.72
5	0.168	32.4	5.46	0.77
6	0.200	33.4	6.50	0.80
7	0.230	34.4	7.47	0.84
8	0.262	34.8	8.51	0.85
9	0.296	34.4	9.62	0.82
10	0.328	35.4	10.66	0.85
11	0.360	36.6	11.70	0.89
12	0.392	37.4	12.74	0.91
13	0.423	38.6	13.75	0.95
14	0.456	39.6	14.82	0.98
15	0.489	39.6	15.89	0.97
16	0.520	41.0	16.90	1.01
17	0.551	41.2	17.91	1.01
18	0.584	41.4	18.98	1.00
19	0.617	41.6	20.05	1.00
20	0.648	42.2	21.06	1.01

Initial:
Moisture(%) = 19.1
Density(pcf)=110.4

Void Ratio =0.544
Saturation(%)= 95.9

Minor Prin. Stress(tsf) =2.02

Major Prin. Stress(tsf) = 3.03

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Singleton Laboratories
UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION(Q) TEST

Project: WIDOWS CREEK SP
Feature: DRY STKG PHS II
Station:
Range :
Boring : US-60

El. : 598.4-597.9
Sample: 1
Part : 2

File : 50
Tested By : CBE
Computed By: MHD
Checked By : GPB
Report Date: 02-27-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	247.0	161.5	200.0
Dry Wt. and Tare(gm)=	217.2	137.0	175.7
Wt. of Tare(gm) =	37.2	0.0	38.7
Moisture(%) =	16.6	17.9	17.7

Test Conditions and Constants:
Proving Ring No. = 2423
Proving Ring Constant:
Slope Const. = 1
Intercept = 0
Confining Pres.(psi) = 42
Initial Pore Pre(psi)= 0

Tube No. = 5
Sample Volume (cc) = 77.249
Sample Height(in.) = 3.077
Specific Gravity = 2.73
Consolidation(in.) = 0
Initial P.R. Rdg = 17.2

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Strain (%)	e1 - e3 (tsf)
1	0.025	31.0	0.81	0.64
1	0.025	31.0	0.81	0.64
2	0.056	35.8	1.82	0.86
3	0.088	39.4	2.86	1.01
4	0.122	41.6	3.96	1.10
5	0.156	43.6	5.07	1.18
6	0.188	45.6	6.11	1.25
7	0.222	47.2	7.21	1.31
8	0.254	49.0	8.25	1.37
9	0.287	50.2	9.33	1.41
10	0.321	51.4	10.43	1.44
11	0.353	51.4	11.47	1.42
12	0.387	51.8	12.58	1.42
13	0.421	52.0	13.68	1.41
14	0.453	52.6	14.72	1.42
15	0.487	52.8	15.83	1.41
16	0.522	52.8	16.96	1.39
17	0.554	53.2	18.00	1.39
18	0.587	54.0	19.08	1.40
19	0.622	54.0	20.21	1.38

Initial:
Moisture(%) = 17.9
Density(pcf)=110.7

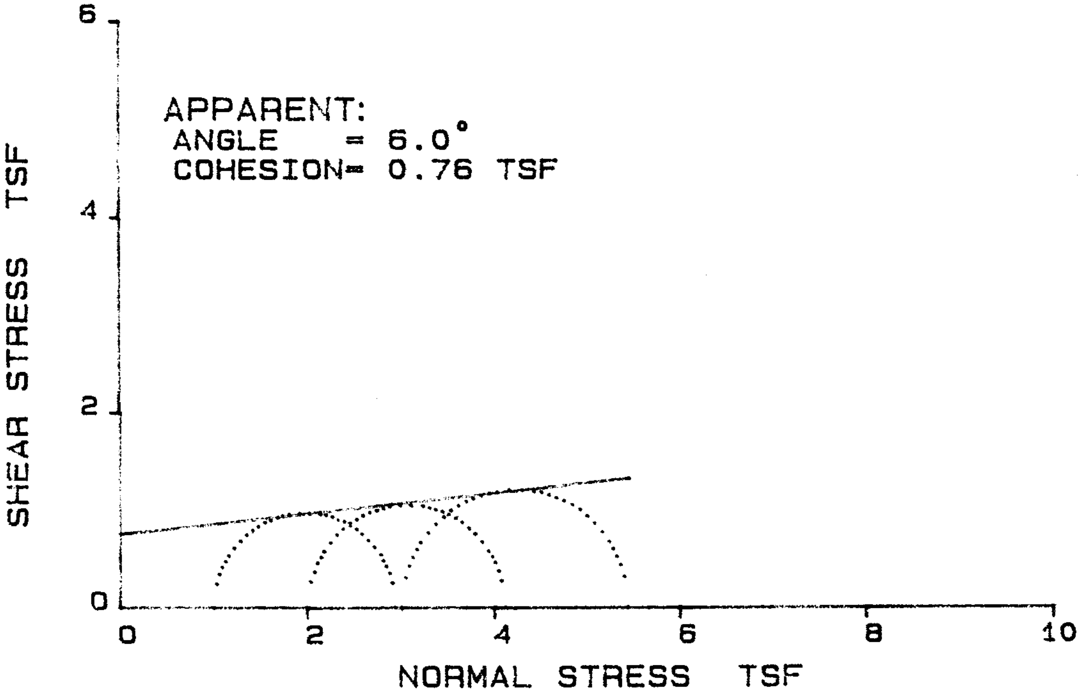
Void Ratio =0.539
Saturation(%)= 90.5

Minor Prin. Stress(tsf) =3.02
Major Prin. Stress(tsf) = 4.46

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

SINGLETON LABORATORIES
UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (Q) TEST

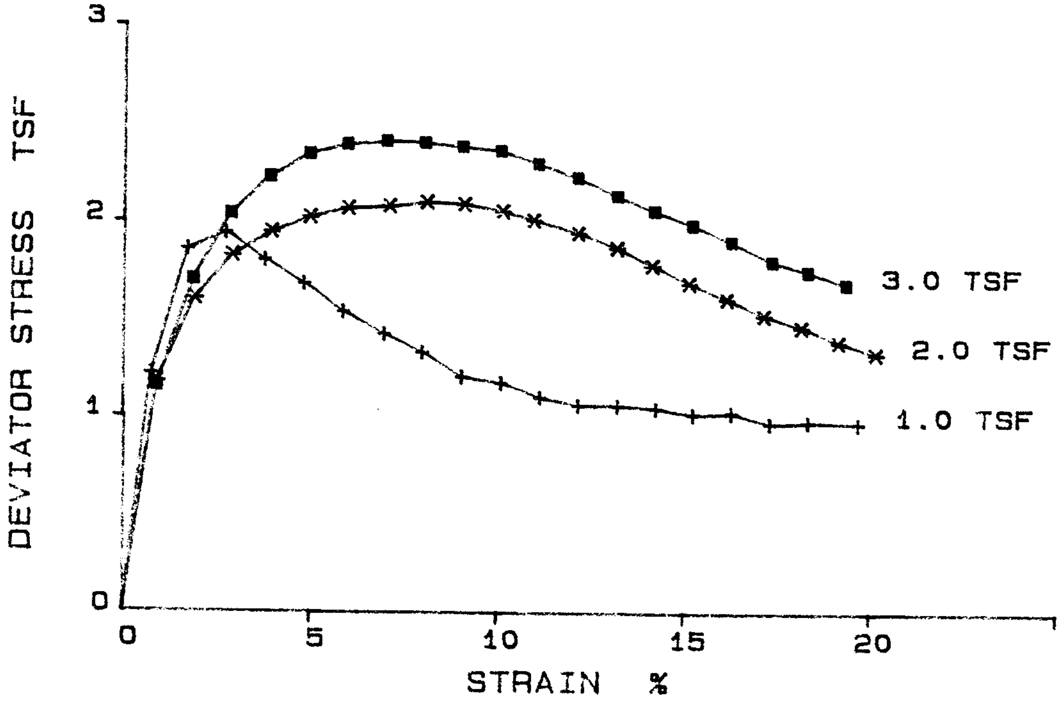
PROJECT:	WIDOWS CREEK SP	EL.	: 590.9-590.5
FEATURE:	DRY STKG PHS II	SAMPLE	: 2
STATION:		PART	: 2
RANGE :		SOIL SYM:	CH
BORING :	US-60	DATE	: 03-14-91



REMARKS:

SINGLETON LABORATORIES
UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (Q) TEST

PROJECT:	WIDOWS CREEK SP	EL.	: 590.9-590.5
FEATURE:	DRY STKG PHS II	SAMPLE	: 2
STATION:		PART	: 2
RANGE :		SOIL SYM:	CH
BORING :	US-60	DATE	: 03-14-91



REMARKS:

Singleton Laboratories
Unconsolidated Undrained Triaxial Compression (Q) Test

Project: WIDOWS CREEK SP		File : 2
Feature: DRY STKG PHS II		Tested By : CBE
Station:	El. : 590.9-590.5	Computed By: MHD
~~Range :~~	~~Sample: 2~~	~~Checked By :~~
Boring : US-60	Part : 2	Report Date: 03-14-91

Soil Symbol= CH	L.L.(%)= 54	P.I.(%) = 32
Sp. Gr. = 2.78	D10(mm)= 0	

Specimen Number	1	2	3	4
Initial:				
Moisture Content(%)	24.4	24.7	23.5	0.0
Dry Density(pcf)	102.0	100.1	101.7	0.0
Void Ratio	0.702	0.733	0.707	0.000
Saturation(%)	96.7	93.6	92.5	0.0
Before Shearing:				
Moisture(%) (after satur.)	--	--	--	--
Saturation(%)	--	--	--	--
Moisture(%) (after cons.)	--	--	--	--
Void Ratio (after cons.)	--	--	--	--
Final Moisture Content(%)	24.4	25.8	23.4	0.0
Minor Principal Stress(tsf)	1.01	2.02	3.02	0.00
Major Principal Stress(tsf)	2.96	4.13	5.45	0.00
Eff. Minor Prin Stress (tsf)	--	--	--	--
Eff. Major Prin Stress (tsf)	--	--	--	--
Time to Failure(min)	3	8	7	0
Rate of Strain(%/min)	0.92	1.02	1.01	0.00
Specimen Height(in.)	3.08	3.08	3.08	0.00
Specimen Dia (in.)	1.40	1.40	1.40	0.00

	Max Deviator Stress		Max Eff Stress Ratio	
Shear Strength	Deg	c(tsf)	Deg	c(tsf)
Apparent	6.0	0.76		
Effective	--	--		

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Remark:

Singleton Laboratories
Unconsolidated Undrained Triaxial Compression (Q) Test

Project: WIDOWS CREEK SP
Feature: DRY STKG PHS II
Station:
~~Range :~~
Boring : US-60

El. : 590.9-590.5
~~Sample: 2~~
Part : 2

File : 2
Tested By : CBE
Computed By: MHD
~~Checked By :~~
Report Date: 03-14-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	150.4	157.0	195.1
Dry Wt. and Tare(gm)=	128.4	126.2	164.3
Wt. of Tare(gm) =	38.9	0.0	38.1
Moisture(%) =	24.6	24.4	24.4

Test Conditions and Constants:

Proving Ring No. = 2423
Proving Ring Constant:
Slope Const. = 1
Intercept = 0
Confining Pres.(psi) = 14
Initial Pore Pre(psi)= 0

Tube No. = 1
Sample Volume (cc) = 77.249
Sample Height(in.) = 3.077
Specific Gravity = 2.78
Consolidation(in.) = 0
Initial P.R. Rdg = 4

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Strain (%)	e1 - e3 (tsf)
1	0.023	30.2	0.75	1.22
2	0.053	44.4	1.72	1.87
3	0.085	46.8	2.76	1.96
4	0.118	44.2	3.83	1.82
5	0.151	42.0	4.91	1.70
6	0.184	39.2	5.98	1.56
7	0.218	37.0	7.08	1.44
8	0.250	35.2	8.12	1.35
9	0.283	32.7	9.20	1.22
10	0.316	32.4	10.27	1.20
11	0.349	31.0	11.34	1.12
12	0.381	30.4	12.38	1.09
13	0.414	30.8	13.45	1.09
14	0.446	30.8	14.49	1.08
15	0.477	30.4	15.50	1.05
16	0.510	31.0	16.57	1.06
17	0.542	30.0	17.61	1.01
18	0.574	30.6	18.65	1.02
19	0.616	30.8	20.02	1.01

Initial:
Moisture(%) = 24.4
Density(pcf)=102.0

Void Ratio =0.702
Saturation(%)= 96.7

Minor Prin. Stress(tsf) =1.01

Major Prin. Stress(tsf) = 2.96

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Singleton Laboratories
UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION(Q) TEST

Project: WIDOWS CREEK SP
Feature: DRY STKG PHS II
Station:
Range :
Boring : US-60

El. : 590.9-590.5
Sample: 2
Part : 2

File : 2
Tested By : CBE
Computed By: MHD
Checked By : GPB
Report Date: 02-27-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	175.0	154.5	192.5
Dry Wt. and Tare(gm)=	148.1	123.9	160.9
Wt. of Tare(gm) =	39.8	0.0	38.2
Moisture(%) =	24.8	24.7	25.8

Test Conditions and Constants:

Proving Ring No. = 2423
Proving Ring Constant:
Slope Const. = 1
Intercept = 0
Confining Pres.(psi) = 28
Initial Pore Pre(psi)= 0

Tube No. = 5
Sample Volume (cc) = 77.249
Sample Height(in.) = 3.077
Specific Gravity = 2.78
Consolidation(in.) = 0
Initial P.R. Rdg = 11

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Strain (%)	$e1 - e3$ (tsf)
1	0.027	36.4	0.88	1.18
2	0.058	46.0	1.88	1.61
3	0.089	51.2	2.89	1.83
4	0.122	54.4	3.96	1.96
5	0.154	56.6	5.00	2.04
6	0.186	58.2	6.04	2.08
7	0.220	59.0	7.15	2.09
8	0.251	60.0	8.16	2.11
9	0.282	60.4	9.16	2.11
10	0.314	60.2	10.20	2.08
11	0.340	59.6	11.05	2.03
12	0.377	58.8	12.25	1.97
13	0.409	57.6	13.29	1.90
14	0.439	56.0	14.27	1.81
15	0.470	54.4	15.27	1.73
16	0.502	53.0	16.31	1.65
17	0.533	51.4	17.32	1.57
18	0.564	50.4	18.33	1.51
19	0.595	49.0	19.34	1.44
20	0.626	48.0	20.34	1.39

Initial:
Moisture(%) = 24.7
Density(pcf)=100.1

Void Ratio =0.733
Saturation(%)= 93.6

Minor Prin. Stress(tsf) =2.02

Major Prin. Stress(tsf) = 4.13

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Singleton Laboratories
UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION(Q) TEST

Project: WIDOWS CREEK SP
Feature: DRY STKG PHS II
Station:
Range :
Boring : US-60

El. : 590.9-590.5
Sample: 2
Part : 2

File : 2
Tested By : CBE
Computed By: MHD
Checked By : GPB
Report Date: 02-27-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	175.4	155.4	193.5
Dry Wt. and Tare(gm)=	148.7	125.8	164.1
Wt. of Tare(gm) =	39.1	0.0	38.3
Moisture(%) =	24.4	23.5	23.4

Test Conditions and Constants:

Proving Ring No. = 2423
Proving Ring Constant:
Slope Const. = 1
Intercept = 0
Confining Pres.(psi) = 42
Initial Pore Pre(psi)= 0

Tube No. = 5
Sample Volume (cc) = 77.249
Sample Height(in.) = 3.077
Specific Gravity = 2.78
Consolidation(in.) = 0
Initial P.R. Rdg = 16.8

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Strain (%)	e1 - e3 (tsf)
1	0.027	41.6	0.88	1.16
2	0.057	53.8	1.85	1.71
3	0.088	61.6	2.86	2.05
4	0.121	66.4	3.93	2.24
5	0.154	69.6	5.00	2.36
6	0.185	71.4	6.01	2.41
7	0.218	72.4	7.08	2.43
8	0.250	72.8	8.12	2.42
9	0.281	73.0	9.13	2.40
10	0.313	73.2	10.17	2.38
11	0.344	72.4	11.18	2.32
12	0.377	71.4	12.25	2.25
13	0.410	69.8	13.32	2.16
14	0.441	68.6	14.33	2.09
15	0.473	67.6	15.37	2.02
16	0.506	66.2	16.44	1.94
17	0.540	64.4	17.55	1.84
18	0.570	63.7	18.52	1.80
19	0.602	62.6	19.56	1.73

Initial:
Moisture(%) = 23.5
Density(pcf)=101.7

Void Ratio =0.707
Saturation(%)= 92.5

Minor Prin. Stress(tsf) =3.02

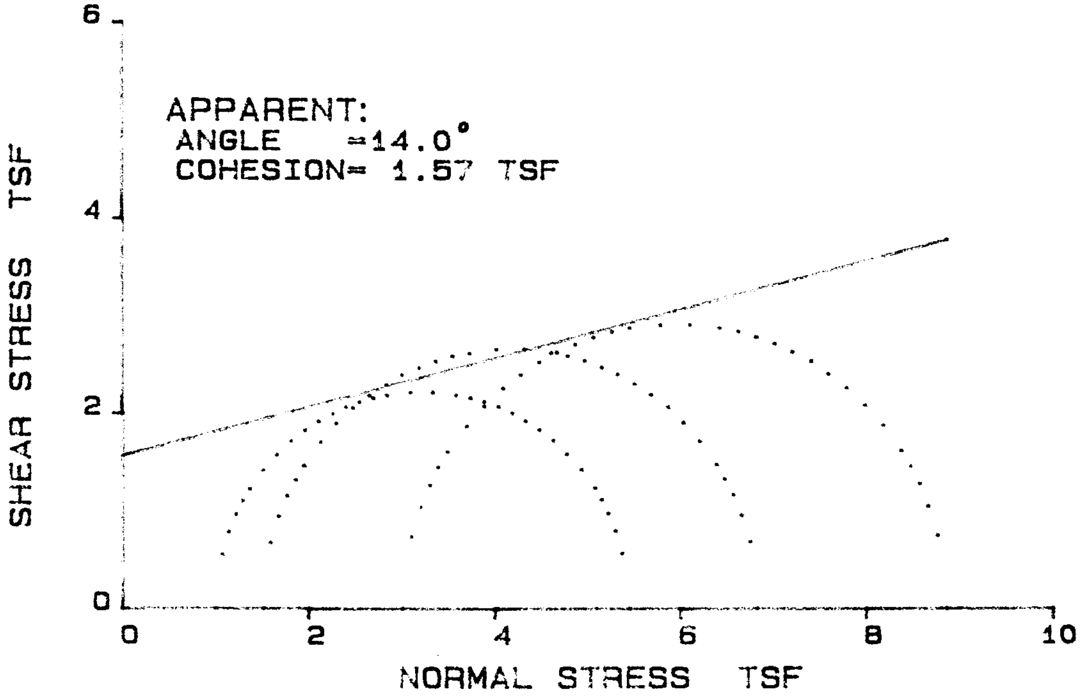
Major Prin. Stress(tsf) = 5.45

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

SINGLETON LABORATORIES
UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (Q) TEST

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STKG PHS II
STATION:
RANGE :
BORING : US-73

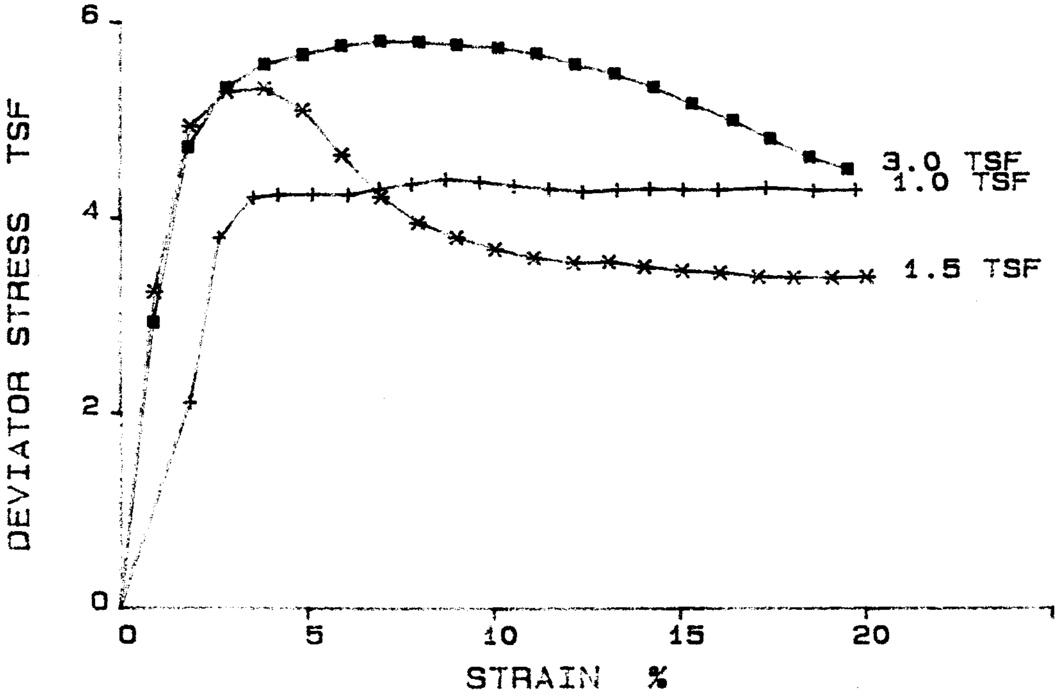
EL. : 618.7-618.3
SAMPLE : 1
PART : 1
SOIL SYM: ML/CL
DATE : 03-29-91



REMARKS:

SINGLETON LABORATORIES
UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (Q) TEST

PROJECT:	WIDOWS CREEK SP	EL.	: 618.7-618.3
FEATURE:	DRY STKG PHS II	SAMPLE	: 1
STATION:		PART	: 1
RANGE :		SOIL SYM:	ML/CL
BORING :	US-73	DATE	: 03-29-91



REMARKS:

Singleton Laboratories
Unconsolidated Undrained Triaxial Compression (Q) Test

Project: WIDOWS CREEK SP
Feature: DRY STACKING PHASE II
Station:
Range :
Boring : US-73

El. : 618.7-618.3
Sample: 1
Part : 1

File : 3
Tested By : TAL
Computed By: MHD
Checked By :
Report Date: 03-29-91

Soil Symbol= ML/CL
Sp. Gr. = 2.66

L.L.(%)= 46
D10(mm)=

P.I.(%) = 18

Specimen Number	1	2	3	4
Initial:				
Moisture Content(%)	21.5	22.5	23.3	0.0
Dry Density(pcf)	102.5	101.4	100.0	0.0
Void Ratio	0.621	0.637	0.661	0.000
Saturation(%)	92.3	93.8	93.7	0.0
Before Shearing:				
Moisture(%) (after satur.)	--	--	--	--
Saturation(%)	--	--	--	--
Moisture(%) (after cons.)	--	--	--	--
Void Ratio (after cons.)	--	--	--	--
Final Moisture Content(%)	21.4	22.1	23.0	0.0
Minor Principal Stress(tsf)	1.01	1.51	3.02	0.00
Major Principal Stress(tsf)	5.46	6.84	8.87	0.00
Eff. Minor Prin Stress (tsf)	--	--	--	--
Eff. Major Prin Stress (tsf)	--	--	--	--
Time to Failure(min)	11	4	7	0
Rate of Strain(%/min)	0.80	0.97	1.01	0.00
Specimen Height(in.)	3.08	3.08	3.08	0.00
Specimen Dia (in.)	1.40	1.40	1.40	0.00

	Max Deviator Stress		Max Eff Stress Ratio	
Shear Strength	Deg	c(tsf)	Deg	c(tsf)
Apparent	14.0	1.57		
Effective	--	--		

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Remark:

Singleton Laboratories
Unconsolidated Undrained Triaxial Compression (Q) Test

Project: WIDOWS CREEK SP
Feature: DRY STACKING PHASE II
Station:
Range :
Boring : US-73

El. : 618.7-618.3
Sample: 1
Part : 1

File : 3
Tested By : TAL
Computed By: MHD
Checked By :
Report Date: 03-29-91

Moisture Content		Trimming	Initial	Final
Wet Wt. and Tare(gm)	=	162.5	154.1	193.7
Dry Wt. and Tare(gm)	=	140.5	126.8	166.6
Wt. of Tare(gm)	=	40.0	0.0	39.8
Moisture(%)	=	21.9	21.5	21.4

Test Conditions and Constants:

Proving Ring No. = 2411
Proving Ring Constant:
Slope Const. = 1
Intercept = 0
Confining Pres.(psi) = 14
Initial Pore Pre(psi)= 0

Tube No. = 5
Sample Volume (cc) = 77.249
Sample Height(in.) = 3.077
Specific Gravity = 2.66
Consolidation(in.) = 0
Initial P.R. Rdg = 9.7

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Strain (%)	e1 - e3 (tsf)
3	0.057	55.6	1.85	2.12
4	0.081	93.1	2.63	3.82
5	0.110	103.0	3.57	4.23
6	0.131	104.4	4.26	4.26
7	0.160	105.5	5.20	4.27
8	0.190	106.7	6.17	4.28
9	0.216	109.1	7.02	4.34
10	0.243	111.3	7.90	4.40
11	0.272	113.6	8.84	4.45
12	0.300	114.0	9.75	4.42
13	0.329	114.2	10.69	4.39
14	0.358	114.6	11.63	4.36
15	0.386	115.1	12.54	4.33
16	0.415	116.9	13.49	4.36
17	0.442	118.3	14.36	4.37
18	0.470	119.3	15.27	4.36
19	0.500	120.6	16.25	4.37
20	0.540	122.9	17.55	4.39
21	0.580	124.0	18.85	4.36
22	0.615	125.9	19.99	4.37

Initial:
Moisture(%) = 21.5
Density(pcf)=102.5

Void Ratio =0.621
Saturation(%)= 92.3

Minor Prin. Stress(tsf) =1.01

Major Prin. Stress(tsf) = 5.46

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Singleton Laboratories
Unconsolidated Undrained Triaxial Compression (Q) Test

Project: WIDOWS CREEK SP
Feature: DRY STACKING PHASE II
Station:
Range :
Boring : US-73

El. : 618.7-618.3
Sample: 1
Part : 1

File : 3
Tested By : TAL
Computed By: MHD
Checked By :
Report Date: 03-29-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	146.8	153.7	192.0
Dry Wt. and Tare(gm)=	127.6	125.5	164.3
Wt. of Tare(gm) =	38.8	0.0	38.8
Moisture(%) =	21.6	22.5	22.1

Test Conditions and Constants:

Proving Ring No. = 2515
Proving Ring Constant:
Slope Const. = 1
Intercept = 0
Confining Pres.(psi) = 21
Initial Pore Pre(psi)= 0

Tube No. = 5
Sample Volume (cc) = 77.249
Sample Height(in.) = 3.077
Specific Gravity = 2.66
Consolidation(in.) = 0
Initial P.R. Rdg = 11

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Strain (%)	e1 - e3 (tsf)
1	0.028	80.8	0.91	3.25
2	0.058	118.2	1.88	4.94
3	0.089	127.0	2.89	5.29
4	0.120	129.0	3.90	5.33
5	0.152	125.4	4.94	5.11
6	0.185	116.4	6.01	4.66
7	0.218	107.8	7.08	4.23
8	0.249	103.0	8.09	3.97
9	0.281	100.6	9.13	3.83
10	0.313	99.0	10.17	3.72
11	0.346	98.0	11.24	3.63
12	0.379	98.0	12.32	3.59
13	0.409	99.4	13.29	3.60
14	0.439	99.4	14.27	3.56
15	0.471	99.6	15.31	3.53
16	0.503	100.2	16.35	3.51
17	0.535	100.4	17.39	3.47
18	0.565	101.4	18.36	3.47
19	0.597	102.6	19.40	3.47
20	0.626	104.0	20.34	3.48

Initial:
Moisture(%) = 22.5
Density(pcf)=101.4

Void Ratio =0.637
Saturation(%)= 93.8

Minor Prin. Stress(tsf) =1.51

Major Prin. Stress(tsf) = 6.84

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Singleton Laboratories
Unconsolidated Undrained Triaxial Compression (Q) Test

Project: WIDOWS CREEK SP
Feature: DRY STACKING PHASE II
Station:
Range :
Boring : US-73

El. : 618.7-618.3
Sample: 1
Part : 1

File : 3
Tested By : TAL
Computed By: MHD
Checked By :
Report Date: 03-29-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	148.0	152.5	190.7
Dry Wt. and Tare(gm)=	127.6	123.7	162.3
Wt. of Tare(gm) =	39.2	0.0	38.6
Moisture(%) =	23.1	23.3	23.0

Test Conditions and Constants:
Proving Ring No. = 2423
Proving Ring Constant:
Slope Const. = 1
Intercept = 0
Confining Pres.(psi) = 42
Initial Pore Pre(psi)= 0

Tube No. = 5
Sample Volume (cc) = 77.249
Sample Height(in.) = 3.077
Specific Gravity = 2.66
Consolidation(in.) = 0
Initial P.R. Rdg = 16.4

Time (Min)	Deflection (Ins.)	Pro.Ring Reading	Strain (%)	*e*1 - *e*3 (tsf)
1	0.027	79.4	0.88	2.93
2	0.056	118.8	1.82	4.72
3	0.088	133.4	2.86	5.34
4	0.120	140.0	3.90	5.58
5	0.152	143.8	4.94	5.69
6	0.184	147.4	5.98	5.79
7	0.217	150.2	7.05	5.84
8	0.250	151.6	8.12	5.84
9	0.281	152.6	9.13	5.82
10	0.315	153.6	10.24	5.79
11	0.347	154.0	11.28	5.74
12	0.379	153.2	12.32	5.64
13	0.412	152.6	13.39	5.54
14	0.445	151.0	14.46	5.41
15	0.477	148.4	15.50	5.24
16	0.511	146.0	16.61	5.08
17	0.542	142.8	17.61	4.89
18	0.575	139.7	18.69	4.71
19	0.607	138.2	19.73	4.59

Initial:
Moisture(%) = 23.3
Density(pcf)=100.0

Void Ratio =0.661
Saturation(%)= 93.7

Minor Prin. Stress(tsf) =3.02

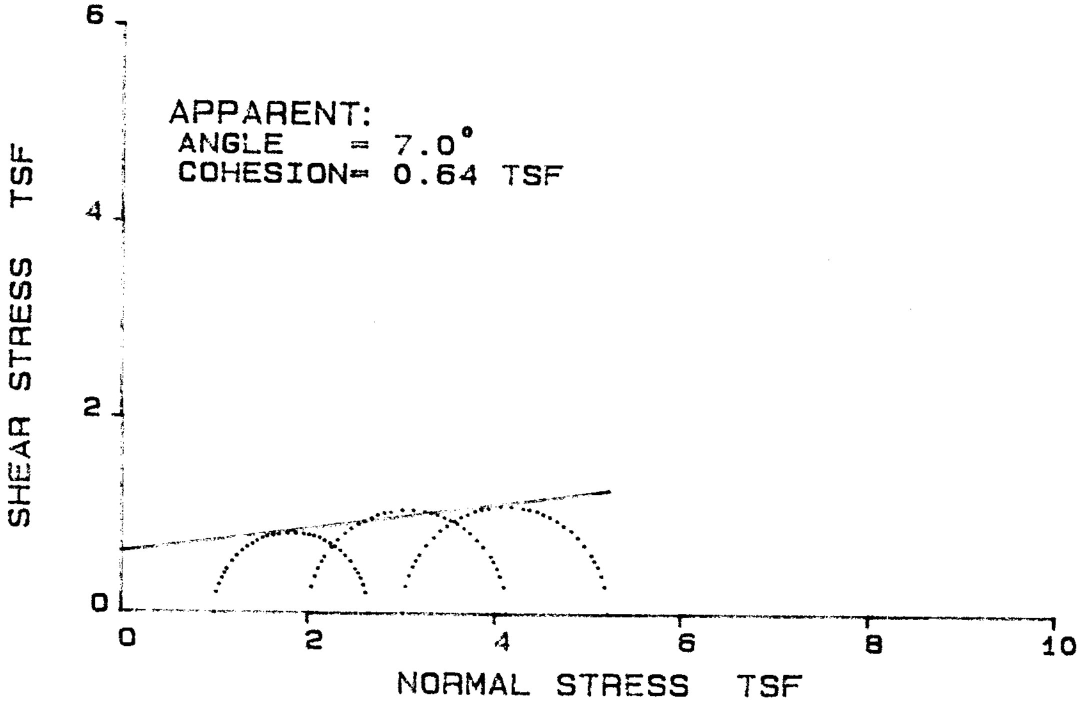
Major Prin. Stress(tsf) = 8.87

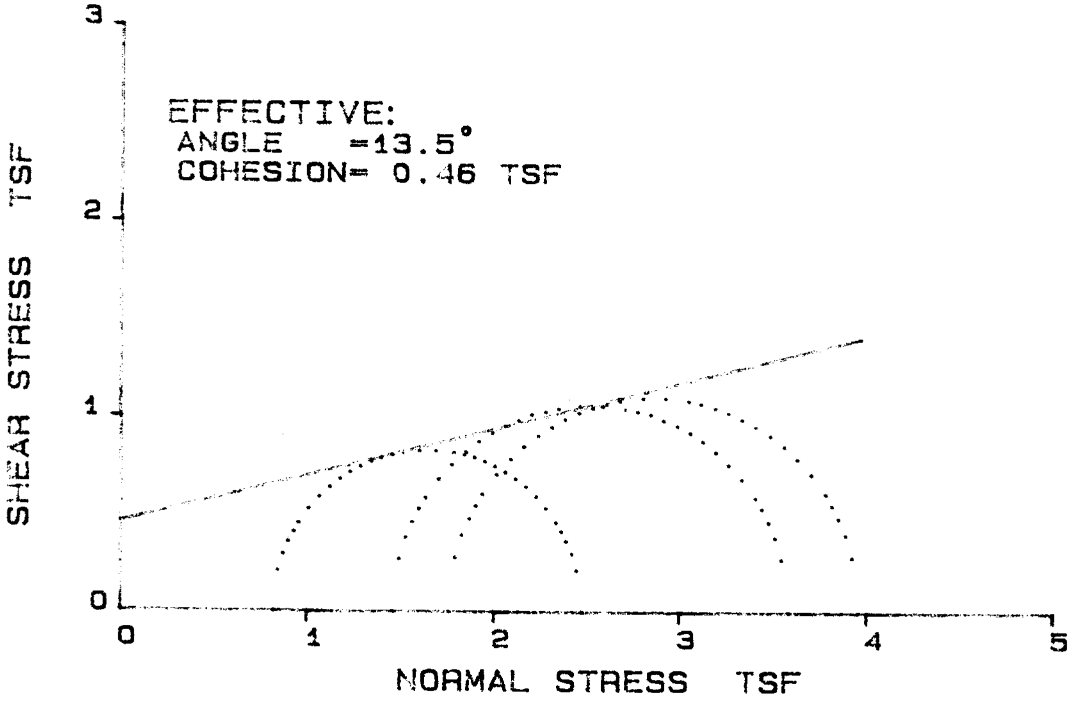
NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

SINGLETON LABORATORIES
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (R) TEST

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STKG PHS II
STATION:
RANGE :
BORING : US-55

EL. : 614.1-613.7
SAMPLE : 1
PART : 4
SOIL SYM: CH
DATE : 03-14-91


APPARENT:
ANGLE = 7.0°
COHESION= 0.64 TSF

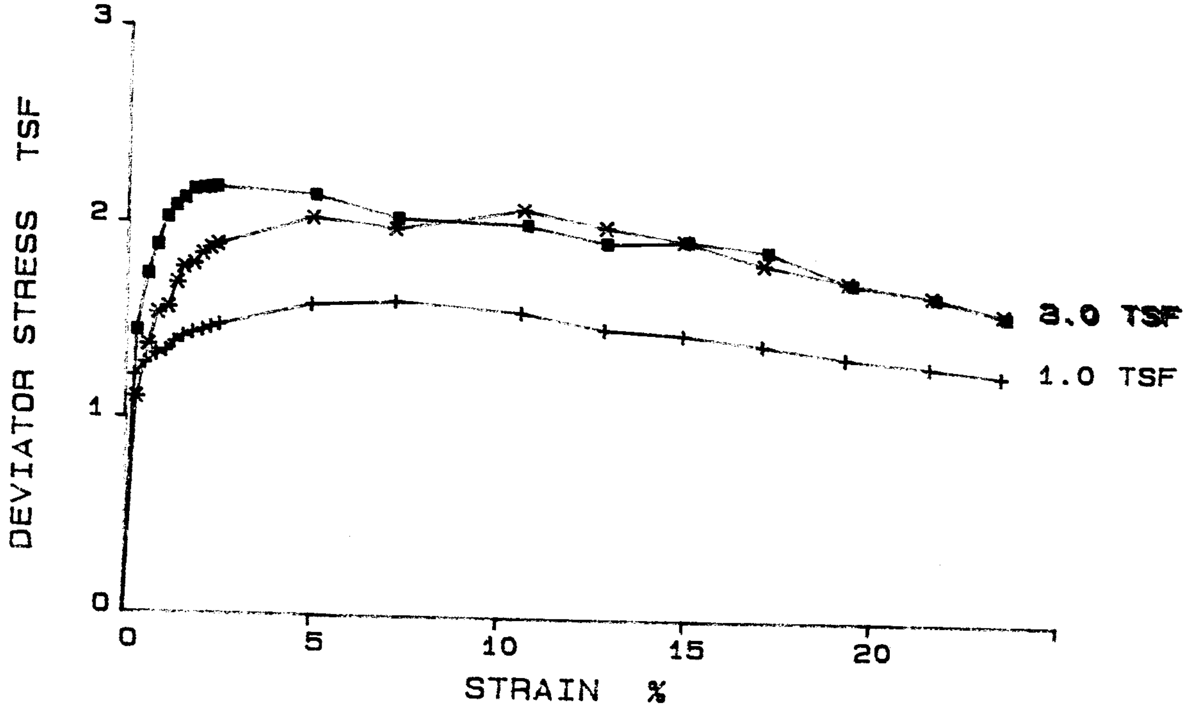

EFFECTIVE:
ANGLE =13.5°
COHESION= 0.46 TSF

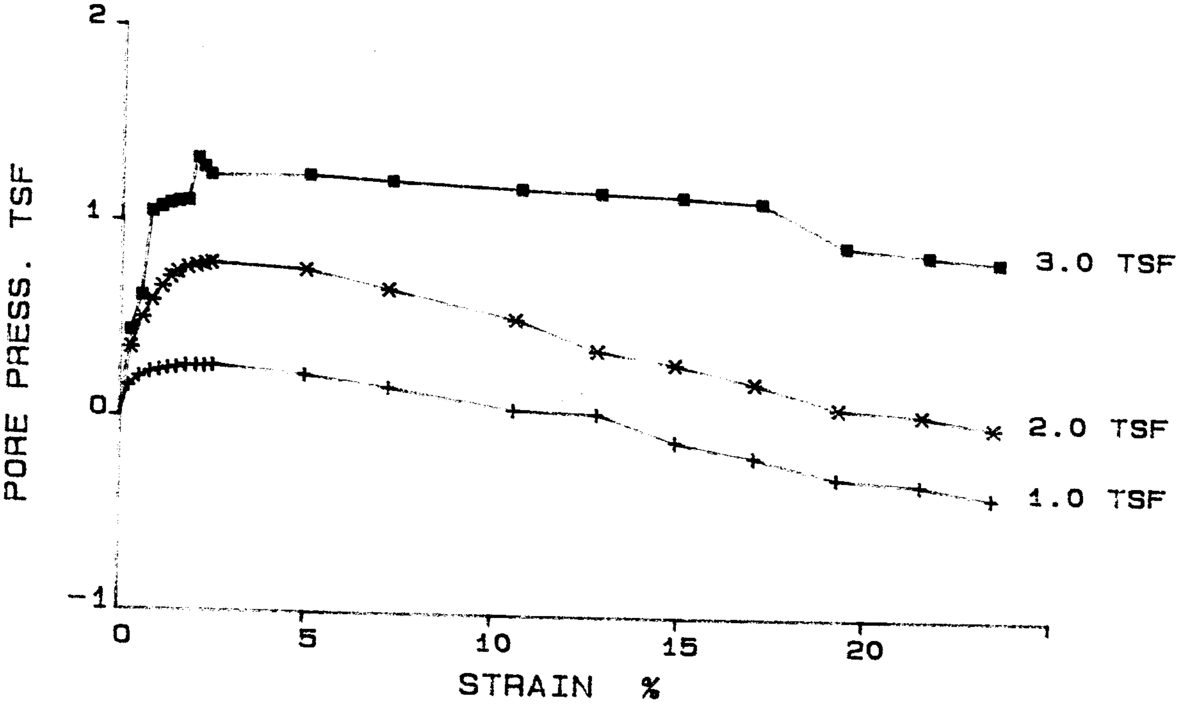
REMARKS:

SINGLETON LABORATORIES
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (R) TEST

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STKG PHS II
STATION:
RANGE :
BORING : US-55

EL. : 614.1-613.7
SAMPLE : 1
PART : 4
SOIL SYM: CH
DATE : 03-14-91





REMARKS:

Singleton Laboratories
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (R) TEST

Project: WIDOWS CREEK SP		File : 49
Feature: DRY STACKING PHS II		Tested By : TAL
Station:	El. : 614.1-613.7	Computed By: MHD
Range :	Sample: 1	Checked By : GPB
Boring : US-55	Part : 4	Report Date: 03-14-91

Soil Symbol= CH	L.L.(%)= 84	P.I.(%) = 55
Sp. Gr. = 2.75	D10(mm)= 0	

Specimen Number	1	2	3	4
Initial:				
Moisture Content(%)	29.3	30.4	30.1	0.0
Dry Density(pcf)	94.3	92.6	93.5	0.0
Void Ratio	0.820	0.854	0.835	0.000
Saturation(%)	98.3	97.8	99.0	0.0
Before Shearing:				
Moisture(%) (after satur.)	29.8	31.1	30.4	0.0
Saturation(%)	100.0	100.0	100.0	0.0
Moisture(%) (after cons.)	28.2	28.5	27.2	0.0
Void Ratio (after cons.)	0.775	0.784	0.747	0.000
Final Moisture Content(%)	31.0	32.2	30.3	0.0
Minor Principal Stress(tsf)	1.01(1.01)	2.02(2.02)	3.02(3.02)	0.00(0.00)
Major Principal Stress(tsf)	2.66(2.64)	4.14(4.08)	5.23(5.22)	0.00(0.00)
Eff. Minor Prin Stress(tsf)	0.82(0.76)	1.46(1.22)	1.76(1.68)	0.00(0.00)
Eff. Major Prin Stress(tsf)	2.48(2.40)	3.59(3.29)	3.97(3.88)	0.00(0.00)
Time to Failure(min)	30	40	10	0
Rate of Strain(%/min)	0.24	0.27	0.25	0.00
Specimen Height(in.)	3.12	3.12	3.12	0.00
Specimen Dia (in.)	1.40	1.40	1.40	0.00

	Max Deviator Stress		Max Eff Stress Ratio	
Shear Strength	Deg	c(tsf)	Deg	c(tsf)
Apparent	7.0	0.64	7.1	0.62
Effective	13.5	0.46	13.7	0.47

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Remark:

Singleton Laboratories
Consolidated Undrained Triaxial Compression (R) Test

Project: WIDOWS CREEK SP
Feature: DRY STACKING PHS II
Station:
Range :
Boring : US-55

El. : 614.1-613.7
Sample: 1
Part : 4

File : 49
Tested By : TAL
Computed By: MHD
Checked By : GPB
Report Date: 02-26-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	155.5	154.4	194.8
Dry Wt. and Tare(gm)=	131.1	119.4	157.8
Wt. of Tare(gm) =	39.1	0.0	38.4
Moisture(%) =	26.5	29.3	31.0

Test Conditions and Constants:

Proving Ring No. = 2212
Proving Ring Constant:
Slope Const. = 1.000236
Intercept = .0823636
Confining Pres.(psi) = 14
Initial Pore Pre(psi)= 100

Tube No. = 1
Sample Volume (cc) = 79.018
Sample Height(in.) = 3.123
Specific Gravity = 2.75
Consolidation(in.) = .026
Initial P.R. Rdg = 92

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Pore Pres. (psi)	Strain (%)	e1 - e3 (tsf)	Pore Press. (tsf)	e1 / e3 (TSF)
1	0.007	117.6	102.1	0.23	1.22	0.15	2.42
2	0.016	119.1	102.8	0.52	1.28	0.20	2.59
3	0.026	120.2	103.2	0.84	1.33	0.23	2.71
4	0.034	120.8	103.4	1.10	1.35	0.24	2.78
5	0.041	121.9	103.6	1.32	1.40	0.26	2.87
6	0.048	122.7	103.7	1.55	1.44	0.27	2.94
7	0.056	123.3	103.9	1.81	1.46	0.28	3.01
8	0.065	123.8	103.9	2.10	1.48	0.28	3.04
9	0.072	124.3	103.9	2.32	1.50	0.28	3.06
10	0.079	124.8	104.0	2.55	1.52	0.29	3.11
20	0.156	128.2	103.4	5.04	1.63	0.24	3.14
30	0.226	129.6	102.6	7.30	1.66	0.19	3.02
40	0.330	129.9	101.2	10.66	1.61	0.09	2.75
50	0.399	129.0	101.0	12.88	1.53	0.07	2.64
60	0.465	129.4	99.1	15.01	1.51	-0.06	2.41
70	0.531	129.1	98.1	17.15	1.46	-0.14	2.28
80	0.600	128.6	96.7	19.37	1.40	-0.24	2.13
90	0.670	128.6	96.3	21.63	1.36	-0.27	2.07
95	0.730	128.5	95.4	23.57	1.33	-0.33	1.99

Initial:
Moisture(%) = 29.3
Density(pcf)= 94.3
Void Ratio =0.820
Saturation(%)= 98.3
After Saturation:
Moisture(%) = 29.8
Void Ratio =0.775

Minor Prin. Stress(tsf) =1.01
Major Prin. Stress(tsf) = 2.66(2.64)
Eff. Minor Prin. Stress(tsf)=0.82(0.76)
Eff. Major Prin. Stress(tsf)= 2.48(2.40)

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Singleton Laboratories
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (R) TEST

Project: WIDOWS CREEK SP
File : 49

Feature: DRY STACKING PHS II
Tested By : TAL

Station:
El. : 614.1-613.7
Computed By: MHD

~~Range :~~
~~Sample: 1~~
~~Checked By : GPB~~

Boring : US-55
Part : 4
Report Date: 03-14-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	167.6	152.8	192.9
Dry Wt. and Tare(gm)=	141.0	117.2	155.2
Wt. of Tare(gm) =	38.4	0.0	38.0
Moisture(%) =	25.9	30.4	32.2

Test Conditions and Constants:

Proving Ring No. = 2284
Proving Ring Constant:
Slope Const. = 1.000268
Intercept = .112727
Confining Pres.(psi) = 28
Initial Pore Pre(psi)= 100

Tube No. = 1
Sample Volume (cc) = 79.018
Sample Height(in.) = 3.123
Specific Gravity = 2.75
Consolidation(in.) = .04
Initial P.R. Rdg = 102

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Pore Pres. (psi)	Strain (%)	*e*1 - *e*3 (tsf)	Pore Press. (tsf)	*e*1 / *e*3 (TSF)
1	0.009	125.1	104.9	0.29	1.11	0.35	1.67
2	0.019	130.9	107.1	0.62	1.38	0.51	1.92
3	0.027	134.5	108.4	0.88	1.55	0.60	2.10
4	0.036	135.3	109.4	1.17	1.58	0.68	2.18
5	0.043	138.1	110.1	1.39	1.71	0.73	2.33
6	0.049	139.9	110.5	1.59	1.79	0.76	2.42
7	0.058	140.5	110.9	1.88	1.81	0.78	2.47
8	0.065	141.7	111.1	2.11	1.87	0.80	2.53
9	0.072	142.5	111.3	2.34	1.90	0.81	2.58
10	0.078	143.1	111.4	2.53	1.92	0.82	2.61
20	0.157	147.4	111.0	5.09	2.07	0.79	2.69
30	0.226	147.4	109.7	7.33	2.02	0.70	2.53
40	0.331	151.7	107.7	10.74	2.13	0.55	2.46
50	0.399	151.0	105.6	12.94	2.05	0.40	2.27
60	0.464	150.7	104.7	15.05	1.98	0.34	2.18
70	0.531	149.2	103.4	17.22	1.87	0.24	2.06
80	0.601	148.4	101.7	19.49	1.79	0.12	1.95
90	0.671	148.1	101.3	21.76	1.73	0.09	1.90
95	0.731	147.0	100.5	23.71	1.65	0.04	1.83

Initial:
Moisture(%) = 30.4
Void Ratio =0.854
Density(pcf)= 92.6
Saturation(%)= 97.8
After Saturation:
Moisture(%) = 31.1
Void Ratio =0.784

Minor Prin. Stress(tsf) =2.02
Major Prin. Stress(tsf) = 4.14(4.08)
Eff. Minor Prin. Stress(tsf)=1.46(1.22)
Eff. Major Prin. Stress(tsf)= 3.59(3.29)

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Singleton Laboratories
Consolidated Undrained Triaxial Compression (R) Test

Project: WIDOWS CREEK SP
Feature: DRY STACKING PHS II
Station:
Range :
Boring : US-55

El. : 614.1-613.7
Sample: 1
Part : 4

File : 49
Tested By : TAL
Computed By: MHD
Checked By : GPB
Report Date: 02-26-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	158.0	154.0	193.3
Dry Wt. and Tare(gm)=	130.4	118.4	157.4
Wt. of Tare(gm) =	37.0	0.0	39.0
Moisture(%) =	29.6	30.1	30.3

Test Conditions and Constants:
Proving Ring No. = 2288
Proving Ring Constant:
Slope Const. = 1
Intercept = 0
Confining Pres.(psi) = 42
Initial Pore Pre(psi)= 100

Tube No. = 1
Sample Volume (cc) = 79.018
Sample Height(in.) = 3.123
Specific Gravity = 2.75
Consolidation(in.) = .051
Initial P.R. Rdg = 113

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Pore Pres. (psi)	Strain (%)	e1 - e3 (tsf)	Pore Press. (tsf)	e1 / e3 (TSF)
1	0.009	143.1	106.1	0.29	1.45	0.44	1.56
2	0.018	149.3	108.6	0.59	1.74	0.62	1.72
3	0.026	152.6	114.6	0.85	1.89	1.05	1.96
4	0.034	155.7	115.0	1.11	2.04	1.08	2.05
5	0.041	157.1	115.3	1.33	2.10	1.10	2.09
6	0.048	158.1	115.5	1.56	2.14	1.12	2.12
7	0.056	159.2	115.6	1.82	2.19	1.12	2.15
8	0.064	159.5	118.6	2.08	2.19	1.34	2.30
9	0.070	159.7	118.0	2.28	2.20	1.30	2.27
10	0.076	159.9	117.5	2.47	2.20	1.26	2.25
20	0.158	160.5	117.6	5.14	2.17	1.27	2.24
30	0.227	159.1	117.3	7.39	2.06	1.25	2.16
40	0.333	160.4	116.9	10.84	2.04	1.22	2.13
50	0.399	159.6	116.7	12.99	1.95	1.20	2.07
60	0.467	161.3	116.5	15.20	1.97	1.19	2.08
70	0.533	161.4	116.2	17.35	1.93	1.17	2.04
80	0.603	158.7	113.2	19.63	1.77	0.95	1.85
90	0.672	158.4	112.7	21.88	1.71	0.91	1.81
95	0.731	157.2	112.3	23.80	1.62	0.89	1.76

Initial:
Moisture(%) = 30.1
Density(pcf)= 93.5

Void Ratio =0.835
Saturation(%)= 99.0

After Saturation:
Moisture(%) = 30.4

Void Ratio =0.747

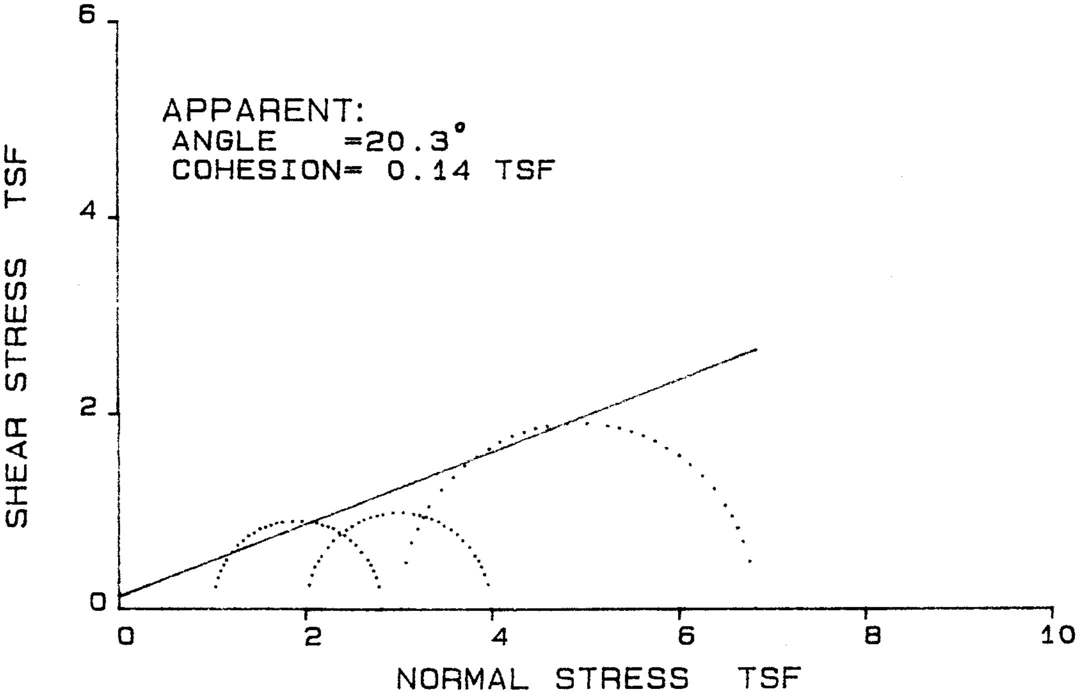
Minor Prin. Stress(tsf) =3.02
Eff. Minor Prin. Stress(tsf)=1.76(1.68)

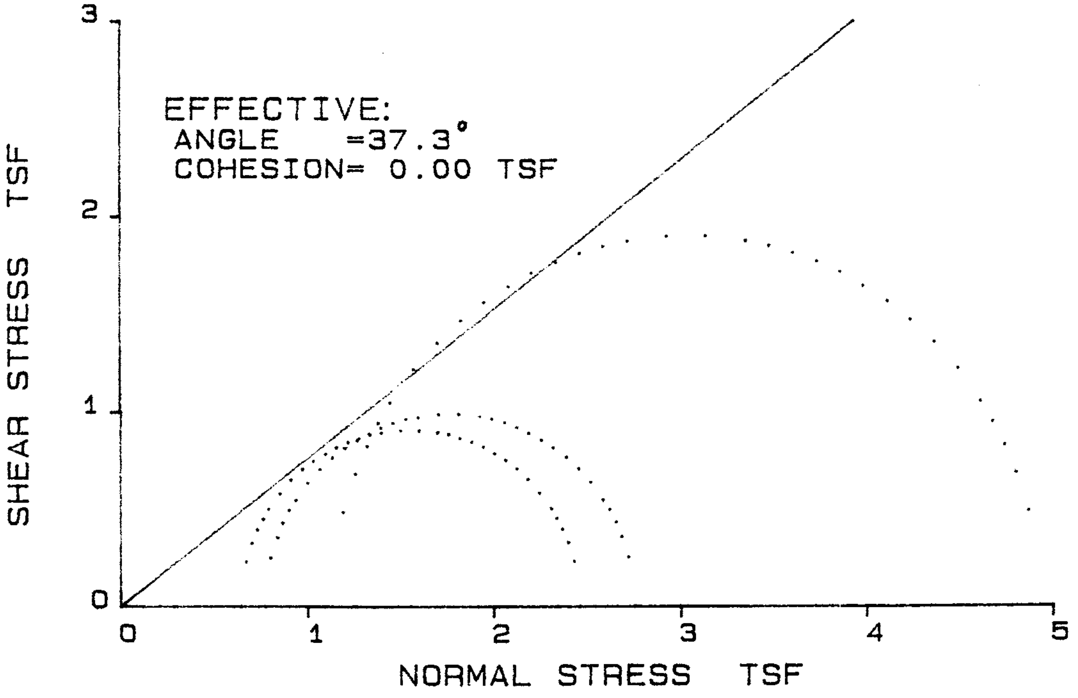
Major Prin. Stress(tsf) = 5.23(5.22)
Eff. Major Prin. Stress(tsf)= 3.97(3.88)

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

SINGLETON LABORATORIES
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (R) TEST

PROJECT:	WIDOWS CREEK SP	EL.	: 597.9-597.6
FEATURE:	DRY STKG PHS II	SAMPLE	: 1
STATION:		PART	: 3
RANGE :		SOIL SYM:	SC
BORING :	US-60	DATE	: 02-27-91



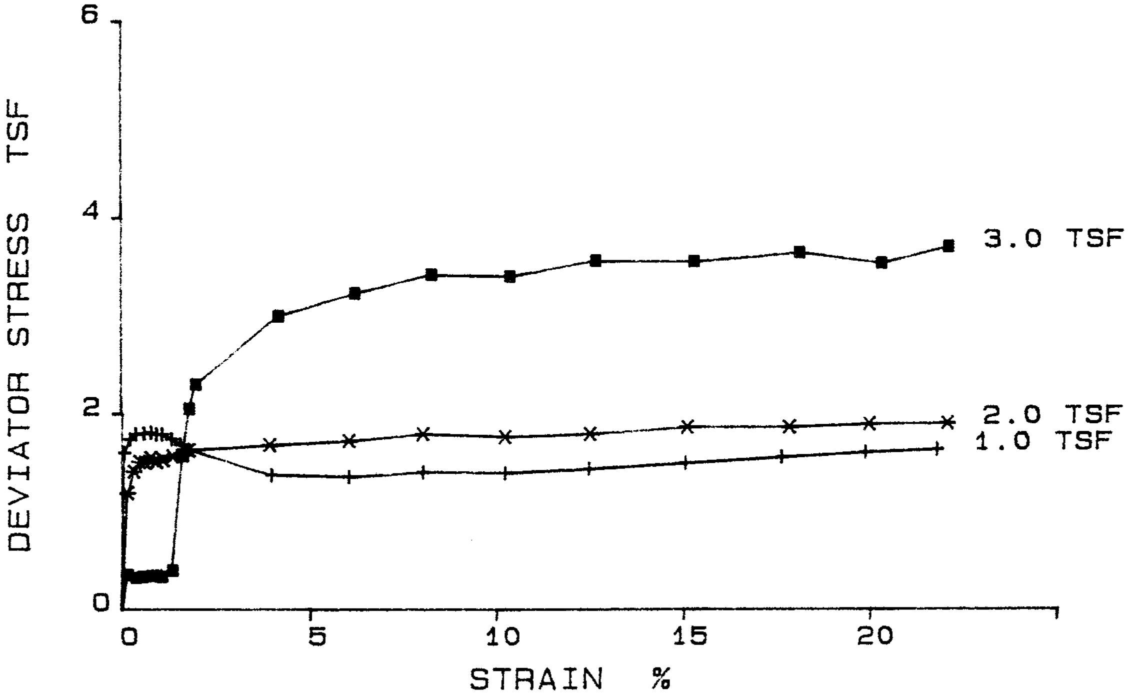


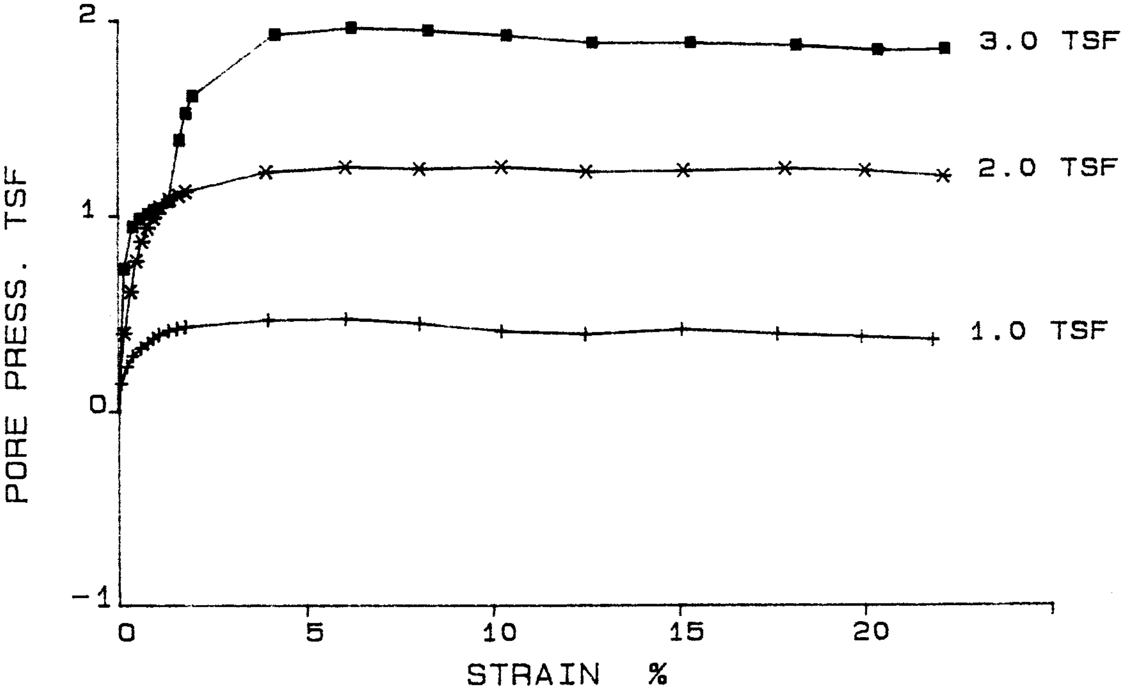
REMARKS: 40% REMOLDED

SINGLETON LABORATORIES
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (R) TEST

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STKG PHS II
STATION:
RANGE :
BORING : US-60

EL. : 597.9-597.6
SAMPLE : 1
PART : 3
SOIL SYM: SC
DATE : 02-27-91





REMARKS: 40% REMOLDED

Singleton Laboratories
Consolidated Undrained Triaxial Compression (R) Test

Project: WIDOWS CREEK SP
Feature: DRY STACKING PHS II
Station:
Range :
Boring : US-60

El. : 597.9-597.6
Sample: 1
Part : 3

File : 50
Tested By : TAL
Computed By: MHD
Checked By : GPB
Report Date: 02-27-91

Soil Symbol= SC
Sp. Gr. = 2.73

L.L.(%)= 46
D10(mm)= .0009

P.I.(%) = 25

Specimen Number	1	2	3	4
Initial:				
Moisture Content(%)	13.3	14.0	14.7	0.0
Dry Density(pcf)	116.1	112.5	113.8	0.0
Void Ratio	0.468	0.515	0.498	0.000
Saturation(%)	77.8	74.1	80.7	0.0
Before Shearing:				
Moisture(%) (after satur.)	17.2	18.9	18.2	0.0
Saturation(%)	100.0	100.0	100.0	0.0
Moisture(%) (after cons.)	15.5	16.0	13.6	0.0
Void Ratio (after cons.)	0.422	0.436	0.372	0.000
Final Moisture Content(%)	17.5	17.0	16.0	0.0
Minor Principal Stress(tsf)	1.01(1.01)	2.02(2.02)	3.02(3.02)	0.00(0.00)
Major Principal Stress(tsf)	2.83(2.77)	4.00(3.99)	6.83(6.83)	0.00(0.00)
Eff. Minor Prin Stress(tsf)	0.64(0.57)	0.77(0.74)	1.13(1.13)	0.00(0.00)
Eff. Major Prin Stress(tsf)	2.46(2.33)	2.76(2.72)	4.94(4.94)	0.00(0.00)
Time to Failure(min)	5	98	98	0
Rate of Strain(%/min)	0.17	0.23	0.23	0.00
Specimen Height(in.)	3.12	3.12	3.12	0.00
Specimen Dia (in.)	1.40	1.40	1.40	0.00

	Max Deviator Stress		Max Eff Stress Ratio	
Shear Strength	Deg	c(tsf)	Deg	c(tsf)
Apparent	20.3	0.14	20.6	0.11
Effective	37.3	0.00	90.0	0.00

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Remark: 40% REMOLDED

Singleton Laboratories
Consolidated Undrained Triaxial Compression (R) Test

Project: WIDOWS CREEK SP
Feature: DRY STACKING PHS II
Station:
Range :
Boring : US-60

El. : 597.9-597.6
Sample: 1
Part : 3

File :
Tested By : TAL
Computed By: MHD
Checked By : GPB
Report Date: 02-27-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	188.1	166.5	212.4
Dry Wt. and Tare(gm)=	170.3	146.9	186.7
Wt. of Tare(gm) =	38.2	0.0	39.8
Moisture(%) =	13.5	13.3	17.5

Test Conditions and Constants:
Proving Ring No. = 2409
Proving Ring Constant:
Slope Const. = 1.002145
Intercept = .194545
Confining Pres.(psi) = 14
Initial Pore Pre(psi)= 100

Tube No. = 1
Sample Volume (cc) = 79.018
Sample Height(in.) = 3.123
Specific Gravity = 2.73
Consolidation(in.) = .033
Initial P.R. Rdg = 92

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Pore Pres. (psi)	Strain (%)	*e1 - e3* (tsf)	Pore Press. (tsf)	*e1 / e3* (TSF)
1	0.003	125.4	102.0	0.10	1.60	0.14	2.85
2	0.008	128.4	103.3	0.26	1.74	0.24	3.26
3	0.013	129.7	104.1	0.42	1.80	0.30	3.53
4	0.020	130.0	104.7	0.65	1.81	0.34	3.71
5	0.026	130.3	105.1	0.84	1.82	0.37	3.84
6	0.031	130.1	105.5	1.00	1.81	0.40	3.96
7	0.036	130.2	105.8	1.17	1.81	0.42	4.07
8	0.044	129.3	106.1	1.42	1.76	0.44	4.10
9	0.051	128.2	106.3	1.65	1.71	0.45	4.08
10	0.058	127.4	106.5	1.88	1.67	0.47	4.09
20	0.126	122.7	107.0	4.08	1.41	0.50	3.81
30	0.190	123.0	107.1	6.15	1.40	0.51	3.81
40	0.252	125.0	106.8	8.16	1.46	0.49	3.81
50	0.320	125.7	106.3	10.36	1.45	0.45	3.62
60	0.390	127.6	106.1	12.62	1.49	0.44	3.62
70	0.470	130.2	106.5	15.21	1.55	0.47	3.88
80	0.550	133.0	106.2	17.80	1.62	0.45	3.88
90	0.620	135.7	106.0	20.06	1.67	0.43	3.91
98	0.680	137.6	105.8	22.01	1.70	0.42	3.89

Initial:
Moisture(%) = 13.3
Density(pcf)=116.1
Void Ratio =0.468
Saturation(%)= 77.8
After Saturation:
Moisture(%) = 17.2
Void Ratio =0.422

Minor Prin. Stress(tsf) =1.01
Eff. Minor Prin. Stress(tsf)=0.64(0.57)
Major Prin. Stress(tsf) = 2.83(2.77)
Eff. Major Prin. Stress(tsf)= 2.46(2.33)

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Singleton Laboratories
Consolidated Undrained Triaxial Compression (R) Test

Project: WIDOWS CREEK SP
Feature: DRY STACKING PHS II
Station:
Range :
Boring : US-60

El. : 597.9-597.6
Sample: 1
Part : 3

File :
Tested By : TAL
Computed By: MHD
Checked By : GPB
Report Date: 02-27-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	158.6	162.3	205.8
Dry Wt. and Tare(gm)=	145.1	142.4	181.6
Wt. of Tare(gm) =	39.0	0.0	39.2
Moisture(%) =	12.7	14.0	17.0

Test Conditions and Constants:
Proving Ring No. = 2410
Proving Ring Constant:
Slope Const. = 1.003969
Intercept =-.01636
Confining Pres.(psi) = 28
Initial Pore Pre(psi)= 100

Tube No. = 1
Sample Volume (cc) = 79.018
Sample Height(in.) = 3.123
Specific Gravity = 2.73
Consolidation(in.) = .055
Initial P.R. Rdg = 100

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Pore Pres. (psi)	Strain (%)	e1 - e3 (tsf)	Pore Press. (tsf)	e1 / e3 (TSF)
1	0.005	124.7	105.6	0.16	1.20	0.40	1.74
2	0.011	129.3	108.6	0.36	1.42	0.62	2.01
3	0.016	131.6	110.8	0.52	1.52	0.78	2.23
4	0.021	131.5	112.2	0.68	1.52	0.88	2.33
5	0.026	132.7	113.2	0.85	1.57	0.95	2.48
6	0.031	132.1	113.9	1.01	1.54	1.00	2.52
7	0.037	132.7	114.7	1.21	1.57	1.06	2.64
8	0.045	133.7	115.3	1.47	1.61	1.10	2.76
9	0.053	134.1	115.6	1.73	1.62	1.12	2.82
10	0.059	135.3	115.9	1.92	1.68	1.14	2.93
20	0.125	137.2	117.3	4.07	1.73	1.25	3.25
30	0.190	139.1	117.7	6.19	1.78	1.27	3.40
40	0.252	141.7	117.6	8.21	1.86	1.27	3.48
50	0.320	142.1	117.8	10.43	1.83	1.28	3.49
60	0.390	144.0	117.5	12.71	1.86	1.26	3.46
70	0.470	147.3	117.6	15.32	1.94	1.27	3.59
80	0.554	148.9	117.8	18.06	1.94	1.28	3.65
90	0.620	151.0	117.7	20.21	1.97	1.27	3.66
98	0.685	152.7	117.3	22.33	1.99	1.25	3.58

Initial:
Moisture(%) = 14.0 Void Ratio =0.515
Density(pcf)=112.5 Saturation(%)= 74.1
After Saturation:
Moisture(%) = 18.9 Void Ratio =0.436

Minor Prin. Stress(tsf) =2.02 Major Prin. Stress(tsf) = 4.00(3.99)
Eff. Minor Prin. Stress(tsf)=0.77(0.74) Eff. Major Prin. Stress(tsf)= 2.76(2.72)

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Singleton Laboratories
Consolidated Undrained Triaxial Compression (R) Test

Project: WIDOWS CREEK SP
Feature: DRY STACKING PHS II
Station:
Range :
Boring : US-60

El. : 597.9-597.6
Sample: 1
Part : 3

File :
Tested By : TAL
Computed By: MHD
Checked By : GPB
Report Date: 02-27-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	165.1	165.2	206.0
Dry Wt. and Tare(gm)=	150.3	144.0	183.0
Wt. of Tare(gm) =	40.3	0.0	39.0
Moisture(%) =	13.5	14.7	16.0

Test Conditions and Constants:

Proving Ring No. = 2411
Proving Ring Constant:
Slope Const. = 1.002878
Intercept = 7.454501E-02
Confining Pres.(psi) = 42
Initial Pore Pre(psi)= 100

Tube No. = 1
Sample Volume (cc) = 79.018
Sample Height(in.) = 3.123
Specific Gravity = 2.73
Consolidation(in.) = 9.000001E-02
Initial P.R. Rdg = 108

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Pore Pres. (psi)	Strain (%)	e1 - e3 (tsf)	Pore Press. (tsf)	e1 / e3 (TSF)
1	0.005	115.1	110.2	0.16	0.36	0.73	1.16
2	0.012	114.6	113.2	0.40	0.33	0.95	1.16
3	0.018	114.9	113.8	0.59	0.34	0.99	1.17
4	0.025	115.2	114.2	0.82	0.36	1.02	1.18
5	0.030	115.4	114.5	0.99	0.37	1.04	1.19
6	0.034	115.4	114.7	1.12	0.37	1.06	1.19
7	0.043	116.9	115.2	1.42	0.44	1.09	1.23
8	0.052	141.0	119.6	1.71	1.61	1.41	2.00
9	0.058	151.1	121.5	1.91	2.10	1.55	2.42
10	0.064	156.4	122.8	2.11	2.35	1.64	2.70
20	0.131	172.3	127.2	4.32	3.05	1.96	3.87
30	0.193	178.8	127.7	6.36	3.29	1.99	4.20
40	0.256	184.8	127.5	8.44	3.49	1.98	4.34
50	0.320	186.2	127.2	10.55	3.47	1.96	4.26
60	0.390	192.2	126.7	12.86	3.64	1.92	4.31
70	0.470	194.8	126.7	15.50	3.64	1.92	4.30
80	0.556	200.2	126.5	18.33	3.74	1.91	4.35
90	0.623	200.0	126.2	20.54	3.63	1.89	4.19
98	0.678	206.8	126.3	22.35	3.81	1.89	4.37

Initial:
Moisture(%) = 14.7
Density(pcf)=113.8
Void Ratio =0.498
Saturation(%)= 80.7

After Saturation:
Moisture(%) = 18.2
Void Ratio =0.372

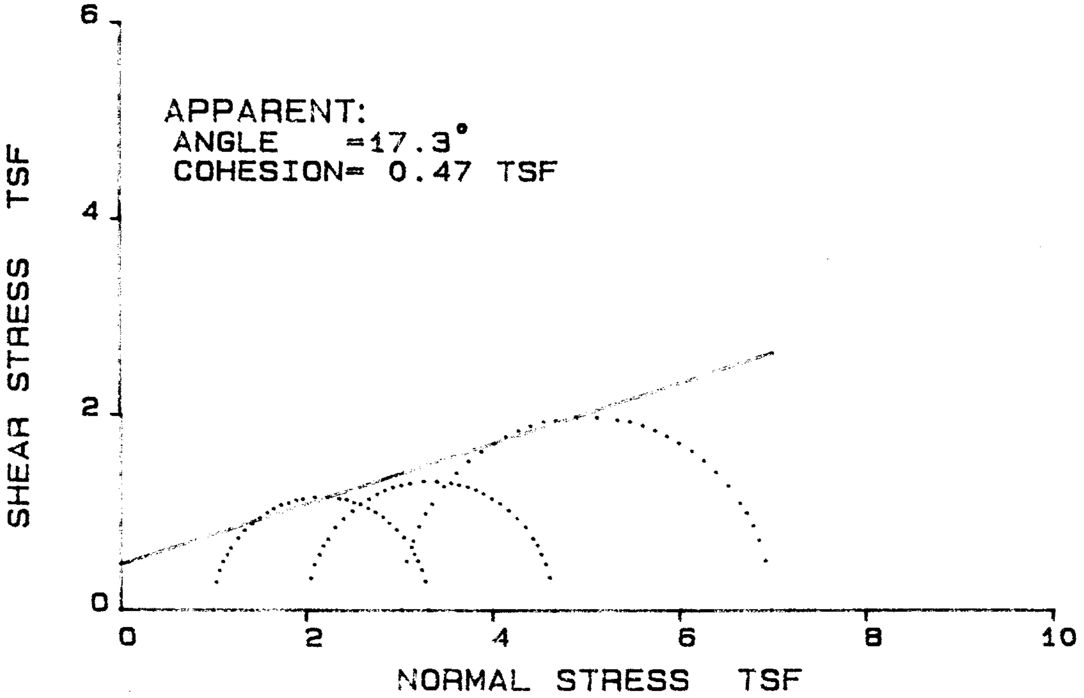
Minor Prin. Stress(tsf) =3.02
Major Prin. Stress(tsf) = 6.83(6.83)
Eff. Minor Prin. Stress(tsf)=1.13(1.13)
Eff. Major Prin. Stress(tsf)= 4.94(4.94)

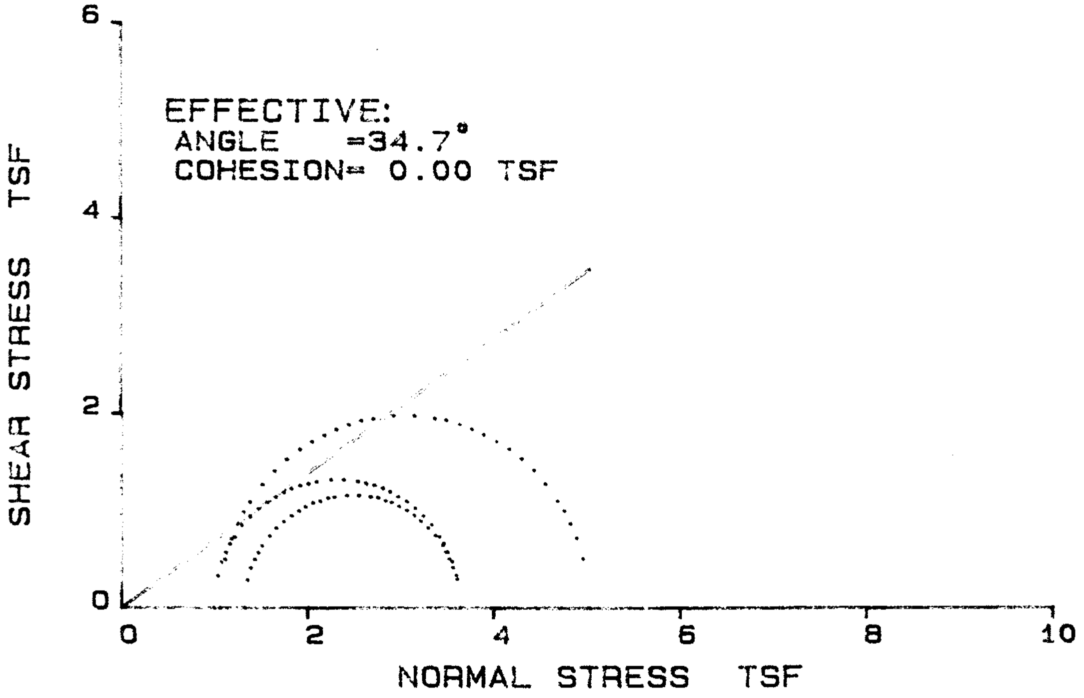
NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

SINGLETON LABORATORIES
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (R) TEST

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STCKG PHS II
STATION:
RANGE :
BORING : US-60

EL. : 590.5-590.1
SAMPLE : 2
PART : 3
SOIL SYM: CH
DATE : 03-14-91



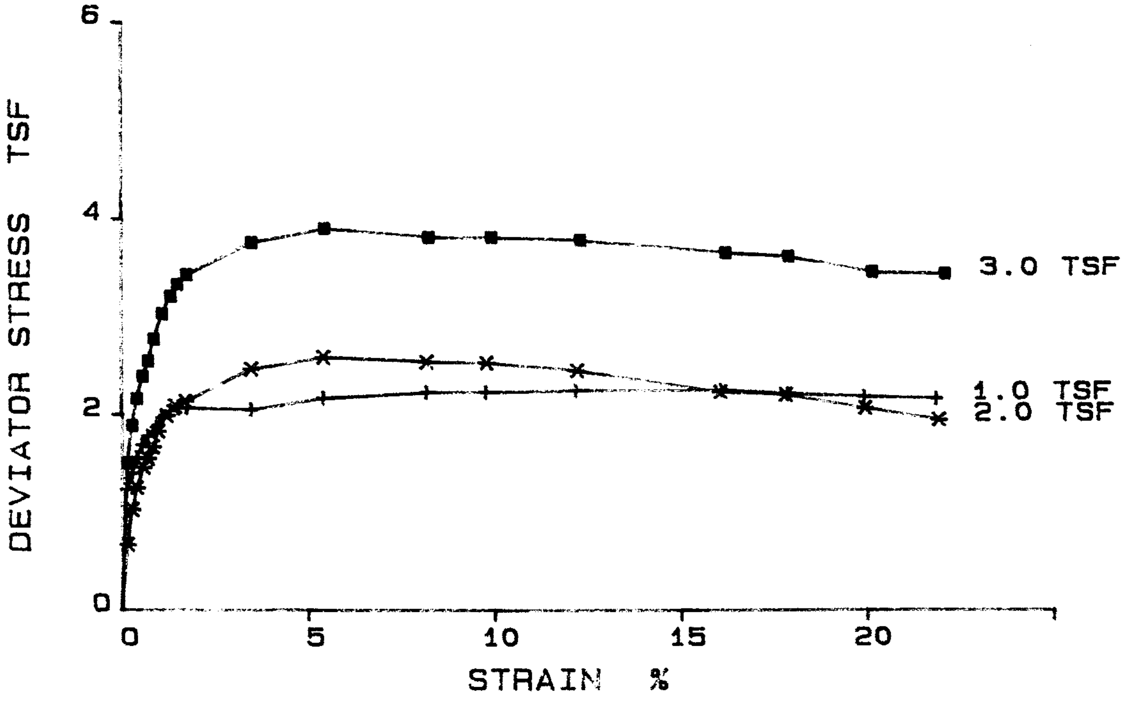


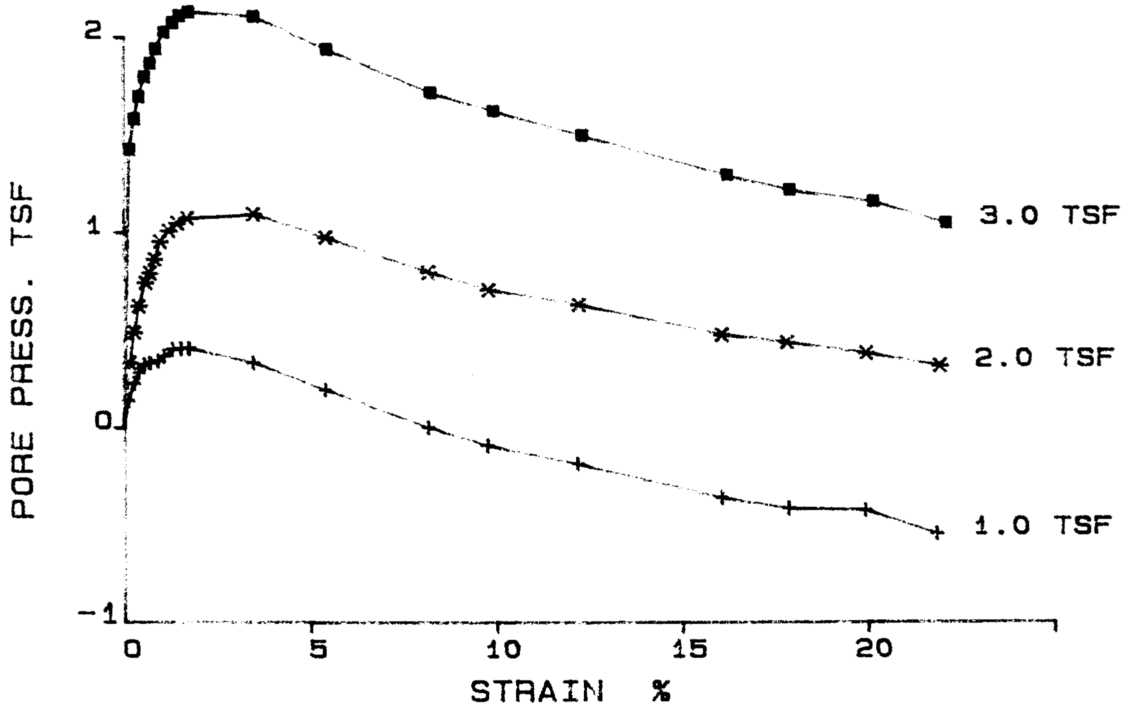
REMARKS:

SINGLETON LABORATORIES
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (R) TEST

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STCKG PHS II
STATION:
RANGE :
BORING : US-60

EL. : 590.5-590.1
SAMPLE : 2
PART : 3
SOIL SYM: CH
DATE : 03-14-91





REMARKS:

Singleton Laboratories
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (R) TEST

Project: WIDOWS CREEK SP		File : 9
Feature: DRY STACKING PHS II		Tested By : TAL
Station:	El. : 590.5-590.1	Computed By: MHD
Range :	Sample: 2	Checked By : GPB
Boring : US-60	Part : 3	Report Date: 03-14-91

Soil Symbol= CH	L.L.(%)= 54	P.I.(%) = 32
Sp. Gr. = 2.78	D10(mm)= 0	

Specimen Number	1	2	3	4
Initial:				
Moisture Content(%)	25.1	25.2	23.7	0.0
Dry Density(pcf)	100.3	100.1	100.8	0.0
Void Ratio	0.731	0.734	0.722	0.000
Saturation(%)	95.6	95.4	91.5	0.0
Before Shearing:				
Moisture(%) (after satur.)	26.3	26.4	26.0	0.0
Saturation(%)	100.0	100.0	100.0	0.0
Moisture(%) (after cons.)	24.3	24.0	22.5	0.0
Void Ratio (after cons.)	0.677	0.668	0.624	0.000
Final Moisture Content(%)	26.2	26.6	24.8	0.0
Minor Principal Stress(tsf)	1.01(1.01)	2.02(2.02)	3.02(3.02)	0.00(0.00)
Major Principal Stress(tsf)	3.33(3.12)	4.67(4.54)	6.99(6.85)	0.00(0.00)
Eff. Minor Prin Stress(tsf)	1.33(0.57)	1.01(0.89)	1.07(0.90)	0.00(0.00)
Eff. Major Prin Stress(tsf)	3.66(2.68)	3.66(3.42)	5.04(4.72)	0.00(0.00)
Time to Failure(min)	70	30	30	0
Rate of Strain(%/min)	0.23	0.18	0.19	0.00
Specimen Height(in.)	3.12	3.12	3.12	0.00
Specimen Dia (in.)	1.40	1.40	1.40	0.00

	Max Deviator Stress		Max Eff Stress Ratio	
Shear Strength	Deg	c(tsf)	Deg	c(tsf)
Apparent	17.3	0.47	17.7	0.39
Effective	34.7	0.00	90.0	0.00

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Remark:

Singleton Laboratories
Consolidated Undrained Triaxial Compression (R) Test

Project: WIDOWS CREEK SP
File :
Feature: DRY STACKING PHS II
Tested By : TAL
Station:
El. : 590.5-590.1
Computed By: MHD
Range :
Sample: 2
Checked By : GPB
Boring : US-60
Part : 3
Report Date: 03-14-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	186.9	158.8	199.4
Dry Wt. and Tare(gm)=	157.2	126.9	166.1
Wt. of Tare(gm) =	38.6	0.0	39.2
Moisture(%) =	25.0	25.1	26.2

Test Conditions and Constants:

Proving Ring No. = 2409
Proving Ring Constant:
Slope Const. = 1.002145
Intercept = .194545
Confining Pres.(psi) = 14
Initial Pore Pre(psi)= 100

Tube No. = 1
Sample Volume (cc) = 79.018
Sample Height(in.) = 3.123
Specific Gravity = 2.78
Consolidation(in.) = .033
Initial P.R. Rdg = 93

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Pore Pres. (psi)	Strain (%)	e1 - e3 (tsf)	Pore Press. (tsf)	e1 / e3 (TSF)
1	0.004	118.7	102.0	0.13	1.23	0.14	2.43
2	0.009	122.4	103.3	0.29	1.41	0.24	2.83
3	0.013	125.9	104.1	0.42	1.57	0.30	3.21
4	0.018	128.9	104.7	0.58	1.71	0.34	3.56
5	0.023	130.9	104.9	0.74	1.80	0.35	3.75
6	0.030	133.0	105.1	0.97	1.90	0.37	3.97
7	0.035	135.2	105.5	1.13	2.00	0.40	4.27
8	0.042	136.9	106.0	1.36	2.08	0.43	4.60
9	0.049	137.7	106.1	1.59	2.11	0.44	4.71
10	0.056	137.9	106.1	1.81	2.11	0.44	4.72
20	0.110	138.3	105.1	3.56	2.09	0.37	4.27
30	0.170	142.1	103.2	5.50	2.22	0.23	3.86
40	0.256	145.0	100.5	8.28	2.29	0.04	3.35
50	0.305	146.1	99.2	9.87	2.29	-0.06	3.15
60	0.380	148.1	97.9	12.30	2.31	-0.15	3.00
70	0.500	150.9	95.5	16.18	2.32	-0.32	2.75
80	0.556	151.3	94.8	17.99	2.29	-0.37	2.66
90	0.620	152.2	94.7	20.06	2.27	-0.38	2.63
95	0.680	153.3	93.1	22.01	2.25	-0.50	2.50

Initial:
Moisture(%) = 25.1
Void Ratio =0.731
Density(pcf)=100.3
Saturation(%)= 95.6
After Saturation:
Moisture(%) = 26.3
Void Ratio =0.677

Minor Prin. Stress(tsf) =1.01
Major Prin. Stress(tsf) = 3.33(3.12)
Eff. Minor Prin. Stress(tsf)=1.33(0.57)
Eff. Major Prin. Stress(tsf)= 3.66(2.68)

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Singleton Laboratories
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (R) TEST

Project: WIDOWS CREEK SP
Feature: DRY STACKING PHS II
Station:
~~Range :~~
Boring : US-60

El. : 590.5-590.1
~~Sample: 2~~
Part : 3

File : 9
Tested By : TAL
Computed By: MHD
~~Checked By :~~ GPB
Report Date: 03-14-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	147.9	158.6	199.4
Dry Wt. and Tare(gm)=	126.1	126.7	165.7
Wt. of Tare(gm) =	37.6	0.0	39.0
Moisture(%) =	24.6	25.2	26.6

Test Conditions and Constants:
Proving Ring No. = 2410
Proving Ring Constant:
Slope Const. = 1.003969
Intercept =-.01636
Confining Pres.(psi) = 28
Initial Pore Pre(psi)= 100

Tube No. = 1
Sample Volume (cc) = 79.018
Sample Height(in.) = 3.123
Specific Gravity = 2.78
Consolidation(in.) = .04
Initial P.R. Rdg = 100

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Pore Pres. (psi)	Strain (%)	e1 - e3 (tsf)	Pore Press. (tsf)	e1 / e3 (TSF)
1	0.005	114.0	104.7	0.16	0.67	0.34	1.40
2	0.009	121.7	106.9	0.29	1.04	0.50	1.68
3	0.013	126.5	108.8	0.42	1.27	0.63	1.92
4	0.019	131.1	110.5	0.62	1.48	0.76	2.18
5	0.023	133.1	111.2	0.75	1.58	0.81	2.30
6	0.027	135.7	112.2	0.88	1.70	0.88	2.49
7	0.032	139.2	113.5	1.04	1.86	0.97	2.78
8	0.039	142.7	114.3	1.27	2.02	1.03	3.05
9	0.046	145.0	114.9	1.49	2.13	1.07	3.26
10	0.055	146.4	115.3	1.78	2.19	1.10	3.39
20	0.110	154.5	115.6	3.57	2.52	1.12	3.83
30	0.170	158.4	114.0	5.51	2.65	1.01	3.63
40	0.256	159.1	111.5	8.30	2.60	0.83	3.19
50	0.306	160.1	110.3	9.93	2.60	0.74	3.04
60	0.381	160.1	109.3	12.36	2.53	0.67	2.88
70	0.500	157.6	107.2	16.22	2.32	0.52	2.55
80	0.554	158.1	106.7	17.97	2.29	0.48	2.49
90	0.620	156.2	106.0	20.11	2.16	0.43	2.36
95	0.681	154.6	105.1	22.09	2.04	0.37	2.24

Initial:
Moisture(%) = 25.2
Density(pcf)=100.1
After Saturation:
Moisture(%) = 26.4

Void Ratio =0.734
Saturation(%)= 95.4

Void Ratio =0.668

Minor Prin. Stress(tsf) =2.02
Eff. Minor Prin. Stress(tsf)=1.01(0.89)

Major Prin. Stress(tsf) = 4.67(4.54)
Eff. Major Prin. Stress(tsf)= 3.66(3.42)

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Singleton Laboratories
Consolidated Undrained Triaxial Compression (R) Test

Project: WIDOWS CREEK SP
Feature: DRY STACKING PHS II
Station:
Range :
Boring : US-60

El. : 590.5-590.1
Sample: 2
Part : 3

File :
Tested By : TAL
Computed By: MHD
Checked By : GPB
Report Date: 03-14-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	188.1	157.9	197.5
Dry Wt. and Tare(gm)=	160.2	127.6	165.8
Wt. of Tare(gm) =	38.4	0.0	38.2
Moisture(%) =	22.9	23.7	24.8

Test Conditions and Constants:
Proving Ring No. = 2411
Proving Ring Constant:
Slope Const. = 1.002878
Intercept = 7.454501E-02
Confining Pres.(psi) = 42
Initial Pore Pre(psi)= 100

Tube No. = 1
Sample Volume (cc) = 79.018
Sample Height(in.) = 3.123
Specific Gravity = 2.78
Consolidation(in.) = .06
Initial P.R. Rdg = 120

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Pore Pres. (psi)	Strain (%)	e1 - e3 (tsf)	Pore Press. (tsf)	e1 / e3 (TSF)
1	0.005	151.0	119.8	0.16	1.51	1.43	1.94
2	0.009	159.0	122.0	0.29	1.89	1.58	2.32
3	0.013	165.0	123.6	0.42	2.18	1.70	2.65
4	0.018	170.0	125.0	0.59	2.42	1.80	2.98
5	0.023	173.6	126.0	0.75	2.59	1.87	3.25
6	0.028	178.4	127.1	0.91	2.82	1.95	3.63
7	0.035	184.0	128.3	1.14	3.08	2.04	4.12
8	0.042	188.0	129.0	1.37	3.26	2.09	4.49
9	0.048	190.7	129.5	1.57	3.39	2.12	4.76
10	0.056	193.1	129.8	1.83	3.49	2.15	4.98
20	0.110	201.5	129.5	3.59	3.82	2.12	5.25
30	0.170	206.4	127.2	5.55	3.97	1.96	4.73
40	0.256	207.2	124.1	8.36	3.89	1.74	4.02
50	0.308	208.9	122.8	10.06	3.89	1.64	3.81
60	0.381	210.7	121.1	12.44	3.86	1.52	3.57
70	0.501	212.0	118.3	16.36	3.74	1.32	3.19
80	0.553	213.0	117.3	18.05	3.71	1.25	3.08
90	0.622	211.7	116.5	20.31	3.56	1.19	2.94
95	0.682	213.5	115.0	22.27	3.54	1.08	2.82

Initial:
Moisture(%) = 23.7
Density(pcf)=100.8

Void Ratio =0.722
Saturation(%)= 91.5

After Saturation:
Moisture(%) = 26.0

Void Ratio =0.624

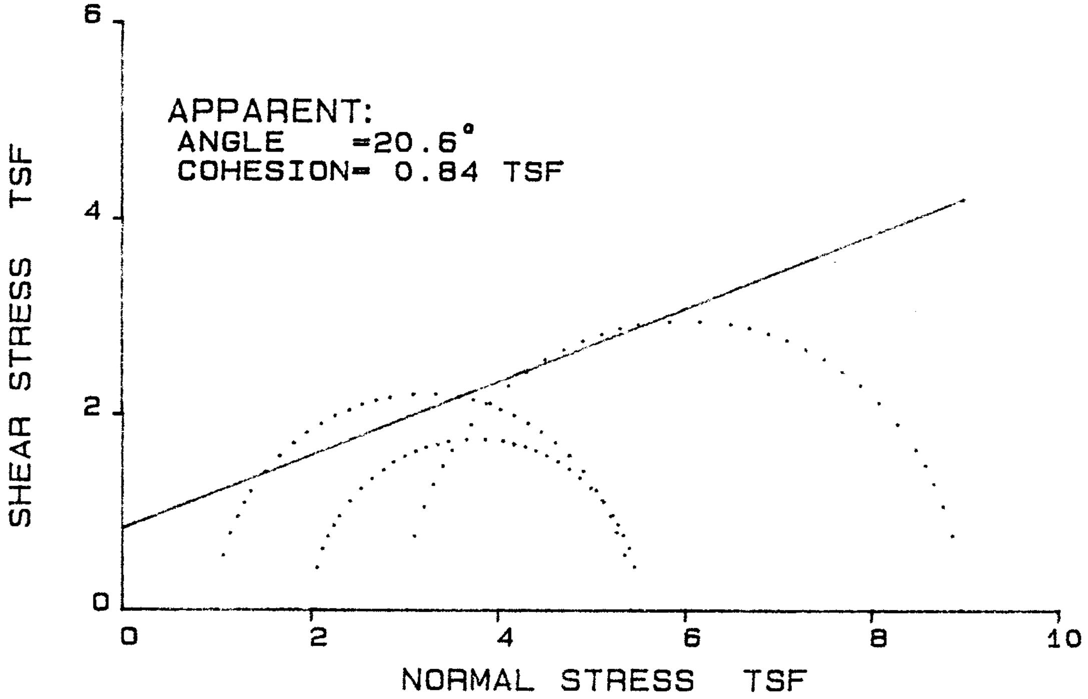
Minor Prin. Stress(tsf) =3.02
Eff. Minor Prin. Stress(tsf)=1.07(0.90)

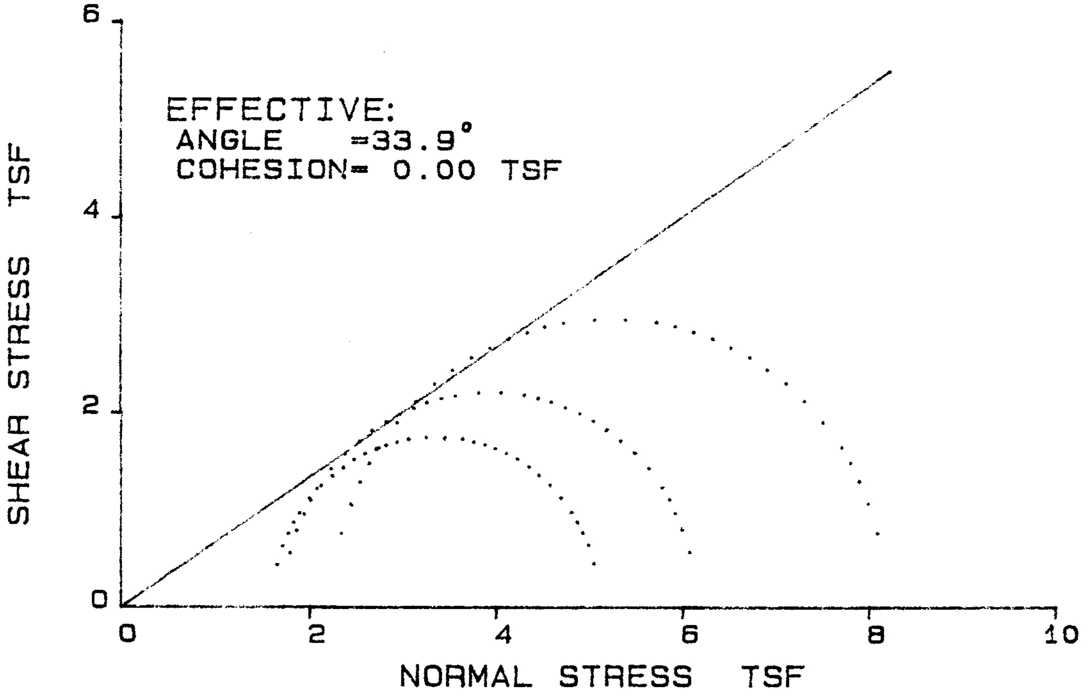
Major Prin. Stress(tsf) = 6.99(6.85)
Eff. Major Prin. Stress(tsf)= 5.04(4.72)

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

SINGLETON LABORATORIES
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (R) TEST

PROJECT:	WIDOWS CREEK SP	EL.	: 618.3-617.9
FEATURE:	DRY STKG PHS II	SAMPLE	: 1
STATION:		PART	: 2
RANGE :		SOIL SYM:	ML/CL
BORING :	US-73	DATE	: 02-27-91



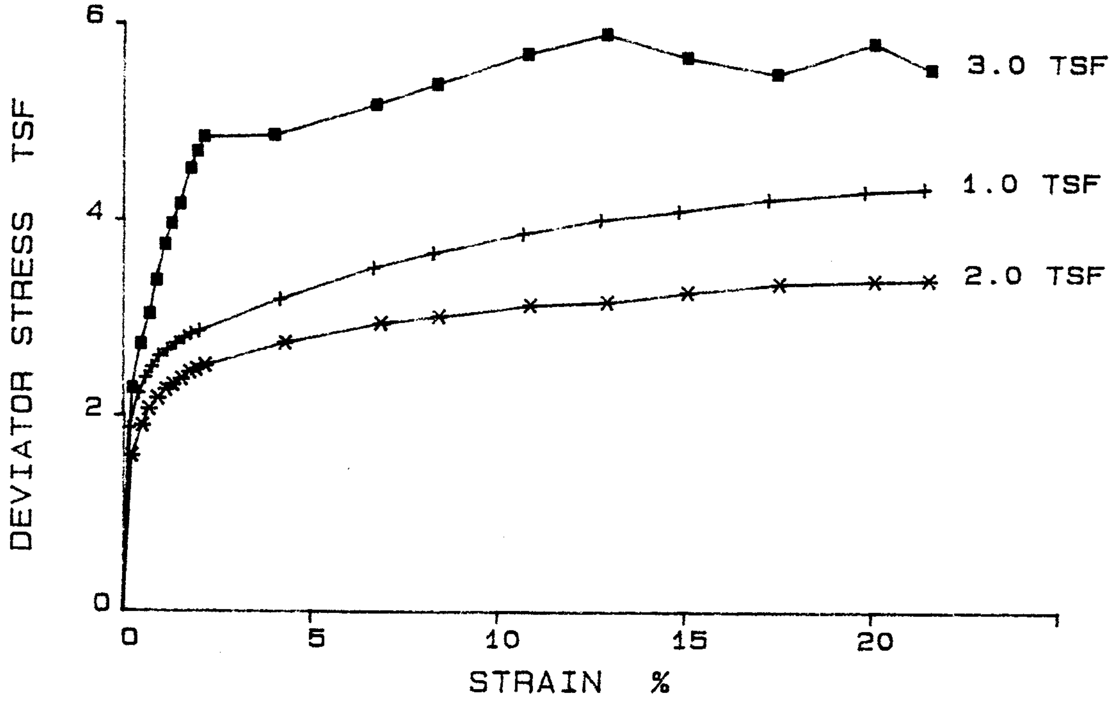


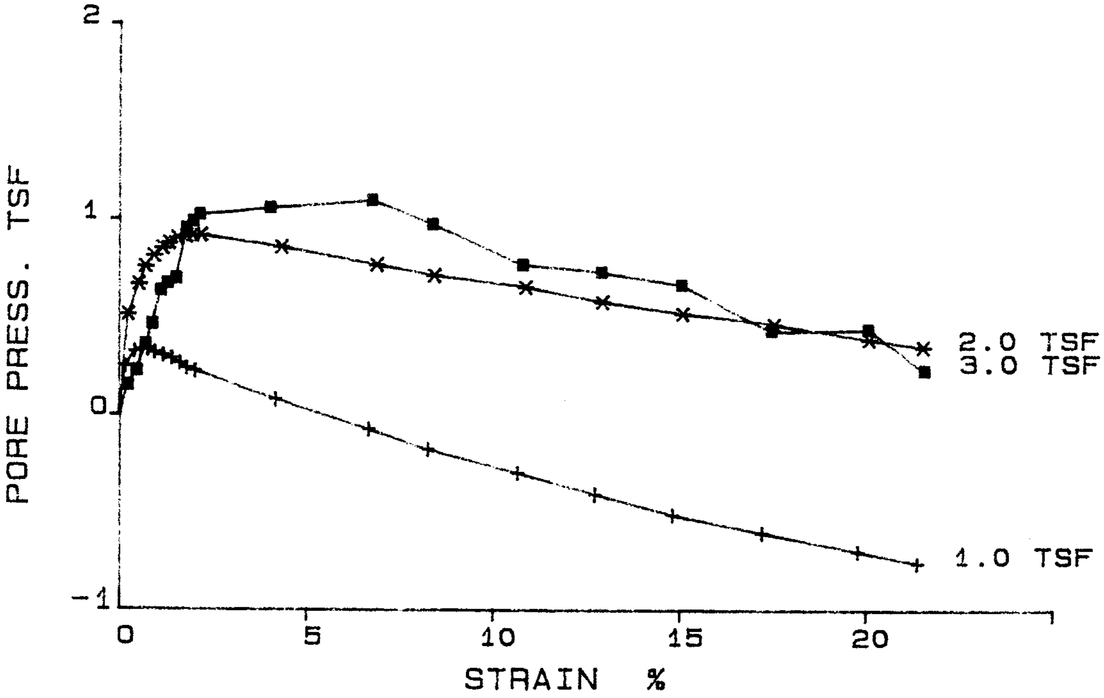
REMARKS:

SINGLETON LABORATORIES
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (R) TEST

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STKG PHS II
STATION:
RANGE :
BORING : US-73

EL. : 618.3-617.9
SAMPLE : 1
PART : 2
SOIL SYM: ML/CL
DATE : 02-27-91





REMARKS:

Singleton Laboratories

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (R) TEST

Project: WIDOWS CREEK SP
Feature: DRY STKG PHS II
Station:
Range :
Boring : US-73

El. : 618.3-617.9
Sample: 1
Part : 2

File : 6
Tested By : TAL
Computed By: MHD
Checked By : GPB
Report Date: 02-27-91

Soil Symbol= ML/CL
Sp. Gr. = 2.66

L.L.(%)= 46
D10(mm)= 0

P.I.(%) = 18

Specimen Number	1	2	3	4
Initial:				
Moisture Content(%)	22.3	23.3	22.9	0.0
Dry Density(pcf)	100.1	98.0	101.0	0.0
Void Ratio	0.659	0.694	0.643	0.000
Saturation(%)	89.8	89.3	94.7	0.0
Before Shearing:				
Moisture(%) (after satur.)	24.8	26.1	24.2	0.0
Saturation(%)	100.0	100.0	100.0	0.0
Moisture(%) (after cons.)	23.3	24.1	20.7	0.0
Void Ratio (after cons.)	0.619	0.641	0.550	0.000
Final Moisture Content(%)	24.7	26.8	24.1	0.0
Minor Principal Stress(tsf)	1.01(1.01)	2.02(2.02)	3.02(3.02)	0.00(0.00)
Major Principal Stress(tsf)	5.44(3.78)	5.53(4.83)	8.97(8.25)	0.00(0.00)
Eff. Minor Prin Stress(tsf)	1.72(0.71)	1.61(1.12)	2.25(1.89)	0.00(0.00)
Eff. Major Prin Stress(tsf)	6.15(3.47)	5.12(3.94)	8.20(7.12)	0.00(0.00)
Time to Failure(min)	100	100	60	0
Rate of Strain(%/min)	0.22	0.22	0.22	0.00
Specimen Height(in.)	3.12	3.12	3.12	0.00
Specimen Dia (in.)	1.40	1.40	1.40	0.00

	Max Deviator Stress		Max Eff Stress Ratio	
Shear Strength	Deg	c(tsf)	Deg	c(tsf)
Apparent	20.6	0.84	23.9	0.28
Effective	33.9	0.00	32.6	0.19

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Remark:

Singleton Laboratories
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (R) TEST

Project: WIDOWS CREEK SP
Feature: DRY STKG PHS II
Station:
Range :
Boring : US-73

El. : 618.3-617.9
Sample: 1
Part : 2

File : 6
Tested By : TAL
Computed By: MHD
Checked By : GPB
Report Date: 02-27-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	173.1	154.9	198.3
Dry Wt. and Tare(gm)=	148.8	126.7	167.0
Wt. of Tare(gm) =	39.7	0.0	40.3
Moisture(%) =	22.3	22.3	24.7

Test Conditions and Constants:
Proving Ring No. = 2212
Proving Ring Constant:
Slope Const. = 1.000236
Intercept = .0823636
Confining Pres.(psi) = 14
Initial Pore Pre(psi)= 100

Tube No. = 1
Sample Volume (cc) = 79.018
Sample Height(in.) = 3.123
Specific Gravity = 2.66
Consolidation(in.) = .025
Initial P.R. Rdg = 92

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Pore Pres. (psi)	Strain (%)	e1 - e3 (tsf)	Pore Press. (tsf)	e1 / e3 (TSF)
1	0.005	131.5	103.5	0.16	1.87	0.25	3.48
2	0.013	139.3	104.6	0.42	2.24	0.33	4.30
3	0.019	142.8	104.8	0.61	2.40	0.35	4.62
4	0.025	145.3	104.8	0.81	2.51	0.35	4.79
5	0.031	147.8	104.6	1.00	2.62	0.33	4.87
6	0.038	149.4	104.4	1.23	2.69	0.32	4.89
7	0.045	151.2	104.2	1.45	2.77	0.30	4.92
8	0.052	152.7	103.9	1.68	2.83	0.28	4.90
9	0.058	153.7	103.6	1.87	2.87	0.26	4.84
10	0.065	154.7	103.4	2.10	2.91	0.24	4.82
20	0.132	163.6	101.4	4.26	3.25	0.10	4.59
30	0.210	173.0	99.3	6.78	3.58	-0.05	4.38
40	0.260	178.1	97.9	8.39	3.74	-0.15	4.23
50	0.335	185.2	96.3	10.81	3.94	-0.27	4.09
60	0.400	191.0	94.8	12.91	4.09	-0.37	3.96
70	0.465	195.9	93.4	15.01	4.19	-0.48	3.82
80	0.540	202.1	92.2	17.43	4.31	-0.56	3.75
90	0.620	207.8	90.9	20.01	4.39	-0.66	3.64
100	0.670	211.1	90.1	21.63	4.43	-0.71	3.57

Initial:
Moisture(%) = 22.3
Density(pcf)=100.1
After Saturation:
Moisture(%) = 24.8

Void Ratio =0.659
Saturation(%)= 89.8

Void Ratio =0.619

Minor Prin. Stress(tsf) =1.01
Eff. Minor Prin. Stress(tsf)=1.72(0.71)

Major Prin. Stress(tsf) = 5.44(3.78)
Eff. Major Prin. Stress(tsf)= 6.15(3.47)

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Singleton Laboratories
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (R) TEST

Project: WIDOWS CREEK SP
Feature: DRY STKG PHS II
Station:
Range :
Boring : US-73

El. : 618.3-617.9
Sample: 1
Part : 2

File : 5
Tested By : TAL
Computed By: MHD
Checked By : GPB
Report Date: 02-27-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	155.5	153.0	194.3
Dry Wt. and Tare(gm)=	134.1	124.1	161.1
Wt. of Tare(gm) =	37.6	0.0	37.0
Moisture(%) =	22.2	23.3	26.8

Test Conditions and Constants:

Proving Ring No. = 2284
Proving Ring Constant:
Slope Const. = 1.000268
Intercept = .112727
Confining Pres.(psi) = 28
Initial Pore Pre(psi)= 100

Tube No. = 1
Sample Volume (cc) = 79.018
Sample Height(in.) = 3.123
Specific Gravity = 2.66
Consolidation(in.) = .033
Initial P.R. Rdg = 104.6

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Pore Pres. (psi)	Strain (%)	e1 - e3 (tsf)	Pore Press. (tsf)	e1 / e3 (TSF)
1	0.007	138.1	107.2	0.23	1.60	0.52	2.07
2	0.016	144.9	109.4	0.52	1.92	0.68	2.43
3	0.022	148.6	110.7	0.71	2.09	0.77	2.68
4	0.029	151.2	111.5	0.94	2.20	0.83	2.86
5	0.036	153.4	112.1	1.17	2.30	0.87	3.01
6	0.042	154.7	112.5	1.36	2.36	0.90	3.11
7	0.049	156.3	112.9	1.59	2.43	0.93	3.23
8	0.056	158.1	113.1	1.81	2.51	0.94	3.34
9	0.062	158.9	113.2	2.01	2.54	0.95	3.38
10	0.069	159.9	113.2	2.23	2.58	0.95	3.42
20	0.136	166.3	112.4	4.40	2.82	0.89	3.51
30	0.215	172.6	111.2	6.96	3.02	0.81	3.50
40	0.263	175.5	110.5	8.51	3.10	0.76	3.46
50	0.339	180.5	109.7	10.97	3.22	0.70	3.45
60	0.403	183.1	108.7	13.04	3.26	0.63	3.34
70	0.470	187.7	107.9	15.21	3.36	0.57	3.32
80	0.546	192.6	107.2	17.67	3.46	0.52	3.31
90	0.625	196.4	106.2	20.23	3.49	0.45	3.23
100	0.670	198.6	105.7	21.68	3.51	0.41	3.19

Initial:
Moisture(%) = 23.3
Density(pcf)= 98.0
Void Ratio =0.694
Saturation(%)= 89.3
After Saturation:
Moisture(%) = 26.1
Void Ratio =0.641

Minor Prin. Stress(tsf) =2.02
Eff. Minor Prin. Stress(tsf)=1.61(1.12)
Major Prin. Stress(tsf) = 5.53(4.83)
Eff. Major Prin. Stress(tsf)= 5.12(3.94)

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Singleton Laboratories
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (R) TEST

Project: WIDOWS CREEK SP
Feature: DRY STKG PHS II
Station:
Range :
Boring : US-73

El. : 618.3-617.9
Sample: 1
Part : 2

File : 5
Tested By : TAL
Computed By: MHD
Checked By : GPB
Report Date: 02-27-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	165.7	157.2	198.4
Dry Wt. and Tare(gm)=	142.4	127.9	167.6
Wt. of Tare(gm) =	39.1	0.0	39.7
Moisture(%) =	22.6	22.9	24.1

Test Conditions and Constants:

Proving Ring No. = 2288
Proving Ring Constant:
Slope Const. = 1
Intercept = 0
Confining Pres.(psi) = 42
Initial Pore Pre(psi)= 100

Tube No. = 1
Sample Volume (cc) = 79.018
Sample Height(in.) = 3.123
Specific Gravity = 2.66
Consolidation(in.) = .06
Initial P.R. Rdg = 115

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Pore Pres. (psi)	Strain (%)	e1 - e3 (tsf)	Pore Press. (tsf)	e1 / e3 (TSF)
1	0.007	162.2	102.1	0.23	2.28	0.15	1.79
2	0.014	171.8	103.2	0.46	2.74	0.23	1.98
3	0.021	178.4	105.1	0.69	3.05	0.37	2.15
4	0.027	185.7	106.6	0.88	3.40	0.48	2.33
5	0.034	193.6	109.0	1.11	3.77	0.65	2.59
6	0.040	198.2	109.6	1.31	3.98	0.69	2.71
7	0.047	202.6	110.0	1.53	4.18	0.72	2.81
8	0.056	210.5	113.6	1.83	4.54	0.98	3.22
9	0.062	214.5	114.1	2.02	4.73	1.02	3.35
10	0.068	218.0	114.6	2.22	4.88	1.05	3.47
20	0.126	220.6	115.1	4.11	4.91	1.09	3.53
30	0.210	230.7	115.7	6.86	5.22	1.13	3.76
40	0.260	237.5	114.0	8.49	5.43	1.01	3.70
50	0.335	248.1	111.2	10.94	5.75	0.81	3.59
60	0.400	256.1	110.7	13.06	5.95	0.77	3.64
70	0.466	254.0	109.8	15.21	5.71	0.71	3.46
80	0.540	254.0	106.6	17.63	5.55	0.48	3.18
90	0.620	267.0	106.8	20.24	5.88	0.49	3.32
100	0.667	262.9	103.9	21.78	5.61	0.28	3.04

Initial:
Moisture(%) = 22.9
Density(pcf)=101.0
After Saturation:
Moisture(%) = 24.2

Void Ratio =0.643
Saturation(%)= 94.7

Void Ratio =0.550

Minor Prin. Stress(tsf) =3.02
Eff. Minor Prin. Stress(tsf)=2.25(1.89)

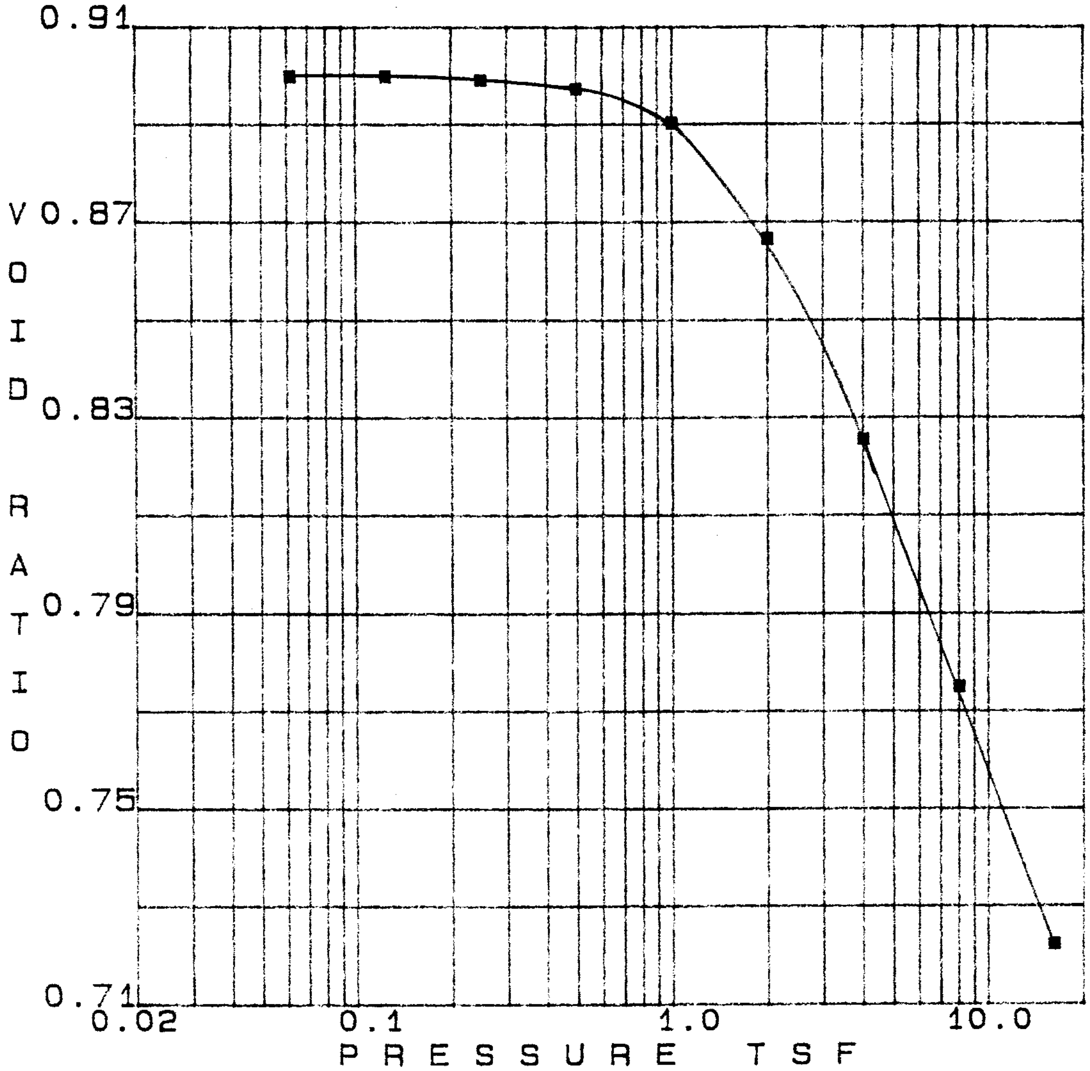
Major Prin. Stress(tsf) = 8.97(8.25)
Eff. Major Prin. Stress(tsf)= 8.20(7.12)

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

SINGLETON LABORATORIES
CONSOLIDATION TEST

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STKG PHS II
STATION:
RANGE :

BORING: US-55
EL. : 614.9-614.5
SAMPLE: 1
DATE : 02-27-91



SOIL SYMBOL=CH
SP GRAVITY =2.75 L.L.(%) = 84
D10 (mm) =0.0000 P.I.(%) = 55

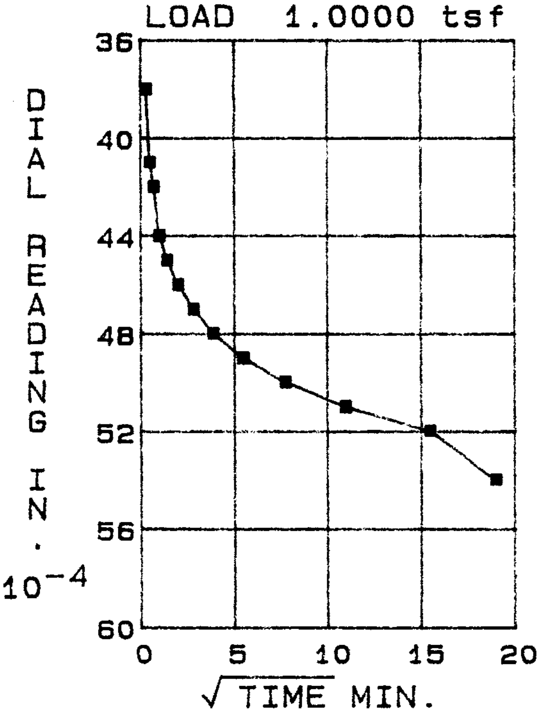
	INITIAL	FINAL
MOISTURE (%)	29.0	27.1
DRY DENSITY (pcf)	90.3	99.7
VOID RATIO	0.901	0.721
SATURATION (%)	88.6	100.0

REMARKS: INUNDATED AT 0.50 TSF

SINGLETON LABORATORIES
CONSOLIDATION TEST

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STKG PHS II
STATION:
RANGE :

BORING: US-55
EL. : 614.9-614.5
SAMPLE: 1
DATE : 02-27-91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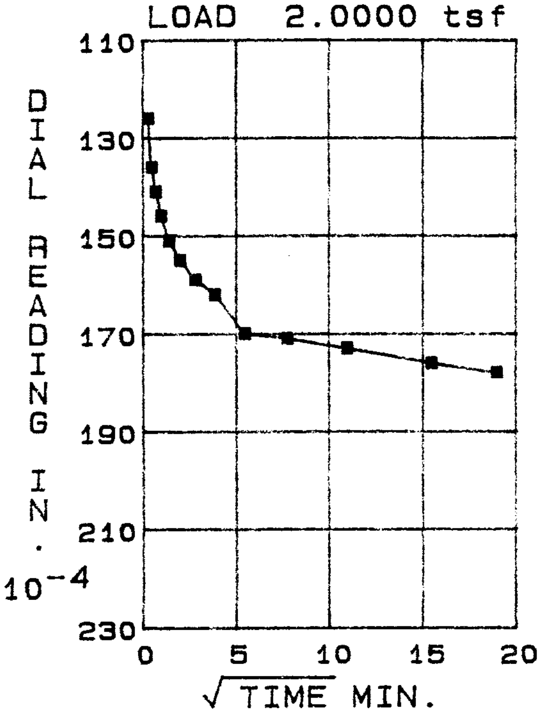
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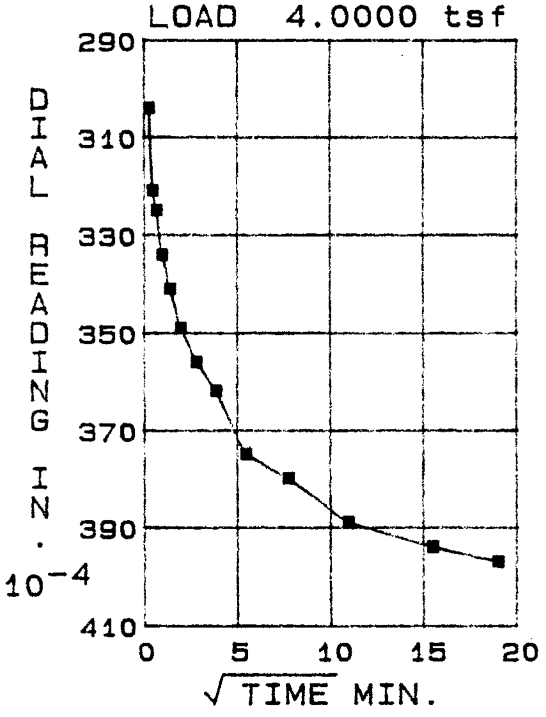
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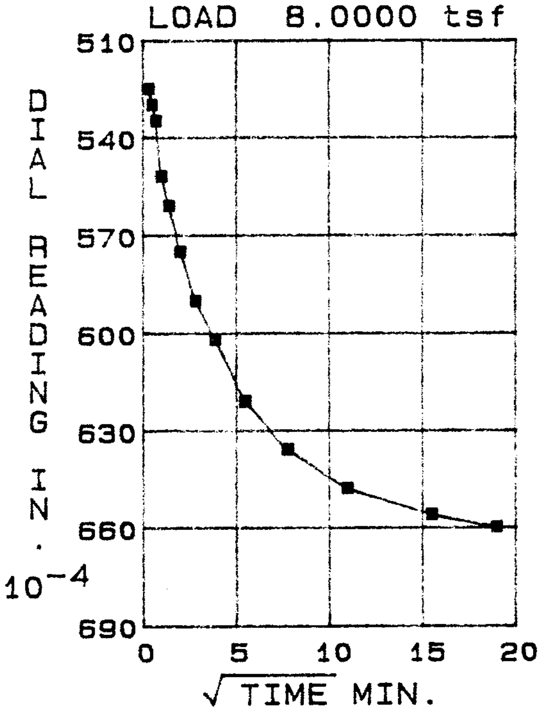
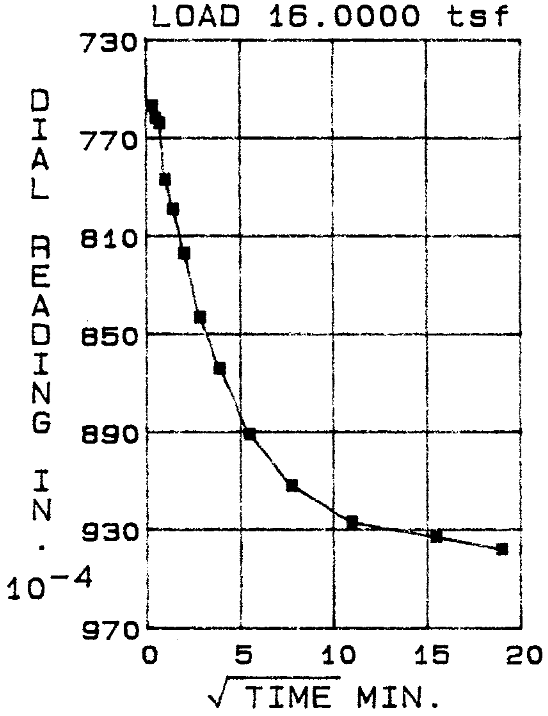

LOAD 8.0000 tsf

REMARKS:

SINGLETON LABORATORIES
CONSOLIDATION TEST

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STKG PHS II
STATION:
RANGE :

BORING: US-55
EL. : 614.9-614.5
SAMPLE: 1
DATE : 02-27-91


LOAD 16.0000 tsf

REMARKS:

Singleton Laboratories
Consolidation Test

Project: WIDOWS CREEK SP
Feature: DRY STKG PHS II
Station:
Range :
Boring : US-55

El. : 614.9-614.5
Sample: 1
Part : 2

File : 1
Tested By : TAL
Computed By: mHD
Checked By : GPB
Report Date: 02-27-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare (gm)=	180.2	264.0	186.6
Dry Wt. and Tare (gm)=	149.2	230.2	155.0
Wt. of Tare (gm) =	38.6	113.7	38.5
Moisture (%) =	28.0	29.0	27.1

Sample Data:
Sample Volume (cc) =80.525
Sample Height (in.)= 1.001

Specific Gravity=2.75
Ring No. =14

	Initial	Final
Moisture (%)	29.0	27.1
Density (pcf)	90.3	99.7
Void Ratio	0.901	0.721
Saturation (%)	88.6	100.0

Load (tsf)	Dial Reading	Correction	Void Ratio
0.0625	0.00070	0.00010	0.8997
0.1250	0.00100	0.00040	0.8997
0.2500	0.00180	0.00070	0.8987
0.5000	0.00330	0.00120	0.8968
1.0000	0.00770	0.00190	0.8898
2.0000	0.02100	0.00270	0.8661
4.0000	0.04370	0.00360	0.8247
8.0000	0.07120	0.00450	0.7741
16.0000	0.09990	0.00530	0.7212

Remarks: INUNDATED AT 0.50 TSF

Singleton Laboratories
Consolidation Test

Project: WIDOWS CREEK SP
Feature: DRY STKG PHS II
Station:
Range :
Boring : US-55

El. : 614.9-614.5
Sample: 1
Part : 2

File : 1
Tested By : TAL
Computed By:
Checked By : GPB
Report Date: 02-27-91

Load= 0.0625 Time Started=7:55
(tsf) 2/18

Time	Dial Reading	Correction
0 sec	0.00000	0.00000
6 sec	0.00080	0.00010
15 sec	0.00080	0.00010
30 sec	0.00080	0.00010
1 min	0.00080	0.00010
2 min	0.00070	0.00010
4 min	0.00070	0.00010
8 min	0.00070	0.00010
15 min	0.00070	0.00010
30 min	0.00070	0.00010
1 hr	0.00070	0.00010
2 hrs	0.00070	0.00010
4 hrs	0.00070	0.00010
6 hrs	0.00070	0.00010
hrs	0.00070	0.00010

Remarks:

Load= 0.1250 Time Started=7:57
(tsf)

Time	Dial Reading	Correction
0 sec	0.00070	0.00010
6 sec	0.00100	0.00040
15 sec	0.00100	0.00040
30 sec	0.00100	0.00040
1 min	0.00110	0.00040
2 min	0.00110	0.00040
4 min	0.00100	0.00040
8 min	0.00100	0.00040
15 min	0.00100	0.00040
30 min	0.00100	0.00040
1 hr	0.00100	0.00040
2 hrs	0.00100	0.00040
4 hrs	0.00100	0.00040
6 hrs	0.00100	0.00040
hrs	0.00100	0.00040

Remarks:

Load= 0.2500 Time Started=8:00
(tsf)

Time	Dial Reading	Correction
0 sec	0.00100	0.00040
6 sec	0.00180	0.00070
15 sec	0.00190	0.00070
30 sec	0.00200	0.00070
1 min	0.00200	0.00070
2 min	0.00200	0.00070
4 min	0.00200	0.00070
8 min	0.00180	0.00070
15 min	0.00180	0.00070
30 min	0.00180	0.00070
1 hr	0.00180	0.00070
2 hrs	0.00180	0.00070
4 hrs	0.00180	0.00070
6 hrs	0.00180	0.00070
hr hrs	0.00180	0.00070

Remarks:

Load= 0.5000 Time Started=8:10
(tsf)

Time	Dial Reading	Correction
0 sec	0.00180	0.00070
6 sec	0.00310	0.00120
15 sec	0.00320	0.00120
30 sec	0.00330	0.00120
1 min	0.00340	0.00120
2 min	0.00340	0.00120
4 min	0.00340	0.00120
8 min	0.00340	0.00120
15 min	0.00330	0.00120
30 min	0.00330	0.00120
1 hr	0.00330	0.00120
2 hrs	0.00330	0.00120
4 hrs	0.00330	0.00120
6 hrs	0.00330	0.00120
hr hrs	0.00330	0.00120

Remarks:

Singleton Laboratories
Consolidation Test

Project: WIDOWS CREEK SP
Feature: DRY STKG PHS II
Station:
Range :
Boring : US-55

El. : 614.9-614.5
Sample: 1
Part : 2

File : 1
Tested By : TAL
Computed By:
Checked By : GPB
Report Date: 02-27-91

Load= 1.0000 Time Started=8:20
(tsf)

Time	Dial Reading	Correction
0 sec	0.00330	0.00120
6 sec	0.00570	0.00190
15 sec	0.00600	0.00190
30 sec	0.00610	0.00190
1 min	0.00630	0.00190
2 min	0.00640	0.00190
4 min	0.00650	0.00190
8 min	0.00660	0.00190
15 min	0.00670	0.00190
30 min	0.00680	0.00190
1 hr	0.00690	0.00190
2 hrs	0.00700	0.00190
4 hrs	0.00710	0.00190
6 hrs	0.00730	0.00190
hrs	0.00770	0.00190

Remarks:

Load= 2.0000 Time Started=7:30
(tsf) 2/19

Time	Dial Reading	Correction
0 sec	0.00770	0.00190
6 sec	0.01530	0.00270
15 sec	0.01630	0.00270
30 sec	0.01680	0.00270
1 min	0.01730	0.00270
2 min	0.01780	0.00270
4 min	0.01820	0.00270
8 min	0.01860	0.00270
15 min	0.01890	0.00270
30 min	0.01970	0.00270
1 hr	0.01980	0.00270
2 hrs	0.02000	0.00270
4 hrs	0.02030	0.00270
6 hrs	0.02050	0.00270
23 hrs	0.02100	0.00270

Remarks:

Load= 4.0000 Time Started=7:30
(tsf) 2/20

Time	Dial Reading	Correction
0 sec	0.02100	0.00270
6 sec	0.03400	0.00360
15 sec	0.03570	0.00360
30 sec	0.03610	0.00360
1 min	0.03700	0.00360
2 min	0.03770	0.00360
4 min	0.03850	0.00360
8 min	0.03920	0.00360
15 min	0.03980	0.00360
30 min	0.04110	0.00360
1 hr	0.04160	0.00360
2 hrs	0.04250	0.00360
4 hrs	0.04300	0.00360
6 hrs	0.04330	0.00360
24 hrs	0.04370	0.00360

Remarks:

Load= 8.0000 Time Started=7:30
(tsf) 2/21

Time	Dial Reading	Correction
0 sec	0.04370	0.00360
6 sec	0.05700	0.00450
15 sec	0.05750	0.00450
30 sec	0.05800	0.00450
1 min	0.05970	0.00450
2 min	0.06060	0.00450
4 min	0.06200	0.00450
8 min	0.06350	0.00450
15 min	0.06470	0.00450
30 min	0.06660	0.00450
1 hr	0.06810	0.00450
2 hrs	0.06930	0.00450
4 hrs	0.07010	0.00450
6 hrs	0.07050	0.00450
24 hrs	0.07120	0.00450

Remarks:

Singleton Laboratories
Consolidation Test

Project: WIDOWS CREEK SP
Feature: DRY STKG PHS II
Station:
Range :
Boring : US-55

El. : 614.9-614.5
Sample: 1
Part : 2

File : 1
Tested By : TAL
Computed By:
Checked By : GPB
Report Date: 02-27-91

Load=16.0000 Time Started=7:30
(tsf) 2/22

Time	Dial Reading	Correction
0 sec	0.07120	0.00450
6 sec	0.08100	0.00530
15 sec	0.08150	0.00530
30 sec	0.08170	0.00530
1 min	0.08400	0.00530
2 min	0.08520	0.00530
4 min	0.08700	0.00530
8 min	0.08960	0.00530
15 min	0.09170	0.00530
30 min	0.09440	0.00530
1 hr	0.09650	0.00530
2 hrs	0.09800	0.00530
4 hrs	0.09860	0.00530
6 hrs	0.09910	0.00530
.0991	0.09990	0.00530

Remarks:

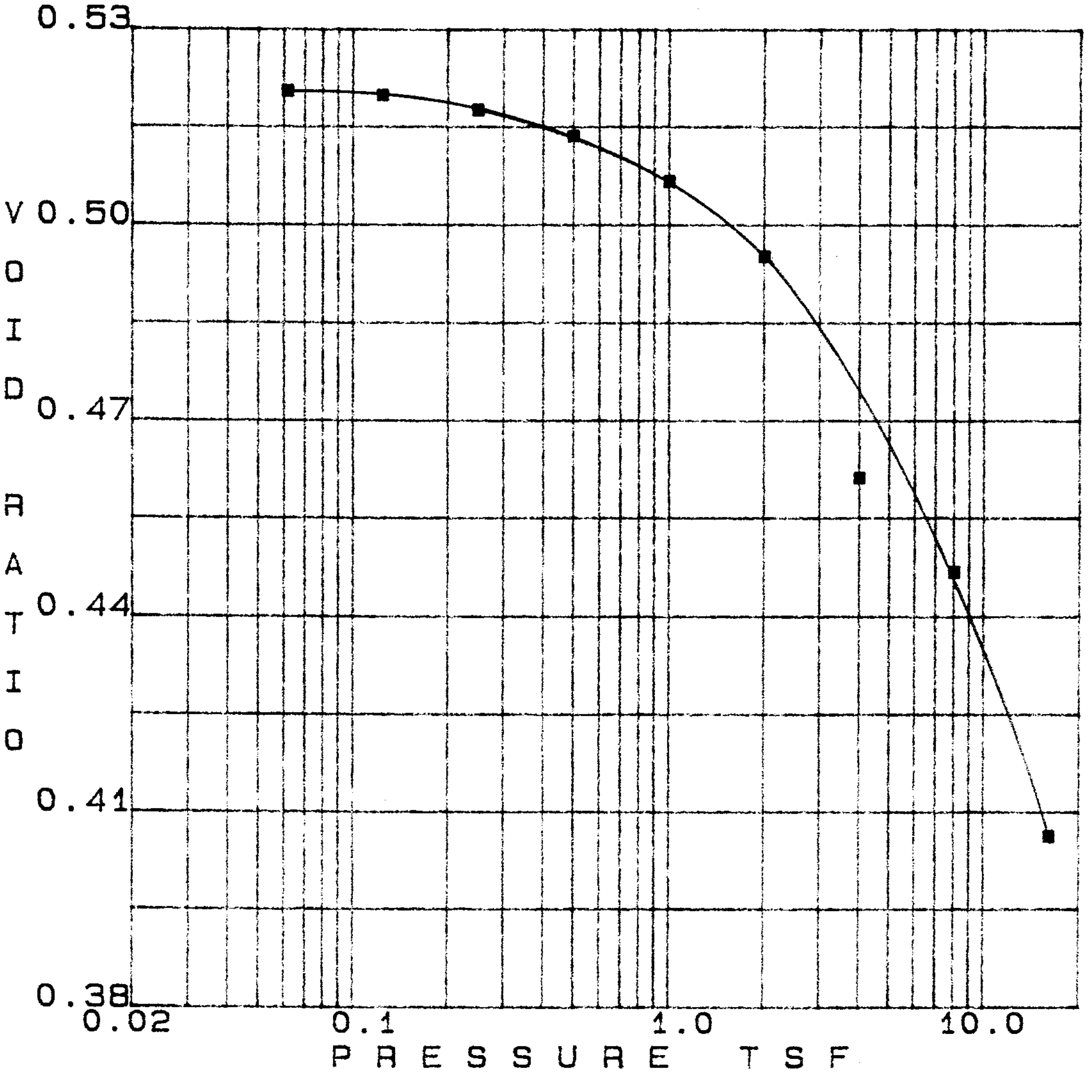
Load= 0.0000 Time Started=
(tsf)

Time	Dial Reading	Correction
0 sec	0.00000	0.00000
6 sec	0.00000	0.00000
15 sec	0.00000	0.00000
30 sec	0.00000	0.00000
1 min	0.00000	0.00000
2 min	0.00000	0.00000
4 min	0.00000	0.00000
8 min	0.00000	0.00000
15 min	0.00000	0.00000
30 min	0.00000	0.00000
1 hr	0.00000	0.00000
2 hrs	0.00000	0.00000
4 hrs	0.00000	0.00000
6 hrs	0.00000	0.00000
	0.00000	0.00000

Remarks:

SINGLETON LABORATORIES
CONSOLIDATION TEST

PROJECT:	WIDOWS CREEK SP	BORING:	US-60
FEATURE:	DRY STKG PHS II	EL.	: 597.6-597.4
STATION:		SAMPLE:	1
RANGE :		DATE	: 02-28-91



SOIL SYMBOL=SC
SP GRAVITY =2.73 L.L.(%) = 46
D10 (mm) =0.0009 P.I.(%) = 25

	INITIAL	FINAL
MOISTURE (%)	17.3	16.7
DRY DENSITY (pcf)	112.0	121.2
VOID RATIO	0.521	0.406
SATURATION (%)	90.9	100.0

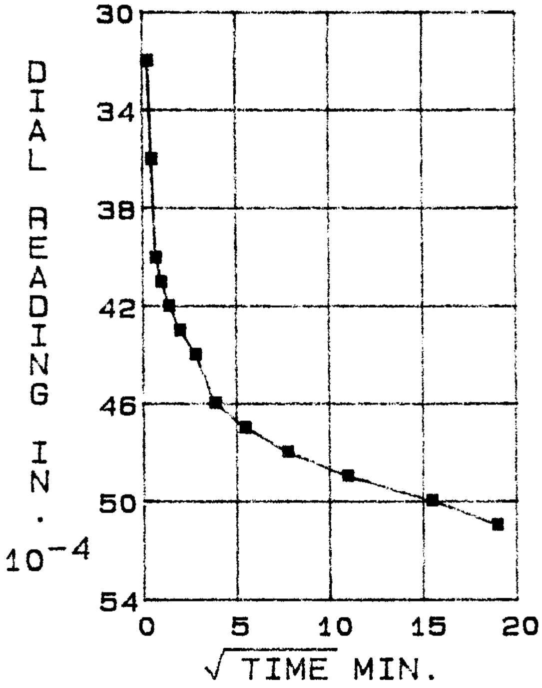
REMARKS: INUNDATED AT 0.50 TSF

SINGLETON LABORATORIES
CONSOLIDATION TEST

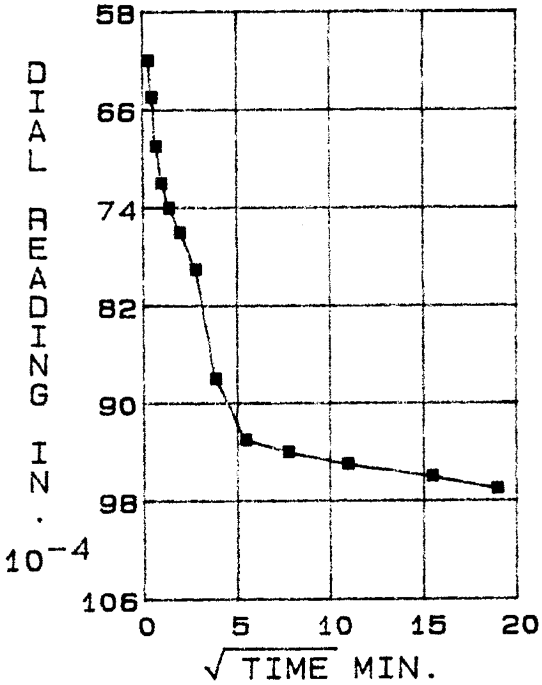
PROJECT: WIDOWS CREEK SP
FEATURE: DRY STKG PHS II
STATION:
RANGE :

BORING: US-60
EL. : 597.6-597.4
SAMPLE: 1
DATE : 02-28-91

LOAD 0.5000 tsf



LOAD 1.0000 tsf



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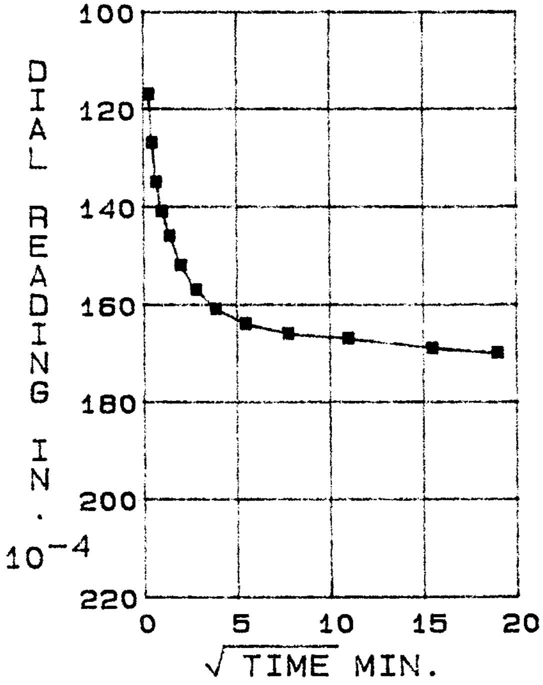
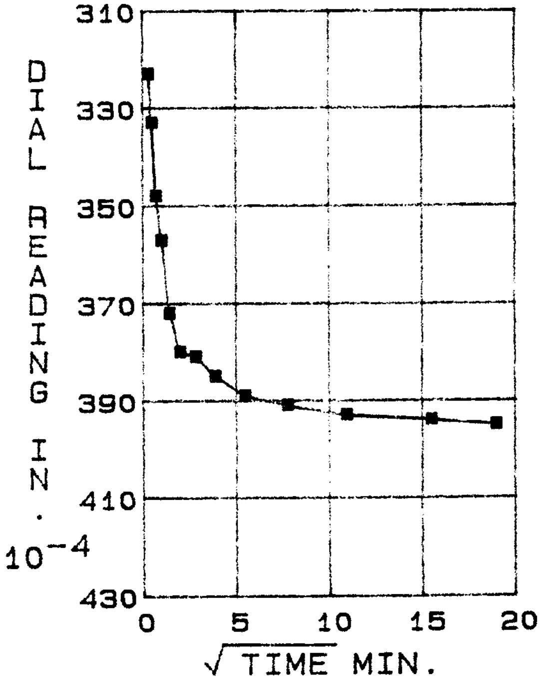


LOAD 4.0000 tsf

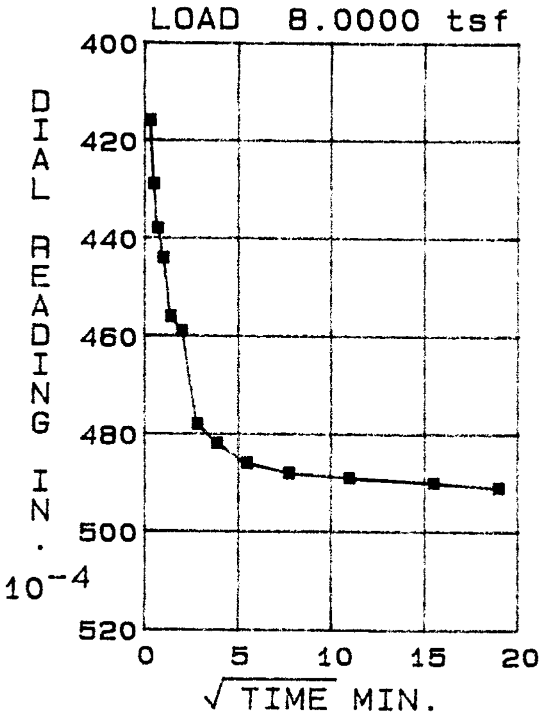


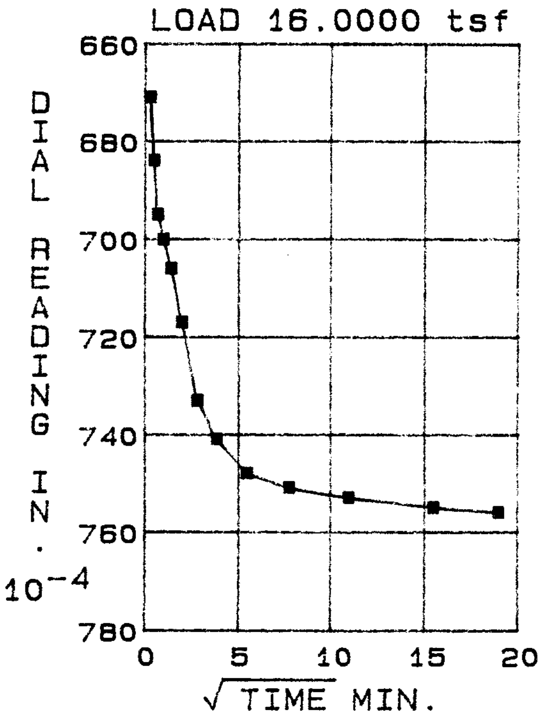
REMARKS:

SINGLETON LABORATORIES
CONSOLIDATION TEST

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STKG PHS II
STATION:
RANGE :

BORING: US-60
EL. : 597.6-597.4
SAMPLE: 1
DATE : 02-28-91





REMARKS:

Singleton Laboratories
Consolidation Test

Project: WIDOWS CREEK SP		File : 2
Feature: DRY STKG PHS II		Tested By : TAL
Station:	El. : 597.6-597.4	Computed By: MHD
Range :	Sample: 1	Checked By : GPB
Boring : US-60	Part : 4	Report Date: 02-28-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare (gm)=	168.1	282.6	358.8
Dry Wt. and Tare (gm)=	150.0	257.6	334.8
Wt. of Tare (gm) =	38.8	113.5	190.7
Moisture (%) =	16.3	17.3	16.7

Sample Data:

Sample Volume (cc) =80.297

Sample Height (in.)= 0.999

Specific Gravity=2.73

Ring No. =15

	Initial	Final
Moisture (%)	17.3	16.7
Density (pcf)	112.0	121.2
Void Ratio	0.521	0.406
Saturation (%)	90.9	100.0

Load (tsf)	Dial Reading	Correction	Void Ratio
0.0625	0.00080	0.00020	0.5203
0.1250	0.00140	0.00040	0.5197
0.2500	0.00330	0.00080	0.5174
0.5000	0.00650	0.00130	0.5133
1.0000	0.01200	0.00220	0.5063
2.0000	0.02020	0.00290	0.4949
4.0000	0.04340	0.00370	0.4608
8.0000	0.05360	0.00440	0.4463
16.0000	0.08070	0.00490	0.4058

Remarks: INUNDATED AT 0.50 TSF

Singleton Laboratories
Consolidation Test

Project: WIDOWS CREEK SP
Feature: DRY STKG PHS II
Station:
Range :
Boring : US-60

El. : 597.6-597.4
Sample: 1
Part : 4

File : 2
Tested By : TAL
Computed By: MHD
Checked By : GPB
Report Date: 02-28-91

Load= 0.0625 Time Started=8:35
(tsf) 2/18

Time	Dial Reading	Correction
0 sec	0.00000	0.00000
6 sec	0.00050	0.00020
15 sec	0.00060	0.00020
30 sec	0.00070	0.00020
1 min	0.00080	0.00020
2 min	0.00080	0.00020
4 min	0.00080	0.00020
8 min	0.00080	0.00020
15 min	0.00090	0.00020
30 min	0.00080	0.00020
1 hr	0.00080	0.00020
2 hrs	0.00080	0.00020
4 hrs	0.00080	0.00020
6 hrs	0.00080	0.00020
hrs	0.00080	0.00020

Remarks:

Load= 0.1250 Time Started=9:05
(tsf)

Time	Dial Reading	Correction
0 sec	0.00080	0.00020
6 sec	0.00110	0.00040
15 sec	0.00120	0.00040
30 sec	0.00120	0.00040
1 min	0.00130	0.00040
2 min	0.00130	0.00040
4 min	0.00130	0.00040
8 min	0.00130	0.00040
15 min	0.00140	0.00040
30 min	0.00140	0.00040
1 hr	0.00140	0.00040
2 hrs	0.00140	0.00040
4 hrs	0.00140	0.00040
6 hrs	0.00140	0.00040
hrs	0.00140	0.00040

Remarks:

Load= 0.2500 Time Started=7:35
(tsf) 2/19

Time	Dial Reading	Correction
0 sec	0.00140	0.00040
6 sec	0.00200	0.00080
15 sec	0.00210	0.00080
30 sec	0.00220	0.00080
1 min	0.00220	0.00080
2 min	0.00230	0.00080
4 min	0.00240	0.00080
8 min	0.00260	0.00080
15 min	0.00280	0.00080
30 min	0.00290	0.00080
1 hr	0.00300	0.00080
2 hrs	0.00310	0.00080
4 hrs	0.00320	0.00080
6 hrs	0.00320	0.00080
23 hrs	0.00330	0.00080

Remarks:

Load= 0.5000 Time Started=7:35
(tsf)

Time	Dial Reading	Correction
0 sec	0.00330	0.00080
6 sec	0.00450	0.00130
15 sec	0.00490	0.00130
30 sec	0.00530	0.00130
1 min	0.00540	0.00130
2 min	0.00550	0.00130
4 min	0.00560	0.00130
8 min	0.00570	0.00130
15 min	0.00590	0.00130
30 min	0.00600	0.00130
1 hr	0.00610	0.00130
2 hrs	0.00620	0.00130
4 hrs	0.00630	0.00130
6 hrs	0.00640	0.00130
24 hrs	0.00650	0.00130

Remarks:

Singleton Laboratories
Consolidation Test

Project: WIDOWS CREEK SP
Feature: DRY STKG PHS II
Station:
Range :
Boring : US-60

El. : 597.6-597.4
Sample: 1
Part : 4

File : 2
Tested By : TAL
Computed By: MHD
Checked By : GPB
Report Date: 02-28-91

Load= 1.0000 Time Started= 7:35
(tsf)

Time	Dial Reading	Correction
0 sec	0.00650	0.00130
6 sec	0.00840	0.00220
15 sec	0.00870	0.00220
30 sec	0.00910	0.00220
1 min	0.00940	0.00220
2 min	0.00960	0.00220
4 min	0.00980	0.00220
8 min	0.01010	0.00220
15 min	0.01100	0.00220
30 min	0.01150	0.00220
1 hr	0.01160	0.00220
2 hrs	0.01170	0.00220
4 hrs	0.01180	0.00220
6 hrs	0.01190	0.00220
24 hrs	0.01200	0.00220

Remarks:

Load= 2.0000 Time Started=7:40
(tsf)

Time	Dial Reading	Correction
0 sec	0.01200	0.00220
6 sec	0.01460	0.00290
15 sec	0.01560	0.00290
30 sec	0.01640	0.00290
1 min	0.01700	0.00290
2 min	0.01750	0.00290
4 min	0.01810	0.00290
8 min	0.01860	0.00290
15 min	0.01900	0.00290
30 min	0.01930	0.00290
1 hr	0.01950	0.00290
2 hrs	0.01960	0.00290
4 hrs	0.01980	0.00290
6 hrs	0.01990	0.00290
72 hrs	0.02020	0.00290

Remarks:

Load= 4.0000 Time Started=7:35
(tsf)

Time	Dial Reading	Correction
0 sec	0.02020	0.00290
6 sec	0.03600	0.00370
15 sec	0.03700	0.00370
30 sec	0.03850	0.00370
1 min	0.03940	0.00370
2 min	0.04090	0.00370
4 min	0.04170	0.00370
8 min	0.04180	0.00370
15 min	0.04220	0.00370
30 min	0.04260	0.00370
1 hr	0.04280	0.00370
2 hrs	0.04300	0.00370
4 hrs	0.04310	0.00370
6 hrs	0.04320	0.00370
24 hrs	0.04340	0.00370

Remarks:

Load= 8.0000 Time Started=7:30
(tsf)

Time	Dial Reading	Correction
0 sec	0.04340	0.00370
6 sec	0.04600	0.00440
15 sec	0.04730	0.00440
30 sec	0.04820	0.00440
1 min	0.04880	0.00440
2 min	0.05000	0.00440
4 min	0.05030	0.00440
8 min	0.05220	0.00440
15 min	0.05260	0.00440
30 min	0.05300	0.00440
1 hr	0.05320	0.00440
2 hrs	0.05330	0.00440
4 hrs	0.05340	0.00440
6 hrs	0.05350	0.00440
24 hrs	0.05360	0.00440

Remarks:

Singleton Laboratories
Consolidation Test

Project: WIDOWS CREEK SP
Feature: DRY STKG PHS II
Station:
Range :
Boring : US-60

El. : 597.6-597.4
Sample: 1
Part : 4

File : 2
Tested By : TAL
Computed By: MHD
Checked By : GPB
Report Date: 02-28-91

Load=16.0000 Time Started=7:30
(tsf)

Time	Dial Reading	Correction
0 sec	0.05360	0.00440
6 sec	0.07200	0.00490
15 sec	0.07330	0.00490
30 sec	0.07440	0.00490
1 min	0.07490	0.00490
2 min	0.07550	0.00490
4 min	0.07660	0.00490
8 min	0.07820	0.00490
15 min	0.07900	0.00490
30 min	0.07970	0.00490
1 hr	0.08000	0.00490
2 hrs	0.08020	0.00490
4 hrs	0.08040	0.00490
6 hrs	0.08050	0.00490
24 hrs	0.08070	0.00490

Remarks:

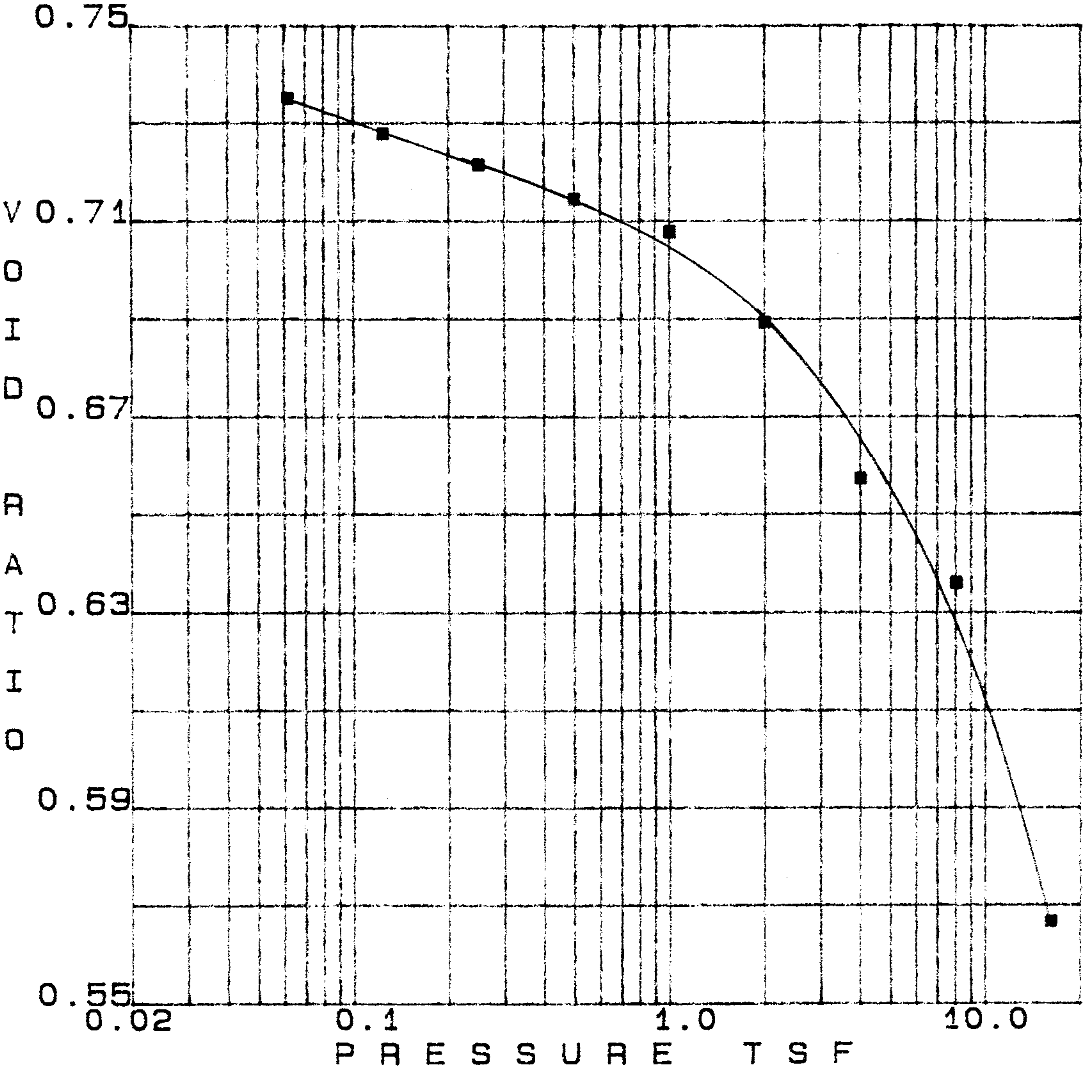
Load= 0.0000 Time Started=
(tsf)

Time	Dial Reading	Correction
0 sec	0.00000	0.00000
6 sec	0.00000	0.00000
15 sec	0.00000	0.00000
30 sec	0.00000	0.00000
1 min	0.00000	0.00000
2 min	0.00000	0.00000
4 min	0.00000	0.00000
8 min	0.00000	0.00000
15 min	0.00000	0.00000
30 min	0.00000	0.00000
1 hr	0.00000	0.00000
2 hrs	0.00000	0.00000
4 hrs	0.00000	0.00000
6 hrs	0.00000	0.00000
	0.00000	0.00000

Remarks:

SINGLETON LABORATORIES
CONSOLIDATION TEST

PROJECT:	WIDOWS CREEK SP	BORING:	US-60
FEATURE:	DRY STKG PHS II	EL. :	591.3-590.9
STATION:		SAMPLE:	2
RANGE :		DATE :	02-28-91



SOIL SYMBOL=CH

SP GRAVITY =2.78 L.L.(%) = 54

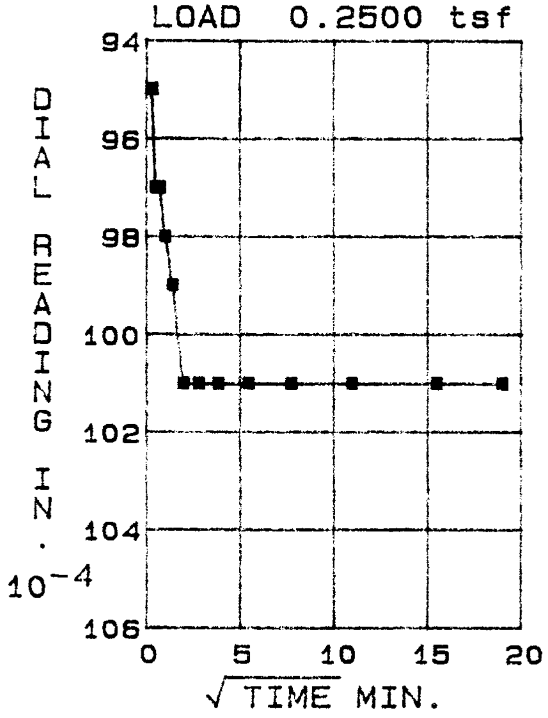
D10 (mm) =0.0000 P.I.(%) = 32

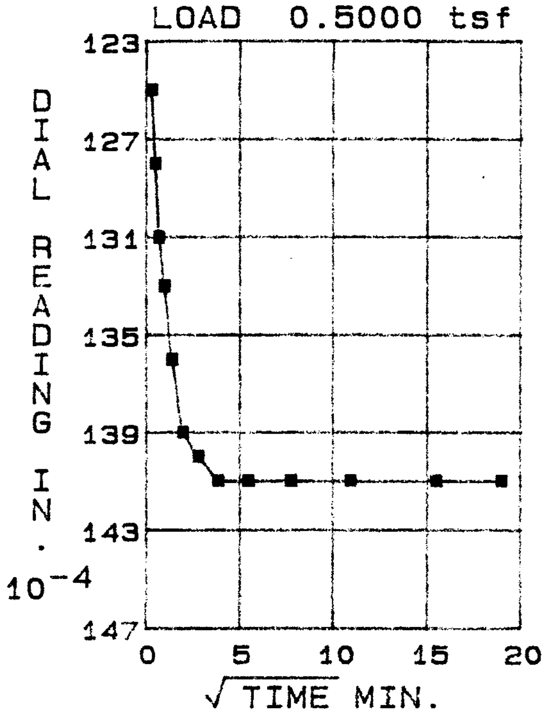
	INITIAL	FINAL
MOISTURE (%)	26.1	23.3
DRY DENSITY (pcf)	99.5	110.8
VOID RATIO	0.739	0.566
SATURATION (%)	97.7	100.0

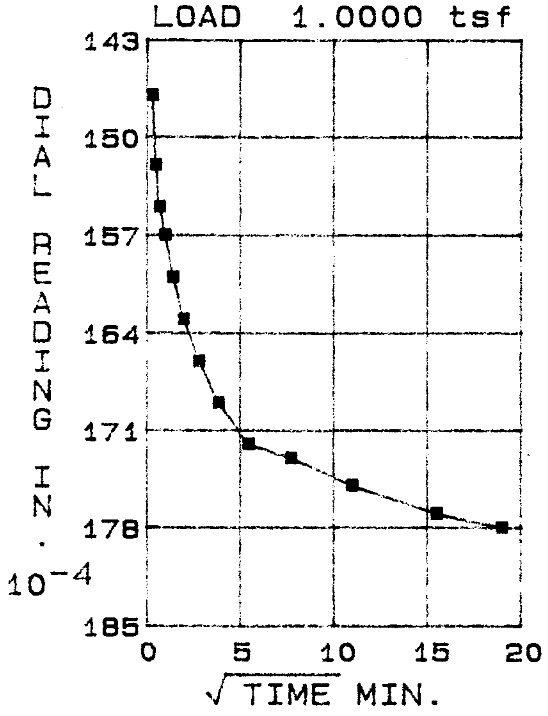
SINGLETON LABORATORIES
CONSOLIDATION TEST

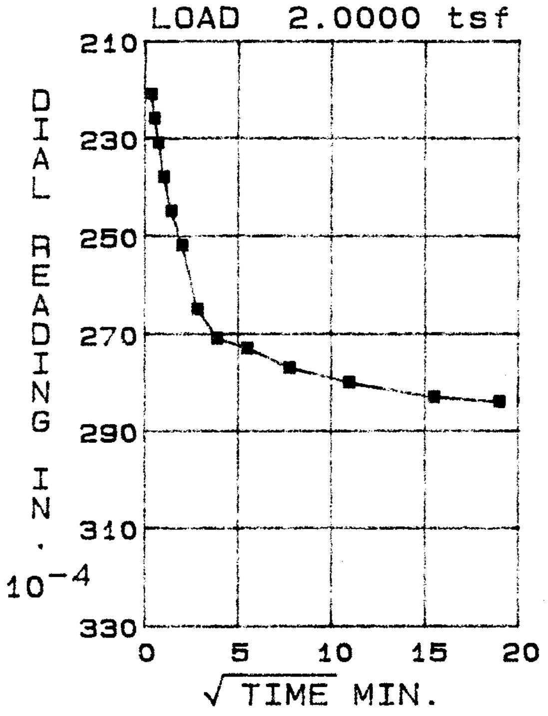
PROJECT: WIDOWS CREEK SP
FEATURE: DRY STKG PHS II
STATION:
RANGE :

BORING: US-60
EL. : 591.3-590.9
SAMPLE: 2
DATE : 02-28-91







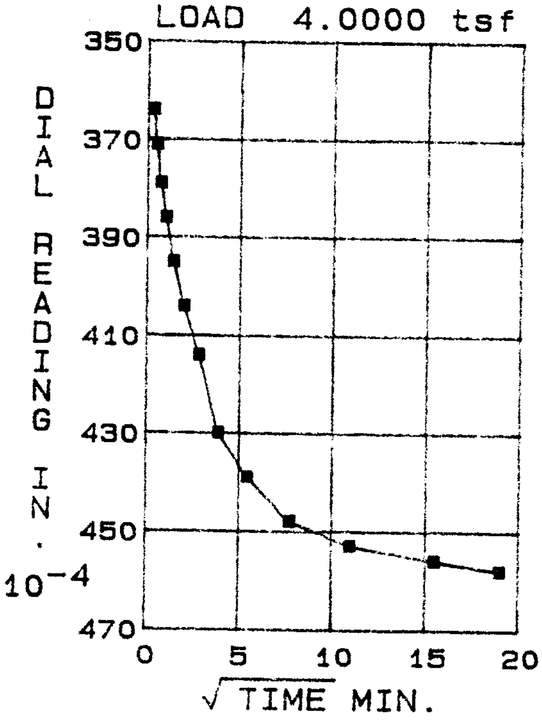


REMARKS:

SINGLETON LABORATORIES
CONSOLIDATION TEST

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STKG PHS II
STATION:
RANGE :

BORING: US-60
EL. : 591.3-590.9
SAMPLE: 2
DATE : 02-28-91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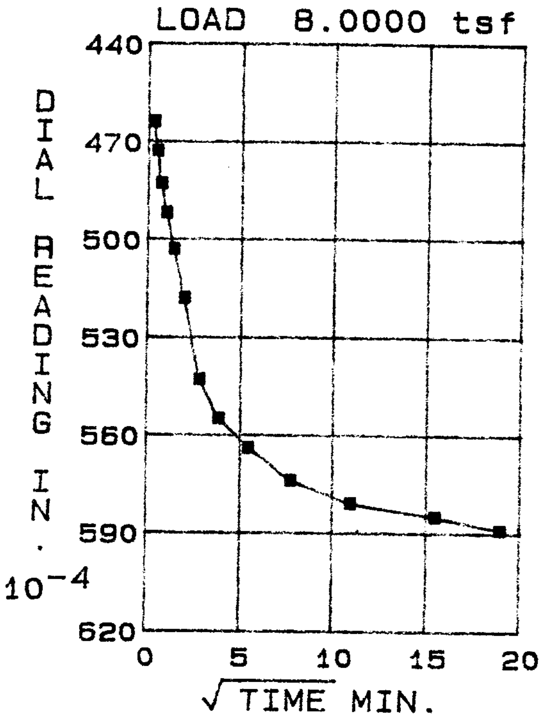
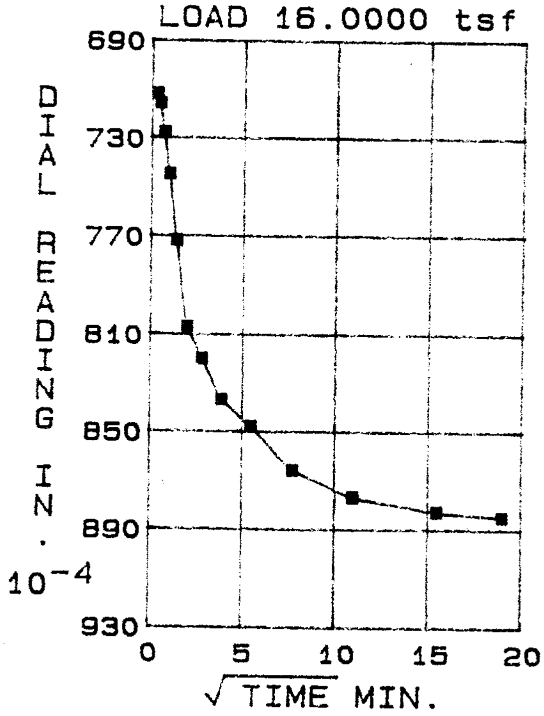

LOAD 8.0000 tsf


LOAD 16.0000 tsf

REMARKS:

Singleton Laboratories
Consolidation Test

Project: WIDOWS CREEK SP
Feature: DRY STKG PHS II
Station:
Range :
Boring : US-60

El. : 591.3-590.9
Sample: 2
Part : 1

File : 4
Tested By : TAL
Computed By: MHD
Checked By : GPB
Report Date: 02-28-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare (gm)=	170.9	669.8	197.1
Dry Wt. and Tare (gm)=	145.0	636.4	167.2
Wt. of Tare (gm) =	38.2	508.2	38.6
Moisture (%) =	24.3	26.1	23.3

Sample Data:

Sample Volume (cc) =80.429
Sample Height (in.)= 0.999

Specific Gravity=2.78
Ring No. =8

	Initial	Final
Moisture (%)	26.1	23.3
Density (pcf)	99.5	110.8
Void Ratio	0.739	0.566
Saturation (%)	97.7	100.0

Load (tsf)	Dial Reading	Correction	Void Ratio
0.0625	0.00240	0.00020	0.7348
0.1250	0.00670	0.00030	0.7275
0.2500	0.01060	0.00050	0.7211
0.5000	0.01510	0.00090	0.7140
1.0000	0.01930	0.00130	0.7073
2.0000	0.03060	0.00190	0.6887
4.0000	0.04970	0.00260	0.6567
8.0000	0.06300	0.00370	0.6355
16.0000	0.10450	0.00530	0.5660

Singleton Laboratories
Consolidation Test

Project: WIDOWS CREEK SP
Feature: DRY STKG PHS II
Station:
Range :
Boring : US-60

El. : 591.3-590.9
Sample: 2
Part : 1

File : 4
Tested By : TAL
Computed By: MHD
Checked By : GPB
Report Date: 02-28-91

Load= 0.0625 (tsf) Time Started=9:10 2/18/91

Time	Dial Reading	Correction
0 sec	0.00000	0.00000
6 sec	0.00210	0.00020
15 sec	0.00230	0.00020
30 sec	0.00240	0.00020
1 min	0.00250	0.00020
2 min	0.00250	0.00020
4 min	0.00250	0.00020
8 min	0.00250	0.00020
15 min	0.00250	0.00020
30 min	0.00240	0.00020
1 hr	0.00240	0.00020
2 hrs	0.00240	0.00020
4 hrs	0.00240	0.00020
6 hrs	0.00240	0.00020
hrs	0.00240	0.00020

Remarks:

Load= 0.1250 (tsf) Time Started=9:40

Time	Dial Reading	Correction
0 sec	0.00240	0.00020
6 sec	0.00600	0.00030
15 sec	0.00610	0.00030
30 sec	0.00620	0.00030
1 min	0.00620	0.00030
2 min	0.00620	0.00030
4 min	0.00630	0.00030
8 min	0.00630	0.00030
15 min	0.00660	0.00330
30 min	0.00670	0.00030
1 hr	0.00670	0.00030
2 hrs	0.00670	0.00030
4 hrs	0.00670	0.00030
6 hrs	0.00670	0.00030
hrs	0.00670	0.00030

Remarks:

Load= 0.2500 (tsf) Time Started=10:45 2/19

Time	Dial Reading	Correction
0 sec	0.00670	0.00030
6 sec	0.01000	0.00050
15 sec	0.01020	0.00050
30 sec	0.01020	0.00050
1 min	0.01030	0.00050
2 min	0.01040	0.00050
4 min	0.01060	0.00050
8 min	0.01060	0.00050
15 min	0.01060	0.00050
30 min	0.01060	0.00050
1 hr	0.01060	0.00050
2 hrs	0.01060	0.00050
4 hrs	0.01060	0.00050
6 hrs	0.01060	0.00050
20 hrs	0.01060	0.00050

Remarks:

Load= 0.5000 (tsf) Time Started=7:40 2/19/91

Time	Dial Reading	Correction
0 sec	0.01060	0.00050
6 sec	0.01340	0.00090
15 sec	0.01370	0.00090
30 sec	0.01400	0.00090
1 min	0.01420	0.00090
2 min	0.01450	0.00090
4 min	0.01480	0.00090
8 min	0.01490	0.00090
15 min	0.01500	0.00090
30 min	0.01500	0.00090
1 hr	0.01500	0.00090
2 hrs	0.01500	0.00090
4 hrs	0.01500	0.00090
6 hrs	0.01500	0.00090
23 hrs	0.01510	0.00090

Remarks:

Singleton Laboratories
Consolidation Test

Project: WIDOWS CREEK SP
Feature: DRY STKG PHS II
Station:
Range :
Boring : US-60

El. : 591.3-590.9
Sample: 2
Part : 1

File : 4
Tested By : TAL
Computed By: MHD
Checked By : GPB
Report Date: 02-28-91

Load= 1.0000 Time Started=7:40
(tsf)

Time	Dial Reading	Correction
0 sec	0.01510	0.00090
6 sec	0.01600	0.00130
15 sec	0.01650	0.00130
30 sec	0.01680	0.00130
1 min	0.01700	0.00130
2 min	0.01730	0.00130
4 min	0.01760	0.00130
8 min	0.01790	0.00130
15 min	0.01820	0.00130
30 min	0.01850	0.00130
1 hr	0.01860	0.00130
2 hrs	0.01880	0.00130
4 hrs	0.01900	0.00130
6 hrs	0.01910	0.00130
24 hrs	0.01930	0.00130

Remarks:

Load= 2.0000 Time Started=7:40
(tsf)

Time	Dial Reading	Correction
0 sec	0.01930	0.00130
6 sec	0.02400	0.00190
15 sec	0.02450	0.00190
30 sec	0.02500	0.00190
1 min	0.02570	0.00190
2 min	0.02640	0.00190
4 min	0.02710	0.00190
8 min	0.02840	0.00190
15 min	0.02900	0.00190
30 min	0.02920	0.00190
1 hr	0.02960	0.00190
2 hrs	0.02990	0.00190
4 hrs	0.03020	0.00190
6 hrs	0.03030	0.00190
24 hrs	0.03060	0.00190

Remarks:

Load= 4.0000 Time Started=7:40
(tsf)

Time	Dial Reading	Correction
0 sec	0.03060	0.00190
6 sec	0.03900	0.00260
15 sec	0.03970	0.00260
30 sec	0.04050	0.00260
1 min	0.04120	0.00260
2 min	0.04210	0.00260
4 min	0.04300	0.00260
8 min	0.04400	0.00260
15 min	0.04560	0.00260
30 min	0.04650	0.00260
1 hr	0.04740	0.00260
2 hrs	0.04790	0.00260
4 hrs	0.04820	0.00260
6 hrs	0.04840	0.00260
72 hrs	0.04970	0.00260

Remarks:

Load= 8.0000 Time Started=7:40
(tsf)

Time	Dial Reading	Correction
0 sec	0.04970	0.00260
6 sec	0.05010	0.00370
15 sec	0.05100	0.00370
30 sec	0.05200	0.00370
1 min	0.05290	0.00370
2 min	0.05400	0.00370
4 min	0.05550	0.00370
8 min	0.05800	0.00370
15 min	0.05920	0.00370
30 min	0.06010	0.00370
1 hr	0.06110	0.00370
2 hrs	0.06180	0.00370
4 hrs	0.06220	0.00370
6 hrs	0.06260	0.00370
24 hrs	0.06300	0.00370

Remarks:

Singleton Laboratories
Consolidation Test

Project: WIDOWS CREEK SP
Feature: DRY STKG PHS II
Station:
Range :
Boring : US-60

El. : 591.3-590.9
Sample: 2
Part : 1

File : 4
Tested By : TAL
Computed By: MHD
Checked By : GPB
Report Date: 02-28-91

Load=16.0000 Time Started=7:40
(tsf)

Time	Dial Reading	Correction
0 sec	0.06300	0.00370
6 sec	0.07650	0.00530
15 sec	0.07690	0.00530
30 sec	0.07810	0.00530
1 min	0.07980	0.00530
2 min	0.08250	0.00530
4 min	0.08600	0.00530
8 min	0.08730	0.00530
15 min	0.08900	0.00530
30 min	0.09010	0.00530
1 hr	0.09190	0.00530
2 hrs	0.09300	0.00530
4 hrs	0.09360	0.00530
6 hrs	0.09380	0.00530
24 hrs	0.10450	0.00530

Remarks:

Load= 0.0000 Time Started=
(tsf)

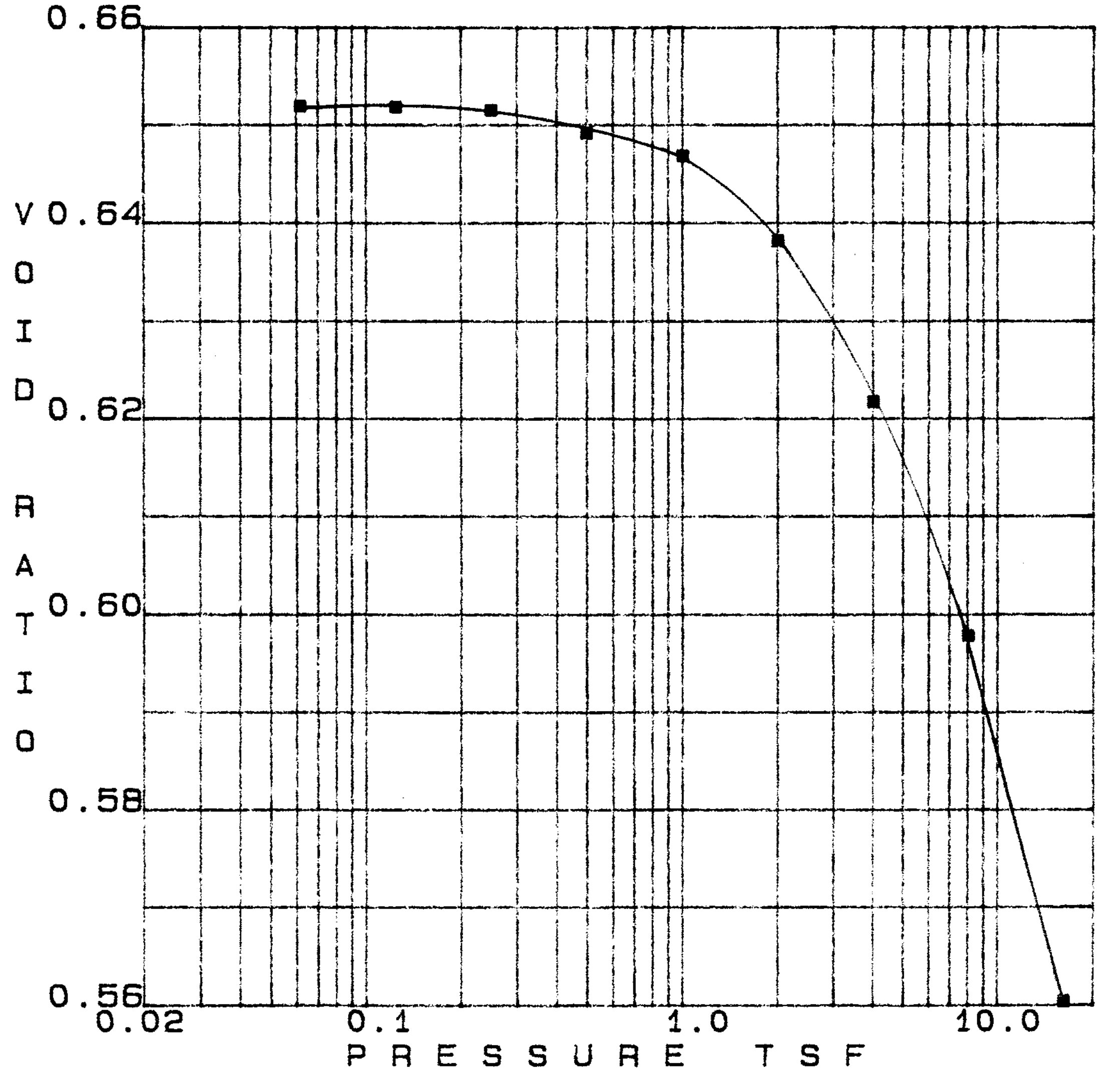
Time	Dial Reading	Correction
0 sec	0.00000	0.00000
6 sec	0.00000	0.00000
15 sec	0.00000	0.00000
30 sec	0.00000	0.00000
1 min	0.00000	0.00000
2 min	0.00000	0.00000
4 min	0.00000	0.00000
8 min	0.00000	0.00000
15 min	0.00000	0.00000
30 min	0.00000	0.00000
1 hr	0.00000	0.00000
2 hrs	0.00000	0.00000
4 hrs	0.00000	0.00000
6 hrs	0.00000	0.00000
	0.00000	0.00000

Remarks:

SINGLETON LABORATORIES
CONSOLIDATION TEST

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STKG PHS II
STATION:
RANGE :

BORING: US-73
EL. : 618.7-618.3
SAMPLE: 1
DATE : 02-28-91



SOIL SYMBOL=ML/CL
SP GRAVITY =2.66 L.L.(%)= 46
D10 (mm) =0.0000 P.I.(%)= 18

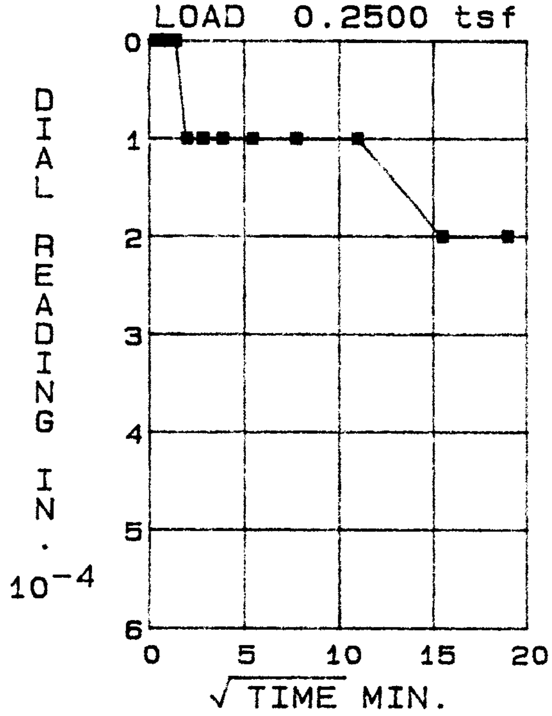
	INITIAL	FINAL
MOISTURE (%)	28.9	23.5
DRY DENSITY (pcf)	100.5	106.4
VOID RATIO	0.652	0.560
SATURATION (%)	100.0	100.0

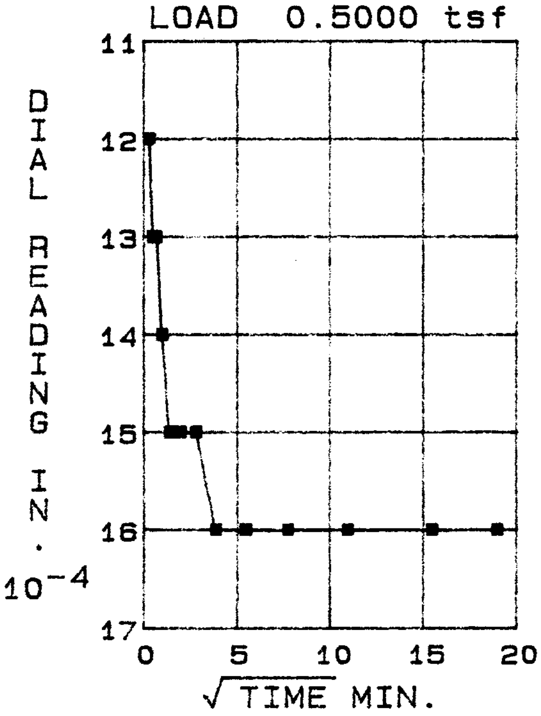
REMARKS: INUNDATED AT 0.50 TSF

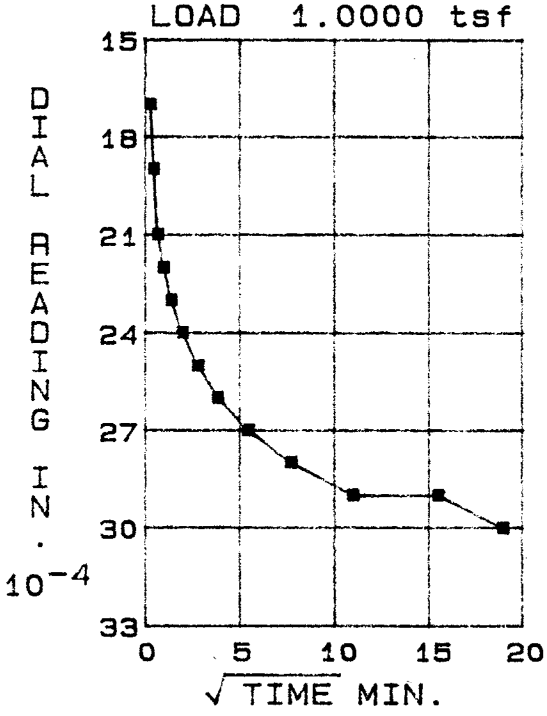
SINGLETON LABORATORIES
CONSOLIDATION TEST

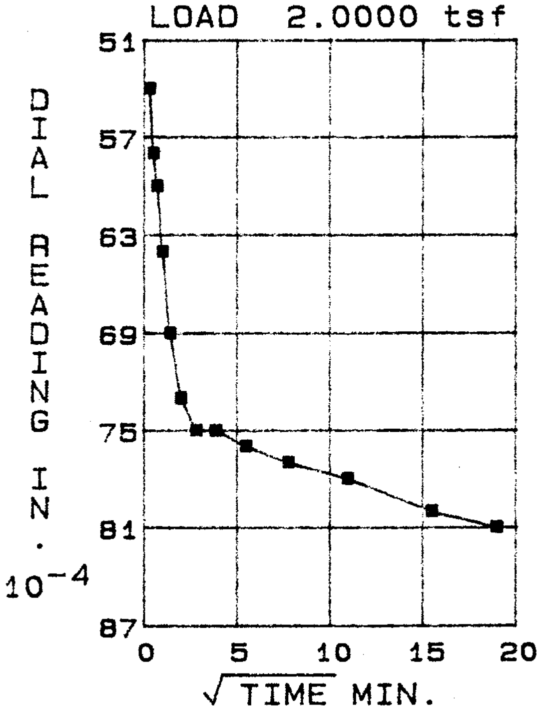
PROJECT: WIDOWS CREEK SP
FEATURE: DRY STKG PHS II
STATION:
RANGE :

BORING: US-73
EL. : 618.7-618.3
SAMPLE: 1
DATE : 02-28-91


LOAD 0.2500 tsf


LOAD 0.5000 tsf


LOAD 1.0000 tsf


LOAD 2.0000 tsf

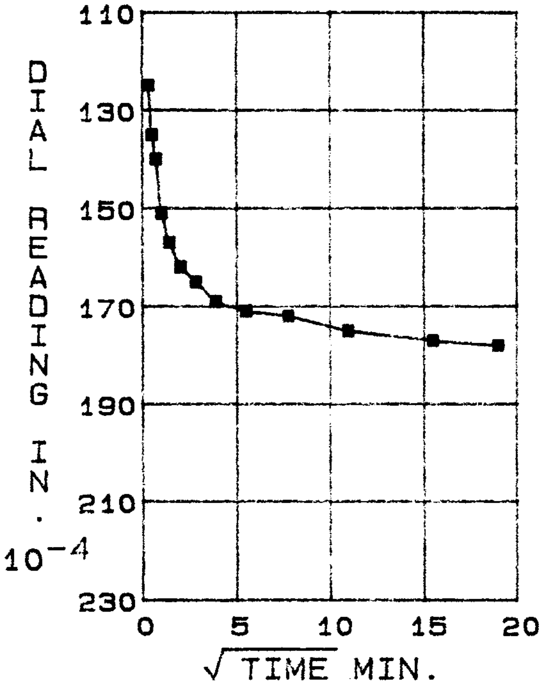
REMARKS:

SINGLETON LABORATORIES
CONSOLIDATION TEST

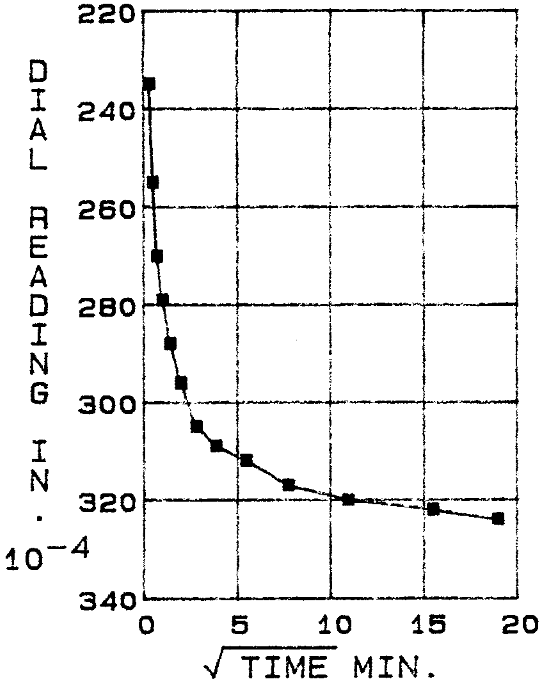
PROJECT: WIDOWS CREEK SP
FEATURE: DRY STKG PHS II
STATION:
RANGE :

BORING: US-73
EL. : 618.7-618.3
SAMPLE: 1
DATE : 02-28-91

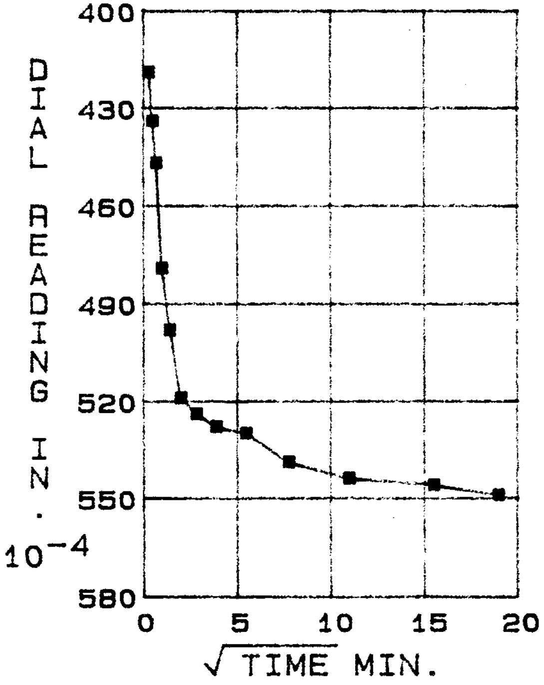
LOAD 4.0000 tsf



LOAD 8.0000 tsf



LOAD 16.0000 tsf



REMARKS:

Singleton Laboratories
Consolidation Test

Project: WIDOWS CREEK SP		File : 3
Feature: DRY STKG PHS II		Tested By : TAL
Station:	El. : 618.7-618.3	Computed By: MHD
Range :	Sample: 1	Checked By : GPB
Boring : US-73	Part : 1	Report Date: 02-28-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare (gm)=	156.9	672.1	198.9
Dry Wt. and Tare (gm)=	133.7	634.7	168.5
Wt. of Tare (gm) =	39.2	505.3	39.1
Moisture (%) =	24.6	28.9	23.5

Sample Data:

Sample Volume (cc) =80.349

Sample Height (in.)= 0.998

Specific Gravity=2.66

Ring No. =9

	Initial	Final
Moisture (%)	28.9	23.5
Density (pcf)	100.5	106.4
Void Ratio	0.652	0.560
Saturation (%)	100.0	100.0

Load (tsf)	Dial Reading	Correction	Void Ratio
0.0625	0.00020	0.00030	0.6519
0.1250	0.00040	0.00040	0.6517
0.2500	0.00080	0.00060	0.6514
0.5000	0.00250	0.00090	0.6490
1.0000	0.00440	0.00130	0.6466
2.0000	0.01010	0.00180	0.6380
4.0000	0.02080	0.00250	0.6214
8.0000	0.03630	0.00350	0.5974
16.0000	0.06050	0.00510	0.5600

Remarks: INUNDATED AT 0.50 TSF

Singleton Laboratories
Consolidation Test

Project: WIDOWS CREEK SP
Feature: DRY STKG PHS II
Station:
Range :
Boring : US-73

El. : 618.7-618.3
Sample: 1
Part : 1

File : 3
Tested By : TAL
Computed By: MHD
Checked By : GPB
Report Date: 02-28-91

Load= 0.0625 (tsf) Time Started=9:55 2/18/91

Time	Dial Reading	Correction
0 sec	0.00000	0.00000
6 sec	0.00030	0.00030
15 sec	0.00030	0.00030
30 sec	0.00030	0.00030
1 min	0.00030	0.00030
2 min	0.00030	0.00030
4 min	0.00030	0.00030
8 min	0.00020	0.00030
15 min	0.00020	0.00030
30 min	0.00020	0.00030
1 hr	0.00020	0.00030
2 hrs	0.00020	0.00030
4 hrs	0.00020	0.00030
6 hrs	0.00020	0.00030
hrs	0.00020	0.00030

Remarks:

Load= 0.1250 (tsf) Time Started=10:05

Time	Dial Reading	Correction
0 sec	0.00020	0.00030
6 sec	0.00040	0.00040
15 sec	0.00040	0.00040
30 sec	0.00040	0.00040
1 min	0.00040	0.00040
2 min	0.00040	0.00040
4 min	0.00040	0.00040
8 min	0.00040	0.00040
15 min	0.00040	0.00040
30 min	0.00030	0.00040
1 hr	0.00040	0.00040
2 hrs	0.00040	0.00040
4 hrs	0.00040	0.00040
6 hrs	0.00040	0.00040
hrs	0.00040	0.00040

Remarks:

Load= 0.2500 (tsf) Time Started=10:40 2/19

Time	Dial Reading	Correction
0 sec	0.00040	0.00040
6 sec	0.00060	0.00060
15 sec	0.00060	0.00060
30 sec	0.00060	0.00060
1 min	0.00060	0.00060
2 min	0.00060	0.00060
4 min	0.00070	0.00060
8 min	0.00070	0.00060
15 min	0.00070	0.00060
30 min	0.00070	0.00060
1 hr	0.00070	0.00060
2 hrs	0.00070	0.00060
4 hrs	0.00080	0.00060
6 hrs	0.00080	0.00060
20 hrs	0.00080	0.00060

Remarks:

Load= 0.5000 (tsf) Time Started=7:45 2/19

Time	Dial Reading	Correction
0 sec	0.00080	0.00060
6 sec	0.00210	0.00090
15 sec	0.00220	0.00090
30 sec	0.00220	0.00090
1 min	0.00230	0.00090
2 min	0.00240	0.00090
4 min	0.00240	0.00090
8 min	0.00240	0.00090
15 min	0.00250	0.00090
30 min	0.00250	0.00090
1 hr	0.00250	0.00090
2 hrs	0.00250	0.00090
4 hrs	0.00250	0.00090
6 hrs	0.00250	0.00090
23 hrs	0.00250	0.00090

Remarks:

Singleton Laboratories
Consolidation Test

Project: WIDOWS CREEK SP
Feature: DRY STKG PHS II
Station:
Range :
Boring : US-73

El. : 618.7-618.3
Sample: 1
Part : 1

File : 3
Tested By : TAL
Computed By: MHD
Checked By : GPB
Report Date: 02-28-91

Load= 1.0000 Time Started=7:45
(tsf)

Time	Dial Reading	Correction
0 sec	0.00250	0.00090
6 sec	0.00300	0.00130
15 sec	0.00320	0.00130
30 sec	0.00340	0.00130
1 min	0.00350	0.00130
2 min	0.00360	0.00130
4 min	0.00370	0.00130
8 min	0.00380	0.00130
15 min	0.00390	0.00130
30 min	0.00400	0.00130
1 hr	0.00410	0.00130
2 hrs	0.00420	0.00130
4 hrs	0.00420	0.00130
6 hrs	0.00430	0.00130
24 hrs	0.00440	0.00130

Remarks:

Load= 2.0000 Time Started=7:45
(tsf)

Time	Dial Reading	Correction
0 sec	0.00440	0.00130
6 sec	0.00720	0.00180
15 sec	0.00760	0.00180
30 sec	0.00780	0.00180
1 min	0.00820	0.00180
2 min	0.00870	0.00180
4 min	0.00910	0.00180
8 min	0.00930	0.00180
15 min	0.00930	0.00180
30 min	0.00940	0.00180
1 hr	0.00950	0.00180
2 hrs	0.00960	0.00180
4 hrs	0.00980	0.00180
6 hrs	0.00990	0.00180
24 hrs	0.01010	0.00180

Remarks:

Load= 4.0000 Time Started=7:45
(tsf)

Time	Dial Reading	Correction
0 sec	0.01010	0.00180
6 sec	0.01500	0.00250
15 sec	0.01600	0.00250
30 sec	0.01650	0.00250
1 min	0.01760	0.00250
2 min	0.01820	0.00250
4 min	0.01870	0.00250
8 min	0.01900	0.00250
15 min	0.01940	0.00250
30 min	0.01960	0.00250
1 hr	0.01970	0.00250
2 hrs	0.02000	0.00250
4 hrs	0.02020	0.00250
6 hrs	0.02030	0.00250
72 hrs	0.02080	0.00250

Remarks:

Load= 8.0000 Time Started=7:45
(tsf)

Time	Dial Reading	Correction
0 sec	0.02080	0.00250
6 sec	0.02700	0.00350
15 sec	0.02900	0.00350
30 sec	0.03050	0.00350
1 min	0.03140	0.00350
2 min	0.03230	0.00350
4 min	0.03310	0.00350
8 min	0.03400	0.00350
15 min	0.03440	0.00350
30 min	0.03470	0.00350
1 hr	0.03520	0.00350
2 hrs	0.03550	0.00350
4 hrs	0.03570	0.00350
6 hrs	0.03590	0.00350
24 hrs	0.03630	0.00350

Remarks:

Singleton Laboratories
Consolidation Test

Project: WIDOWS CREEK SP
Feature: DRY STKG PHS II
Station:
Range :
Boring : US-73

El. : 618.7-618.3
Sample: 1
Part : 1

File : 3
Tested By : TAL
Computed By: MHD
Checked By : GPB
Report Date: 02-28-91

Load=16.0000 Time Started=7:40
(tsf)

Time	Dial Reading	Correction
0 sec	0.03630	0.00350
6 sec	0.04700	0.00510
15 sec	0.04850	0.00510
30 sec	0.04980	0.00510
1 min	0.05300	0.00510
2 min	0.05490	0.00510
4 min	0.05700	0.00510
8 min	0.05750	0.00510
15 min	0.05790	0.00510
30 min	0.05810	0.00510
1 hr	0.05900	0.00510
2 hrs	0.05950	0.00510
4 hrs	0.05970	0.00510
6 hrs	0.06000	0.00510
24 hrs	0.06050	0.00510

Remarks:

Load= 0.0000 Time Started=
(tsf)

Time	Dial Reading	Correction
0 sec	0.00000	0.00000
6 sec	0.00000	0.00000
15 sec	0.00000	0.00000
30 sec	0.00000	0.00000
1 min	0.00000	0.00000
2 min	0.00000	0.00000
4 min	0.00000	0.00000
8 min	0.00000	0.00000
15 min	0.00000	0.00000
30 min	0.00000	0.00000
1 hr	0.00000	0.00000
2 hrs	0.00000	0.00000
4 hrs	0.00000	0.00000
6 hrs	0.00000	0.00000
	0.00000	0.00000

Remarks:

*** PERMEABILITY ANALYSIS ***

PROJECT: WIDOWS CREEK
FEATURE: DRY STACKING PHASE II
TEST NO: US-53 630.7-630.0

Vertical Permeability

RUN [illegible].	CONF. PRESS (PSI)	AREA PIPETTE CM2	AREA SPEC CM2	HT SPEC CM	TIME INTERVAL SEC	HEAD DIFF INITIAL CM	HEAD DIFF FINAL CM	PERMEABILITY K CM/SEC
1	14.0	0.3777	9.70	7.83	86400.0	28.00	27.70	0.00000004
[illegible]	14.0	0.3777	9.70	7.83	93600.0	27.50	25.50	0.00000025
[illegible]	14.0	0.3777	9.70	7.83	100800.0	27.30	25.10	0.00000025
4	14.0	0.3777	9.70	7.83	68400.0	26.80	26.60	0.00000003

Average = 1.4×10^{-7}

*** PERMEABILITY ANALYSIS ***

PROJECT: WIDOWS CREEK
FEATURE: DRY STACKING PHASE II
EST NO: US-53 622.3-622.0 2 2

Vertical Permeability

RUN O.	CONF. PRESS (PSI)	AREA PIPETTE CM2	AREA SPEC CM2	HT SPEC CM	TIME INTERVAL SEC	HEAD DIFF INITIAL CM	FINAL CM	PERMEABILITY K CM/SEC
1	14.0	0.3918	9.57	7.78	86400.0	27.50	27.30	0.00000003
2	14.0	0.3918	9.57	7.78	93600.0	27.00	26.80	0.00000003
3	14.0	0.3918	9.57	7.78	100800.0	27.00	26.60	0.00000005
4	14.0	0.3918	9.57	7.78	68400.0	27.00	26.80	0.00000003

Average = 3.5×10^{-8}

*** PERMEABILITY ANALYSIS ***

PROJECT: WIDOWS CREEK
FEATURE: DRY STACKING PHASE II
EST NO: US-55 1 2 615.3-613.7

Horizontal Permeability

RUN	CONF.	AREA	AREA	HT	TIME	HEAD DIFF		PERMEABILITY
NO.	PRESS (PSI)	PIPETTE CM2	SPEC CM2	SPEC CM	INTERVAL SEC	INITIAL CM	FINAL CM	K CM/SEC
1	14.0	0.3656	9.68	7.82	54000.0	28.50	28.20	0.00000006
2	14.0	0.3656	9.68	7.82	32400.0	28.50	28.30	0.00000006
3	14.0	0.3656	9.68	7.82	57600.0	28.50	28.40	0.00000002
4	14.0	0.3656	9.68	7.82	82800.0	28.50	28.10	0.00000005

Average = 4.8×10^{-7}

*** PERMEABILITY ANALYSIS ***

ROJECT: WIDOWS CREEK
ATURE: DRY STACKING PHASE II
ST NO: US-55   614.1-613.7   1 4

Vertical Permeability

N	~~CONF.~~	~~AREA~~	~~AREA~~	~~HT~~	~~TIME~~	~~HEAD DIFF~~		~~PERMEABILITY~~
.	PRESS (PSI)	PIPETTE CM2	SPEC CM2	SPEC CM	INTERVAL SEC	INITIAL CM	FINAL CM	K CM/SEC
1	14.0	0.3821	9.96	7.93	28800.0	27.70	27.50	0.00000008
	14.0	0.3821	9.96	7.93	61200.0	27.70	26.50	0.00000022
3	14.0	0.3821	9.96	7.93	28800.0	27.70	26.20	0.00000059
4	14.0	0.3821	9.96	7.93	64800.0	27.70	26.00	0.00000030

Average = 3.0×10^{-7}

*** PERMEABILITY ANALYSIS ***

ROJECT: WIDOWS CREEK
ATURE: DRY STACKING PHASE II
ST NO: US-58   610.4   1 4

Vertical Permeability

N	CONF.	AREA	AREA	HT	TIME	HEAD DIFF		PERMEABILITY
.	PRESS (PSI)	PIPETTE CM2	SPEC CM2	SPEC CM	INTERVAL SEC	INITIAL CM	FINAL CM	K CM/SEC
1	14.0	0.3656	9.44	7.73	86400.0	28.00	27.80	0.00000002
	14.0	0.3656	9.44	7.73	93600.0	28.00	27.70	0.00000003
3	14.0	0.3656	9.44	7.73	100800.0	27.50	27.10	0.00000004
4	14.0	0.3656	9.44	7.73	68400.0	27.50	27.40	0.00000002

Average = 2.8×10^{-8}

*** PERMEABILITY ANALYSIS ***

PROJECT: WIDOWS CREEK
ATURE: DRY STACKING PHASE II
ST NO: US-60 1 4 598.8-597.4

Horizontal Permeability

RUN .	CONF. PRESS (PSI)	AREA PIPETTE CM2	AREA SPEC CM2	HT SPEC CM	TIME INTERVAL SEC	HEAD DIFF INITIAL CM	 FINAL CM	PERMEABILITY K CM/SEC
1	14.0	0.3918	9.60	7.79	54000.0	27.20	23.70	0.00000081
	14.0	0.3918	9.58	7.79	32400.0	26.50	25.40	0.00000042
	14.0	0.3918	9.58	7.79	57600.0	26.20	25.30	0.00000019
4	14.0	0.3918	9.58	7.79	82800.0	25.50	24.80	0.00000011

Average = 3.8 x 10^{-7}

*** PERMEABILITY ANALYSIS ***

PROJECT: WIDOWS CREEK
EATURE: DRY STACKING PHASE II
EST NO: US-60 597.9-597.6 1 3

Vertical Permeability

RUN O.	CONF. PRESS (PSI)	AREA PIPETTE CM2	AREA SPEC CM2	HT SPEC CM	TIME INTERVAL SEC	HEAD DIFF INITIAL CM	FINAL CM	PERMEABILITY K CM/SEC
1	14.0	0.3777	9.75	7.85	28800.0	28.00	20.20	0.00000345
2	14.0	0.3777	9.75	7.85	57600.0	28.00	20.00	0.00000178
3	14.0	0.3777	9.75	7.85	18000.0	28.00	21.00	0.00000486

Average = 3.36×10^{-6}

*** PERMEABILITY ANALYSIS ***

PROJECT: WIDOWS CREEK
EATURE: DRY STACKING PHASE II
EST NO: US-60   2 4   591.3-589.8

Horizontal Permeability

RUN	CONF.	AREA	AREA	HT	TIME	HEAD DIFF		PERMEABILITY
O.	PRESS (PSI)	PIPETTE CM2	SPEC CM2	SPEC CM	INTERVAL SEC	INITIAL CM	FINAL CM	K CM/SEC
1	14.0	0.3777	9.68	7.82	54000.0	28.50	28.30	0.00000004
2	14.0	0.3777	9.68	7.82	32400.0	28.50	28.40	0.00000003
3	14.0	0.3777	9.68	7.82	57600.0	28.50	28.30	0.00000004
4	14.0	0.3777	9.68	7.82	82800.0	28.50	28.10	0.00000005

Average = 4.0 x 10^{-8}

```
          *** PERMEABILITY ANALYSIS ***

ROJECT: WIDOWS CREEK
ATURE: DRY STACKING PHASE II
ST NO: US-60    590.5-590.1    2  3

UN    CONF.     AREA      AREA    HT        TIME       HEAD DIFF       PERMEABILITY
 .    PRESS    PIPETTE    SPEC    SPEC    INTERVAL   INITIAL  FINAL          K
      (PSI)     CM2       CM2     CM        SEC        CM       CM         CM/SEC
 1    14.0     0.3777     9.75    7.85    68400.0    27.00    26.90    0.00000002
      14.0     0.3777     9.75    7.85    82800.0    27.00    26.80    0.00000003
```

Vertical Permeability

Average=2.5×10^{-8}

*** PERMEABILITY ANALYSIS ***

PROJECT: WIDOWS CREEK
EATURE: DRY STACKING PHASE II
EST NO: US-65 605.0-604.5 1 3

Vertical Permeability

UN O.	CONF. PRESS (PSI)	AREA PIPETTE CM2	AREA SPEC CM2	HT SPEC CM	TIME INTERVAL SEC	HEAD DIFF		PERMEABILITY K CM/SEC
						INITIAL CM	FINAL CM	
1	14.0	0.3821	9.64	7.81	86400.0	26.50	25.80	0.00000010
2	14.0	0.3821	9.64	7.81	93600.0	26.00	25.70	0.00000004
3	14.0	0.3821	9.64	7.81	100800.0	26.00	25.50	0.00000006
4	14.0	0.3821	9.64	7.81	68400.0	26.00	25.80	0.00000003

Average = 5.8×10^{-7}

*** PERMEABILITY ANALYSIS ***

PROJECT: WIDOWS CREEK
FEATURE: DRY STACKING PHASE II
TEST NO: US-66 602.9-602.4 1 1

Vertical Permeability

RUN NO.	CONF. PRESS (PSI)	AREA PIPETTE CM2	AREA SPEC CM2	HT SPEC CM	TIME INTERVAL SEC	HEAD DIFF		PERMEABILITY K CM/SEC
						INITIAL CM	FINAL CM	
1	14.0	0.3829	9.53	7.76	86400.0	25.50	25.30	0.00000003
2	14.0	0.3829	9.53	7.76	93600.0	25.30	25.20	0.00000001
3	14.0	0.3829	9.53	7.76	100800.0	25.00	24.90	0.00000001
4	14.0	0.3829	9.53	7.76	68400.0	25.00	24.90	0.00000002

Average = 1.8×10^{-8}

*** PERMEABILITY ANALYSIS ***

PROJECT: WIDOWS CREEK
EATURE: DRY STACKING PHASE II
EST NO: US-73 1 2 618.7-617.9

<u>Horizontal Permeability</u>

UN O.	CONF. PRESS (PSI)	AREA PIPETTE CM2	AREA SPEC CM2	HT SPEC CM	TIME INTERVAL SEC	HEAD DIFF		PERMEABILITY K CM/SEC
						INITIAL CM	FINAL CM	
1	14.0	0.3835	9.64	7.81	54000.0	28.00	26.00	0.00000043
2	14.0	0.3835	9.64	7.81	32400.0	27.50	26.60	0.00000032
3	14.0	0.3835	9.64	7.81	57600.0	27.30	25.50	0.00000037
4	14.0	0.3835	9.64	7.81	82800.0	27.30	24.50	0.00000041

Average = 3.8 x 10^{-7}

*** PERMEABILITY ANALYSIS ***

Vertical Permeability

PROJECT: WIDOWS CREEK
FEATURE: DRY STACKING PHASE II
TEST NO: US-73 618.3-617.9 1 1

RUN NO.	CONF. PRESS (PSI)	AREA PIPETTE CM2	AREA SPEC CM2	HT SPEC CM	TIME INTERVAL SEC	HEAD DIFF		PERMEABILITY K CM/SEC
						INITIAL CM	FINAL CM	
1	14.0	0.3821	9.80	7.87	68400.0	24.00	10.00	0.00000393
2	14.0	0.3821	9.80	7.87	82800.0	27.70	12.00	0.00000310

Average = 3.5×10^{-6}

*** PERMEABILITY ANALYSIS ***

PROJECT: WIDOWS CREEK
EATURE: DRY STACKING PHASE II
EST NO: US-73 615.7-614.7

Vertical Permeability

RUN O.	CONF. PRESS (PSI)	AREA PIPETTE CM2	AREA SPEC CM2	HT SPEC CM	TIME INTERVAL SEC	HEAD DIFF INITIAL CM	FINAL CM	PERMEABILITY K CM/SEC
1	14.0	0.3872	9.44	7.73	86400.0	27.00	26.90	0.00000001
2	14.0	0.3872	9.44	7.73	93600.0	27.00	26.80	0.00000003
3	14.0	0.3872	9.44	7.73	100800.0	27.00	26.70	0.00000004
4	14.0	0.3872	9.44	7.73	68400.0	27.00	26.80	0.00000003

Average = 2.8×10^{-8}

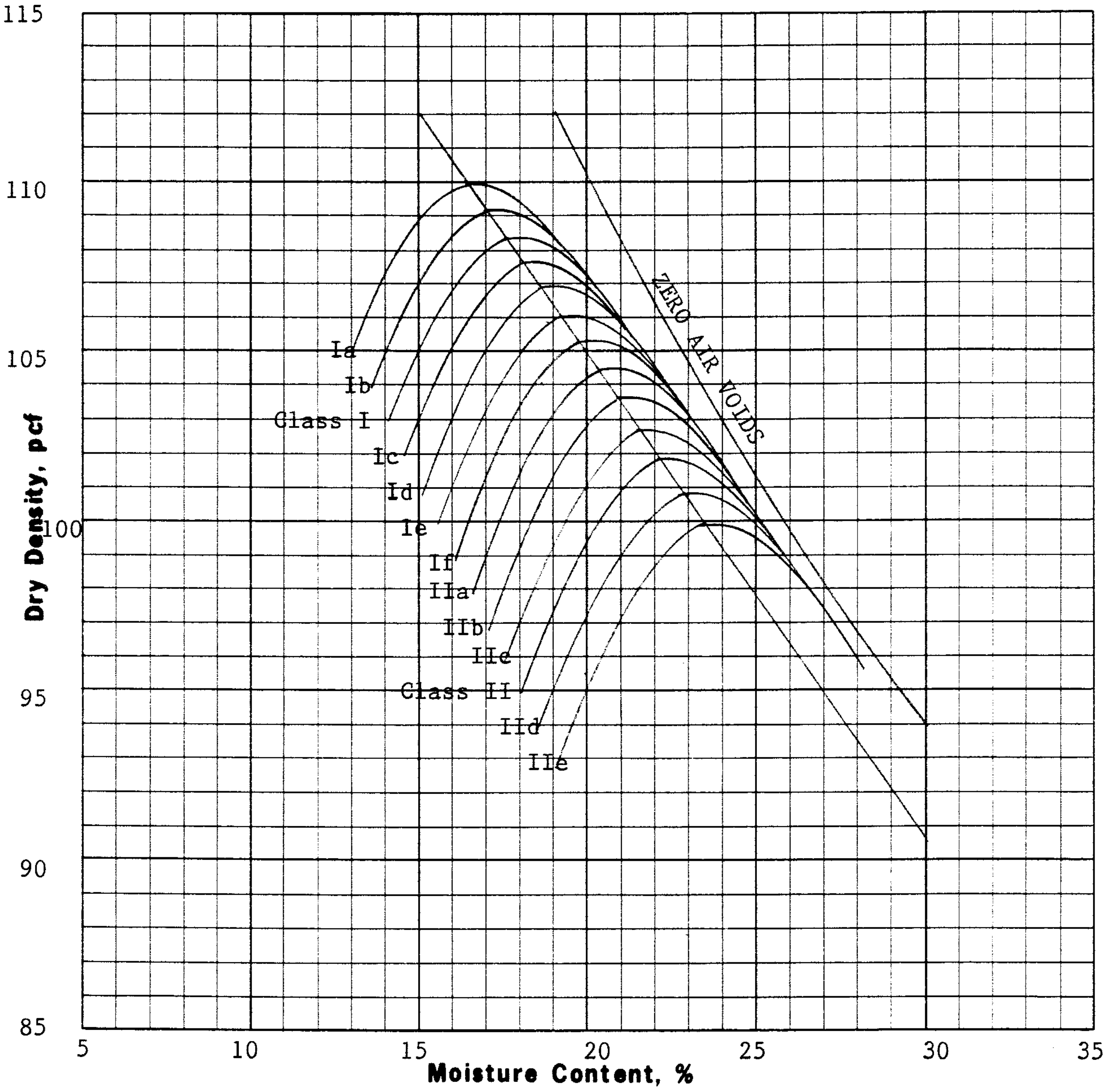
WIDOWS CREEK STEAM PLANT
FORCED OXIDATION GYPSUM STACKING - PHASE II
GEOTECHNICAL INVESTIGATION
DE-F19-392222

Singleton Laboratories Report 30-02-0016A

APPENDIX G

LABORATORY TEST DATA FOR BORROW SOILS

ATTACHMENT 8
CONST-QCP 5.3



Soil Class	Gravel %	Sand %	Silt %	Clay %	Specific Gravity	LL %	PI %	Optimum Moisture, %	Maximum Density, pcf
I CL	0	22	30	48	2.75	43	23	17.8	108.4
II CH	0	14	24	62	2.76	56	34	22.2	101.8

Plus No. 4 Specific Gravity, S S D	--
Plus No. 4 Absorption, %	--

Remarks:
Class I - Dark Brown Silty Clay
Class II - Brown Fat Clay

Project Widows Creek S.P.

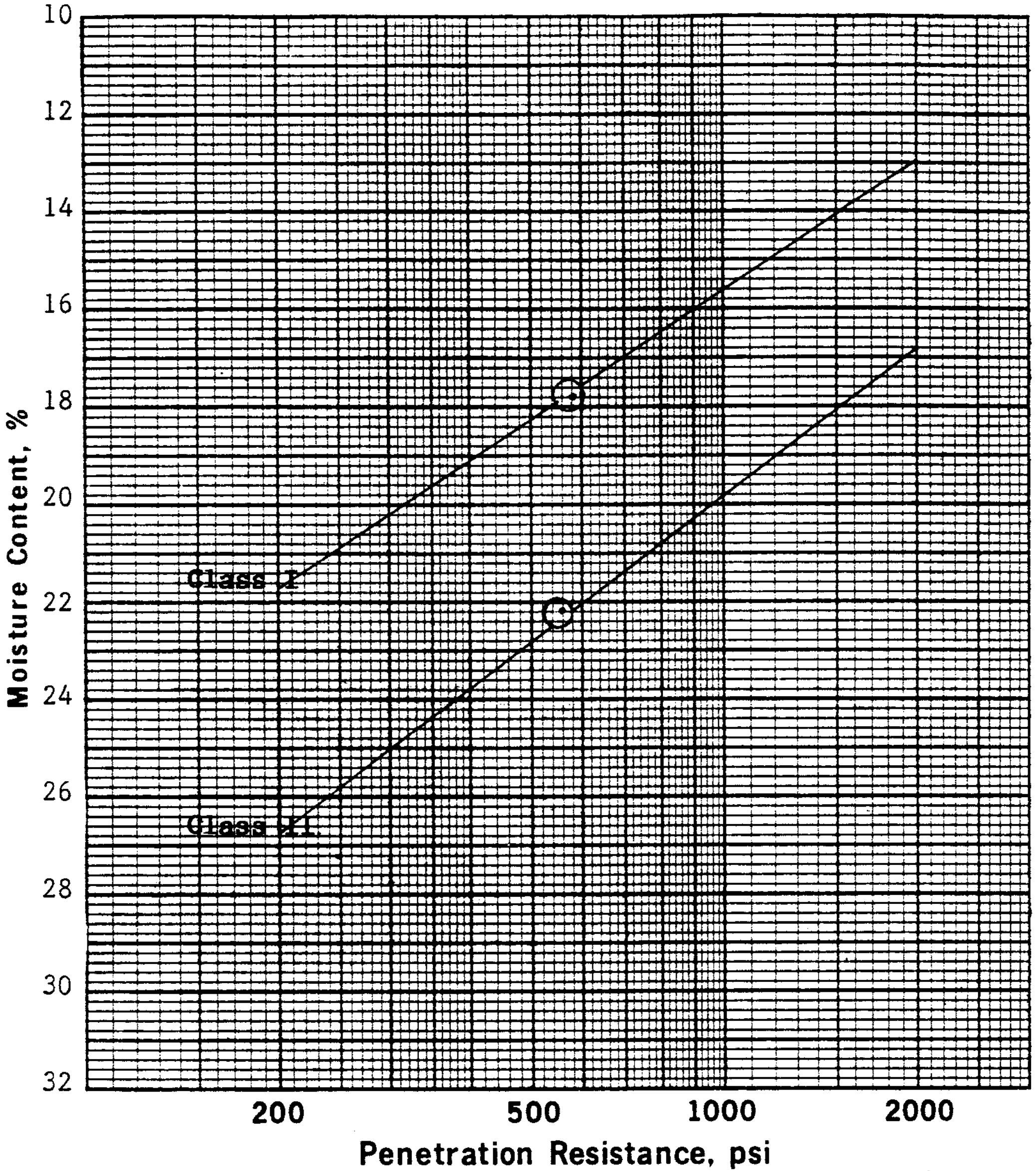
Feature Gypsum Stacking, Phase II

ASTM Designation D 698A

Date Tested 2/18/91

COMPACTION TEST (FAMILY OF CURVES)

Tested by: TAL Reviewed by: JEC



Soil Class	Optimum Moisture, %	Maximum Density, pcf	Penetration Resistance, psi
I CL	17.8	108.4	580
II CH	22.2	101.8	560

Remarks:

Class I - Dark Brown Silty Clay

Class II - Brown Fat Clay

Denotes Optimum Moisture ○

Project Widows Creek S.P.

Feature Gypsum Stacking, Phase II

ASTM Designation D 1558

Date Tested 2/18/91

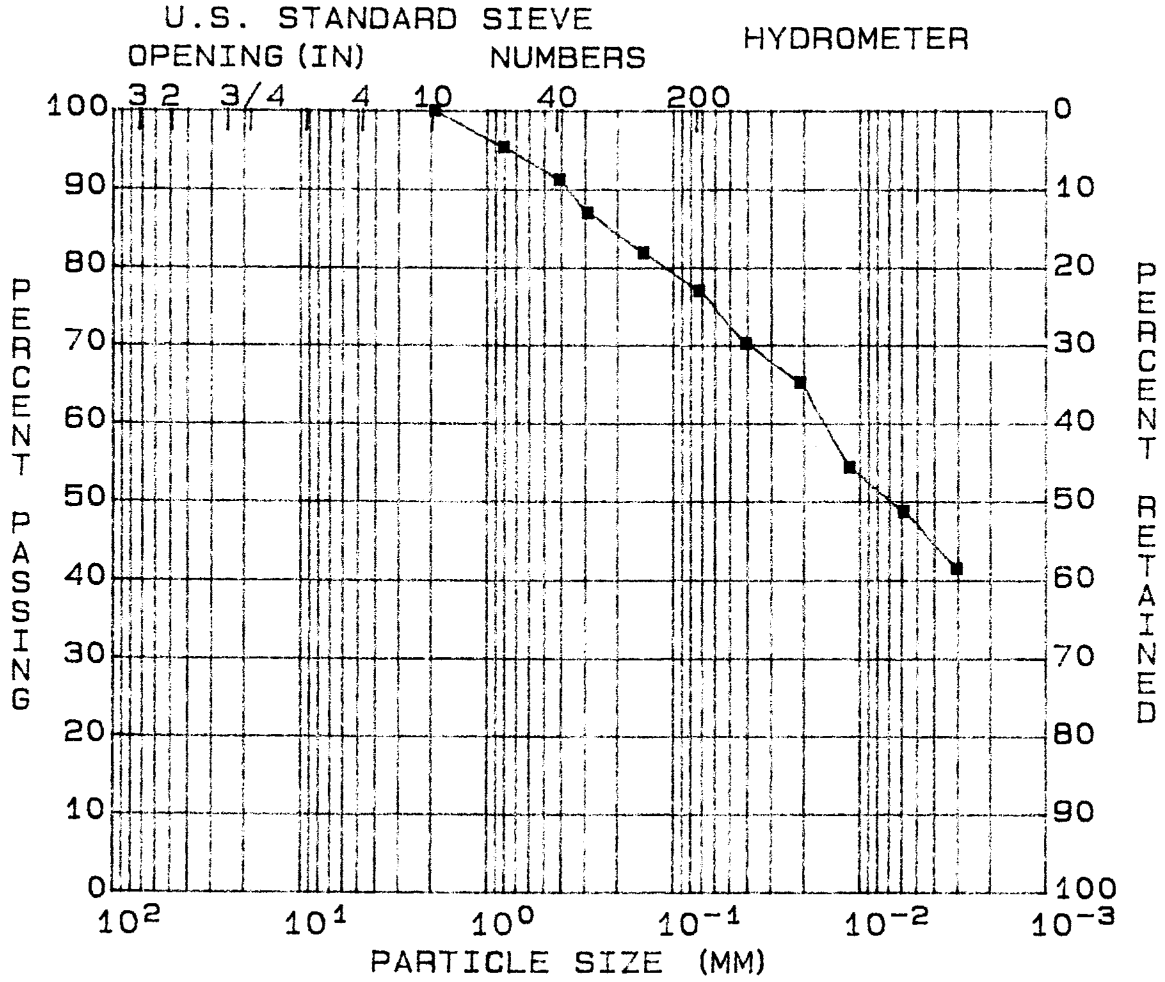
MOISTURE - PENETRATION TEST

Tested by: TAL Reviewed by:

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK
FEATURE: DRY STACKING PHS II
STATION:
RANGE :
PART :

BORING:
EL. :
SAMPLE: CLASS I
DATE : 02-21-91



GRAVEL (%) = 0
SAND (%) = 22
SILT (%) = 30
CLAY (%) = 48

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= CL
MOISTURE (%) = --
SP. GR. = 2.75

L.L. (%) = 43
P.I. (%) = 23

DENSITY (pcf) = --
SATURATION (%) = --
VOID RATIO = --

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK
Feature: DRY STACKING PHS II
Station:
Range :
Boring :

El. :
Sample: CLASS I
Part :

FILE : 35
TESTED BY : GPB/CBE
Computed By:MHD
Checked By : TAL
Report Date:02-21-91

Specific Gravity = 2.752
Flask No. = 16.00
Soil Wt.(gm) = 50.00
Temp.(deg.c.) = 21.30
Total Wt.(gm) =708.01

Moisture Determination
Dry Wt.+Tare(gm)= 1028.70
Tare Wt(gm) = 88.40

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 94.20
Tare Wt(gm) = 38.30
Dry Wt.+Tare(gm)= 92.00
Moisture(%) = 4.10

Liquid Limit
Blows = 26.00
Wet Wt.(gm) = 14.22
Dry Wt.(gm) = 11.16
Tare Wt.(gm) = 3.93
Liquid Limit(%) = 42.52
Plasticity Index= 22.54

Plastic Limit
Wet Wt.(gm) = 17.42
Dry Wt.(gm) = 15.19
Tare Wt.(gm) = 4.03
Plastic Limit(%)= 19.98

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 940.2999

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	0.0	100.0	19.0500
3/8 in.	0.0	100.0	9.5300
NO.4	0.0	100.0	4.7500
NO.10	0.0	100.0	2.0000
NO.20	1.8	96.3	0.8500
NO.40	3.8	92.1	0.4250
NO.50	5.9	87.7	0.3000
NO.100	8.4	82.5	0.1500
NO.200	10.8	77.5	0.0750

Air Dry Weight(gm)= 50.00
Corrected Weight(gm)= 48.03

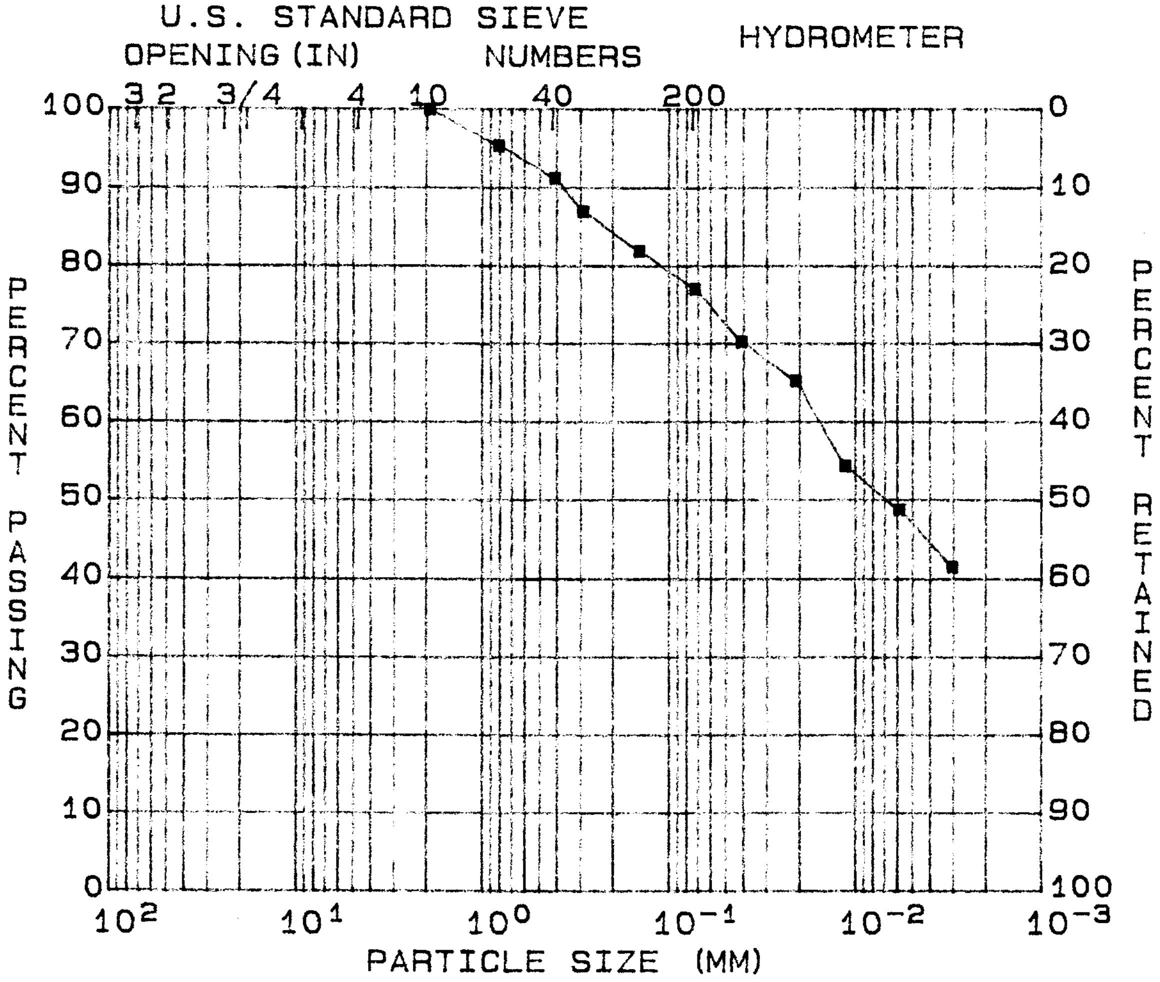
Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	17.0	41.2	6.5	70.7	0.0421
4 min.	17.0	38.7	6.5	65.6	0.0215
15 min.	17.0	33.3	6.5	54.6	0.0116
1 hour	17.0	30.5	6.5	48.9	0.0059
4 hours	17.0	26.8	6.4	41.5	0.0030

Soil Symbol= CL (Inorganic sandy clay of medium plasticity)
Gravel(%)= 0 Sand(%)=22 Silt(%)= 30 Clay(%)= 48

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK
FEATURE: DRY STACKING PHS II
STATION:
RANGE :
PART :

BORING:
EL. :
SAMPLE: CLASS I
DATE : 02-21-91



GRAVEL (%) = 0
SAND (%) = 22
SILT (%) = 30
CLAY (%) = 48

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= CL
MOISTURE (%) = --
SP. GR. = 2.75

L.L. (%) = 42
P.I. (%) = 23

DENSITY (pcf) = --
SATURATION (%) = --
VOID RATIO = --

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK
Feature: DRY STACKING PHS II
Station:
Range :
Boring :

El. :
Sample: CLASS I
Part :

FILE : 36
TESTED BY : GPB/CBE
Computed By:MHD
Checked By : TA
Report Date:02-21-91

Specific Gravity = 2.752
Flask No. = 16.00
Temp.(deg.c.) = 21.30
Soil Wt.(gm) = 50.00
Total Wt.(gm) =708.01

Moisture Determination
Dry Wt.+Tare(gm)= 1028.70
Tare Wt(gm) = 88.40

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 94.20
Dry Wt.+Tare(gm)= 92.00
Tare Wt(gm) = 38.30
Moisture(%) = 4.10

Liquid Limit
Blows = 26.00
Wet Wt.(gm) = 16.14
Dry Wt.(gm) = 12.55
Tare Wt.(gm) = 4.06
Liquid Limit(%) = 42.48
Plasticity Index= 22.50

Plastic Limit
Wet Wt.(gm) = 17.42
Dry Wt.(gm) = 15.19
Tare Wt.(gm) = 4.03
Plastic Limit(%)= 19.98

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 940.2999

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	0.0	100.0	19.0500
3/8 in.	0.0	100.0	9.5300
NO.4	0.0	100.0	4.7500
NO.10	0.0	100.0	2.0000
NO.20	1.8	96.3	0.8500
NO.40	3.8	92.1	0.4250
NO.50	5.9	87.7	0.3000
NO.100	8.4	82.5	0.1500
NO.200	10.8	77.5	0.0750

Air Dry Weight(gm)= 50.00
Corrected Weight(gm)= 48.03

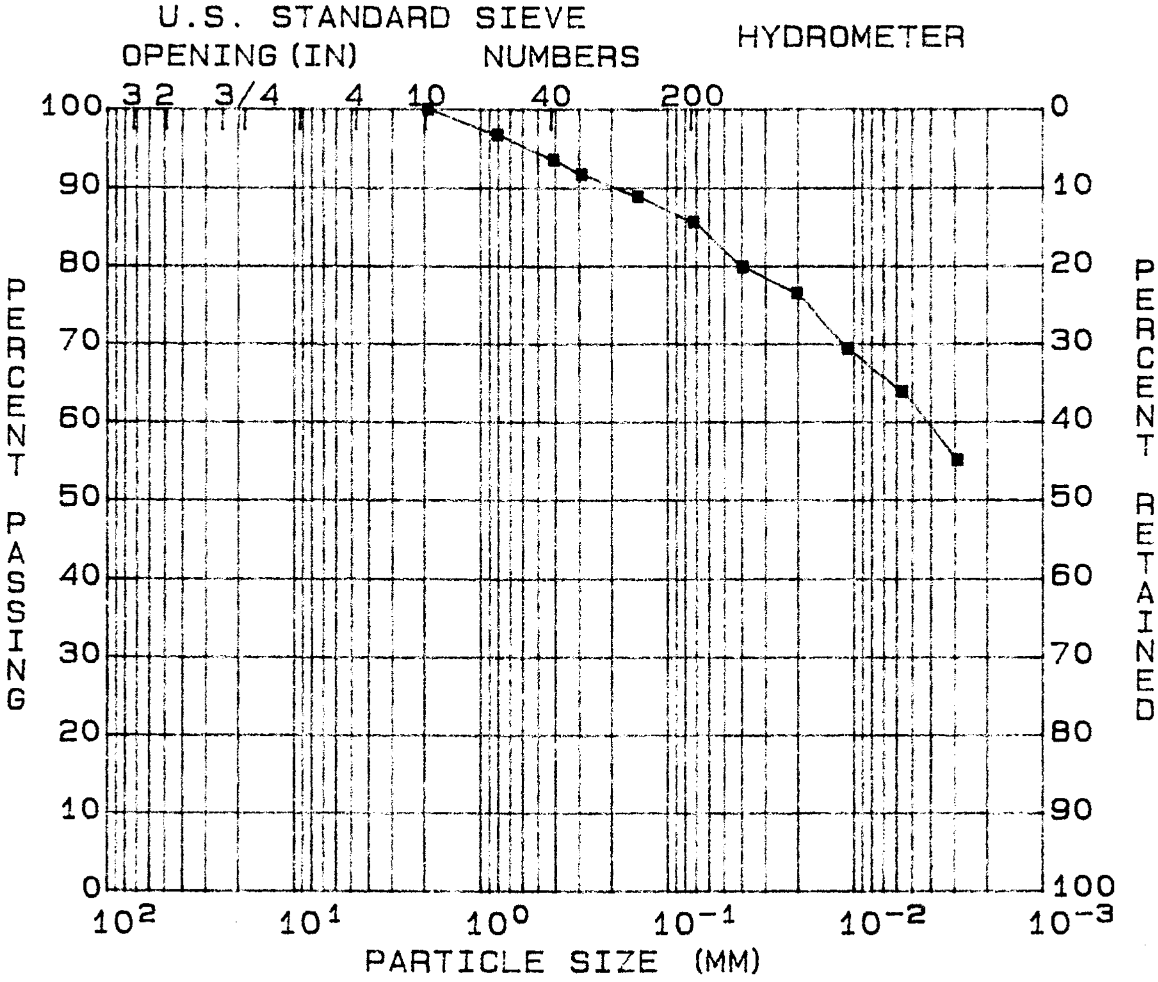
Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	17.0	41.2	6.5	70.7	0.0421
4 min.	17.0	38.7	6.5	65.6	0.0215
15 min.	17.0	33.3	6.5	54.6	0.0116
1 hour	17.0	30.5	6.5	48.9	0.0059
4 hours	17.0	26.8	6.4	41.5	0.0030

Soil Symbol= CL (Inorganic sandy clay of medium plasticity)
Gravel(%)= 0
Sand(%)=22
Silt(%)= 30
Clay(%)= 48

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK
FEATURE: DRY STACKING PHS II
STATION:
RANGE :
PART :

BORING:
EL. :
SAMPLE: CLASS II
DATE : 02-21-91



GRAVEL (%) = 0
SAND (%) = 14
SILT (%) = 24
CLAY (%) = 62

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= CH
MOISTURE (%) = --
SP. GR. = 2.76

L.L. (%) = 56
P.I. (%) = 34

DENSITY (pcf) = --
SATURATION (%) = --
VOID RATIO = --

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK
Feature: DRY STACKING PHS II
Station:
Range :
Boring :

El :
Sample: CLASS II
Part :

FILE : 37
TESTED BY : GPB/CBE
Computed By:MHD
Checked By : TAL
Report Date:02-21-91

Specific Gravity = 2.755
Flask No. = 24.00
Soil Wt.(gm) = 50.00
Temp.(deg.c.) = 21.30
Total Wt.(gm) =707.77

Moisture Determination
Dry Wt.+Tare(gm)= 718.30
Tare Wt(gm) = 70.10

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 91.10
Tare Wt(gm) = 38.90
Dry Wt.+Tare(gm)= 88.50
Moisture(%) = 5.24

Liquid Limit
Blows = 30.00
Wet Wt.(gm) = 12.66
Dry Wt.(gm) = 9.59
Tare Wt.(gm) = 3.95
Liquid Limit(%) = 55.64
Plasticity Index= 33.86

Plastic Limit
Wet Wt.(gm) = 12.64
Dry Wt.(gm) = 11.12
Tare Wt.(gm) = 4.14

Plastic Limit(%)= 21.78

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 648.2

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	0.0	100.0	19.0500
3/8 in.	0.0	100.0	9.5300
NO.4	0.0	100.0	4.7500
NO.10	0.0	100.0	2.0000
NO.20	1.2	97.5	0.8500
NO.40	2.7	94.3	0.4250
NO.50	3.6	92.4	0.3000
NO.100	5.0	89.5	0.1500
NO.200	6.6	86.1	0.0750

Air Dry Weight(gm)= 50.00
Corrected Weight(gm)= 47.51

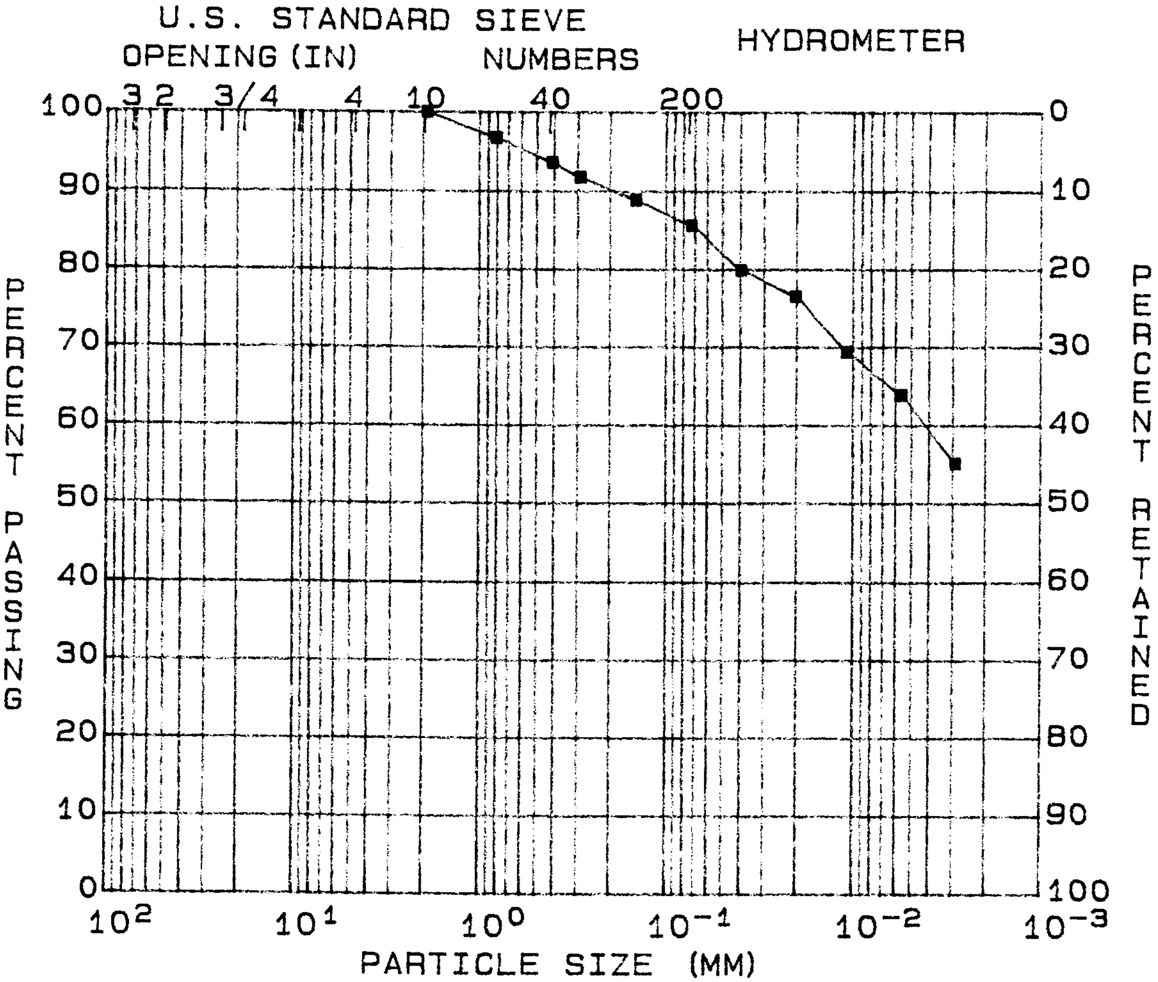
Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	17.0	45.5	6.5	80.2	0.0404
4 min.	17.0	43.8	6.5	76.7	0.0205
15 min.	17.0	40.3	6.5	69.5	0.0109
1 hour	17.0	37.6	6.5	64.0	0.0056
4 hours	17.0	33.2	6.4	55.1	0.0029

Soil Symbol= CH (Inorganic clay of high plasticity)
Gravel(%)= 0 Sand(%)=14 Silt(%)= 24 Clay(%)= 62

SINGLETON LABORATORIES
PARTICLE SIZE ANALYSIS

PROJECT: WIDOWS CREEK
FEATURE: DRY STACKING PHS II
STATION:
RANGE :
PART :

BORING:
EL. :
SAMPLE: CLASS II
DATE : 02-21-91



GRAVEL (%) = 0
SAND (%) = 14
SILT (%) = 24
CLAY (%) = 62

D10 (MM) = --
D30 (MM) = --
D60 (MM) = --
COEF UNIF= --

SOIL SYMBOL= CH
MOISTURE (%) = --
SP. GR. = 2.76

L.L. (%) = 56
P.I. (%) = 34

DENSITY (pcf) = --
SATURATION (%) = --
VOID RATIO = --

REMARKS:

Singleton Laboratories
General Classification Tests

Project: WIDOWS CREEK
Feature: DRY STACKING PHS II
Station:
Range :
Boring :

El. :
Sample: CLASS II
Part :

FILE : 38
TESTED BY : GPB/CBE
Computed By:MHD
Checked By : TAL
Report Date:02-21-91

Specific Gravity = 2.755
Flask No. = 24.00
Soil Wt.(gm) = 50.00
Temp.(deg.c.) = 21.30
Total Wt.(gm) =707.77

Moisture Determination
Dry Wt.+Tare(gm)= 718.30
Tare Wt(gm) = 70.10

Hygroscopic Moisture
Wet Wt.+Tare(gm)= 91.10
Tare Wt(gm) = 38.90
Dry Wt.+Tare(gm)= 88.50
Moisture(%) = 5.24

Liquid Limit
Blows = 30.00
Wet Wt.(gm) = 15.03
Dry Wt.(gm) = 11.09
Tare Wt.(gm) = 3.87
Liquid Limit(%) = 55.78
Plasticity Index= 34.00

Plastic Limit
Wet Wt.(gm) = 12.64
Dry Wt.(gm) = 11.12
Tare Wt.(gm) = 4.14
Plastic Limit(%)= 21.78

Sieve and Hydrometer Analysis
Total Dry Weight(gm) = 648.2

Sieve	Wt.Ret.	% Pass.	Size(mm)
3 in.	0.0	100.0	76.2000
2 in.	0.0	100.0	50.8000
1.5 in.	0.0	100.0	38.1000
1 in.	0.0	100.0	25.4000
3/4 in.	0.0	100.0	19.0500
3/8 in.	0.0	100.0	9.5300
NO.4	0.0	100.0	4.7500
NO.10	0.0	100.0	2.0000
NO.20	1.2	97.5	0.8500
NO.40	2.7	94.3	0.4250
NO.50	3.6	92.4	0.3000
NO.100	5.0	89.5	0.1500
NO.200	6.6	86.1	0.0750

Air Dry Weight(gm)= 50.00
Corrected Weight(gm)= 47.51

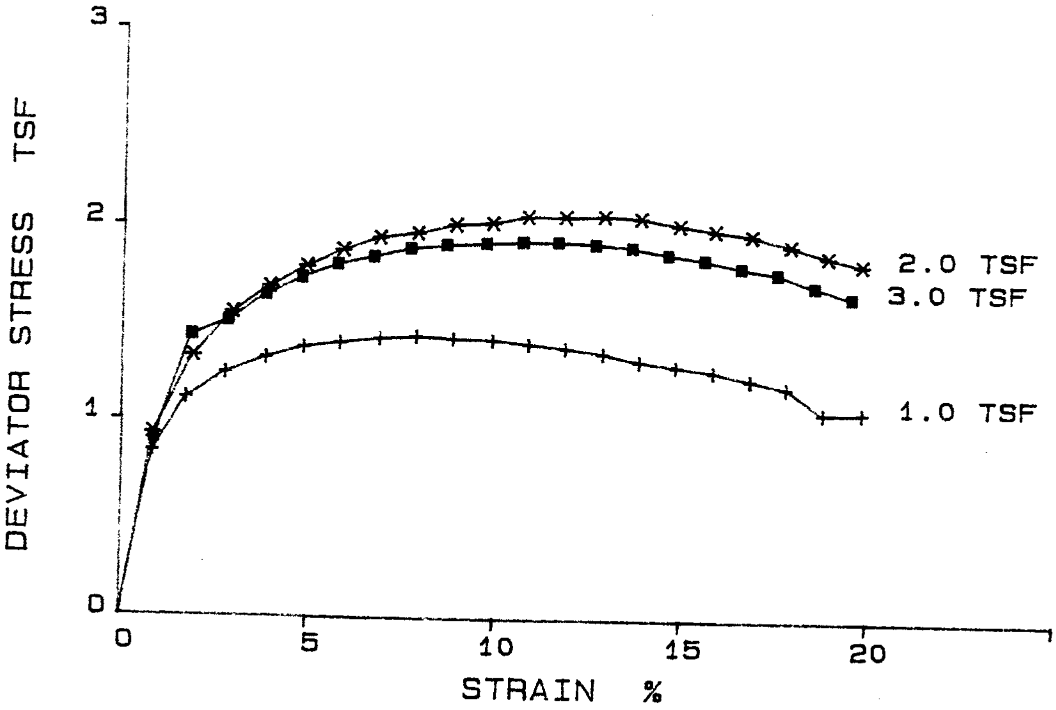
Time	Temp.	Hyd.Rdg	Corr	% Pass	Size(mm)
1 min.	17.0	45.5	6.5	80.2	0.0404
4 min.	17.0	43.8	6.5	76.7	0.0205
15 min.	17.0	40.3	6.5	69.5	0.0109
1 hour	17.0	37.6	6.5	64.0	0.0056
4 hours	17.0	33.2	6.4	55.1	0.0029

Soil Symbol= CH (inorganic clay of high plasticity)
Gravel(%)= 0 Sand(%)=14 Silt(%)= 24 Clay(%)= 62

SINGLETON LABORATORIES
UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (Q) TEST

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STKG PHS II
STATION:
RANGE :
BORING :

EL. :
SAMPLE : CLASS I
PART :
SOIL SYM: CL
DATE : 02-27-91

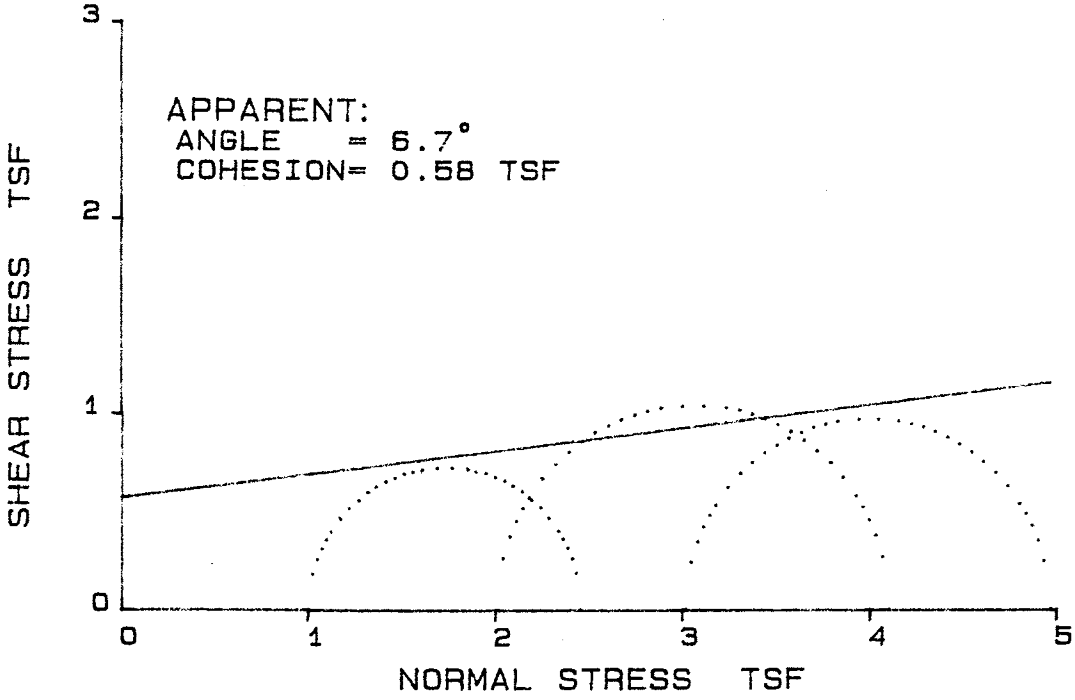


REMARKS: REMOLDED AT 3% WET OF OPTIMUM MOISTURE
AND AT 95% MAXIMUM UNIT WEIGHT.

SINGLETON LABORATORIES
UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (Q) TEST

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STKG PHS II
STATION:
RANGE :
BORING :

EL. :
SAMPLE : CLASS I
PART :
SOIL SYM: CL
DATE : 02-27-91



REMARKS: REMOLDED AT 3% WET OF OPTIMUM MOISTURE
AND AT 95% MAXIMUM UNIT WEIGHT.

Singleton Laboratories

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION(Q) TEST

Project: WIDOWS CREEK SP		File : 5
Feature: DRY STKG PHS II		Tested By : CBE
Station:	El. :	Computed By: MHD
Range :	Sample: CLASS I	Checked By : GPB
Boring :	Part :	Report Date: 02-27-91

Soil Symbol= CL	L.L.(%)= 43	P.I.(%) = 23
Sp. Gr. = 2.75	D10(mm)= 0	

Specimen Number	1	2	3	4
Initial:				
Moisture Content(%)	20.5	20.7	20.6	0.0
Dry Density(pcf)	103.4	103.3	103.3	0.0
Void Ratio	0.660	0.662	0.662	0.000
Saturation(%)	85.4	85.9	85.6	0.0
Before Shearing:				
Moisture(%) (after satur.)	--	--	--	--
Saturation(%)	--	--	--	--
Moisture(%) (after cons.)	--	--	--	--
Void Ratio (after cons.)	--	--	--	--
Final Moisture Content(%)	20.7	20.5	20.5	0.0
Minor Principal Stress(tsf)	1.01	2.02	3.02	0.00
Major Principal Stress(tsf)	2.47	4.11	4.97	0.00
Eff. Minor Prin Stress (tsf)	--	--	--	--
Eff. Major Prin Stress (tsf)	--	--	--	--
Time to Failure(min)	8	13	12	0
Rate of Strain(%/min)	1.00	1.00	0.98	0.00
Specimen Height(in.)	3.13	3.13	3.13	0.00
Specimen Dia (in.)	1.40	1.40	1.40	0.00

	Max Deviator Stress		Max Eff Stress Ratio	
Shear Strength	Deg	c(tsf)	Deg	c(tsf)
Apparent	6.7	0.58		
Effective	--	--		

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Remark: REMOLDED AT 3% WET OF OPTIMUM MOISTURE
AND AT 95% MAXIMUM UNIT WEIGHT.

Singleton Laboratories
UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION(Q) TEST

Project: WIDOWS CREEK SP
Feature: DRY STKG PHS II
Station:
Range :
Boring :

El. :
Sample: CLASS I
Part :

File : 2
Tested By : CBE
Computed By: MHD
Checked By : GPB
Report Date: 02-27-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	143.2	158.1	196.6
Dry Wt. and Tare(gm)=	125.2	131.2	169.5
Wt. of Tare(gm) =	38.2	0.0	38.3
Moisture(%) =	20.7	20.5	20.7

Test Conditions and Constants:

Proving Ring No. = 2423
Proving Ring Constant:
Slope Const. = 1
Intercept = 0
Confining Pres.(psi) = 14
Initial Pore Pre(psi)= 0

Tube No. = 1
Sample Volume (cc) = 79.194
Sample Height(in.) = 3.13
Specific Gravity = 2.75
Consolidation(in.) = 0
Initial P.R. Rdg = 6.2

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Strain (%)	e1 - e3 (tsf)
1	0.027	24.4	0.86	0.84
2	0.055	30.6	1.76	1.12
3	0.088	33.8	2.81	1.25
4	0.122	36.0	3.90	1.34
5	0.154	37.6	4.92	1.39
6	0.185	38.6	5.91	1.42
7	0.219	39.6	7.00	1.45
8	0.250	40.2	7.99	1.46
9	0.281	40.4	8.98	1.45
10	0.314	40.8	10.03	1.45
11	0.344	40.8	10.99	1.44
12	0.376	40.8	12.01	1.42
13	0.408	40.6	13.04	1.40
14	0.439	40.0	14.03	1.36
15	0.471	39.8	15.05	1.33
16	0.503	39.6	16.07	1.31
17	0.534	39.0	17.06	1.27
18	0.565	38.4	18.05	1.23
19	0.597	35.4	19.07	1.10
20	0.630	36.0	20.13	1.11

Initial:
Moisture(%) = 20.5
Density(pcf)=103.4

Void Ratio =0.660
Saturation(%)= 85.4

Minor Prin. Stress(tsf) =1.01

Major Prin. Stress(tsf) = 2.47

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Singleton Laboratories
UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION(Q) TEST

Project: WIDOWS CREEK SP
Feature: DRY STKG PHS II
Station:
Range :
Boring :

El. :
Sample: CLASS I
Part :

File : 2
Tested By : CBE
Computed By: MHD
Checked By : GPB
Report Date: 02-27-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	145.6	158.1	196.2
Dry Wt. and Tare(gm)=	127.3	131.0	169.4
Wt. of Tare(gm) =	39.1	0.0	38.4
Moisture(%) =	20.7	20.7	20.5

Test Conditions and Constants:

Proving Ring No. = 2515
Proving Ring Constant:
Slope Const. = 1
Intercept = 0
Confining Pres.(psi) = 28
Initial Pore Pre(psi)= 0

Tube No. = 1
Sample Volume (cc) = 79.194
Sample Height(in.) = 3.13
Specific Gravity = 2.75
Consolidation(in.) = 0
Initial P.R. Rdg = 11.8

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Strain (%)	e1 - e3 (tsf)
1	0.027	32.0	0.86	0.93
2	0.060	41.0	1.92	1.34
3	0.093	46.4	2.97	1.57
4	0.124	49.8	3.96	1.70
5	0.155	52.6	4.95	1.81
6	0.186	55.0	5.94	1.89
7	0.218	57.0	6.96	1.96
8	0.250	58.2	7.99	1.99
9	0.282	59.8	9.01	2.04
10	0.313	60.6	10.00	2.05
11	0.343	62.0	10.96	2.08
12	0.375	62.6	11.98	2.09
13	0.408	63.4	13.04	2.09
14	0.439	63.8	14.03	2.08
15	0.472	63.6	15.08	2.05
16	0.502	63.6	16.04	2.03
17	0.533	63.6	17.03	2.00
18	0.566	63.0	18.08	1.96
19	0.598	62.2	19.11	1.90
20	0.627	61.8	20.03	1.86

Initial:
Moisture(%) = 20.7
Density(pcf)=103.3

Void Ratio =0.662
Saturation(%)= 85.9

Minor Prin. Stress(tsf) =2.02
Major Prin. Stress(tsf) = 4.11

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Singleton Laboratories
UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION(Q) TEST

Project: WIDOWS CREEK SP
Feature: DRY STKG PHS II
Station:
Range :
Boring :

El. :
Sample: CLASS I
Part :

File : 2
Tested By : CBE
Computed By: MHD
Checked By : GPB
Report Date: 02-27-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	140.6	158.0	196.1
Dry Wt. and Tare(gm)=	123.2	131.0	169.3
Wt. of Tare(gm) =	38.7	0.0	38.3
Moisture(%) =	20.6	20.6	20.5

Test Conditions and Constants:
Proving Ring No. = 2423
Proving Ring Constant:
Slope Const. = 1
Intercept = 0
Confining Pres.(psi) = 42
Initial Pore Pre(psi)= 0

Tube No. = 1
Sample Volume (cc) = 79.194
Sample Height(in.) = 3.13
Specific Gravity = 2.75
Consolidation(in.) = 0
Initial P.R. Rdg = 16.8

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Strain (%)	e1 - e3 (tsf)
1	0.028	36.4	0.89	0.91
2	0.059	48.2	1.88	1.44
3	0.090	50.2	2.88	1.51
4	0.122	53.6	3.90	1.65
5	0.152	56.0	4.86	1.74
6	0.182	58.0	5.81	1.81
7	0.213	59.4	6.81	1.85
8	0.244	61.0	7.80	1.90
9	0.274	62.0	8.75	1.92
10	0.307	62.8	9.81	1.93
11	0.338	63.6	10.80	1.95
12	0.368	64.2	11.76	1.95
13	0.400	64.6	12.78	1.94
14	0.431	64.8	13.77	1.93
15	0.462	64.6	14.76	1.90
16	0.493	64.6	15.75	1.88
17	0.524	64.2	16.74	1.84
18	0.555	64.0	17.73	1.81
19	0.587	63.0	18.75	1.75
20	0.619	62.2	19.78	1.70

Initial:
Moisture(%) = 20.6
Density(pcf)=103.3

Void Ratio =0.662
Saturation(%)= 85.6

Minor Prin. Stress(tsf) =3.02

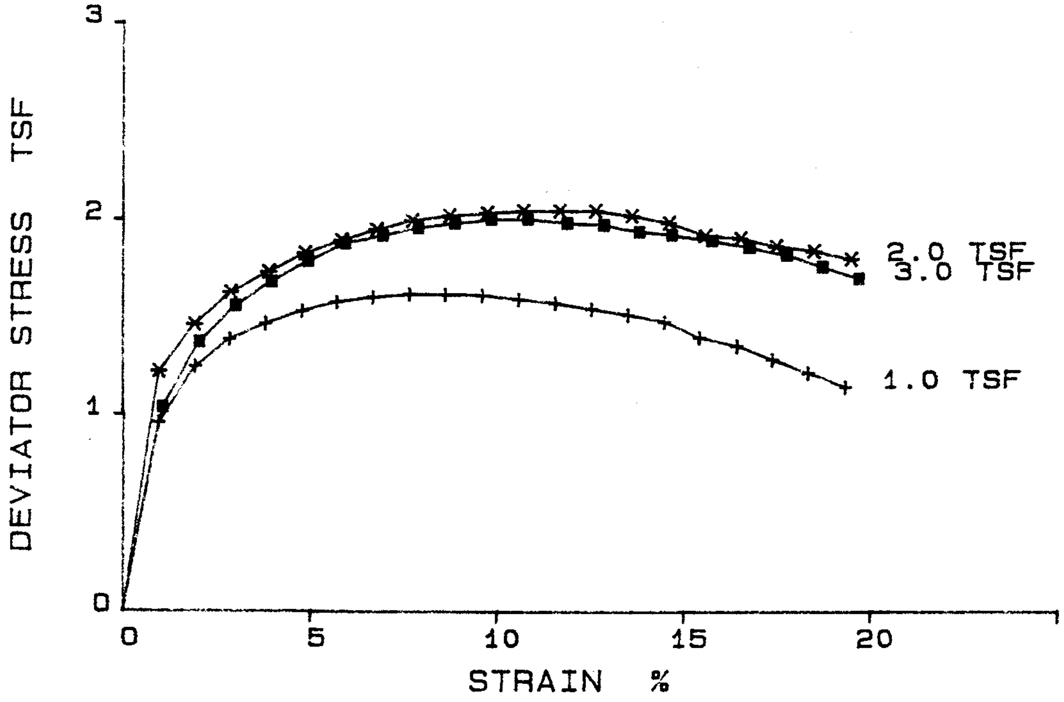
Major Prin. Stress(tsf) = 4.97

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

SINGLETON LABORATORIES
UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (Q) TEST

PROJECT: WIDOWS CREEK SP
FEATURE: DRY STKG PHS II
STATION:
RANGE :
BORING :

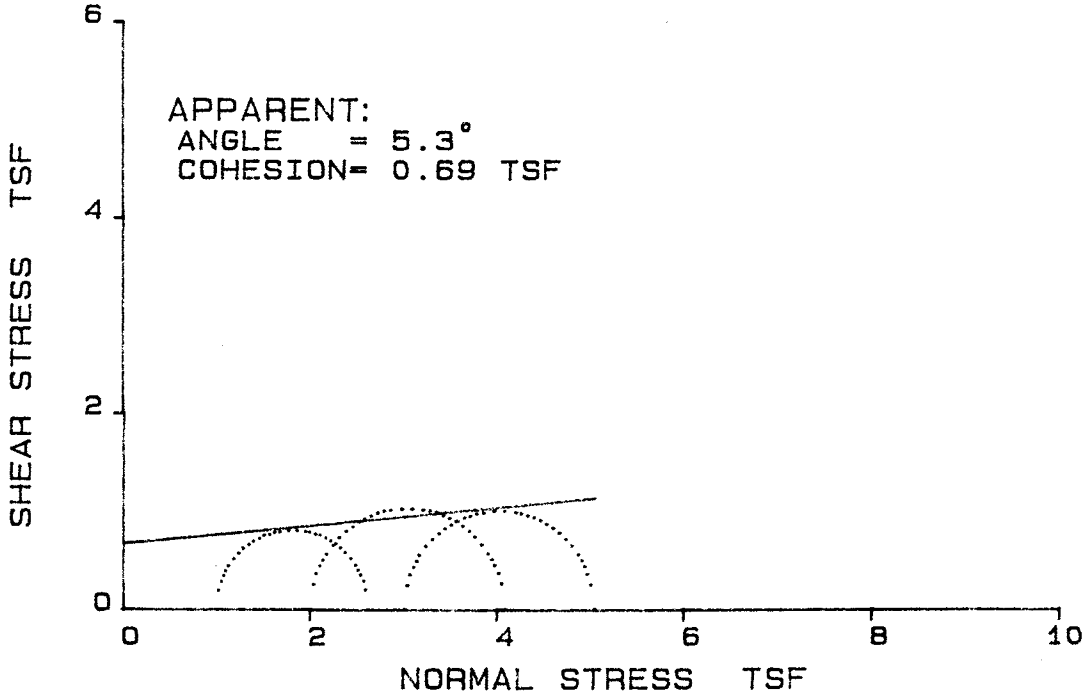
EL. :
SAMPLE : Class II
PART :
SOIL SYM: CH
DATE : 02-27-91



REMARKS: REMOLDED AT 3% WET OF OPTIMUM MOISTURE
AND AT 95% MAXIMUM UNIT WEIGHT.

SINGLETON LABORATORIES
UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (Q) TEST

PROJECT:	WIDOWS CREEK SP	EL.	:
FEATURE:	DRY STKG PHS II	SAMPLE	: Class II
STATION:		PART	:
RANGE :		SOIL SYM:	CH
BORING :		DATE	: 02-27-91



REMARKS: REMOLDED AT 3% WET OF OPTIMUM MOISTURE
AND AT 95% MAXIMUM UNIT WEIGHT.

Singleton Laboratories
Unconsolidated Undrained Triaxial Compression (Q) Test

Project: WIDOWS CREEK SP		File : 7
Feature: DRY STKG PHS II		Tested By : CBE
Station:	El. :	Computed By: MHD
Range :	Sample: Class II	Checked By : GPB
Boring :	Part :	Report Date: 02-27-91

Soil Symbol= CH	L.L.(%)= 56	P.I.(%) = 34
Sp. Gr. = 2.76	D10(mm)= 0	

Specimen Number	1	2	3	4
Initial:				
Moisture Content(%)	25.1	24.9	25.0	0.0
Dry Density(pcf)	96.9	97.0	97.0	0.0
Void Ratio	0.778	0.776	0.777	0.000
Saturation(%)	89.1	88.7	88.9	0.0
Before Shearing:				
Moisture(%) (after satur.)	--	--	--	--
Saturation(%)	--	--	--	--
Moisture(%) (after cons.)	--	--	--	--
Void Ratio (after cons.)	--	--	--	--
Final Moisture Content(%)	25.0	24.8	25.0	0.0
Minor Principal Stress(tsf)	1.01	2.02	3.02	0.00
Major Principal Stress(tsf)	2.64	4.10	5.05	0.00
Eff. Minor Prin Stress (tsf)	--	--	--	--
Eff. Major Prin Stress (tsf)	--	--	--	--
Time to Failure(min)	9	13	11	0
Rate of Strain(%/min)	0.97	0.99	1.00	0.00
Specimen Height(in.)	3.13	3.13	3.13	0.00
Specimen Dia (in.)	1.40	1.40	1.40	0.00

	Max Deviator Stress		Max Eff	Stress Ratio
Shear Strength	Deg	c(tsf)	Deg	c(tsf)
Apparent	5.3	0.69		
Effective	--	--		

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Remark: REMOLDED AT 3% WET OF OPTIMUM MOISTURE
AND AT 95% MAXIMUM UNIT WEIGHT.

Singleton Laboratories
Unconsolidated Undrained Triaxial Compression (Q) Test

Project: WIDOWS CREEK SP
Feature: DRY STKG PHS II
Station:
Range :
Boring :

El. :
Sample: Class II
Part :

File : 5
Tested By : CBE
Computed By: MHD
Checked By : GPB
Report Date: 02-27-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	137.6	153.8	193.8
Dry Wt. and Tare(gm)=	117.8	122.9	163.1
Wt. of Tare(gm) =	39.1	0.0	40.2
Moisture(%) =	25.2	25.1	25.0

Test Conditions and Constants:
Proving Ring No. = 2423
Proving Ring Constant:
Slope Const. = 1
Intercept = 0
Confining Pres.(psi) = 14
Initial Pore Pre(psi)= 0

Tube No. = 1
Sample Volume (cc) = 79.194
Sample Height(in.) = 3.13
Specific Gravity = 2.76
Consolidation(in.) = 0
Initial P.R. Rdg = 6

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Strain (%)	e1 - e3 (tsf)
1	0.030	26.8	0.96	0.96
2	0.061	33.4	1.95	1.25
3	0.090	36.8	2.88	1.39
4	0.120	38.9	3.83	1.48
5	0.151	40.8	4.82	1.54
6	0.180	42.2	5.75	1.59
7	0.211	43.2	6.74	1.62
8	0.242	44.0	7.73	1.64
9	0.272	44.4	8.69	1.64
10	0.304	44.8	9.71	1.63
11	0.335	44.8	10.70	1.62
12	0.366	44.8	11.69	1.60
13	0.397	44.6	12.68	1.57
14	0.428	44.4	13.67	1.55
15	0.459	44.0	14.66	1.51
16	0.489	42.4	15.62	1.43
17	0.521	41.8	16.65	1.39
18	0.551	40.4	17.60	1.32
19	0.581	39.0	18.56	1.25
20	0.613	37.6	19.58	1.18

Initial:
Moisture(%) = 25.1
Density(pcf)= 96.9

Void Ratio =0.778
Saturation(%)= 89.1

Minor Prin. Stress(tsf) =1.01
Major Prin. Stress(tsf) = 2.64

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Singleton Laboratories
Unconsolidated Undrained Triaxial Compression (Q) Test

Project: WIDOWS CREEK SP
Feature: DRY STKG PHS II
Station:
Range :
Boring :

El. :
Sample: Class II
Part :

File : 5
Tested By : CBE
Computed By: MHD
Checked By : GPB
Report Date: 02-27-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	138.7	153.8	192.1
Dry Wt. and Tare(gm)=	118.4	123.1	161.6
Wt. of Tare(gm) =	37.2	0.0	38.5
Moisture(%) =	25.0	24.9	24.8

Test Conditions and Constants:
Proving Ring No. = 2515
Proving Ring Constant:
Slope Const. = 1
Intercept = 0
Confining Pres.(psi) = 28
Initial Pore Pre(psi)= 0

Tube No. = 1
Sample Volume (cc) = 79.194
Sample Height(in.) = 3.13
Specific Gravity = 2.76
Consolidation(in.) = 0
Initial P.R. Rdg = 11.8

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Strain (%)	e1 - e3 (tsf)
1	0.030	38.4	0.96	1.23
2	0.060	44.0	1.92	1.47
3	0.091	48.0	2.91	1.64
4	0.123	50.8	3.93	1.75
5	0.154	53.4	4.92	1.84
6	0.185	55.4	5.91	1.91
7	0.215	57.2	6.87	1.97
8	0.245	58.8	7.83	2.02
9	0.277	60.0	8.85	2.05
10	0.309	61.0	9.87	2.07
11	0.340	61.8	10.86	2.08
12	0.371	62.4	11.85	2.08
13	0.401	63.0	12.81	2.08
14	0.432	63.0	13.80	2.06
15	0.464	62.8	14.82	2.03
16	0.495	61.8	15.81	1.96
17	0.525	62.0	16.77	1.95
18	0.555	61.6	17.73	1.91
19	0.587	61.6	18.75	1.89
20	0.619	61.2	19.78	1.85

Initial:
Moisture(%) = 24.9
Density(pcf)= 97.0

Void Ratio =0.776
Saturation(%)= 88.7

Minor Prin. Stress(tsf) =2.02
Major Prin. Stress(tsf) = 4.10

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Singleton Laboratories
Unconsolidated Undrained Triaxial Compression (Q) Test

Project: WIDOWS CREEK SP
Feature: DRY STKG PHS II
Station:
Range :
Boring :

El. :
Sample: Class II
Part :

File : 5
Tested By : CBE
Computed By: MHD
Checked By : GPB
Report Date: 02-27-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	163.2	153.8	191.8
Dry Wt. and Tare(gm)=	138.3	123.0	161.1
Wt. of Tare(gm) =	39.1	0.0	38.1
Moisture(%) =	25.1	25.0	25.0

Test Conditions and Constants:

Proving Ring No. = 2515
Proving Ring Constant:
Slope Const. = 1
Intercept = 0
Confining Pres.(psi) = 42
Initial Pore Pre(psi)= 0

Tube No. = 1
Sample Volume (cc) = 79.194
Sample Height(in.) = 3.13
Specific Gravity = 2.76
Consolidation(in.) = 0
Initial P.R. Rdg = 20.8

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Strain (%)	e1 - e3 (tsf)
1	0.033	43.4	1.05	1.04
2	0.064	51.0	2.04	1.38
3	0.095	55.4	3.04	1.56
4	0.125	58.6	3.99	1.69
5	0.156	61.4	4.98	1.80
6	0.188	64.0	6.01	1.89
7	0.220	65.4	7.03	1.93
8	0.250	66.8	7.99	1.97
9	0.281	68.0	8.98	2.00
10	0.312	69.0	9.97	2.02
11	0.343	69.6	10.96	2.03
12	0.376	69.8	12.01	2.01
13	0.407	70.2	13.00	2.00
14	0.437	70.0	13.96	1.97
15	0.465	70.2	14.86	1.96
16	0.499	70.2	15.94	1.94
17	0.531	70.0	16.96	1.91
18	0.563	69.6	17.99	1.87
19	0.593	68.7	18.95	1.81
20	0.624	67.8	19.94	1.75

Initial:
Moisture(%) = 25.0
Density(pcf)= 97.0

Void Ratio =0.777
Saturation(%)= 88.9

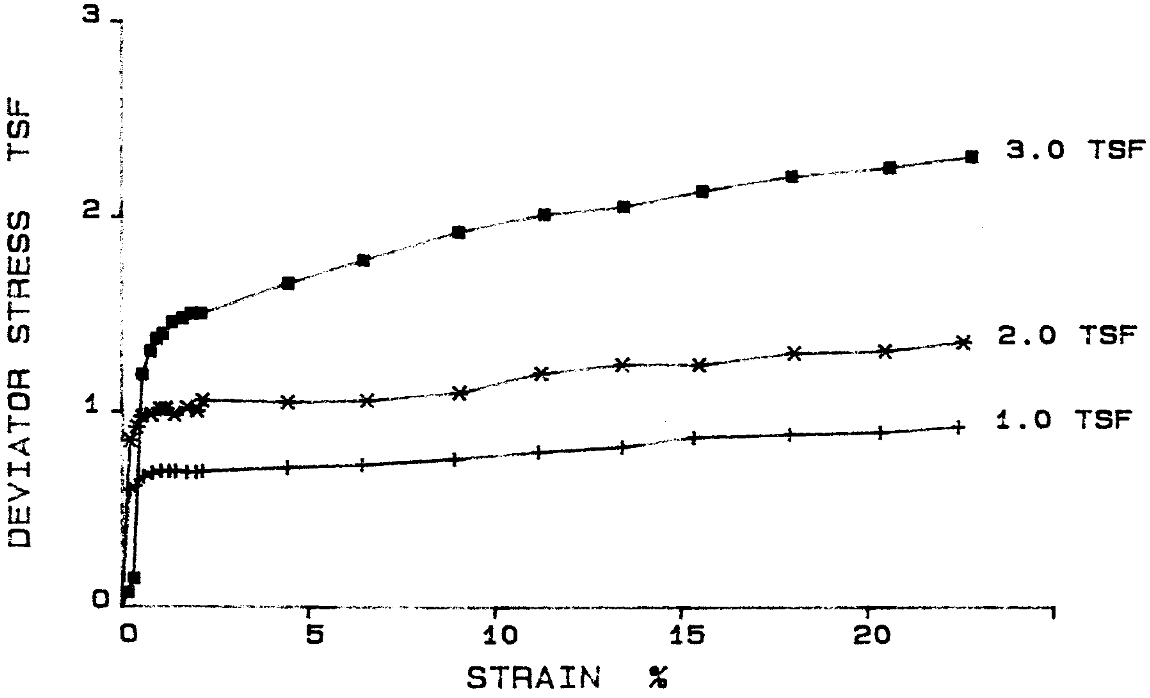
Minor Prin. Stress(tsf) =3.02
Major Prin. Stress(tsf) = 5.05

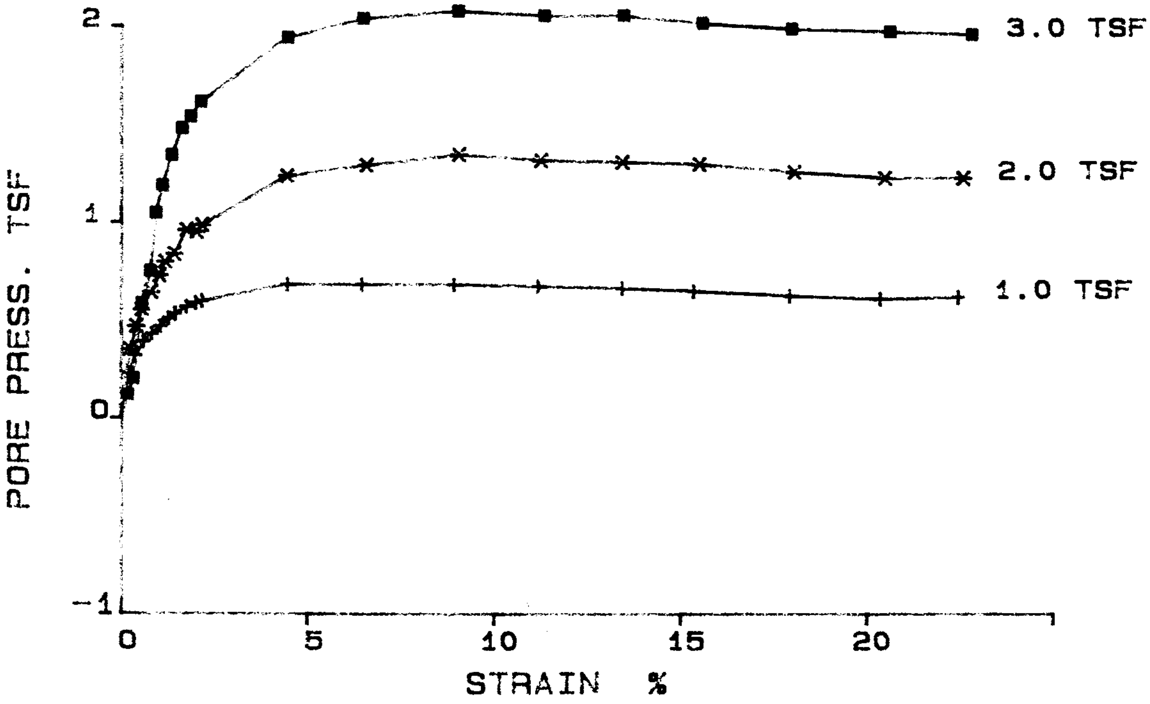
NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

SINGLETON LABORATORIES
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (R) TEST

PROJECT: WIDOWS CREEK S.P.
FEATURE: GYPSM STKG PHS II
STATION:
RANGE :
BORING :

EL. :
SAMPLE : CLASS I
PART :
SOIL SYM: CL
DATE : 03-25-91



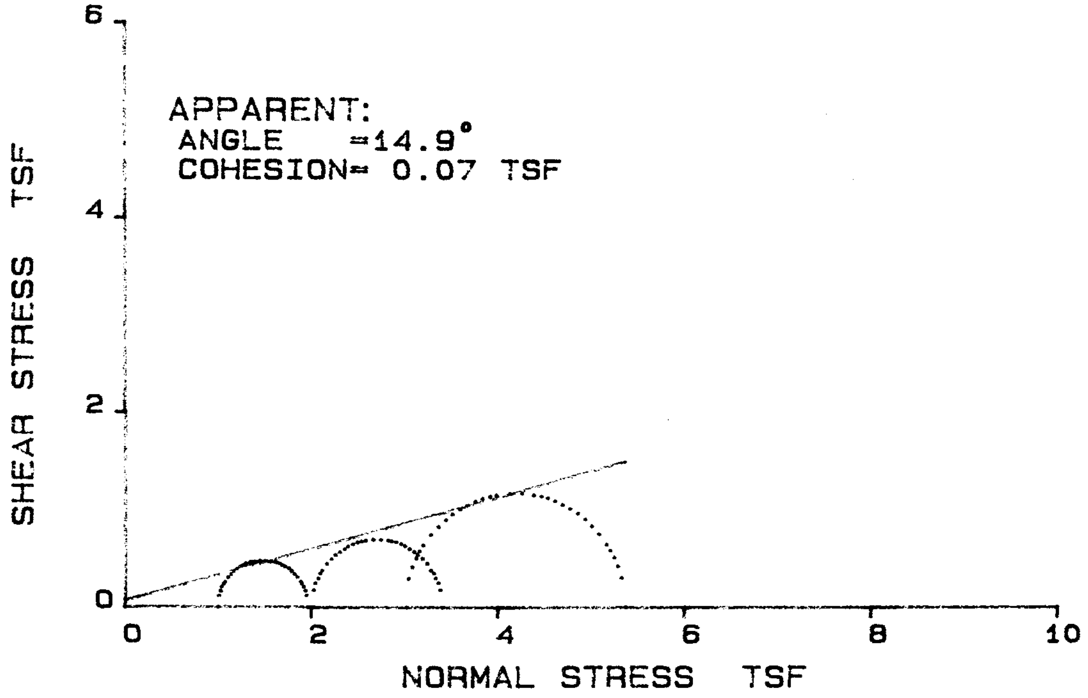


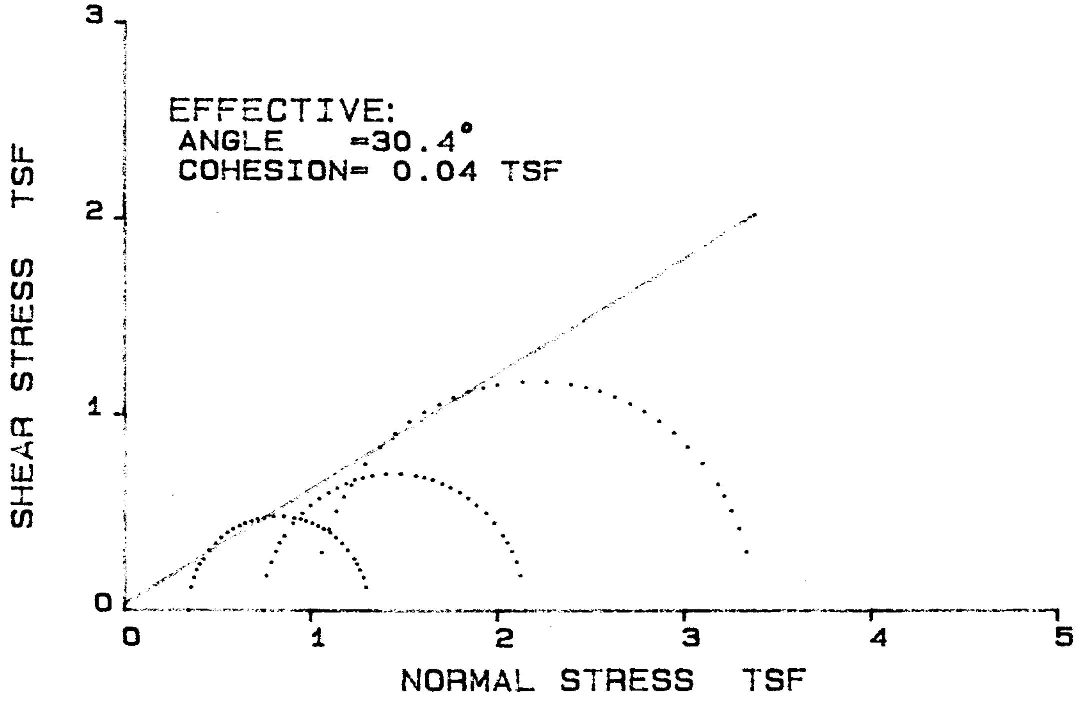
REMARKS: REMOLDED AT 2% DRY OF OPTIMUM MOISTURE
AND AT 95% MAXIMUM UNIT WEIGHT.

SINGLETON LABORATORIES
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (R) TEST

PROJECT: WIDOWS CREEK S.P.
FEATURE: GYPSM STKG PHS II
STATION:
RANGE :
BORING :

EL. :
SAMPLE : CLASS I
PART :
SOIL SYM: CL
DATE : 03-25-91


APPARENT:
ANGLE =14.9°
COHESION= 0.07 TSF


EFFECTIVE:
ANGLE =30.4°
COHESION= 0.04 TSF

REMARKS: REMOLDED AT 2% DRY OF OPTIMUM MOISTURE
AND AT 95% MAXIMUM UNIT WEIGHT.

Singleton Laboratories
Consolidated Undrained Triaxial Compression (R) Test

Project: WIDOWS CREEK S.P.
Feature: GYPSUM STACKING PHS II
Station:
Range :
Boring :

El. :
Sample: CLASS I
Part :

File : 2
Tested By : TAL
Computed By: MHD
Checked By : TAL
Report Date: 03-25-91

Soil Symbol= CL
Sp. Gr. = 2.75

L.L.(%)= 43
D10(mm)=

P.I.(%) = 23

Specimen Number	1	2	3	4
Initial:				
Moisture Content(%)	16.0	16.0	15.9	0.0
Dry Density(pcf)	102.8	102.8	102.9	0.0
Void Ratio	0.670	0.670	0.669	0.000
Saturation(%)	65.8	65.8	65.5	0.0
Before Shearing:				
Moisture(%) (after satur.)	24.4	24.4	24.3	0.0
Saturation(%)	100.0	100.0	100.0	0.0
Moisture(%) (after cons.)	22.1	20.9	19.2	0.0
Void Ratio (after cons.)	0.607	0.576	0.529	0.000
Final Moisture Content(%)	24.3	22.2	21.1	0.0
Minor Principal Stress(tsf)	1.01(1.01)	2.02(2.02)	3.02(3.02)	0.00(0.00)
Major Principal Stress(tsf)	1.98(1.98)	3.42(3.29)	5.38(5.38)	0.00(0.00)
Eff. Minor Prin Stress(tsf)	0.35(0.35)	0.75(0.68)	1.03(1.03)	0.00(0.00)
Eff. Major Prin Stress(tsf)	1.32(1.32)	2.16(1.95)	3.38(3.38)	0.00(0.00)
Time to Failure(min)	100	100	100	0
Rate of Strain(%/min)	0.23	0.23	0.23	0.00
Specimen Height(in.)	3.13	3.13	3.13	0.00
Specimen Dia (in.)	1.40	1.40	1.40	0.00

	Max Deviator Stress		Max Eff Stress Ratio	
Shear Strength	Deg	c(tsf)	Deg	c(tsf)
Apparent	14.9	0.07	15.1	0.05
Effective	30.4	0.04	31.0	0.02

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Remark: REMOLDED AT 2% DRY OF OPTIMUM MOISTURE AND AT 95% MAXIMUM UNIT WEIGHT.

Singleton Laboratories
Consolidated Undrained Triaxial Compression (R) Test

Project: WIDOWS CREEK S.P.
Feature: GYPSUM STACKING PHS II
Station:
Range :
Boring :
El. :
Sample: CLASS I
Part :
File : 2
Tested By : TAL
Computed By: MHD
Checked By : TA
Report Date: 03-25-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	175.4	151.3	200.3
Dry Wt. and Tare(gm)=	156.3	130.4	168.6
Wt. of Tare(gm) =	37.0	0.0	38.2
Moisture(%) =	16.0	16.0	24.3

Test Conditions and Constants:
Proving Ring No. = 2409
Proving Ring Constant:
Slope Const. = 1
Intercept = 0
Confining Pres.(psi) = 14
Initial Pore Pre(psi)= 100
Tube No. = 1
Sample Volume (cc) = 79.194
Sample Height(in.) = 3.13
Specific Gravity = 2.75
Consolidation(in.) = .04
Initial P.R. Rdg = 92

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Pore Pres. (psi)	Strain (%)	e1 - e3 (tsf)	Pore Press. (tsf)	e1 / e3 (TSF)
1	0.007	104.6	103.2	0.23	0.60	0.23	1.77
2	0.012	105.1	104.5	0.39	0.62	0.32	1.91
3	0.019	106.1	105.5	0.61	0.67	0.40	2.10
4	0.026	106.6	106.1	0.84	0.69	0.44	2.22
5	0.033	106.9	106.7	1.07	0.71	0.48	2.34
6	0.040	107.0	107.3	1.29	0.71	0.53	2.47
7	0.046	107.1	107.7	1.49	0.71	0.55	2.57
8	0.056	107.1	108.2	1.81	0.71	0.59	2.70
9	0.064	107.2	108.5	2.07	0.71	0.61	2.80
10	0.070	107.4	108.7	2.27	0.72	0.63	2.89
20	0.141	108.3	109.9	4.56	0.74	0.71	3.52
30	0.203	109.0	109.9	6.57	0.76	0.71	3.57
40	0.280	110.2	109.9	9.06	0.79	0.71	3.68
50	0.350	111.5	109.8	11.33	0.83	0.71	3.74
60	0.420	112.7	109.7	13.59	0.86	0.70	3.76
70	0.480	114.5	109.5	15.53	0.91	0.68	3.81
80	0.560	115.7	109.2	18.12	0.93	0.66	3.69
90	0.635	116.8	109.0	20.55	0.94	0.65	3.62
100	0.700	118.3	109.2	22.65	0.97	0.66	3.82

Initial:
Moisture(%) = 16.0
Density(pcf)=102.8
Void Ratio =0.670
Saturation(%)= 65.8
After Saturation:
Moisture(%) = 24.4
Void Ratio =0.607

Minor Prin. Stress(tsf) =1.01
Eff. Minor Prin. Stress(tsf)=0.35(0.35)
Major Prin. Stress(tsf) = 1.98(1.98)
Eff. Major Prin. Stress(tsf)= 1.32(1.32)

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Singleton Laboratories
Consolidated Undrained Triaxial Compression (R) Test

Project: WIDOWS CREEK S.P.
Feature: GYPSUM STACKING PHS II
Station:
Range :
Boring :

El. :
Sample: CLASS I
Part :

File : 2
Tested By : TAL
Computed By: MHD
Checked By : TAL
Report Date: 03-25-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	175.2	151.3	198.4
Dry Wt. and Tare(gm)=	156.5	130.4	169.4
Wt. of Tare(gm) =	39.7	0.0	39.0
Moisture(%) =	16.0	16.0	22.2

Test Conditions and Constants:
Proving Ring No. = 2410
Proving Ring Constant:
Slope Const. = 1
Intercept = 0
Confining Pres.(psi) = 28
Initial Pore Pre(psi)= 100

Tube No. = 1
Sample Volume (cc) = 79.194
Sample Height(in.) = 3.13
Specific Gravity = 2.75
Consolidation(in.) = .06
Initial P.R. Rdg = 100

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Pore Pres. (psi)	Strain (%)	e1 - e3 (tsf)	Pore Press. (tsf)	e1 / e3 (TSF)
1	0.007	117.6	104.9	0.23	0.85	0.35	1.51
2	0.013	119.1	106.6	0.42	0.92	0.48	1.60
3	0.018	120.3	107.8	0.59	0.98	0.56	1.67
4	0.026	120.6	109.1	0.85	0.99	0.66	1.73
5	0.033	121.3	110.3	1.07	1.02	0.74	1.80
6	0.038	121.4	111.3	1.24	1.02	0.81	1.85
7	0.046	120.9	111.9	1.50	1.00	0.86	1.86
8	0.056	121.8	113.6	1.82	1.04	0.98	2.00
9	0.065	121.6	113.5	2.12	1.02	0.97	1.98
10	0.070	122.9	114.0	2.28	1.08	1.01	2.08
20	0.140	123.3	117.5	4.56	1.08	1.26	2.43
30	0.206	124.1	118.3	6.71	1.09	1.32	2.56
40	0.282	125.7	119.1	9.19	1.13	1.38	2.77
50	0.350	128.7	118.7	11.40	1.23	1.35	2.84
60	0.417	130.5	118.6	13.58	1.28	1.34	2.89
70	0.481	131.3	118.5	15.67	1.28	1.33	2.87
80	0.560	133.9	118.0	18.24	1.34	1.30	2.87
90	0.635	135.3	117.6	20.68	1.36	1.27	2.81
100	0.700	137.6	117.6	22.80	1.41	1.27	2.88

Initial:
Moisture(%) = 16.0
Density(pcf)=102.8
After Saturation:
Moisture(%) = 24.4

Void Ratio =0.670
Saturation(%)= 65.8

Void Ratio =0.576

Minor Prin. Stress(tsf) =2.02
Eff. Minor Prin. Stress(tsf)=0.75(0.68)

Major Prin. Stress(tsf) = 3.42(3.29)
Eff. Major Prin. Stress(tsf)= 2.16(1.95)

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Singleton Laboratories
Consolidated Undrained Triaxial Compression (R) Test

Project: WIDOWS CREEK S.P.
Feature: GYPSUM STACKING PHS II
Station:
Range :
Boring :

El. :
Sample: CLASS I
Part :

File : 2
Tested By : TAL
Computed By: MHD
Checked By : TA
Report Date: 03-25-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	166.5	151.3	197.2
Dry Wt. and Tare(gm)=	148.8	130.5	169.6
Wt. of Tare(gm) =	38.1	0.0	39.1
Moisture(%) =	16.0	15.9	21.1

Test Conditions and Constants:
Proving Ring No. = 2411
Proving Ring Constant:
Slope Const. = 1
Intercept = 0
Confining Pres.(psi) = 42
Initial Pore Pre(psi)= 100

Tube No. = 1
Sample Volume (cc) = 79.194
Sample Height(in.) = 3.13
Specific Gravity = 2.75
Consolidation(in.) = 9.000001E-02
Initial P.R. Rdg = 115

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Pore Pres. (psi)	Strain (%)	e1 - e3 (tsf)	Pore Press. (tsf)	e1 / e3 (TSF)
1	0.006	116.6	101.6	0.20	0.08	0.12	1.03
2	0.011	118.1	102.8	0.36	0.15	0.20	1.05
3	0.018	139.4	108.2	0.59	1.20	0.59	1.49
4	0.025	142.0	110.5	0.82	1.32	0.76	1.58
5	0.030	143.4	114.6	0.99	1.39	1.05	1.70
6	0.036	144.0	116.6	1.18	1.42	1.20	1.77
7	0.044	145.4	118.8	1.45	1.48	1.35	1.89
8	0.053	146.0	120.7	1.74	1.51	1.49	1.98
9	0.060	146.6	121.6	1.97	1.53	1.56	2.04
10	0.069	146.7	122.7	2.27	1.53	1.63	2.10
20	0.140	150.8	127.3	4.61	1.69	1.97	2.60
30	0.202	154.2	128.7	6.64	1.81	2.07	2.89
40	0.280	158.6	129.3	9.21	1.96	2.11	3.14
50	0.350	161.8	129.0	11.51	2.05	2.09	3.19
60	0.415	164.0	129.0	13.65	2.09	2.09	3.23
70	0.480	167.2	128.5	15.79	2.17	2.05	3.24
80	0.553	170.6	128.1	18.19	2.25	2.02	3.25
90	0.633	173.6	127.9	20.82	2.29	2.01	3.26
100	0.700	176.8	127.7	23.03	2.35	1.99	3.28

Initial:
Moisture(%) = 15.9
Density(pcf)=102.9
After Saturation:
Moisture(%) = 24.3

Void Ratio =0.669
Saturation(%)= 65.5

Void Ratio =0.529

Minor Prin. Stress(tsf) =3.02
Eff. Minor Prin. Stress(tsf)=1.03(1.03)

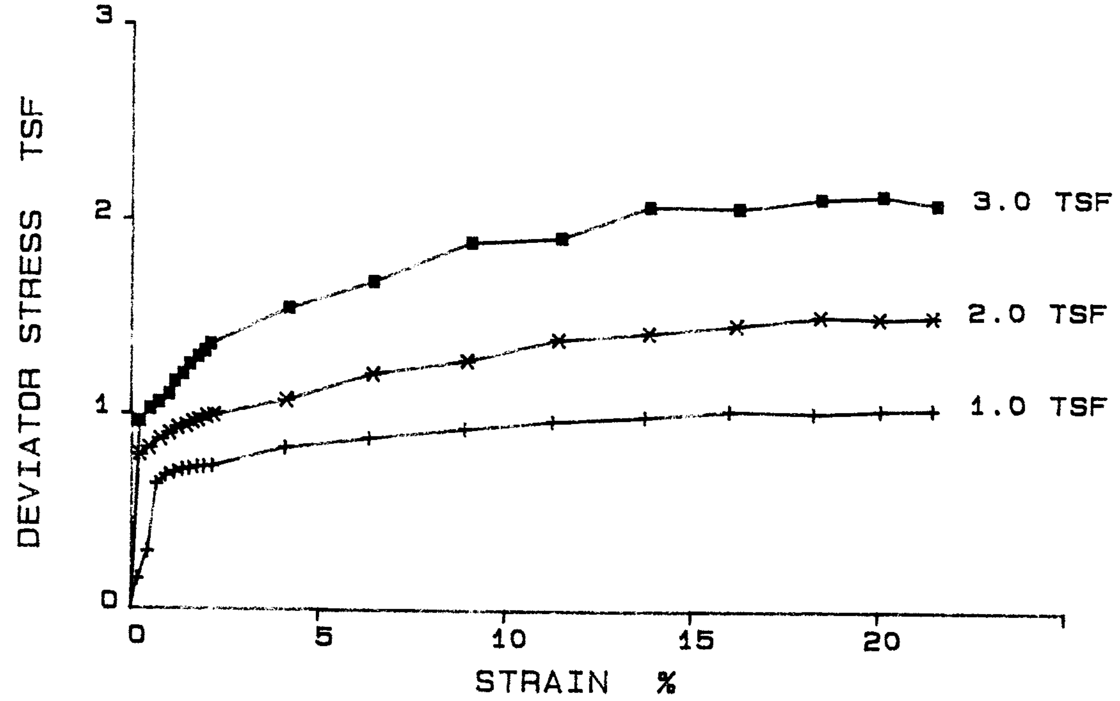
Major Prin. Stress(tsf) = 5.38(5.38)
Eff. Major Prin. Stress(tsf)= 3.38(3.38)

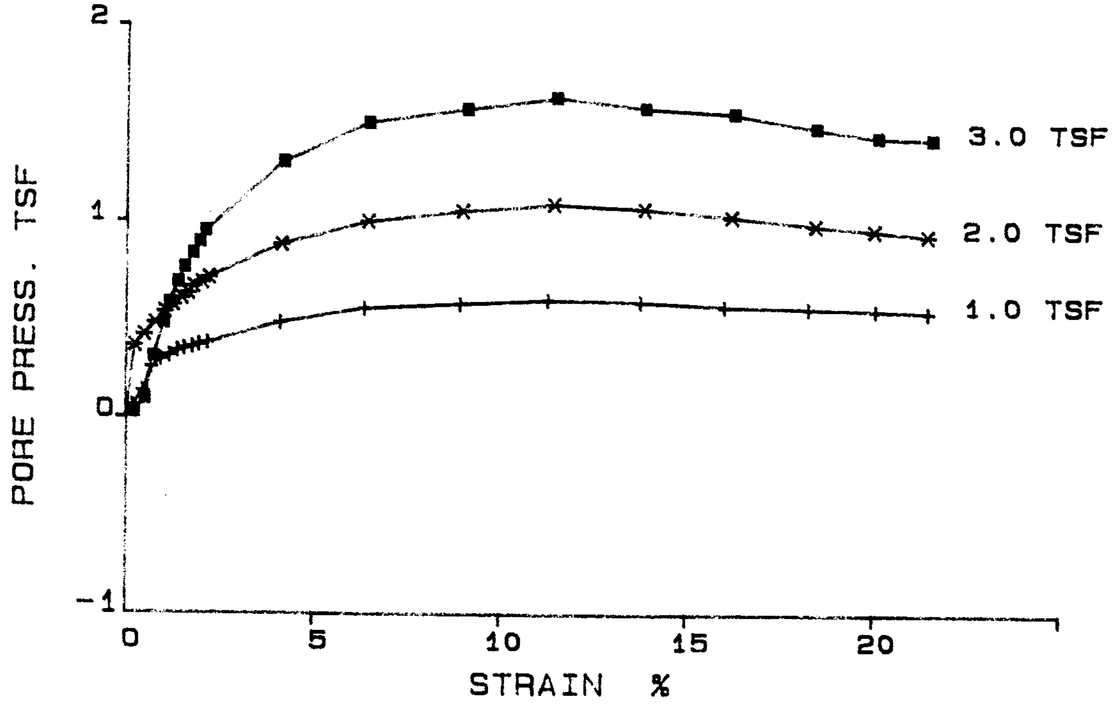
NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

SINGLETON LABORATORIES
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (R) TEST

PROJECT: WIDOWS CREEK SP
FEATURE: GYSPUM STACKING
STATION:
RANGE :
BORING : PHASE II

EL. :
SAMPLE : CLASS II
PART :
SOIL SYM: CH
DATE : 03-14-91



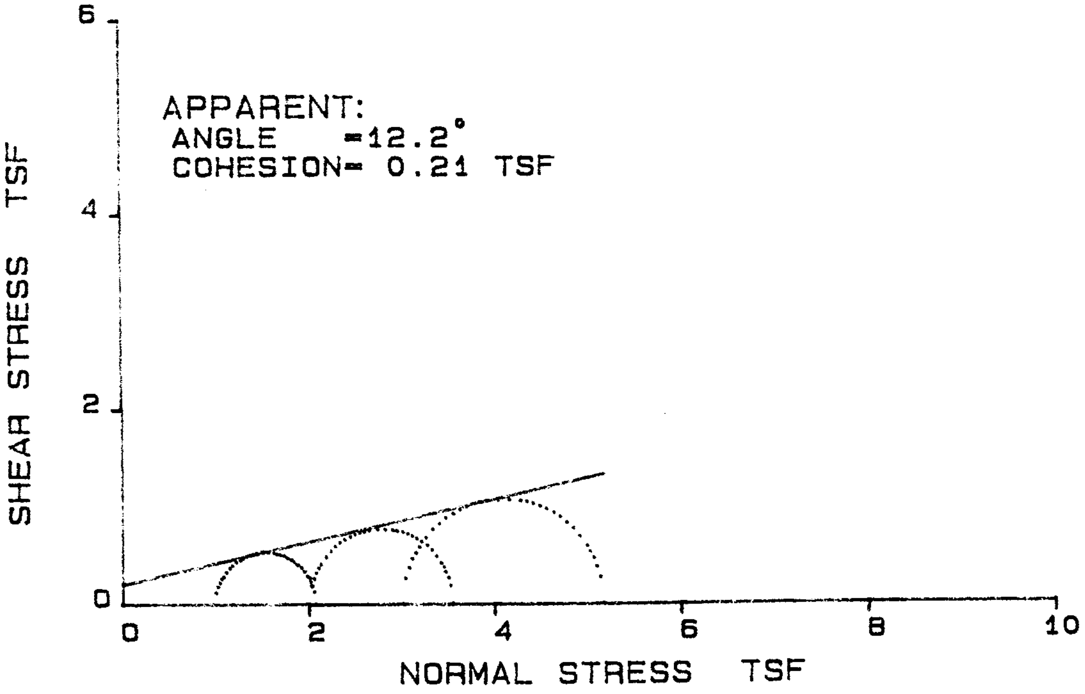


REMARKS: REMOLDED AT 2% DRY OF OPTIMUM MOISTURE
AND AT 95% OF MAXIMUM UNIT WEIGHT.

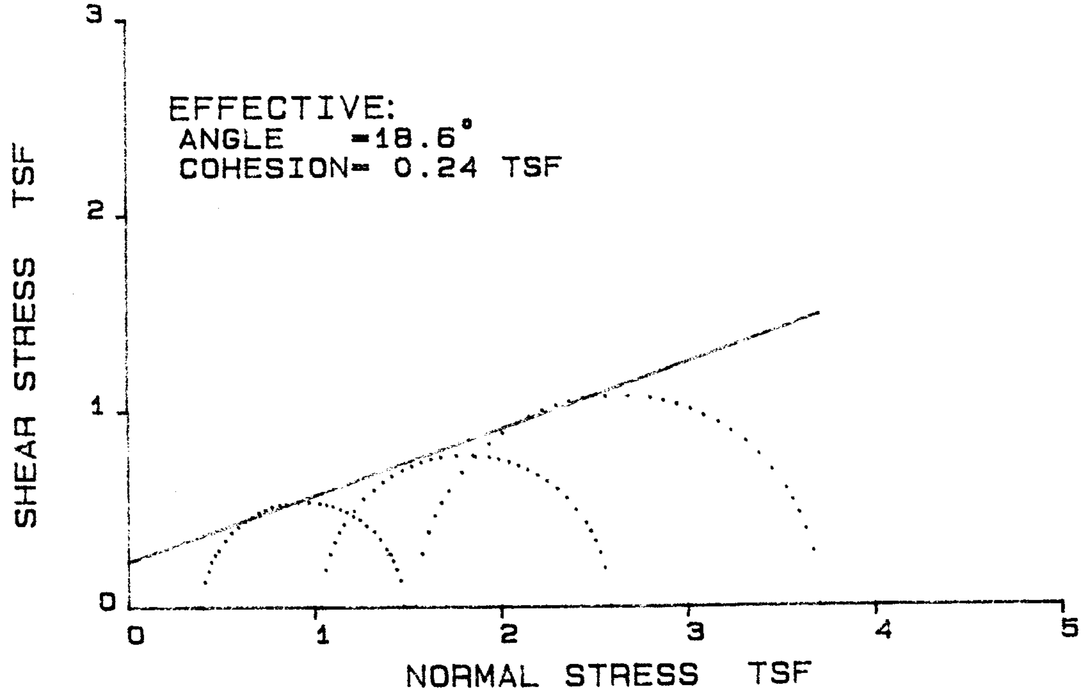
SINGLETON LABORATORIES
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (R) TEST

PROJECT: WIDOWS CREEK SP
FEATURE: GYSPUM STACKING
STATION:
RANGE :
BORING : PHASE II

EL. :
SAMPLE : CLASS II
PART :
SOIL SYM: CH
DATE : 03-14-91



APPARENT:
ANGLE =12.2°
COHESION= 0.21 TSF



EFFECTIVE:
ANGLE =18.6°
COHESION= 0.24 TSF

REMARKS: REMOLDED AT 2% DRY OF OPTIMUM MOISTURE
AND AT 95% OF MAXIMUM UNIT WEIGHT.

Singleton Laboratories
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (R) TEST

Project: WIDOWS CREEK SP
Feature: GYSPUM STACKING
Station:
Range :
Boring : PHASE II

El. :
Sample: CLASS II
Part :

File : 12
Tested By : TAL
Computed By: MHD
Checked By : GPB
Report Date: 03-14-91

Soil Symbol= CH
Sp. Gr. = 2.76
L.L.(%)= 56
D10(mm)=
P.I.(%) = 34

Specimen Number	1	2	3	4
Initial:				
Moisture Content(%)	20.4	20.0	20.0	0.0
Dry Density(pcf)	96.6	96.9	96.9	0.0
Void Ratio	0.784	0.778	0.778	0.000
Saturation(%)	71.8	71.0	71.0	0.0
Before Shearing:				
Moisture(%) (after satur.)	28.4	28.2	28.2	0.0
Saturation(%)	100.0	100.0	100.0	0.0
Moisture(%) (after cons.)	26.3	25.2	24.0	0.0
Void Ratio (after cons.)	0.725	0.695	0.662	0.000
Final Moisture Content(%)	28.7	26.2	25.5	0.0
Minor Principal Stress(tsf)	1.01(1.01)	2.02(2.02)	3.02(3.02)	0.00(0.00)
Major Principal Stress(tsf)	2.09(2.04)	3.57(3.47)	5.19(5.12)	0.00(0.00)
Eff. Minor Prin Stress(tsf)	0.40(0.36)	1.04(0.91)	1.55(1.40)	0.00(0.00)
Eff. Major Prin Stress(tsf)	1.49(1.39)	2.59(2.37)	3.71(3.50)	0.00(0.00)
Time to Failure(min)	95	95	90	0
Rate of Strain(%/min)	0.23	0.23	0.23	0.00
Specimen Height(in.)	3.13	3.13	3.13	0.00
Specimen Dia (in.)	1.40	1.40	1.40	0.00

	Max Deviator Stress		Max Eff Stress Ratio	
Shear Strength	Deg	c(tsf)	Deg	c(tsf)
Apparent	12.2	0.21	12.1	0.19
Effective	18.6	0.24	19.7	0.22

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Remark: REMOLDED AT 2% DRY OF OPTIMUM MOISTURE AND AT 95% OF MAXIMUM UNIT WEIGHT.

Singleton Laboratories
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (R) TEST

Project: WIDOWS CREEK SP
Feature: GYSPUM STACKING
Station:
Range :
Boring : PHASE II

El. :
Sample: CLASS II
Part :

File : 11
Tested By : TAL
Computed By: MHD
Checked By : GPB
Report Date: 03-14-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	346.2	147.5	197.2
Dry Wt. and Tare(gm)=	320.3	122.5	162.0
Wt. of Tare(gm) =	190.6	0.0	39.5
Moisture(%) =	20.0	20.4	28.7

Test Conditions and Constants:

Proving Ring No. = 2212
Proving Ring Constant:
Slope Const. = 1.000236
Intercept = .0823636
Confining Pres.(psi) = 14
Initial Pore Pre(psi)= 100

Tube No. = 1
Sample Volume (cc) = 79.194
Sample Height(in.) = 3.13
Specific Gravity = 2.76
Consolidation(in.) = .035
Initial P.R. Rdg = 92

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Pore Pres. (psi)	Strain (%)	*e*1 - *e*3 (tsf)	Pore Press. (tsf)	*e*1 / *e*3 (TSF)
1	0.006	95.2	100.8	0.19	0.16	0.06	1.16
2	0.015	98.2	101.9	0.48	0.30	0.14	1.34
3	0.022	105.6	103.7	0.71	0.65	0.27	1.87
4	0.030	106.6	104.3	0.97	0.69	0.31	1.99
5	0.037	107.0	104.6	1.20	0.71	0.33	2.05
6	0.044	107.4	105.0	1.42	0.73	0.36	2.12
7	0.050	107.6	105.2	1.62	0.74	0.37	2.16
8	0.057	107.9	105.4	1.84	0.75	0.39	2.21
9	0.063	108.0	105.6	2.04	0.75	0.40	2.24
10	0.070	108.2	105.8	2.26	0.76	0.42	2.29
20	0.130	110.7	107.3	4.20	0.86	0.53	2.78
30	0.200	112.3	108.4	6.46	0.91	0.60	3.26
40	0.280	114.1	108.8	9.05	0.96	0.63	3.57
50	0.353	115.7	109.1	11.41	1.01	0.66	3.85
60	0.430	117.1	109.0	13.89	1.03	0.65	3.87
70	0.500	118.6	108.7	16.16	1.07	0.63	3.80
80	0.570	119.1	108.6	18.42	1.06	0.62	3.72
90	0.626	120.2	108.5	20.23	1.08	0.61	3.72
95	0.670	120.9	108.4	21.65	1.08	0.60	3.69

Initial:
Moisture(%) = 20.4
Density(pcf)= 96.6
Void Ratio =0.784
Saturation(%)= 71.8

After Saturation:
Moisture(%) = 28.4
Void Ratio =0.725

Minor Prin. Stress(tsf) =1.01
Eff. Minor Prin. Stress(tsf)=0.40(0.36)
Major Prin. Stress(tsf) = 2.09(2.04)
Eff. Major Prin. Stress(tsf)= 1.49(1.39)

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Singleton Laboratories
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (R) TEST

Project: WIDOWS CREEK SP
Feature: GYSPUM STACKING
Station:
Range :
Boring : PHASE II

El. :
Sample: CLASS II
Part :

File : 11
Tested By : TAL
Computed By: MHD
Checked By : GPB
Report Date: 03-14-91

Moisture Content		Trimming	Initial	Final
Wet Wt. and Tare(gm)	=	162.2	147.5	193.0
Dry Wt. and Tare(gm)	=	140.9	122.9	160.8
Wt. of Tare(gm)	=	38.6	0.0	37.9
Moisture(%)	=	20.8	20.0	26.2

Test Conditions and Constants:
Proving Ring No. = 2284
Proving Ring Constant:
Slope Const. = 1.000268
Intercept = .112727
Confining Pres.(psi) = 28
Initial Pore Pre(psi)= 100

Tube No. = 1
Sample Volume (cc) = 79.194
Sample Height(in.) = 3.13
Specific Gravity = 2.76
Consolidation(in.) = .05
Initial P.R. Rdg = 105

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Pore Pres. (psi)	Strain (%)	e1 - e3 (tsf)	Pore Press. (tsf)	e1 / e3 (TSF)
1	0.007	121.4	105.1	0.23	0.79	0.37	1.48
2	0.015	122.2	105.9	0.49	0.83	0.42	1.52
3	0.025	123.3	106.8	0.81	0.88	0.49	1.58
4	0.033	124.0	107.7	1.07	0.91	0.55	1.62
5	0.040	124.7	108.2	1.30	0.94	0.59	1.66
6	0.047	125.0	108.7	1.53	0.95	0.63	1.69
7	0.053	125.5	109.1	1.72	0.98	0.66	1.72
8	0.058	125.8	109.6	1.88	0.99	0.69	1.75
9	0.065	126.3	109.9	2.11	1.01	0.71	1.77
10	0.071	126.5	110.3	2.31	1.02	0.74	1.80
20	0.131	128.7	112.7	4.25	1.10	0.91	2.00
30	0.203	132.4	114.3	6.59	1.24	1.03	2.26
40	0.281	134.8	115.1	9.12	1.31	1.09	2.41
50	0.357	138.3	115.6	11.59	1.42	1.12	2.59
60	0.432	140.1	115.3	14.03	1.46	1.10	2.59
70	0.504	142.2	114.8	16.36	1.50	1.07	2.58
80	0.574	144.4	114.2	18.64	1.55	1.02	2.56
90	0.623	145.0	113.9	20.23	1.54	1.00	2.52
95	0.667	146.1	113.6	21.66	1.56	0.98	2.50

Initial:
Moisture(%) = 20.0
Density(pcf)= 96.9
After Saturation:
Moisture(%) = 28.2

Void Ratio =0.778
Saturation(%)= 71.0

Void Ratio =0.695

Minor Prin. Stress(tsf) =2.02
Eff. Minor Prin. Stress(tsf)=1.04(0.91)

Major Prin. Stress(tsf) = 3.57(3.47)
Eff. Major Prin. Stress(tsf)= 2.59(2.37)

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

Singleton Laboratories
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (R) TEST

Project: WIDOWS CREEK SP
Feature: GYSPUM STACKING
Station:
Range :
Boring : PHASE II

El. :
Sample: CLASS II
Part :

File : 11
Tested By : TAL
Computed By: MHD
Checked By : GPB
Report Date: 03-14-91

Moisture Content	Trimming	Initial	Final
Wet Wt. and Tare(gm)=	159.3	147.5	192.4
Dry Wt. and Tare(gm)=	138.5	122.9	161.1
Wt. of Tare(gm) =	38.0	0.0	38.2
Moisture(%) =	20.7	20.0	25.5

Test Conditions and Constants:

Proving Ring No. = 2288
Proving Ring Constant:
Slope Const. = 1
Intercept = 0
Confining Pres.(psi) = 42
Initial Pore Pre(psi)= 100

Tube No. = 1
Sample Volume (cc) = 79.194
Sample Height(in.) = 3.13
Specific Gravity = 2.76
Consolidation(in.) = .07
Initial P.R. Rdg = 114

Time (Min)	Deflection (ins.)	Pro.Ring Reading	Pore Pres. (psi)	Strain (%)	e1 - e3 (tsf)	Pore Press. (tsf)	e1 / e3 (TSF)
1	0.007	133.8	100.3	0.23	0.96	0.02	1.32
2	0.016	135.3	101.3	0.52	1.03	0.09	1.35
3	0.023	136.1	104.3	0.75	1.07	0.31	1.39
4	0.032	137.0	106.8	1.05	1.11	0.49	1.44
5	0.037	138.4	108.3	1.21	1.18	0.60	1.48
6	0.044	139.3	109.8	1.44	1.22	0.71	1.52
7	0.050	140.4	110.9	1.63	1.27	0.78	1.57
8	0.057	141.3	111.9	1.86	1.31	0.86	1.60
9	0.063	142.0	112.8	2.06	1.34	0.92	1.64
10	0.068	142.8	113.6	2.22	1.37	0.98	1.67
20	0.132	147.5	118.5	4.31	1.56	1.33	1.92
30	0.202	151.3	121.3	6.60	1.70	1.53	2.14
40	0.283	157.1	122.3	9.25	1.91	1.61	2.35
50	0.357	158.9	123.2	11.67	1.94	1.67	2.43
60	0.430	164.0	122.5	14.05	2.10	1.62	2.49
70	0.503	165.3	122.1	16.44	2.09	1.59	2.46
80	0.571	168.0	121.1	18.66	2.14	1.52	2.42
90	0.622	169.6	120.5	20.33	2.16	1.48	2.40
95	0.667	169.5	120.4	21.80	2.12	1.47	2.36

Initial:
Moisture(%) = 20.0
Density(pcf)= 96.9
Void Ratio =0.778
Saturation(%)= 71.0

After Saturation:
Moisture(%) = 28.2
Void Ratio =0.662

Minor Prin. Stress(tsf) =3.02
Eff. Minor Prin. Stress(tsf)=1.55(1.40)
Major Prin. Stress(tsf) = 5.19(5.12)
Eff. Major Prin. Stress(tsf)= 3.71(3.50)

NOTE: Figures in parenthesis are based on the failure criteria of Maximum Effective Principal Stress Ratio.

*** PERMEABILITY ANALYSIS ***

PROJECT: WIDOWS CREEK
FEATURE: GYPSUM STACKING PHASE II
EST NO: CLASS II

Vertical

RUN O.	CONF. PRESS (PSI)	AREA PIPETTE CM2	AREA SPEC CM2	HT SPEC CM	TIME INTERVAL SEC	HEAD DIFF INITIAL CM	 FINAL CM	PERMEABILITY K CM/SEC
1	14.0	0.3777	9.67	7.82	75600.0	28.00	27.90	0.00000001
2	14.0	0.3777	9.67	7.82	111600.0	28.00	27.70	0.00000003
3	14.0	0.3777	9.67	7.82	86400.0	28.00	27.80	0.00000003
4	14.0	0.3777	9.67	7.82	86400.0	28.00	27.80	0.00000003

Average = 2.5×10^{-8}

*** PERMEABILITY ANALYSIS ***

PROJECT: WIDOWS CREEK
FEATURE: GYPSUM STACKING PHASE II

<u>Horizontal</u>

TEST NO: CLASS II

RUN	CONF.	AREA	AREA	HT	TIME	HEAD DIFF		PERMEABILITY
NO.	PRESS	PIPETTE	SPEC	SPEC	INTERVAL	INITIAL	FINAL	K
	(PSI)	CM2	CM2	CM	SEC	CM	CM	CM/SEC
1	14.0	0.3835	9.67	7.82	75600.0	27.40	27.30	0.00000001
2	14.0	0.3835	9.67	7.82	111600.0	27.30	27.10	0.00000002
3	14.0	0.3835	9.67	7.82	86400.0	27.30	27.10	0.00000003
4	14.0	0.3835	9.67	7.82	86400.0	27.30	27.10	0.00000003

Average = 2.25×10^{-8}

*** PERMEABILITY ANALYSIS ***

PROJECT: WIDOWS CREEK
FEATURE: GYPSUM STACKING PHSE II
EST NO: CLASS I

Vertical

RUN	CONF.	AREA	AREA	HT	TIME	HEAD DIFF		PERMEABILITY
O.	PRESS (PSI)	PIPETTE CM2	SPEC CM2	SPEC CM	INTERVAL SEC	INITIAL CM	FINAL CM	K CM/SEC
1	14.0	0.3656	9.57	7.78	75600.0	26.70	26.60	0.00000001
2	14.0	0.3656	9.57	7.78	111600.0	26.40	26.30	0.00000001
3	14.0	0.3656	9.57	7.78	86400.0	26.70	26.40	0.00000004
4	14.0	0.3656	9.57	7.78	86400.0	26.50	26.20	0.00000004

Average = 2.5 x 10^{-8}

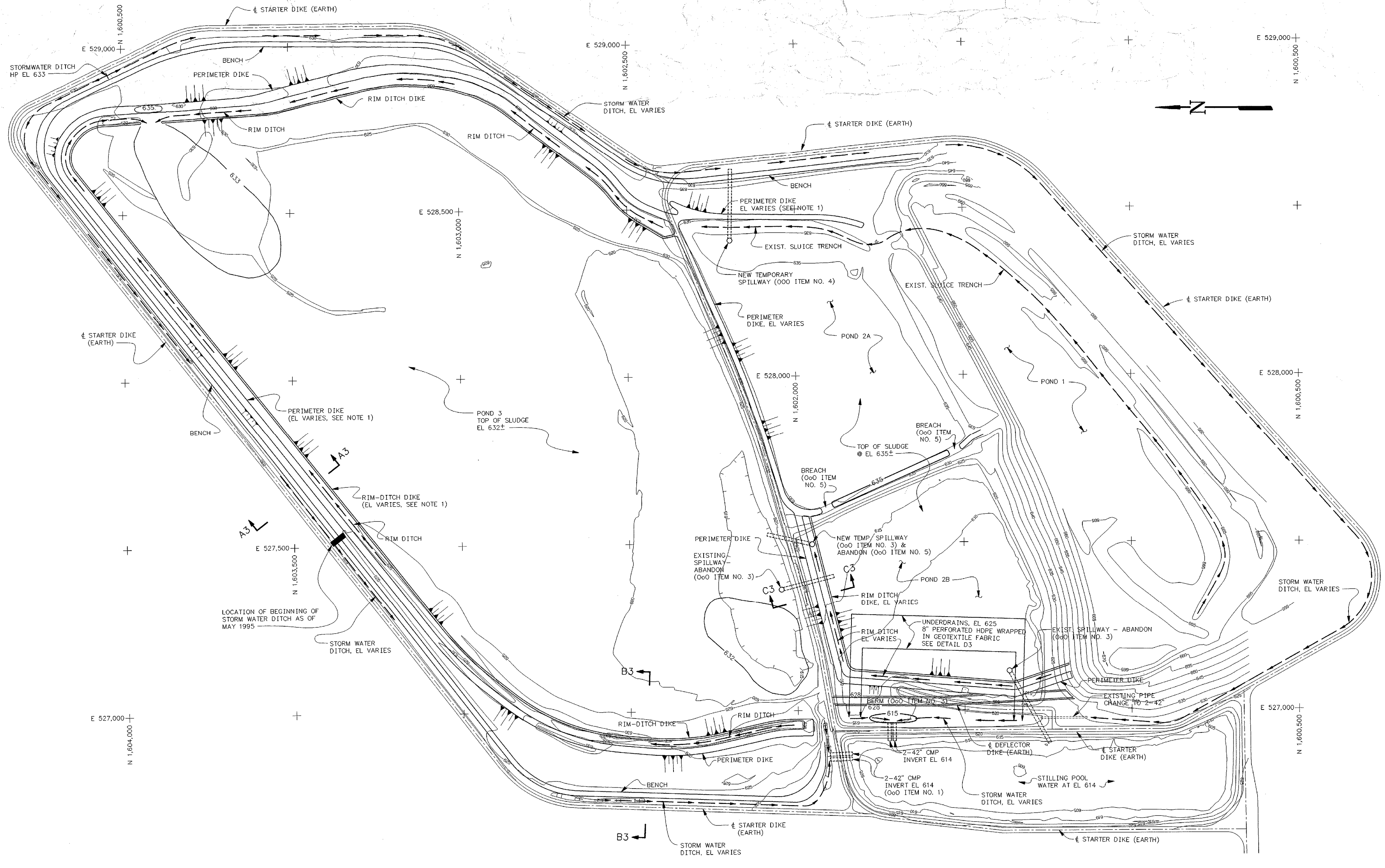
*** PERMEABILITY ANALYSIS ***

PROJECT: WIDOWS CREEK
FEATURE: GYPSUM STACKING PHASE II
EST NO: CLASS I

Horizontal

RUN NO.	CONF. PRESS (PSI)	AREA PIPETTE CM2	AREA SPEC CM2	HT SPEC CM	TIME INTERVAL SEC	HEAD DIFF		PERMEABILITY K CM/SEC
						INITIAL CM	FINAL CM	
1	14.0	0.3918	9.57	7.78	75600.0	25.40	25.20	0.00000003
2	14.0	0.3918	9.57	7.78	111600.0	25.20	24.70	0.00000006
3	14.0	0.3918	9.57	7.78	86400.0	25.00	24.80	0.00000003
4	14.0	0.3918	9.57	7.78	86400.0	25.00	24.80	0.00000003

Average = 3.8×10^{-8}



E 526,500
N 1,602,500
E 526,500
N 1,601,500

OoO = WIDOWS CREEK FOSSIL PLANT
SCRUBBER SLUDGE STACKING PLAN
ORDER OF OPERATIONS

NOTES:

1. THE PURPOSE OF THIS CONCEPTUAL PLAN IS TO DEVELOP A SCHEME BY WHICH THE EXISTING SCRUBBER POND CAN BE DEVELOPED INTO A TRUE RIM-DITCHING OPERATION. EVERY EFFORT MUST BE MADE TO CONSTRUCT THE PERIMETER AND RIM-DITCH DIKES WITH WET CAST MATERIAL.
2. LIGHT CONTOURS (GENERALLY 5-FOOT INTERVAL) REPRESENT EXISTING GRADE BASED ON SURVEY BY TVA'S MAPPING UNIT IN MAY 1995. HEAVY CONTOURS REPRESENT PROJECTED GRADE FOR 10/1/96 (STAGE 1) OR 10/1/00 (STAGE 2).
3. BERM DITCHES SHALL HAVE A SLOPE OF 1% ALONG THE FLOW LINE AND SHALL BE A MAXIMUM OF 300 FEET BETWEEN HIGH POINT ELEVATIONS AND LOW POINT ELEVATIONS. A BERM DITCH DISCHARGE DOWN THE SLOPE SHALL BE PROVIDED AT ALL BERM DITCH LOW POINT ELEVATIONS. THE VERTICAL DISTANCE BETWEEN BERMS SHALL NOT EXCEED 30 FEET.

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R											
R 0	9-8-95	JGA	MGH	JLG	JLG	KWB	RGJ	WDH			
INITIAL ISSUE											

DISCIPLINE INTERFACE
1
2
3
4

SCALE: 1" = 100' EXCEPT AS NOTED

YARD
UNITS 7 & 8

FORCED OXIDATION GYPSUM STACKING
CONCEPTUAL PLAN - STAGE 1
CONFIGURATION @ 10/1/96

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
J.G.ALBRIGHT	M.G.HRANEK	J.L.GLOVER	J.L.GLOVER	K.W.BURNETT	R.G.JOHNSON	W.D.HALL

WIDOWS CREEK FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

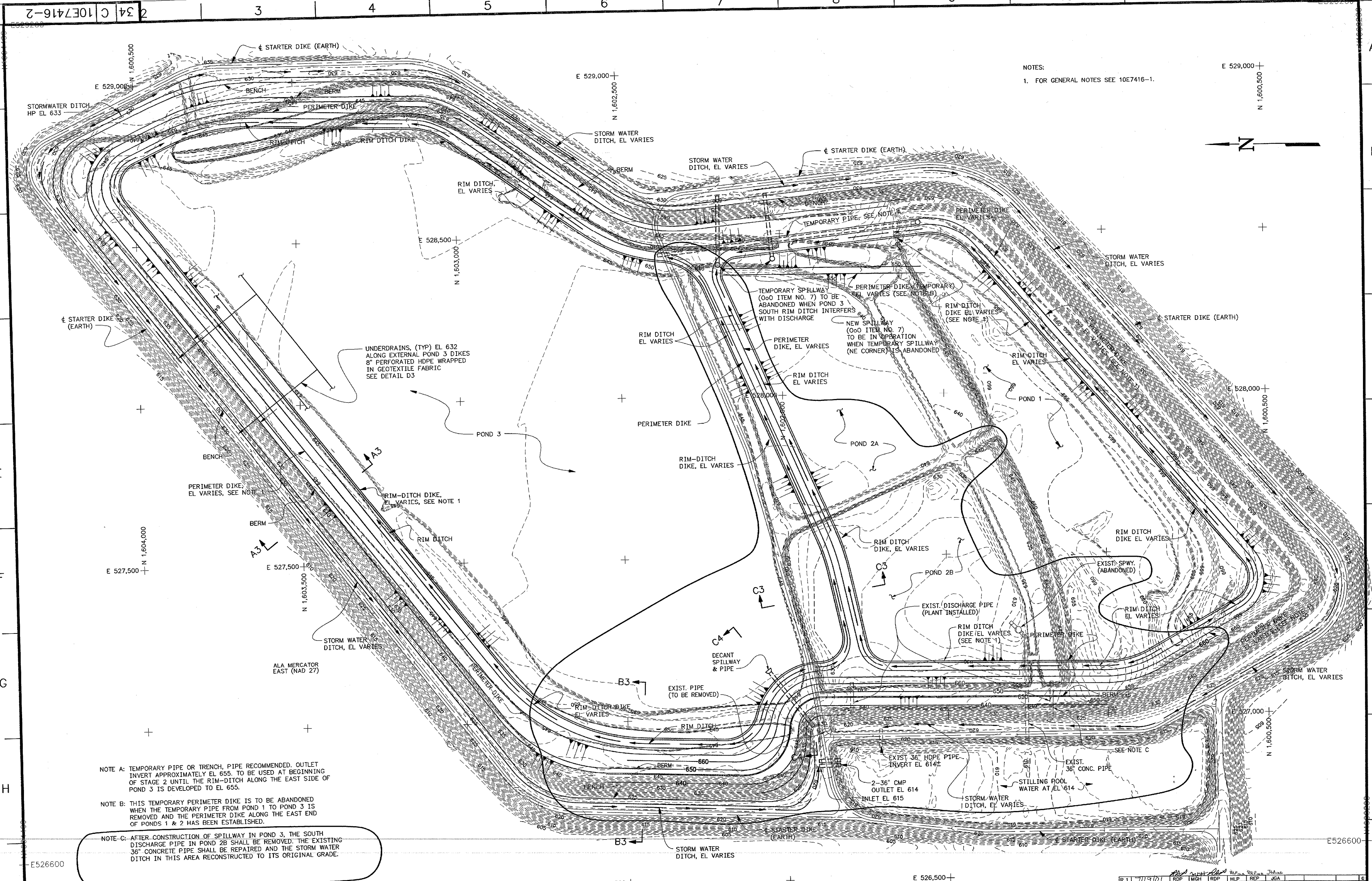
AUTOCAD R12 | DATE 9-8-95 | 34 | C | 10E7416-1 | R 0

PLOT FACTOR:1200
E_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

NOTES:

1. FOR GENERAL NOTES SEE 10E7416-1.



NOTE A: TEMPORARY PIPE OR TRENCH, PIPE RECOMMENDED. OUTLET INVERT APPROXIMATELY EL 655. TO BE USED AT BEGINNING OF STAGE 2 UNTIL THE RIM-DITCH ALONG THE EAST SIDE OF POND 3 IS DEVELOPED TO EL 655.

NOTE B: THIS TEMPORARY PERIMETER DIKE IS TO BE ABANDONED WHEN THE TEMPORARY PIPE FROM POND 1 TO POND 3 IS REMOVED AND THE PERIMETER DIKE ALONG THE EAST END OF PONDS 1 & 2 HAS BEEN ESTABLISHED.

NOTE C: AFTER CONSTRUCTION OF SPILLWAY IN POND 3, THE SOUTH DISCHARGE PIPE IN POND 2B SHALL BE REMOVED. THE EXISTING 36" CONCRETE PIPE SHALL BE REPAIRED AND THE STORM WATER DITCH IN THIS AREA RECONSTRUCTED TO ITS ORIGINAL GRADE.

RDP MGH RDP HLP REP JGA

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R 1	7/19/01	RDP	MGH	RDP	HLP	REP	JGA				G
REVISED TO SHOW GENERAL REVISIONS											
R 0	9-7-1995	JGA	MGH	JLG	JLG	KWB	RGJ	WDH			
INITIAL ISSUE											

DISCIPLINE INTERFACE
1
2
3
4

SCALE: 1" = 100' EXCEPT AS NOTED

YARD
UNITS 7 & 8

FORCED OXIDATION GYPSUM STACKING – CONCEPTUAL PLAN STAGE 2, CONFIGURATION @ 10/1/00

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
J.G.ALBRIGHT	M.G.HRANEK	J.L.GLOVER	J.L.GLOVER	K.W.BURNETT	R.G.JOHNSON	W.D.HALL

WIDOWS CREEK FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

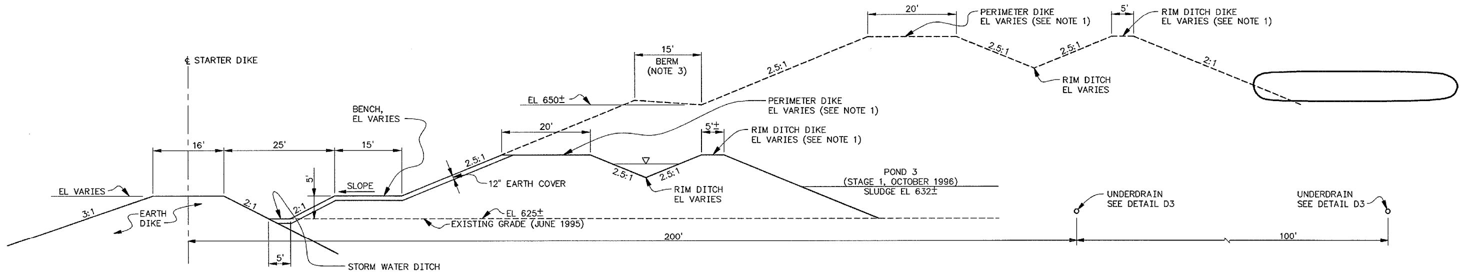
AUTOCAD R14 | DATE 9-7-95 | 34 | C | 10E7416-2 | R 1

MF

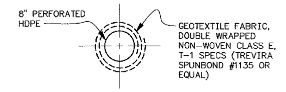
PLOT FACTOR:1200
E_TVA
FILENAME: 10E7416-2SHTrev1.DWG

C.A.D. DRAWING
DO NOT ALTER MANUALLY

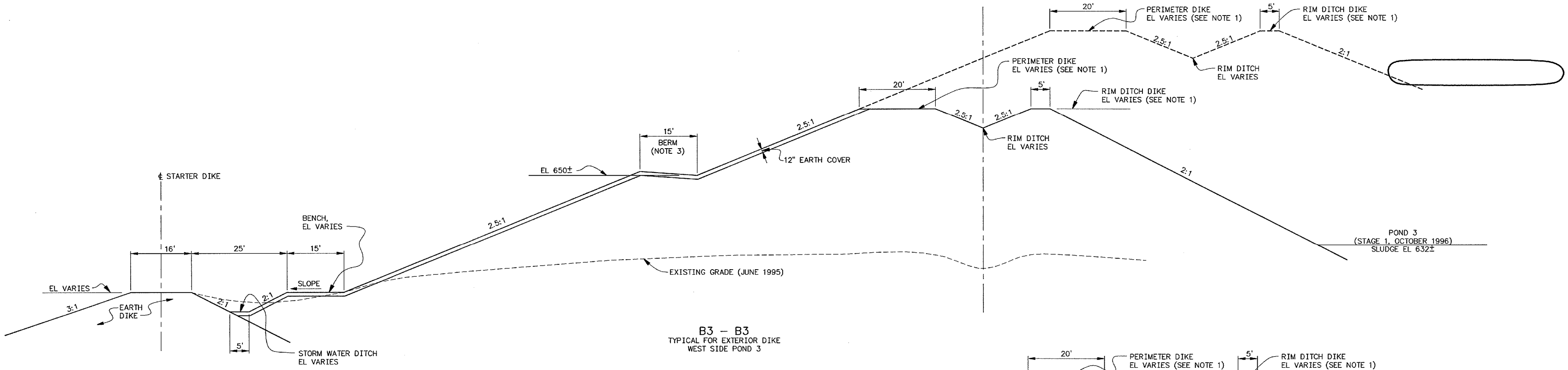
TASK COMPLETED BY: | REV NO.



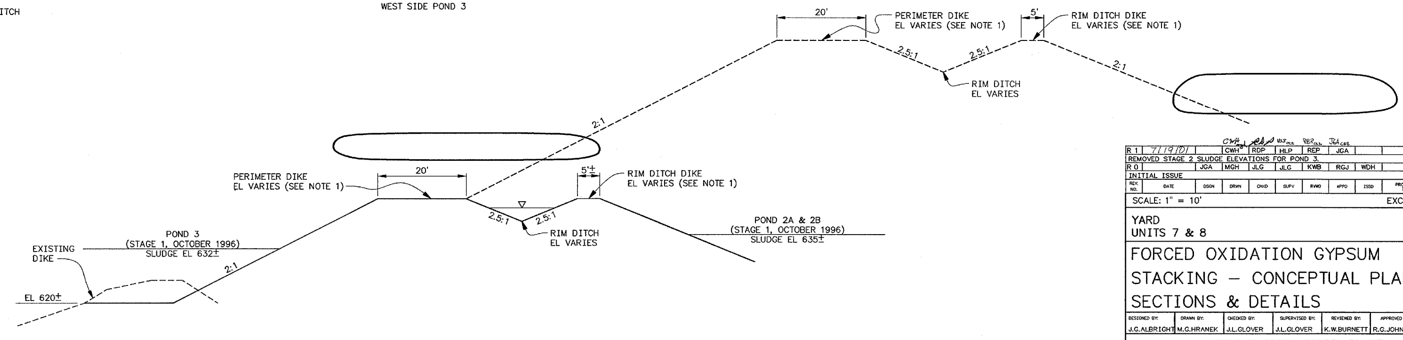
A3 – A3
TYPICAL FOR EXTERIOR DIKES



DETAIL D3
1" = 1'-0"



B3 – B3
TYPICAL FOR EXTERIOR DIKE
WEST SIDE POND 3



C3 – C3
TYPICAL FOR PONDS 2/3
COMMON DIKE

CWH RDP HLP REP JGA

R 1	7/19/01		CWH	RDP	HLP	REP	JGA				G
REMOVED STAGE 2 SLUDGE ELEVATIONS FOR POND 3.											
R 0		JGA	MGH	JLG	JLG	KWB	RGJ	WDH			
INITIAL ISSUE											
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD

DISCIPLINE INTERFACE
1
2
3
4

SCALE: 1" = 10' EXCEPT AS NOTED

YARD
UNITS 7 & 8

FORCED OXIDATION GYPSUM STACKING – CONCEPTUAL PLAN SECTIONS & DETAILS

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
J.G.ALBRIGHT	M.G.HRANEK	J.L.GLOVER	J.L.GLOVER	K.W.BURNETT	R.G.JOHNSON	W.D.HALL

WIDOWS CREEK FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R12	DATE	34	C	10W7416–3	R 1

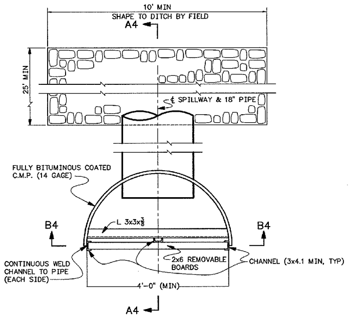
MF

PLOT FACTOR:120
W_TVA
FILENAME: SECT–WRK.DWG

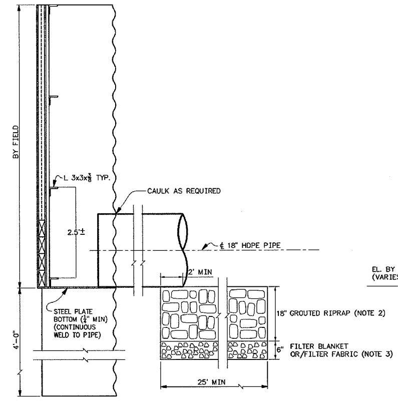
C.A.D. DRAWING
DO NOT ALTER MANUALLY

TASK COMPLETED BY: REV NO.

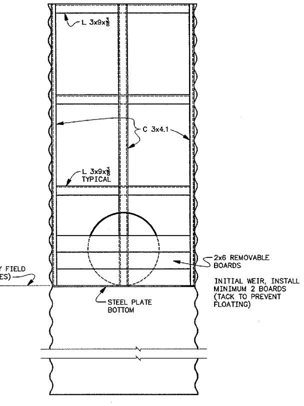
34 C 10W7416-4



PLAN – METAL SPILLWAY
NOT TO SCALE



A4 – A4
NTS



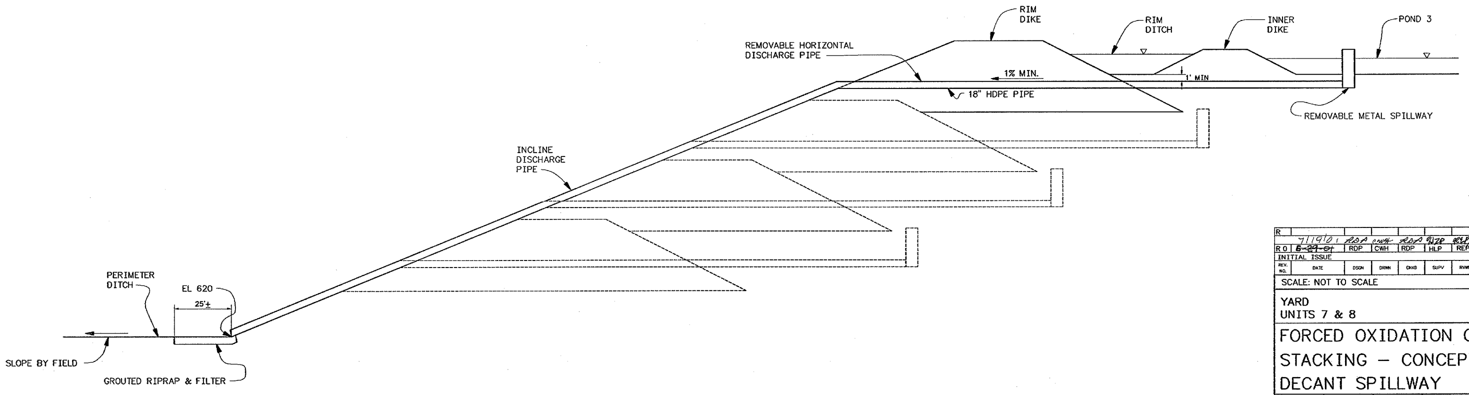
B4 – B4
NTS

SUMMARY OF QUANTITIES

DESCRIPTION	QUANTITY	UNIT
METAL SPILLWAY		
CHANNEL (C3x4.1 MIN)	24	LF
ANGLE (L3x3x$\frac{3}{8}$ MIN)	16	LF
STEEL PLATE ($\frac{1}{4}$" MIN)	64	LB
48"ø CMP	6	LF
2x6 BOARD	48	LF

* QUANTITIES GIVEN ARE FOR ONE SPILLWAY, MULTIPLY BY NUMBER OF SPILLWAYS REQUIRED FOR TOTAL QUANTITIES.

NOTES:
1. FOR GENERAL NOTES FOR GYPSUM STACK CONSTRUCTION SEE DRAWING 10W215-34.
2. RIPRAP SHALL BE IN ACCORDANCE WITH SECTION 575 AND SHALL CONSIST OF 50% OF THE STONES WEIGHING 100 LBS EACH OR GREATER. AFTER PLACEMENT THE RIPRAP SHALL BE GROUTED WITH CONCRETE.
3. FILTER BLANKET SHALL BE IN ACCORDANCE WITH SECTION 570 . FILTER FABRIC SHALL BE CLASS C IN ACCORDANCE WITH SECTION 571.



C4 – C4
STAGE DECANT SPILLWAY SYSTEM
NOT TO SCALE

R											
	7/19/01	RDP	CWH	RDP	HLP	REP/mo	JGA/mo				
R 0	~~6-29-01~~	RDP	CWH	RDP	HLP	REP	JGA				G
INITIAL ISSUE											
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD

DISCIPLINE INTERFACE
1
2
3
4

SCALE: NOT TO SCALE EXCEPT AS NOTED

YARD
UNITS 7 & 8

FORCED OXIDATION GYPSUM
STACKING – CONCEPTUAL PLAN
DECANT SPILLWAY

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
R.D. POWELL	C.W. HENSLEY	R.D. POWELL	H.L. PETTY	R.E. PURKEY	J.G. ADAIR	

WIDOWS CREEK FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R14 | DATE 7/19/01 | 34 | C | 10W7416-4 | R 0

MF

PLOT FACTOR:240
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

TASK COMPLETED BY: | REV NO.

34 | C | 10W215-01

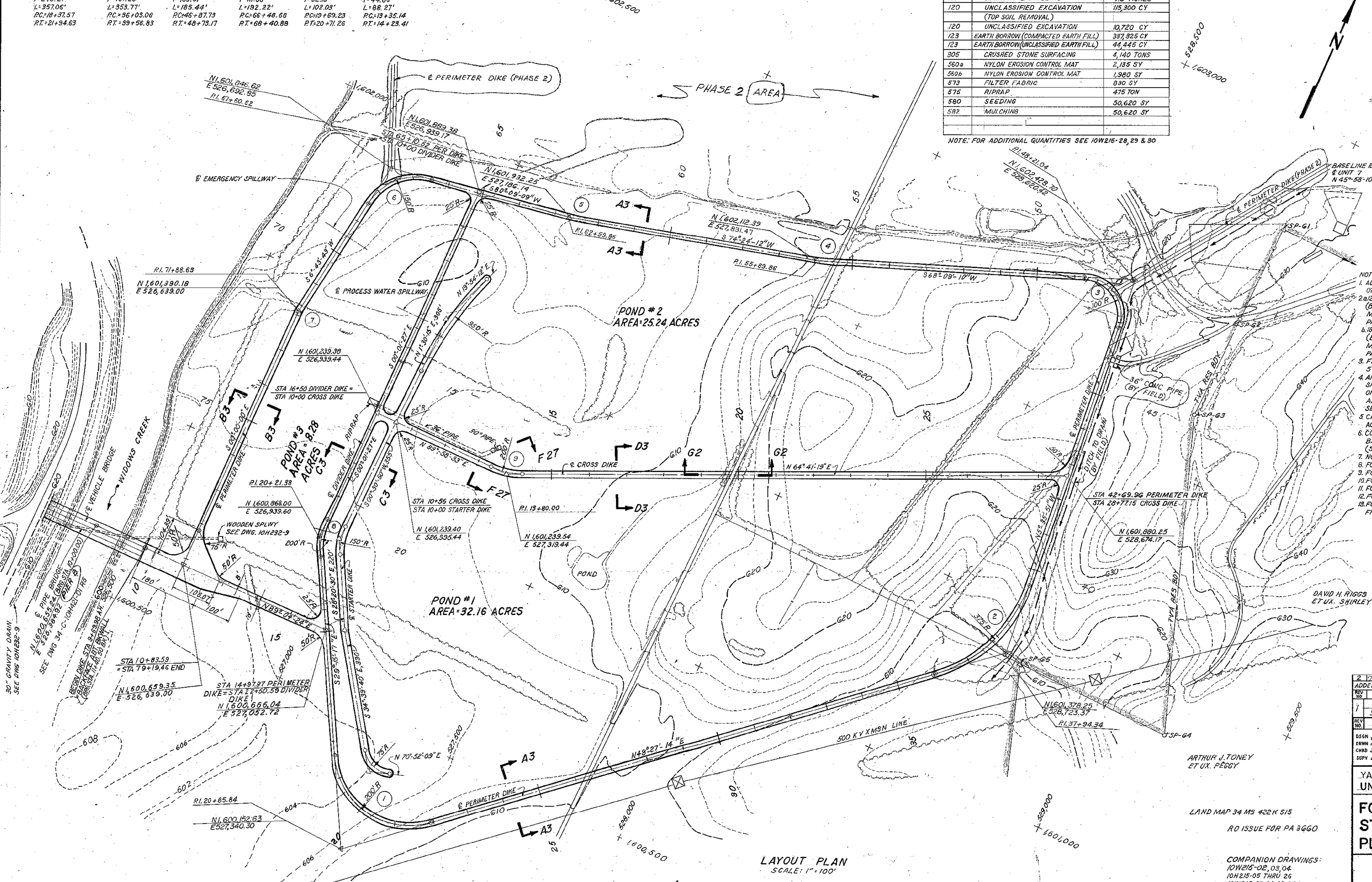
438 5 RO
~~884 RO~~
744 RO

CURVE # ①	CURVE # ②	CURVE # ③	CURVE # ⑥	CURVE # ⑧	CURVE # ⑨
P.I. = 20+85.84	P.I. = 37+94.34	P.I.=48+21.04	P.I.=67+60.52	P.I. = 20+21.38	P.I.= 13+80.00
Δ=102°-17'-28"	Δ=54°-03'-05"	Δ=106°-14'-59"	Δ=73°-25'-26"	Δ=29°-13'-50"	Δ=25°-17'-14"
R=200'	R=375'	R=100'	R=150'	R=200'	R=200'
D=28°-38'-52"	D=15°-16'-44"	D=57°-17'-45"	D=38°-11'-50"	D=28°-38'-52"	D=28°-38'-52"
T=248.27'	T=191.28'	T=133.31'	T=111.86'	T=52.15'	T=44.86'
L=357.06'	L=353.77'	L=185.44'	L=192.22'	L=102.03'	L=88.27'
P.C.=18+37.57	P.C.=36+03.06	P.C.=46+87.73	P.C.=66+48.66	P.C.=19+69.23	P.C.=13+35.14
P.T.=21+94.63	P.T.=39+56.83	P.T.=48+73.17	P.T.=68+40.88	P.T.=20+71.26	P.T.=14+23.41

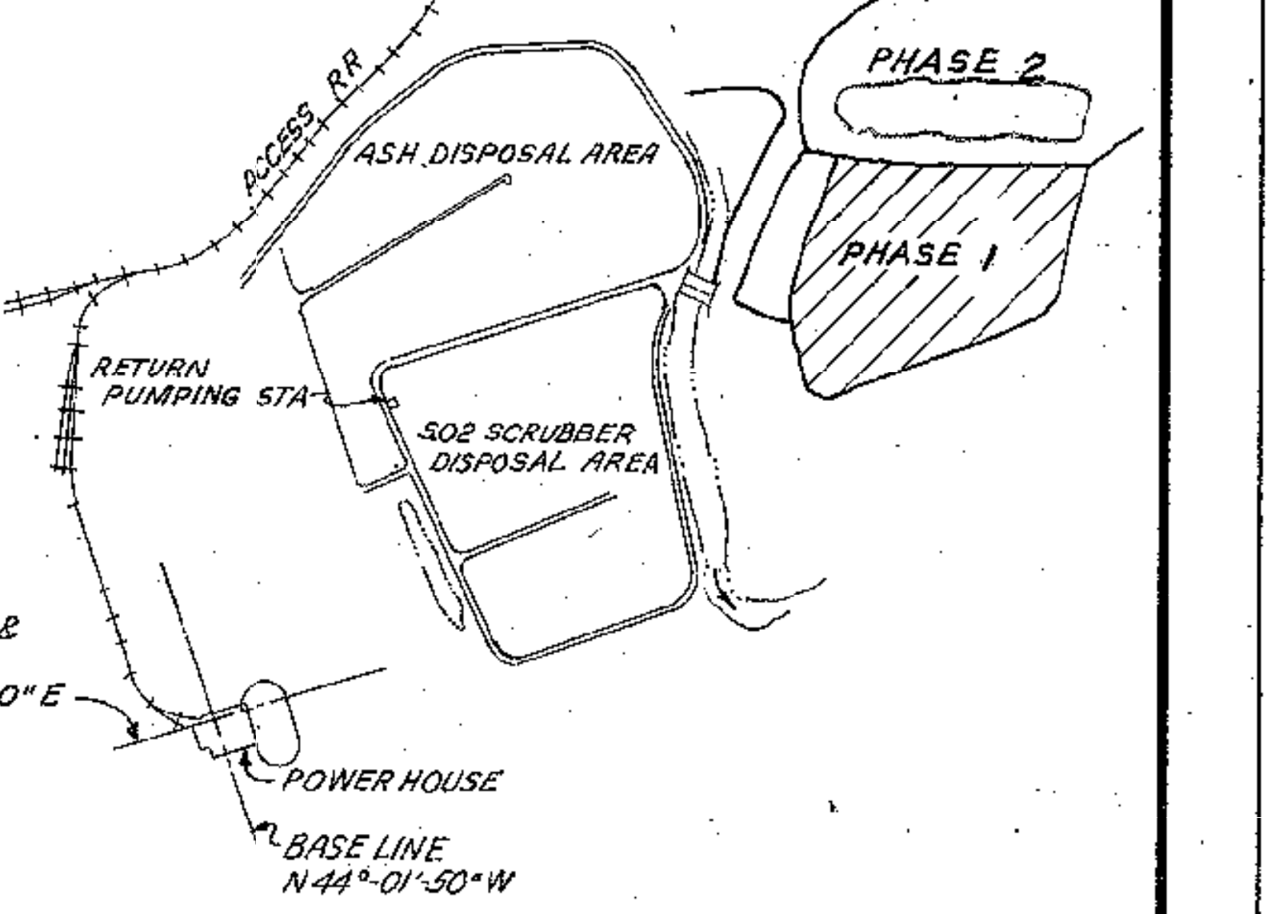
SUMMARY OF QUANTITIES - PHASE ONE

ITEM	DESCRIPTION	QUANTITIES
101	CLEARING & GRUBBING	4.3 ACRES
120	UNCLASSIFIED EXCAVATION	115,300 CY
	(TOP SOIL REMOVAL)	
120	UNCLASSIFIED EXCAVATION	10,720 CY
123	EARTH BORROW (COMPACTED EARTH FILL)	337,325 CY
123	EARTH BORROW (UNCLASSIFIED EARTH FILL)	44,445 CY
305	CRUSHED STONE SURFACING	4,140 TONS
560a	NYLON EROSION CONTROL MAT	2,135 SY
560b	NYLON EROSION CONTROL MAT	1,980 SY
573	FILTER FABRIC	830 SY
575	RIPRAP	475 TON
580	SEEDING	50,620 SY
582	MULCHING	50,620 SY

NOTE: FOR ADDITIONAL QUANTITIES SEE 10W215-28, 29 & 30



LAYOUT PLAN
SCALE: 1" = 100'



KEY PLAN
NTS

NOTES:

1. ALL WORK TO BE IN ACCORDANCE WITH T-1 SPECIFICATION UNLESS OTHERWISE NOTED.
2. a. 12" RIPRAP SHALL CONSIST OF STONES WITH AT LEAST 50% (BY WEIGHT) EQUAL TO OR GREATER THAN 100 LBS. WITH THE MAXIMUM SIZE BEING 300 LBS. AND NOT MORE THAN 5% PASSING THE 1 INCH SIEVE. SEE SECTION 575.
   b. 18" RIPRAP SHALL CONSIST OF STONES WITH AT LEAST 50% (BY WEIGHT) EQUAL TO OR GREATER THAN 150 LBS WITH THE MAXIMUM SIZE BEING 450 LBS AND NOT MORE THAN 5% PASSING THE 1 INCH SIEVE. SEE SECTION 575.
3. FILTER FABRIC SHALL BE IN ACCORDANCE WITH SECTION 573-CLASS C.
4. AREAS DESIGNATED FOR GRASSING (SEE SECTIONS SHEET -03) SHALL BE SEEDED WITH TYPE 8 MIXTURE FOR FALL SEEDING OR TYPE 6 MIXTURE FOR SPRING SEEDING. SEEDED AREAS ARE TO BE FERTILIZED AND MULCHED IN ACCORDANCE WITH SECTION 580 AND 582 RESPECTIVELY.
5. CRUSHED STONE SURFACING 4 INCHES THICK, SHALL BE IN ACCORDANCE WITH SECTION 305.
6. COORDINATES OF PI's ARE GIVEN IN ALABAMA STATE COORDINATES, BASED ON THE ℄ OF THE VEHICULAR BRIDGE AND ℄ OF PIER B (STA. 10+00) BEING N1,600,655.24; E 526,384.92.
7. NOTES FOR DIKE CONSTRUCTION ARE ON DWG 10W215-03.
8. FOR BORROW NOTES SEE DWG 10W215-04.
9. FOR SPILLWAY DISCHARGE PIPE SECTION SEE DWG 10W215-27.
10. FOR SKIMMER SEE DWG 10W215-28 & 29.
11. FOR TEMPORARY WOODEN SKIMMER SPILLWAY SEE DWG 10W215-30.
12. FOR DIKE CROSS SECTION SEE DWGS 10W215-05 THRU 26.
13. FOR OPERATIONS AND MAINTENANCE INSTRUCTIONS SEE: MEMO FROM W.M.BIVENS TO PAUL WADE JUNE 11, 1986 (BG5 '86 0611 006)

LAND MAP 34 MS 422 K 515

R0 ISSUE FOR PA 3660

COMPANION DRAWINGS:
10W215-02, 03, 04
10H215-05 THRU 26
10W215-27, 28, 29 & 30
10H215-31, 32 & 33

INSPECTED AND APPROVED FOR ISSUE
O.P. Thornton
DESIGN PROJECT MANAGER

2	7/23/91	RDP	CAR	RDR	JLG	KWB		JWC		
ADDED DITCH FOR PHASE 2 CONSTRUCTION; REM FUT SPLWY ℄										
REV NO	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD		AS CONST
1		8/21/86	AHS			KWB	REH	OPTG		
SIGNED AS CONSTRUCTED										
REV NO.	ECN/FCR	DATE	DRWN	CHKD	DSGN	RVWD	APPD	ISSD		

DSGN J.P. Hillier Stivers / M.D. Hranik
DRWN A.H. SPERBER / M.L. Terman
CHKD R.D. Howell
SUPV wmmartin

INSP Ralph B. Johnson ... BR
ENGINEER M.H. Miller

YARD
UNITS 7 & 8

FORCED OXIDATION GYPSUM STACKING PHASE I-DIKES PLAN SHEET I

WIDOWS CREEK STEAM PLANT
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

SUBMITTED	RECOMMENDED	APPROVED
M.H. Miller	L.E. Harris	R.O. Barnett, Jr

KNOXVILLE | 3/18/83 | 34 | C | 10W215-01 | R2

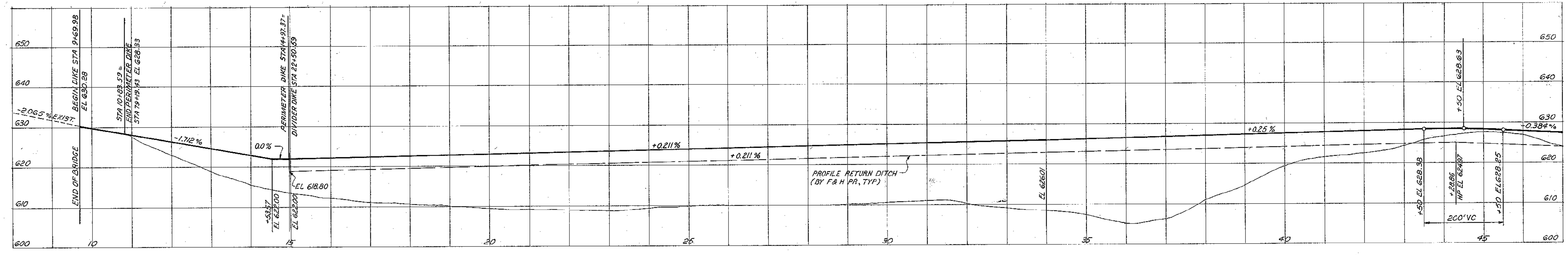
RECORD DRAWING AS CONSTRUCTED
Dene Farmer 6/15/86 R1

TECHNICAL INFORMATION CENTER
KNOXVILLE
INDEXED

PRINTS REQD-R		
	DWG SIZE	
	F	H
ME		
EE		
CE		
AD		
CD		
ED		
MD		
BF		
SW		
BL		
PA		

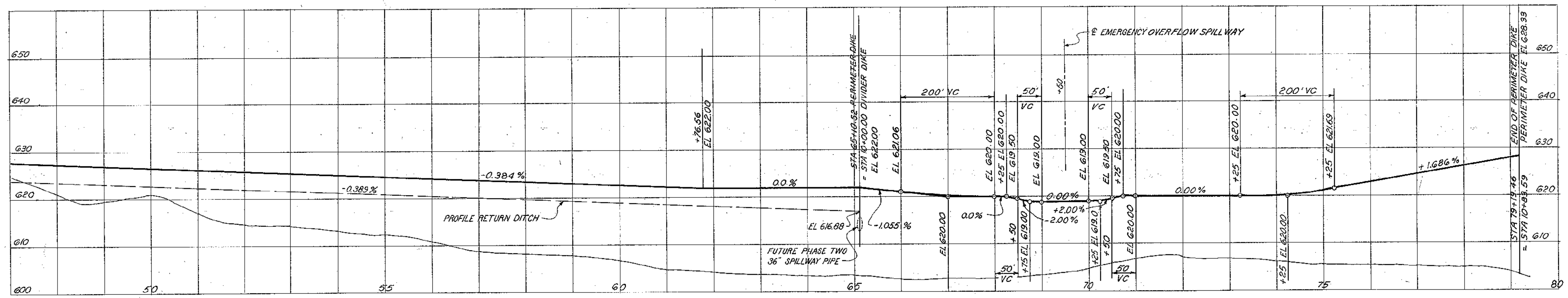
MF
RD
R1
R2

WKG
DCB
JWF
AMR
PPN
RGS
SBA
CDT



PERIMETER DIKE

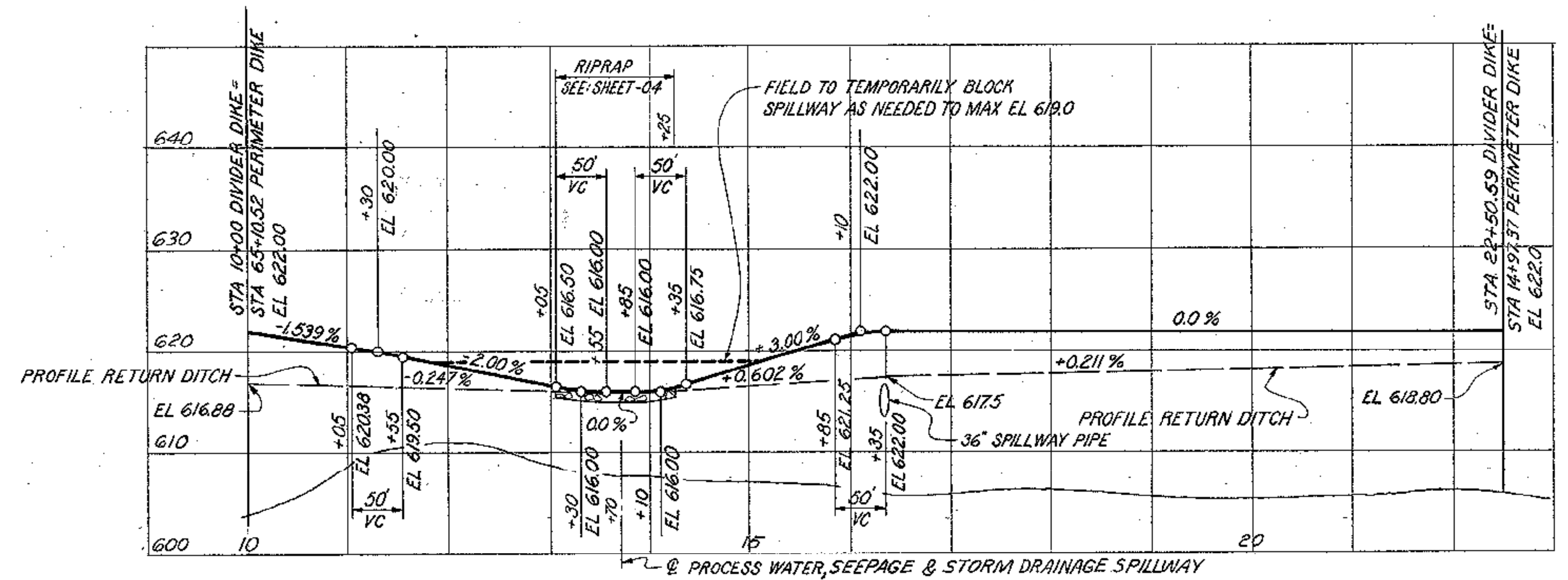
STA 9+69.98 TO 47+00



PERIMETER DIKE

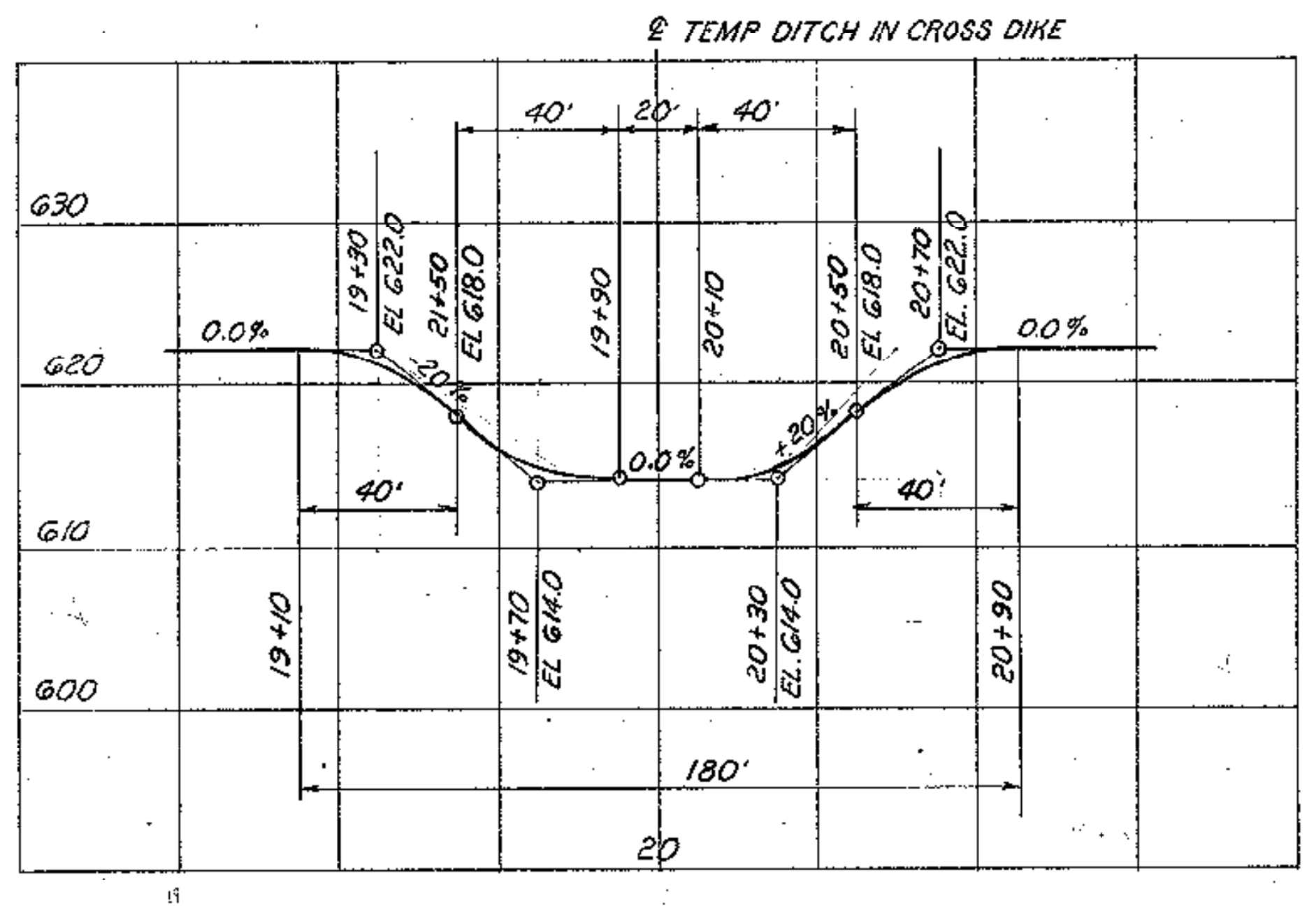
STA. 47+00 TO STA 79+19.43

NOTES:
1. FOR NOTES SEE 10W215-01, -03 & -04



DIVIDER DIKE

DRAINAGE



G2 - G2

NTS

RO ISSUE FOR PA 3660
COMPANION DWGS.
10W215-01

1	8/21/86	AHS			KWB	REH	OPTK	
	SIGNED AS CONSTRUCTED							
REV NO.	ECN/FCR	DATE	DRWN	CHKD	DSGN	RVWD	APPD	ISSD

DSGN R Hillier Stevens / M.D. Hranek
DRWN A.H. Sperber
CHKD wmMartin
SUPV wmMartin
INSP Ralph G. Johnson RJB
ENGINEER M. H. Miller

SCALE: HORIZ 1"=1' - VERT. 1"=10' EXCEPT AS NOTED

YARD
UNITS 7 & 8

FORCED OXIDATION GYPSUM STACKING PHASE I - PROFILE SHEET

WIDOWS CREEK STEAM PLANT
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

SUBMITTED	RECOMMENDED	APPROVED
M.H. Miller	R. E. Hanson	R. O. Barnett

INSPECTED AND APPROVED FOR ISSUE
D. P. Thornton

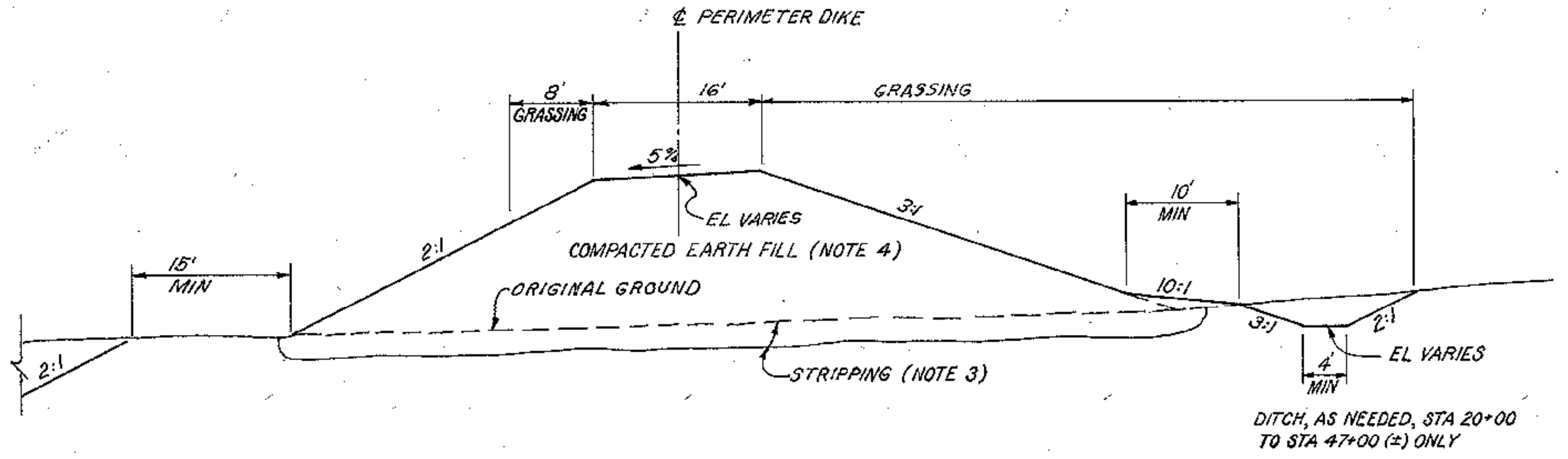
KNOXVILLE 3/18/85 34 C 10W215-02 R1

RECORD DRAWING AS CONSTRUCTED 6/5/86
Dene Farmer R1

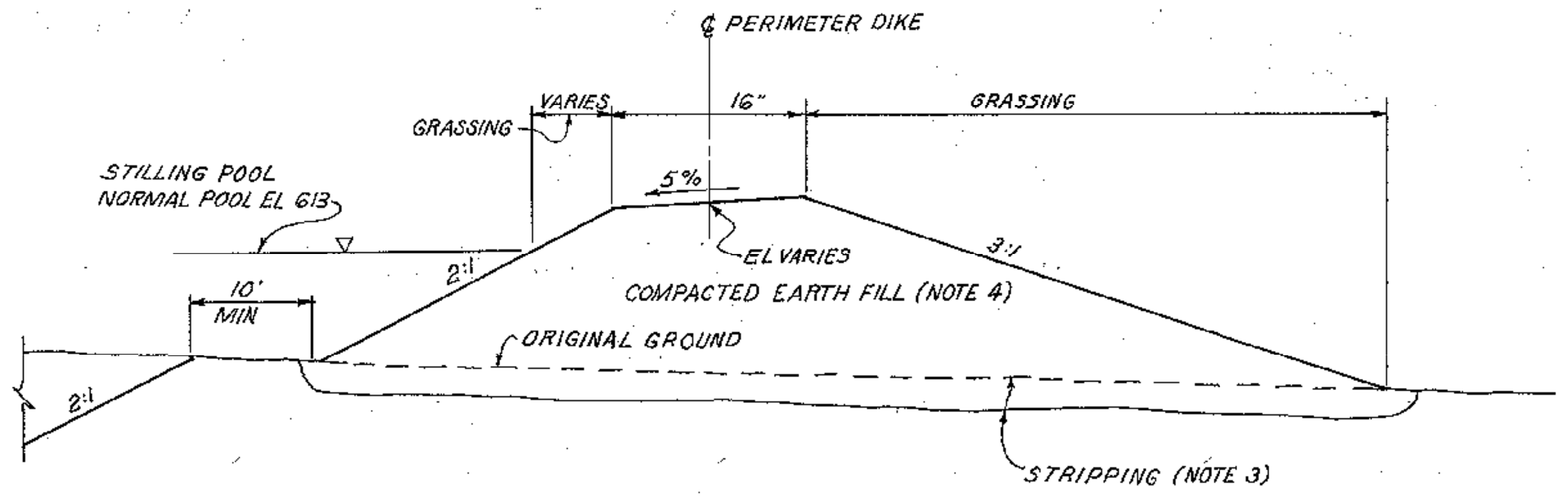
PRINT H
SIZE F
BR OR PROJ AS CE EE ME NE FD HD SD SL BW WB PW
PRINTS REQD - R

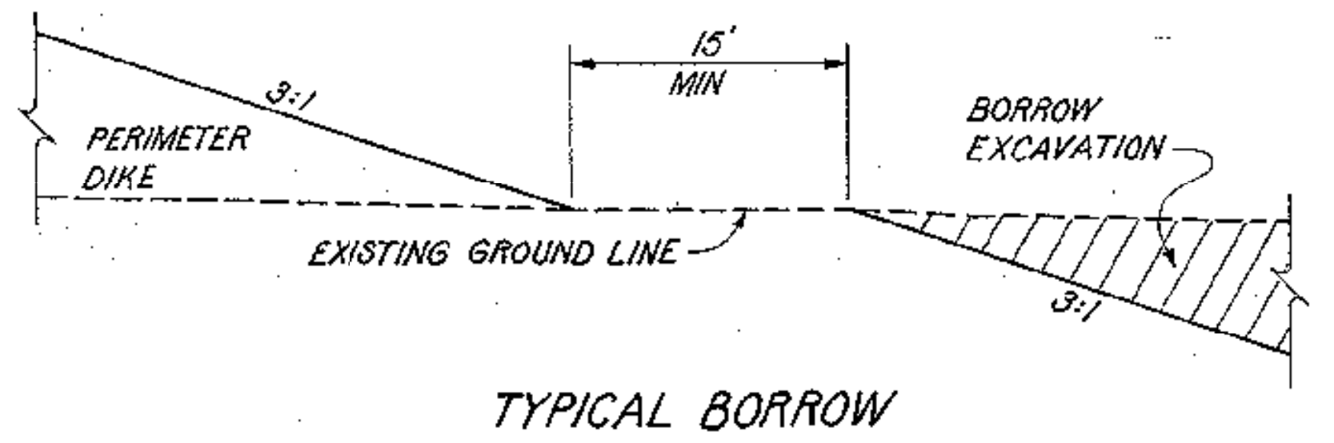
TECHNICAL INFORMATION CENTER INDEXED

34 C 10W215-03



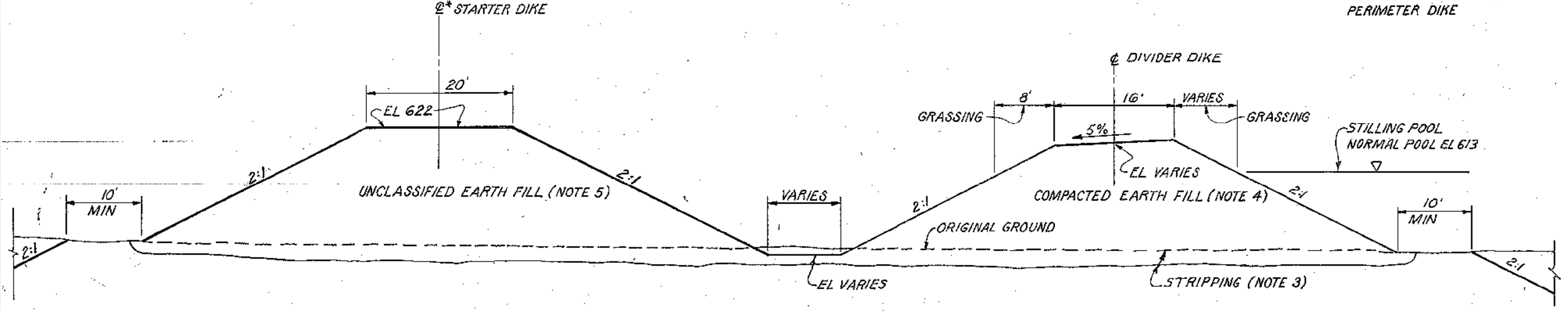
A3-A3

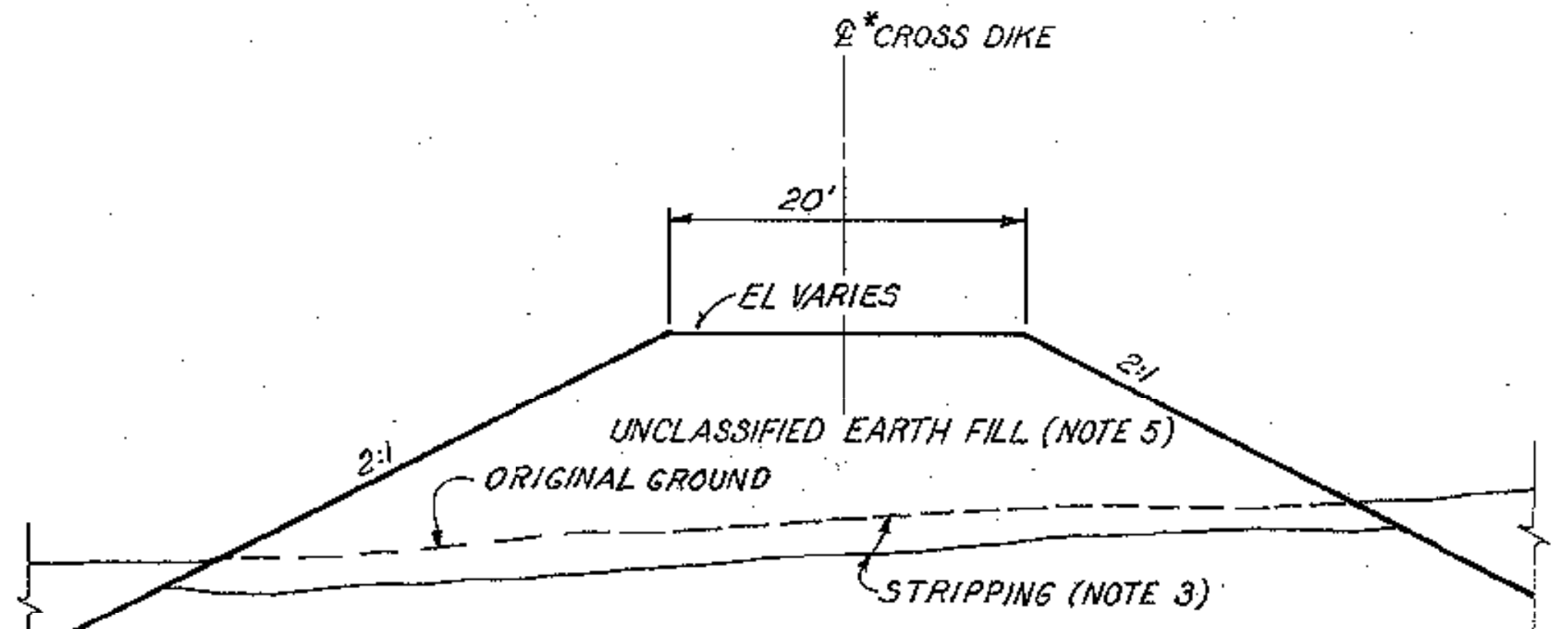




B3-B3

TYPICAL BORROW
ADJACENT TO OUTSIDE TOE
PERIMETER DIKE





*NOTE: PORTION OF DIKE TO BE CONSTRUCTED WITH COMPACTED EARTH FILL TO SUPPORT THE SPILLWAY AND DISCHARGE PIPE. (SEE SPILLWAY SECTION SHEET 27)

C3-C3

D3-D3

DIKE CONSTRUCTION NOTES:

1. ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH GENERAL CONSTRUCTION SPECIFICATION NO. G9, "ROLLED EARTHFILL FOR DAMS AND POWER PLANTS," EXCEPT AS NOTED.
2. ALL EXCAVATION AND FILL PLACEMENT SHALL BE DONE UNDER THE SUPERVISION OF A QUALIFIED SOILS INSPECTOR.
3. DIKE FOUNDATION PREPARATION-
   - a. THE AREAS FOR THE PROPOSED DIKE SHALL BE CLEARED OF ALL VEGETATION, ROOTS, AND ORGANIC TOPSOIL.
   - b. SOFT SOILS, WHEN ENCOUNTERED BENEATH THE TOP SOIL SHALL ALSO BE REMOVED. NOTIFY FEP CIVILS IF MORE THAN 12 INCHES MUST BE REMOVED.
   - c. THE ENTIRE FOUNDATION AREA SHALL BE COMPACTED WITH A SHEEPSFOOT ROLLER FOLLOWED BY A SMOOTH-DRUM ROLLER UNTIL THE AREA WILL SUPPORT HEAVY EQUIPMENT WITHOUT RUTTING INTO THE GROUND AND HEAVING THE AREA.
   - d. PRIOR TO PLACING FILL THE FOUNDATION AREA SHALL BE SCARIFIED TO PROVIDE A GOOD BOND BETWEEN FOUNDATION AND FILL.
4. EARTH FILL NOTES:
   - a. EARTH FILL SHALL BE OBTAINED FROM THE DESIGNATED AREA AS SHOWN ON DRAWING 10W215-04.
   - b. EARTH FILL SHALL BE UNIFORMLY COMPACTED IN LAYERS WHICH WHEN COMPACTED DO NOT EXCEED A THICKNESS OF 6 INCHES. COMPACTION SHALL BE ACCOMPLISHED USING A SHEEPSFOOT ROLLER PULLED BY A DOZER OR A SELF PROPELLED TAMPING (SHEEPSFOOT) ROLLER (REX PACTOR 3-50, OR AN OFFICE OF ENGINEERING APPROVED EQUAL). EACH LAYER SHALL BE COMPACTED TO AT LEAST 95% OF MAXIMUM DRY DENSITY AS DETERMINED BY ASTM D698. THE MOISTURE CONTENT SHALL BE CONTROLLED TO ACHIEVE ADEQUATE COMPACTION. ALLOWABLE MOISTURE CONTENT DURING PLACEMENT AND COMPACTION SHALL BE BETWEEN 3% ABOVE AND 3% BELOW OPTIMUM MOISTURE CONTENT. THE FAMILY-OF-COMPACTION CURVES DEVELOPED FOR BORROW AREA BY SME IS TO BE USED TO CONTROL THE EARTHFILL COMPACTION.
   - c. IN PLACE DENSITY TESTS USING THE SAND CONE (ASTM D1556) OR RUBBER BALLOON (ASTM D2167) TEST METHODS SHALL BE MADE AT A RATE OF AT LEAST ONE TEST PER EACH 2000 CUBIC YARDS OF EARTH FILL PLACED (IN-PLACE VOLUME), OR A MINIMUM OF ONE PER DAY.
5. UNCLASSIFIED EARTH FILL:
   - a. TO BE OBTAINED FROM BORROW AREA #4 OR MATERIAL OBTAINED FROM CONSTRUCTING DITCHES OR OTHER EXCAVATED MATERIAL THAT ARE UNSUITABLE FOR CONSTRUCTING COMPACTED EARTH FILL.
   - b. COMPACTION WILL BE BY HAUL EQUIPMENT ONLY AND SHALL BE PLACED AND GRADED IN UNIFORM LAYERS OF APPROXIMATELY 12 INCHES.
   - c. NO FIELD TEST WILL BE REQUIRED.
6. BORROW:
   SEE BORROW NOTE 2, 10W215-04.

NOTES:

1. FOR ADDITIONAL NOTES SEE 10W215-01 & -04

MF
RO
R1

RO ISSUE FOR PA 3660

COMPANION DWGS: 10W215-01

1		8/21/86	AHS			KWB	REH	OPT	
	SIGNED AS CONSTRUCTED								
REV NO.	ECN/EGR	DATE	DRWN	CHKD	DSGN	RVWD	APPD	ISSD	

DSGN Hillier Stover / M.D. Hranek
DRWN A.H. SPERBER
CHKD wmmartin
SUPV wmmartin
INSP Ralph G. Johnson RJB
ENGINEER M.H. Miller

SCALE: 1" = 10' EXCEPT AS NOTED

YARD
UNITS 7&8

FORCED OXIDATION GYPSUM
STACKING PHASE I
TYPICAL SECTIONS

WIDOWS CREEK STEAM PLANT
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

SUBMITTED	RECOMMENDED	APPROVED
M.H. Miller	R.E. Harris	R.O. Barnett

INSPECTED AND APPROVED FOR ISSUE
O.P. Thornton

KNOXVILLE 3/18/85 34 C 10W215-03 R1

RECORD DRAWING AS CONSTRUCTED
Gene Farmer 6/5/86 R1

TECHNICAL INFORMATION CENTER KNOXVILLE INDEXED

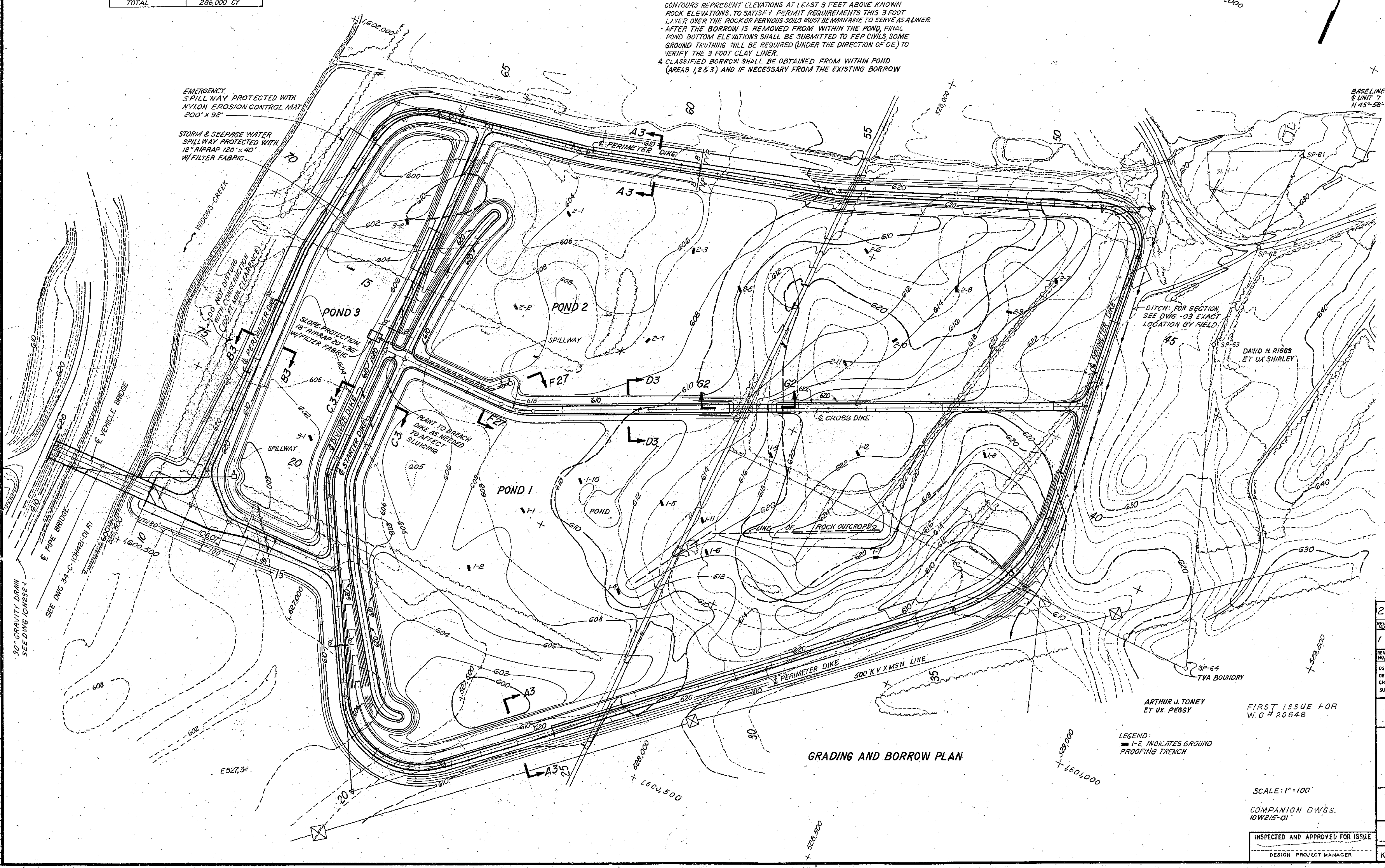
PRINT	H														
SIZE	F														

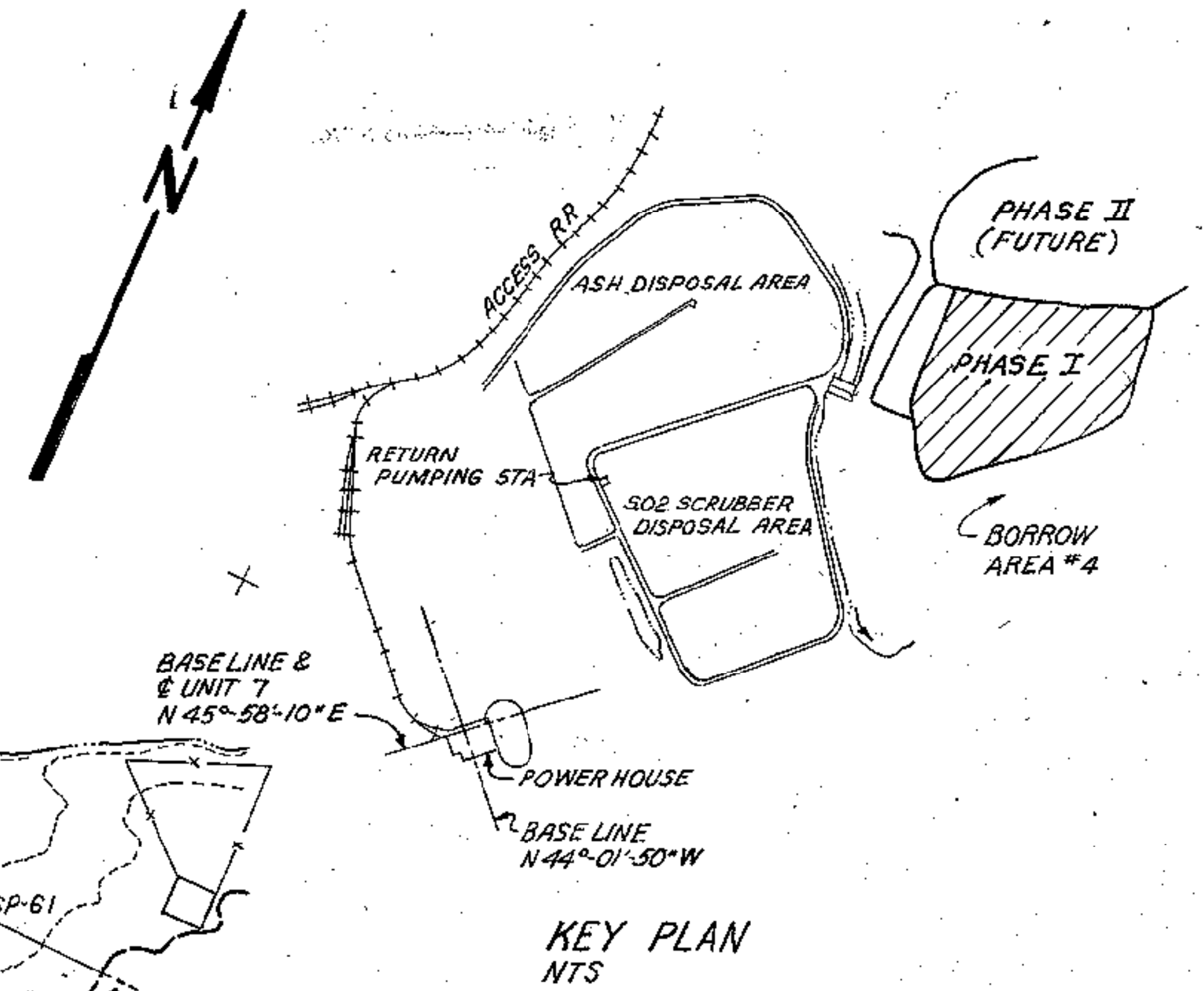
BR OR PROJ AS CE EE ME NE FD HD SD BL BW WB PW
PRINTS REQD- R____

34 C 10W215-04

ESTIMATED BORROW AVAILABLE	
POND 1	151,300 CY
POND 2	113,500 CY
POND 3	21,200 CY
TOTAL	286,000 CY

BORROW NOTES:
1. BORROW QUANTITIES SHOWN WERE OBTAINED BY CALCULATING "IN PLACE FILL VOLUME FROM THE DIKE X-SECTION AND INCREASING THIS BY 20% TO ALLOW FOR WASTE AND SHRINKAGE (FROM "INSITU" DENSITIES TO "COMPACTED FILL" DENSITIES). FOUNDATION PREPARATION QUANTITIES WERE CALCULATED ASSUMING AN AVERAGE OF 12" OF SOFT MATERIAL, AND SOD WOULD BE REMOVED BEFORE PLACING DIKE FILL.
2. INITIAL DIKE X-SECTION SHOWING ORIGINAL GROUND AND X-SECTIONS AFTER FOUNDATION PREPARATION SHALL BE SUBMITTED TO FEP CIVILS. THESE SECTIONS WILL BE USED TO OBTAIN FINAL IN-PLACE FILL AND FOUNDATION PREPARATION VOLUMES.
3. CONSTRUCTION SHALL USE EXTREME CAUTION WHEN EXCAVATING BORROW FROM WITHIN THE LIMITS OF THE POND. THE BORROW CONTOURS REPRESENT ELEVATIONS AT LEAST 3 FEET ABOVE KNOWN ROCK ELEVATIONS. TO SATISFY PERMIT REQUIREMENTS THIS 3 FOOT LAYER OVER THE ROCK OR PERVIOUS SOILS MUST BE MAINTAINE TO SERVE AS A LINER. AFTER THE BORROW IS REMOVED FROM WITHIN THE POND, FINAL POND BOTTOM ELEVATIONS SHALL BE SUBMITTED TO FEP CIVILS, SOME GROUND TRUTHING WILL BE REQUIRED (UNDER THE DIRECTION OF OE) TO VERIFY THE 3 FOOT CLAY LINER.
4. CLASSIFIED BORROW SHALL BE OBTAINED FROM WITHIN POND (AREAS 1,2 & 3) AND IF NECESSARY FROM THE EXISTING BORROW AREAS SOUTH OF AND ADJACENT TO THE 500 KV TRANSMISSION LINE (AREA 4). UNCLASSIFIED BORROW SHALL BE OBTAINED FROM AREA 4.
5. ANY TOP SOIL OR UNSUITABLE SOIL SHALL BE STOCK PILED FOR FUTURE USE BY POWER TO ESTABLISH VEGETATION. (COORDINATE LOCATION WITH PLANT)
6. SHOULD BORROW EXCAVATION UNCOVER PERVIOUS SOILS OR HIGH PORTION OF ROCK, A MINIMUM BACKFILL OF 3 FEET OF COMPACTED CLAY WILL BE INSTALLED. IF OUTCROPS ARE ENCOUNTERED ON THE EXISTING GROUND THEY WILL ALSO BE COVERED WITH A MINIMUM BLANKET OF 3 FEET OF COMPACTED CLAY.





KEY PLAN
NTS

NOTES:
1. ALL WORK TO BE IN ACCORDANCE WITH T-1 SPECIFICATIONS EXCEPT AS NOTED.
2. WHERE EXCAVATION IS ADJACENT TO PROPOSED DIKES THE CUT SLOPES SHALL NOT BE STEEPER THAN 2:1 (U.O.N) AND TOP OF CUT SHALL BE A MINIMUM OF 10 FEET FROM THE TOE OF THE INTERIOR DIKE AND 15 FEET FROM THE TOE OF THE EXTERIOR OR AS SHOWN ON THE CROSS SECTIONS.
3. DASHED CONTOURS (---) INDICATE EXISTING GROUND, SOLID CONTOURS (—) INDICATE FINISHED GRADE.
4. THE TOP OF EARTH, AFTER BORROW EXCAVATION, SHALL BE SEALED BY ROLLING WITH RUBBER-TIRED EQUIPMENT OR SMOOTH-DRUM ROLLER TO PROVIDE A RELATIVELY IMPERVIOUS LAYER.
5. FOR DIKE LAYOUT, PROFILES AND SECTION SEE 10W215-01 THRU-03.

mf RU R1 R2

LEGEND:
▬ 1-2 INDICATES GROUND PROOFING TRENCH.

FIRST ISSUE FOR
W.O # 20648

SCALE: 1" = 100'

COMPANION DWGS.
10W215-01

2		8/21/86		AHS		KWB	REH	OPTy		
	FINAL FIELD REVISION									
REV NO	ECN/FCR	DATE	DSGN	DRWN	CHKD	RVWD	APPD	ISSD		
1	PA3660	3/18/85		AHS	LDS		MHM	RJB	MHM	REH
	REV. ADDED GRADING & GENERAL REV. ADDED NOTES.									
REV NO.	ECN NO.	DATE	DSGN	DRWN	CHKD	SUPY	ENGR	INSP	SUBM	RECM	APPR

DSGN
DRWN A.H. SPERBER / M.P. TERMON
CHKD JP Killen Storer
SUPV JP Killen Storer
INSP Ralph G. Johnson RJB
ENGINEER M.H. Miller

YARD
UNITS 7 & 8

FORCED OXIDATION GYPSUM STACKING PHASE 1 - DIKES & GRG PLAN SHEET 4

WIDOWS CREEK STEAM PLANT
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

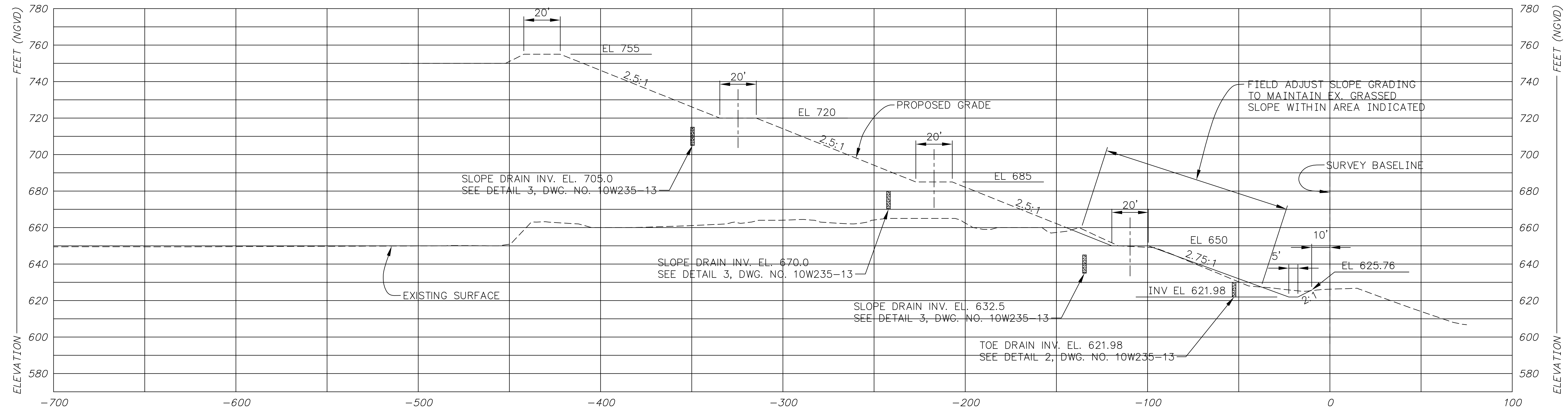
SUBMITTED M.H. Miller
RECOMMENDED R.E. Harris
APPROVED

INSPECTED AND APPROVED FOR ISSUE
DESIGN PROJECT MANAGER

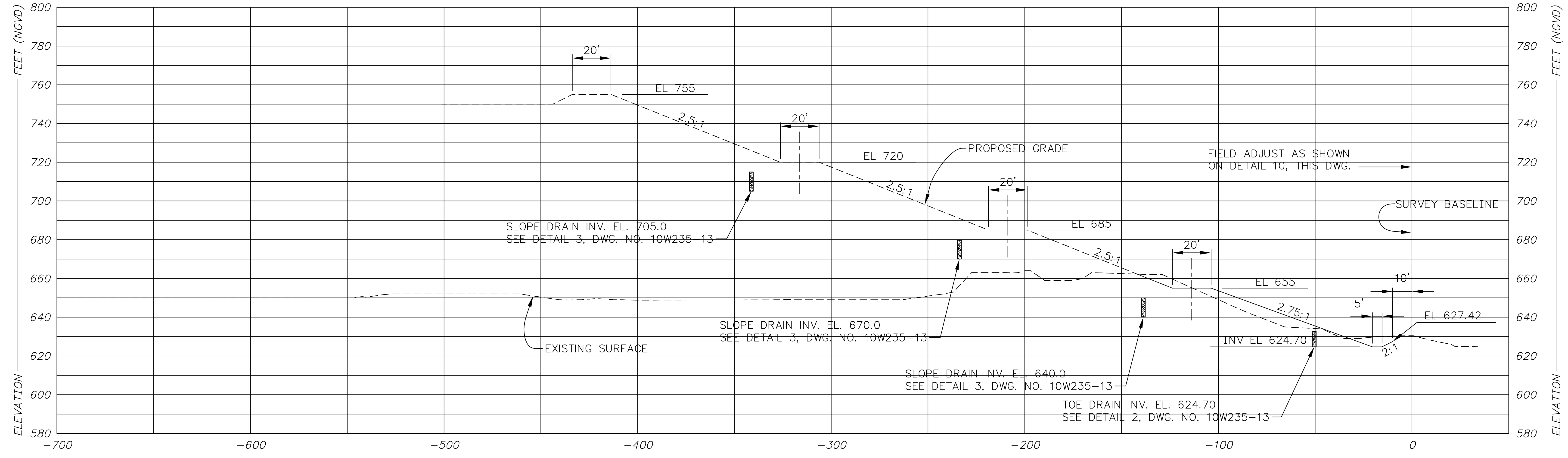
KNOXVILLE 4-29-83 34 C 10W215-04 R2

RECORD DRAWING AS CONSTRUCTED Dene Farmer 6/5/86 R2

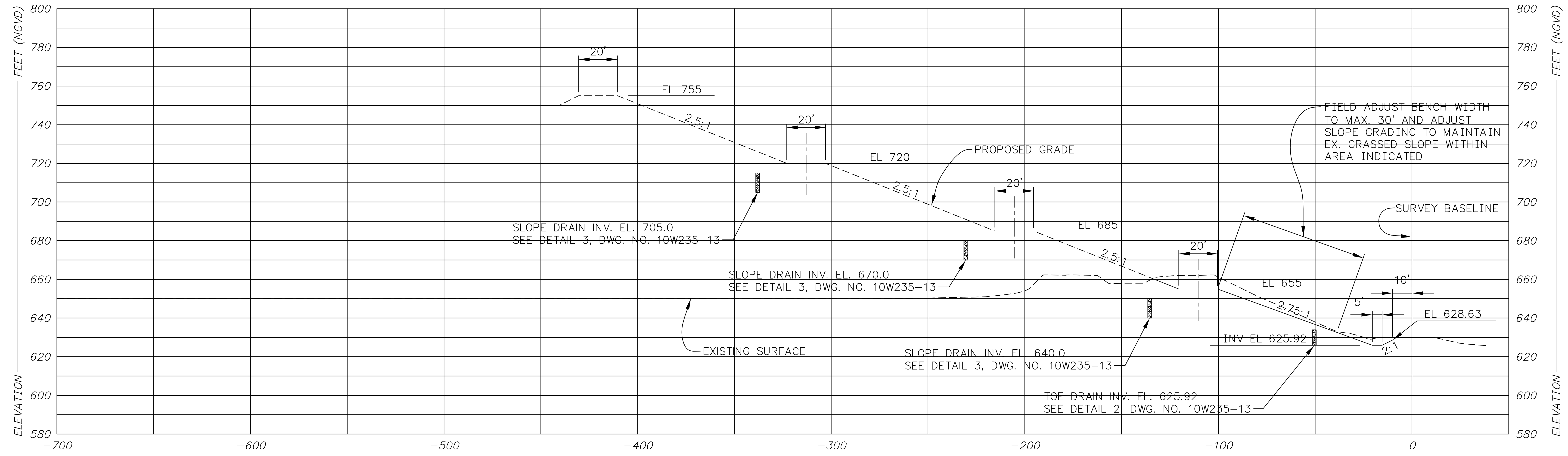
PRINTS REQ'D
ME
EE
CE
AD
CD
ED
MD
BF
SW
BL
PA



SECTION D–D
STATION 135+00

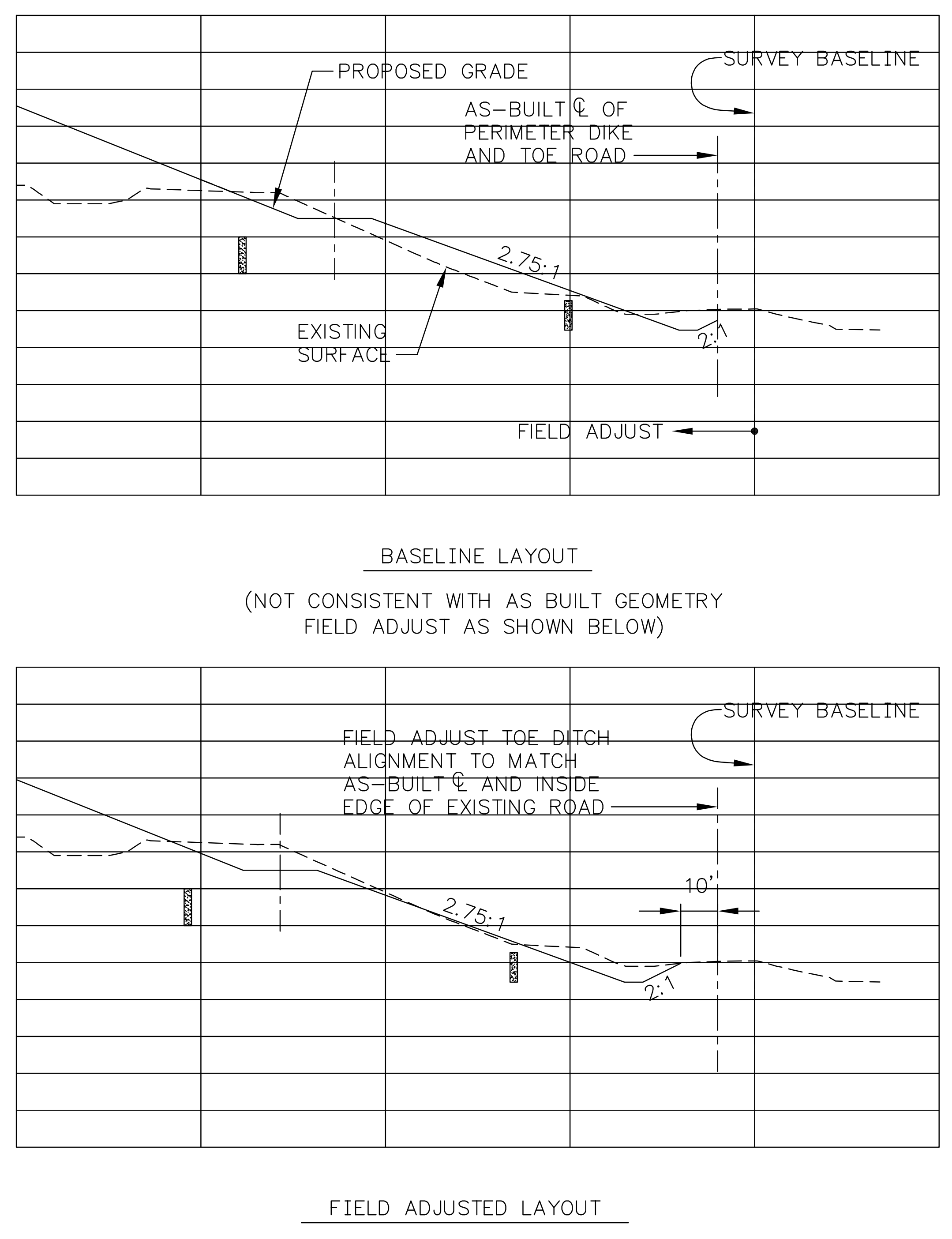


SECTION E–E
STATION 147+00



SECTION F–F
STATION 214+00

WHERE SURVEY BASELINE DOES NOT MATCH AS–BUILT TOE ROAD CENTERLINE, FIELD ADJUST TOE DITCH ALIGNMENT AND SLOPE GRADING TO MATCH ACTUAL TOE ROAD CENTRELINE AND INSIDE EDGE OF ROAD SHOWN BELOW.



DETAIL 10
SURVEY BASELINE FIELD ADJUSTMENT GUIDE
NOT TO SCALE

CONTOURS AND GRADES REPRESENT THRU 2023.
AS–DESIGNED CONFIGURATION ONLY.
FIRST BENCH DIRT COVER COMPLETED IN 2006.

LEGEND

——— *INITIAL CONSTRUCTION PHASE PROPOSED GRADE*

– – – – *FUTURE CONSTRUCTION PHASES PROPOSED GRADE*

NOTES

1. *ELEVATIONS SHOWN ON THESE CROSS SECTIONS INDICATE FINISHED GRADES (TOP OF SOIL COVER OR FINISHED GYPSUM/FLYASH SURFACE)*

R											
R 0	12/3/07	CWH	SEL	DRD	SRC	LJP	JCK		WCF408		J
INITIAL ISSUE PER DCN WCF–04–1016–010											
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD

DISCIPLINE INTERFACE
1
2
3
4

SCALE: 1"=30' EXCEPT AS NOTED

YARD
UNITS 7 & 8

FORCED OXIDATION GYPSUM STACKING
PHASE 1 & 2
CROSS SECTIONS D THROUGH F

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
			Samuel R. Cathey	Leonard J. Peterson	L.J. Peterson for John C. Kammeyer	

WIDOWS CREEK FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

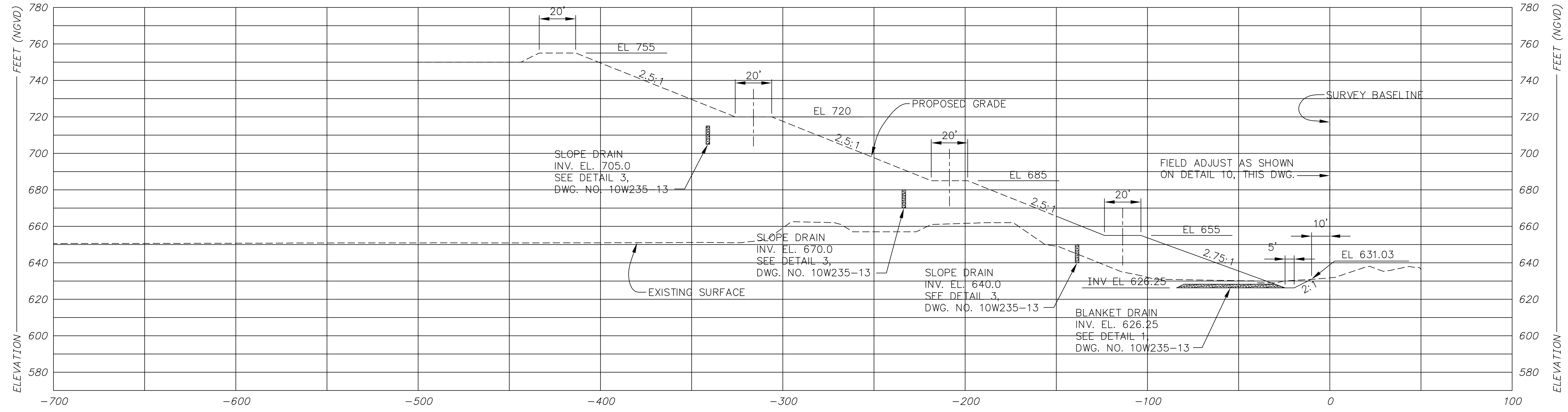
AUTOCAD R2K	DATE	34	C	10W235–10	R 0

PLOT FACTOR:30
W_TVA

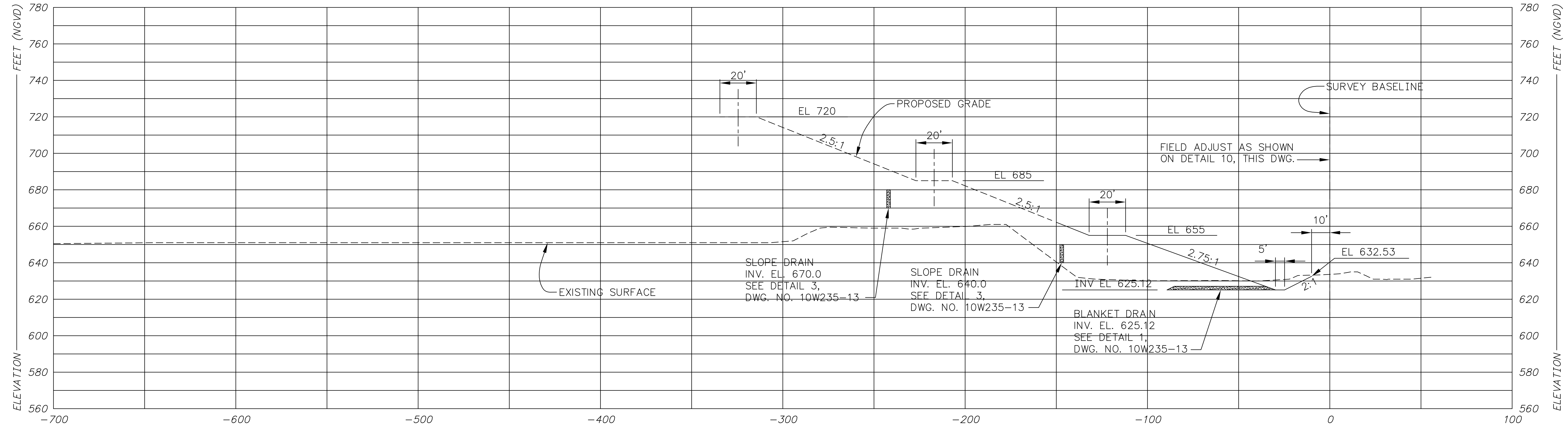
C.A.D. DRAWING
DO NOT ALTER MANUALLY

TASK COMPLETED BY: REV NO.

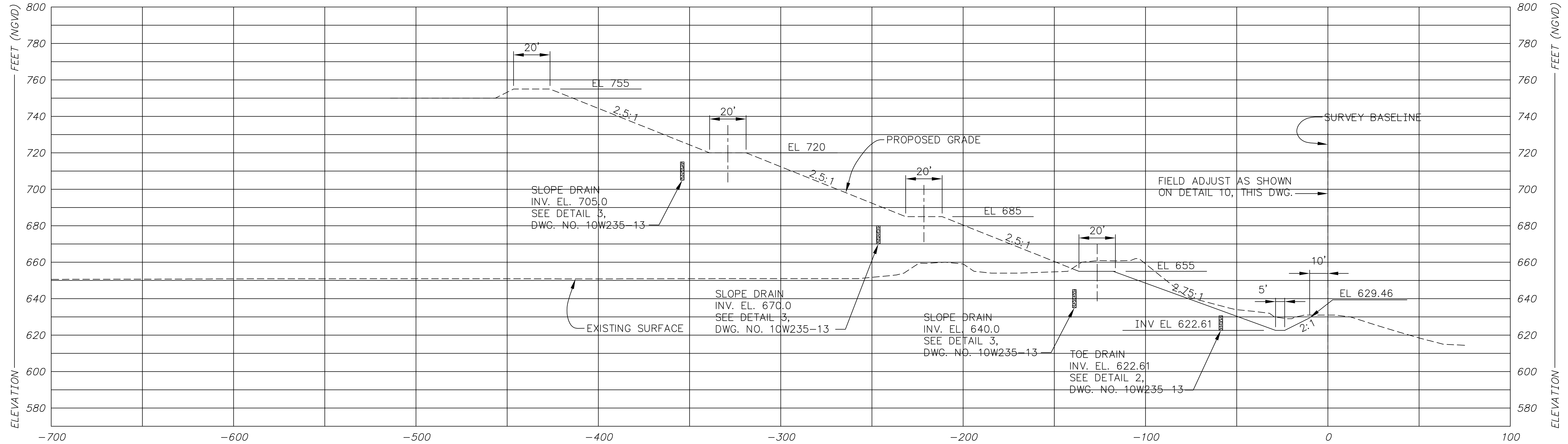
34 C 10W235-11



SECTION G-G
STATION 222+00

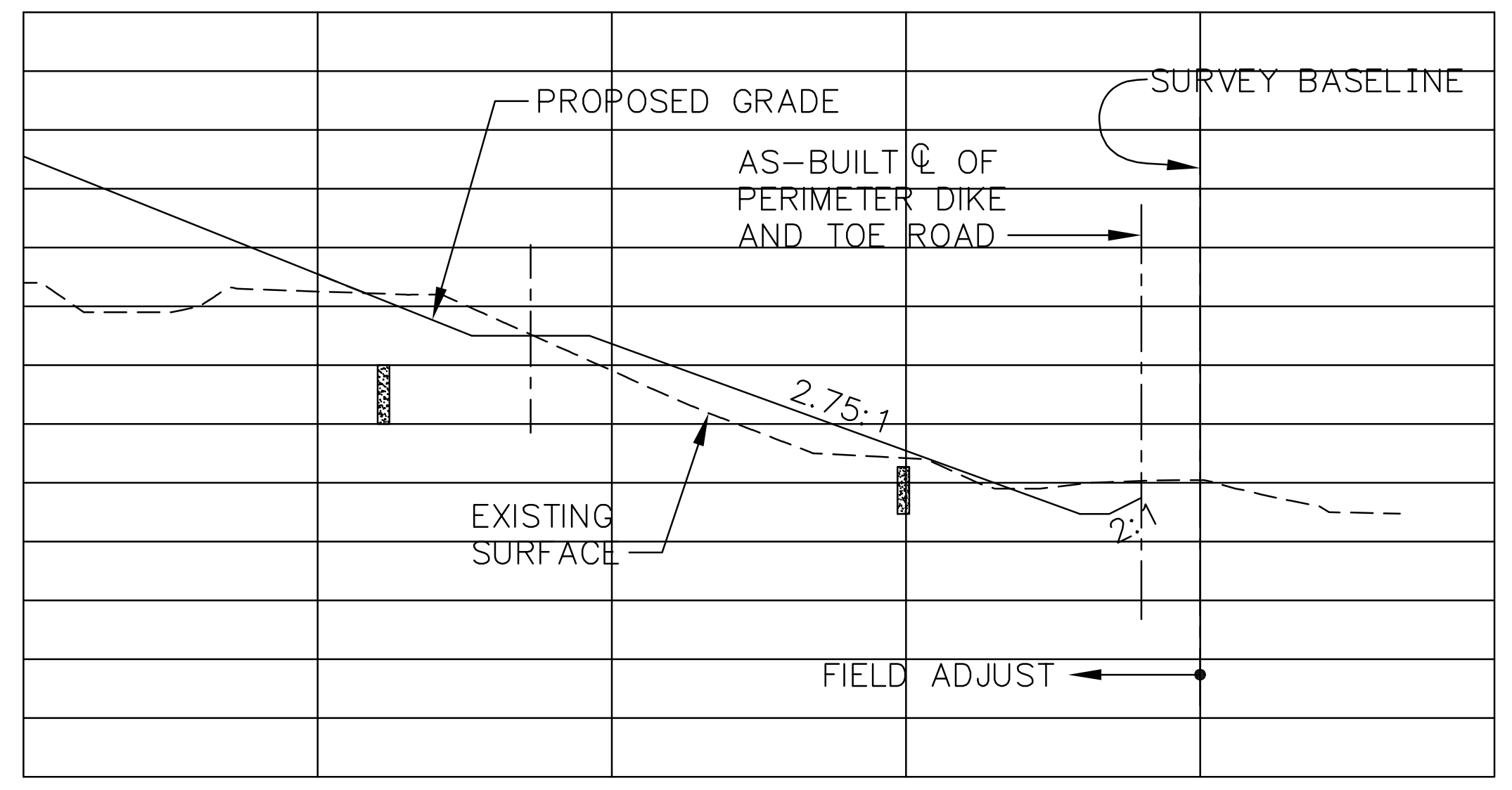


SECTION H-H
STATION 227+00



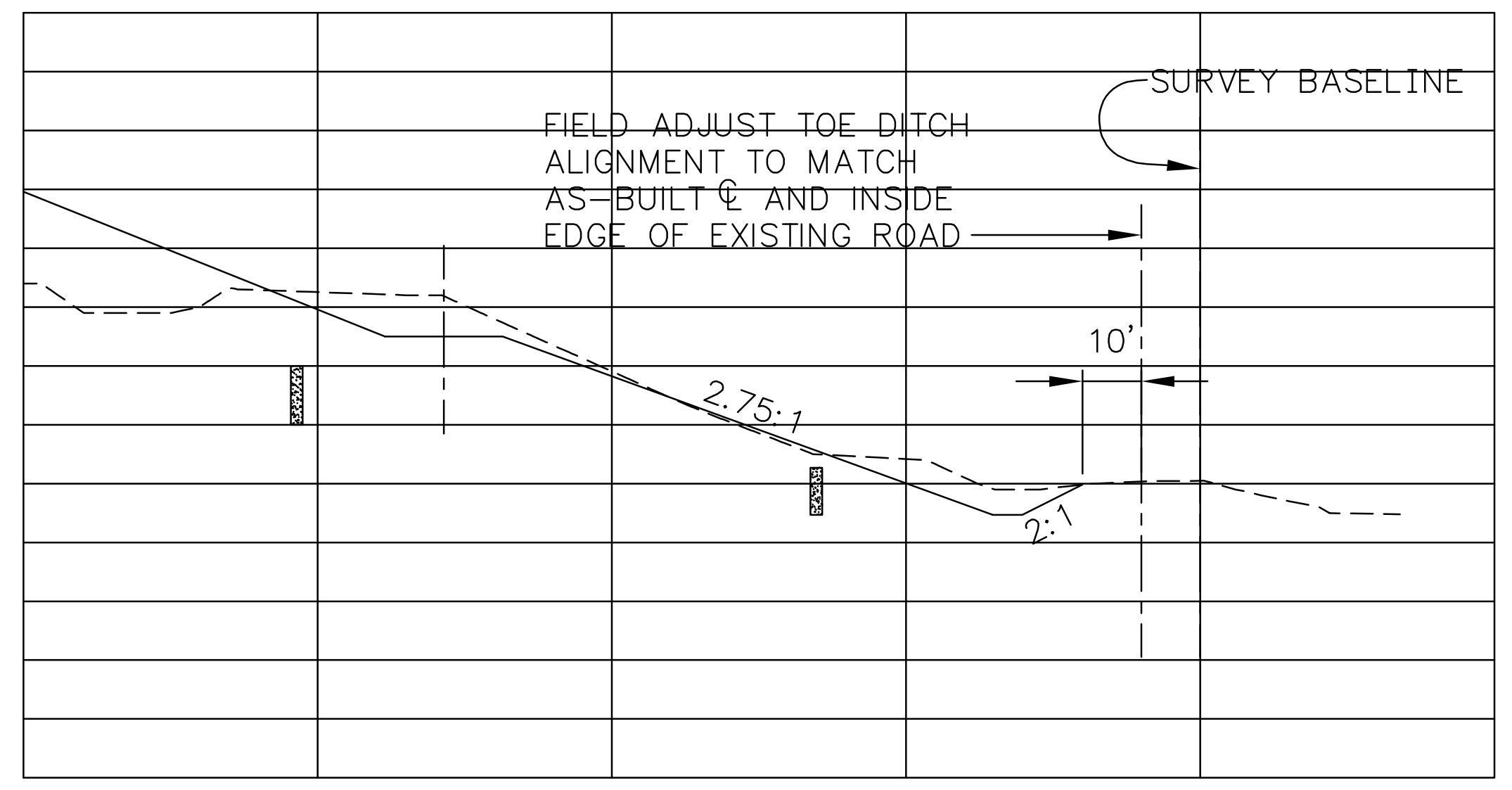
SECTION J-J
STATION 238+00

WHERE SURVEY BASELINE DOES NOT MATCH AS-BUILT TOE ROAD CENTERLINE, FIELD ADJUST TOE DITCH ALIGNMENT AND SLOPE GRADING TO MATCH ACTUAL TOE ROAD CENTRELINE AND INSIDE EDGE OF ROAD SHOWN BELOW.



BASELINE LAYOUT

(NOT CONSISTENT WITH AS BUILT GEOMETRY
FIELD ADJUST AS SHOWN BELOW)



FIELD ADJUSTED LAYOUT

DETAIL 10
SURVEY BASELINE FIELD ADJUSTMENT GUIDE
NOT TO SCALE

CONTOURS AND GRADES REPRESENT THRU 2023.
AS-DESIGNED CONFIGURATION ONLY.
FIRST BENCH DIRT COVER COMPLETED IN 2006.

LEGEND

——— *INITIAL CONSTRUCTION PHASE PROPOSED GRADE*
- - - - *FUTURE CONSTRUCTION PHASES PROPOSED GRADE*

NOTES

1. *ELEVATIONS SHOWN ON THESE CROSS SECTIONS INDICATE FINISHED GRADES (TOP OF SOIL COVER OR FINISHED GYPSUM/FLYASH SURFACE)*

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R											
R 0	12/3/07	CWH	SEL	DRD	SRC	LJP	JCK		WCF408		J
INITIAL ISSUE PER DCN WCF-04-1016-011											

DISCIPLINE INTERFACE
1
2
3
4

SCALE: 1"=30' EXCEPT AS NOTED

YARD
UNITS 7 & 8

FORCED OXIDATION GYPSUM STACKING
PHASE 1 & 2
CROSS SECTIONS G, H, & J

DESIGNED BY:
DRAWN BY:
CHECKED BY:
SUPERVISED BY: Samuel R. Cathey
REVIEWED BY: Leonard J. Peterson
APPROVED BY: L.J. Peterson for John C. Kammeyer
ISSUED BY:

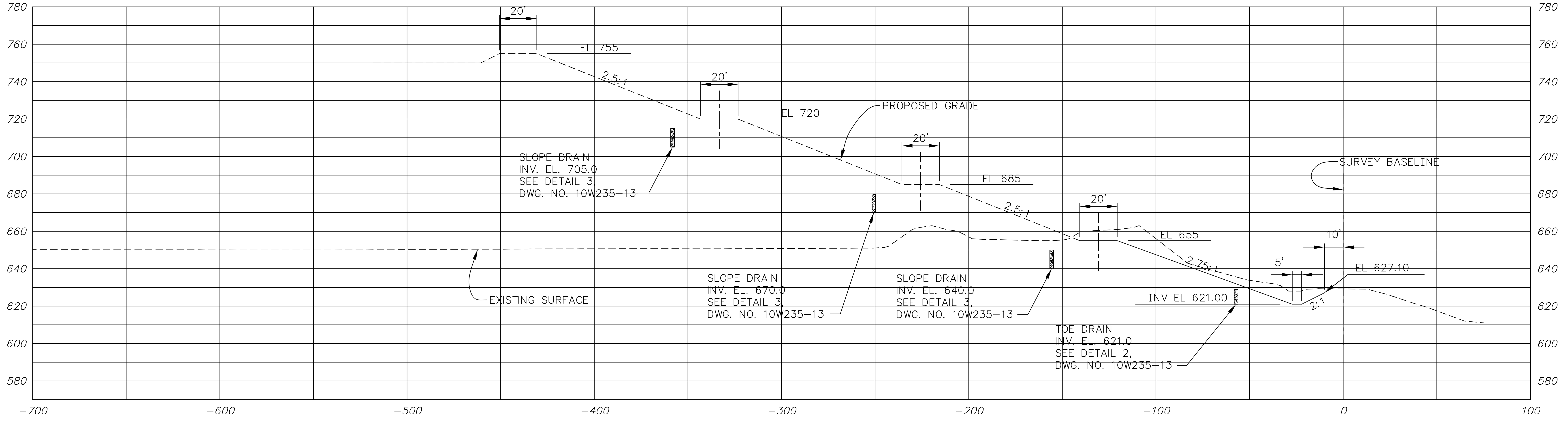
WIDOWS CREEK FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R2K | DATE | 34 | C | 10W235-11 | R 0

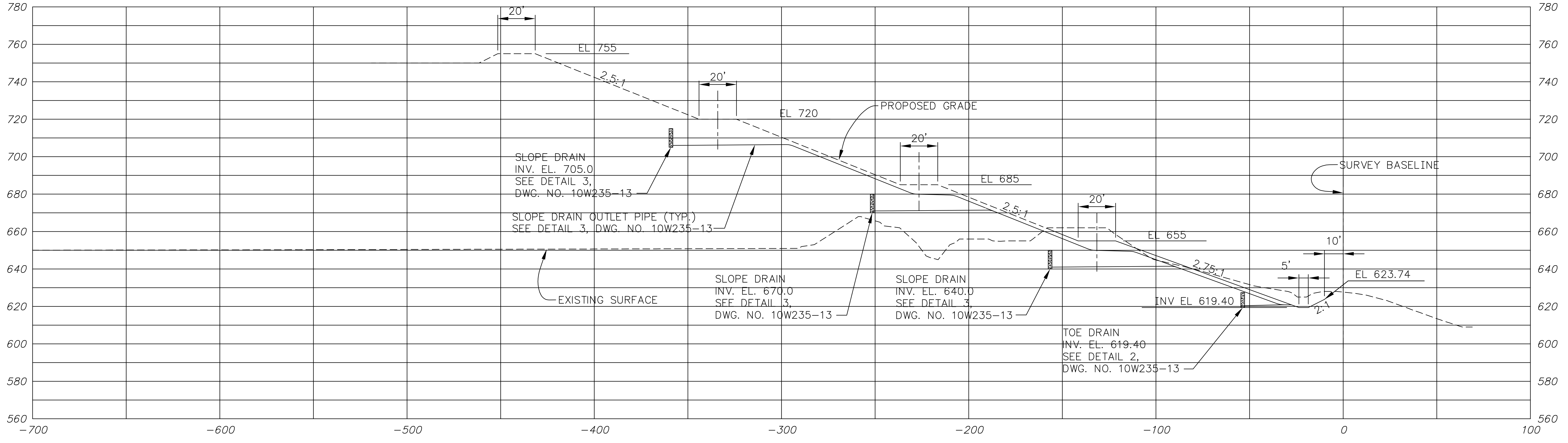
PLOT FACTOR:30
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

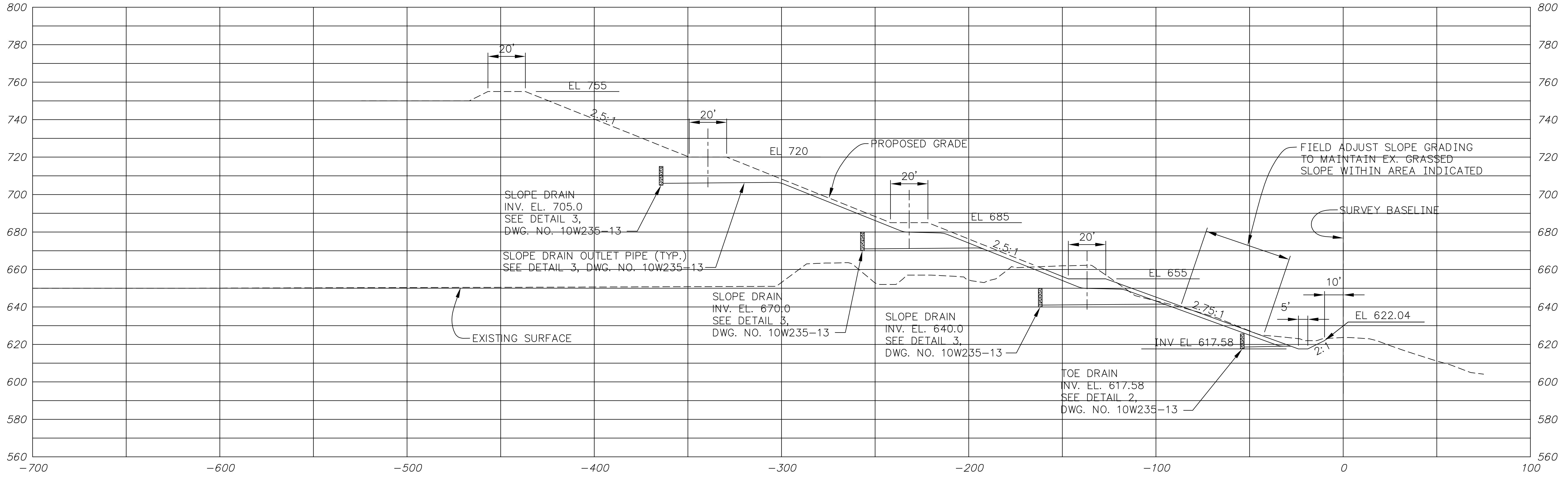
TASK COMPLETED BY: | REV NO.



SECTION K-K
STATION 245+00

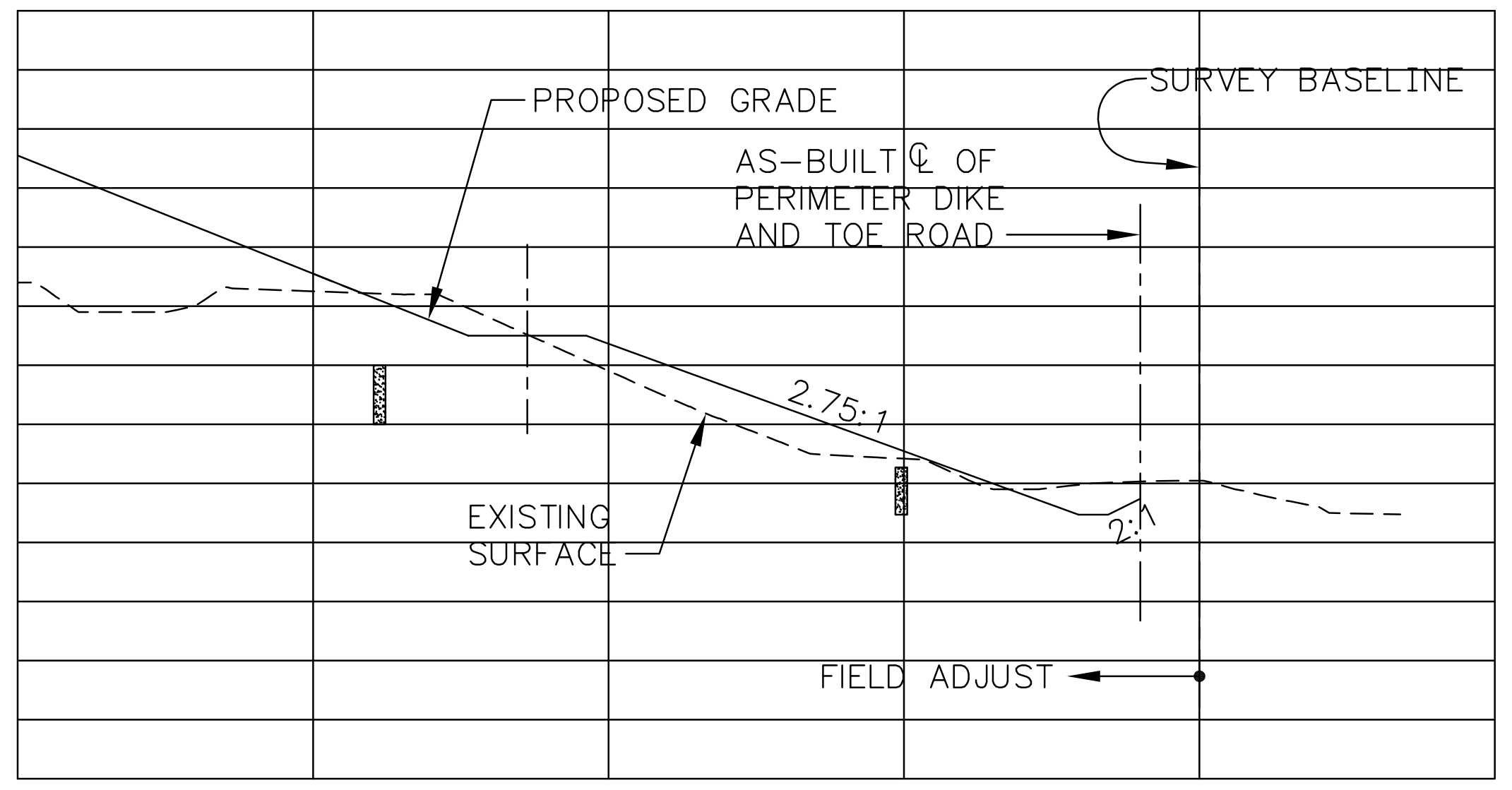


SECTION L-L
STATION 252+00



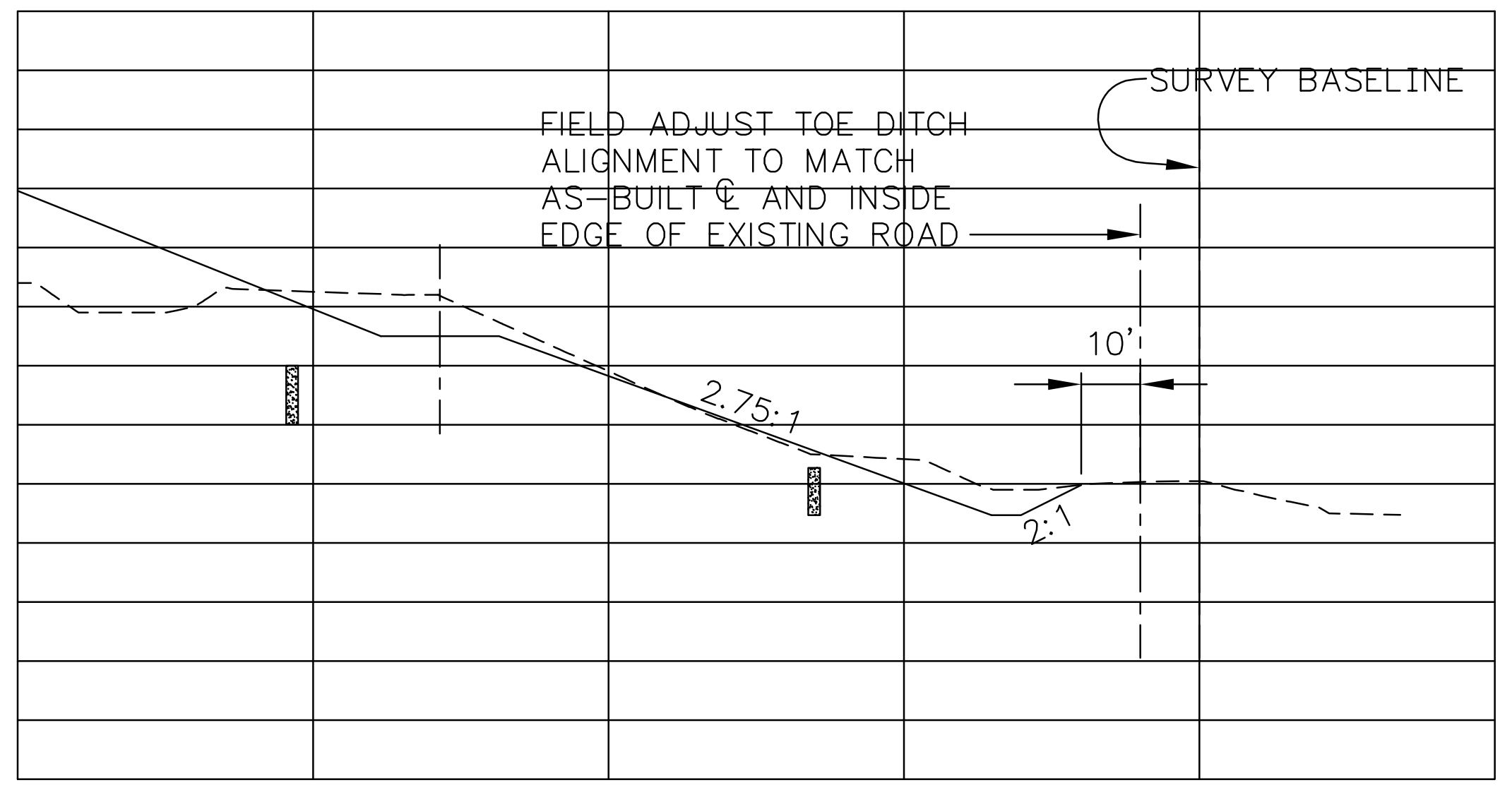
SECTION M-M
STATION 260+00

WHERE SURVEY BASELINE DOES NOT MATCH AS-BUILT TOE ROAD CENTERLINE, FIELD ADJUST TOE DITCH ALIGNMENT AND SLOPE GRADING TO MATCH ACTUAL TOE ROAD CENTRELINE AND INSIDE EDGE OF ROAD SHOWN BELOW.



BASELINE LAYOUT

(NOT CONSISTENT WITH AS BUILT GEOMETRY
FIELD ADJUST AS SHOWN BELOW)



FIELD ADJUSTED LAYOUT

DETAIL 10
SURVEY BASELINE FIELD ADJUSTMENT GUIDE
NOT TO SCALE

CONTOURS AND GRADES REPRESENT THRU 2023.
AS-DESIGNED CONFIGURATION ONLY.
FIRST BENCH DIRT COVER COMPLETED IN 2006.

LEGEND

——— *INITIAL CONSTRUCTION PHASE PROPOSED GRADE*
- - - - *FUTURE CONSTRUCTION PHASES PROPOSED GRADE*

NOTES

1. *ELEVATIONS SHOWN ON THESE CROSS SECTIONS INDICATE FINISHED GRADES (TOP OF SOIL COVER OR FINISHED GYPSUM/FLYASH SURFACE)*

R											
R 0	12/3/07	CWH	SEL	DRD	SRC	LJP	JCK		WCF408		J
INITIAL ISSUE PER DCN WCF-04-1016-012											
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD

DISCIPLINE INTERFACE
1
2
3
4

SCALE: 1"=30' EXCEPT AS NOTED

YARD
UNITS 7 & 8

FORCED OXIDATION GYPSUM STACKING
PHASE 1 & 2
CROSS SECTIONS K THROUGH M

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
			Samuel R. Cathey	Leonard J. Peterson	L.J. Peterson for John C. Kammeyer	

WIDOWS CREEK FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

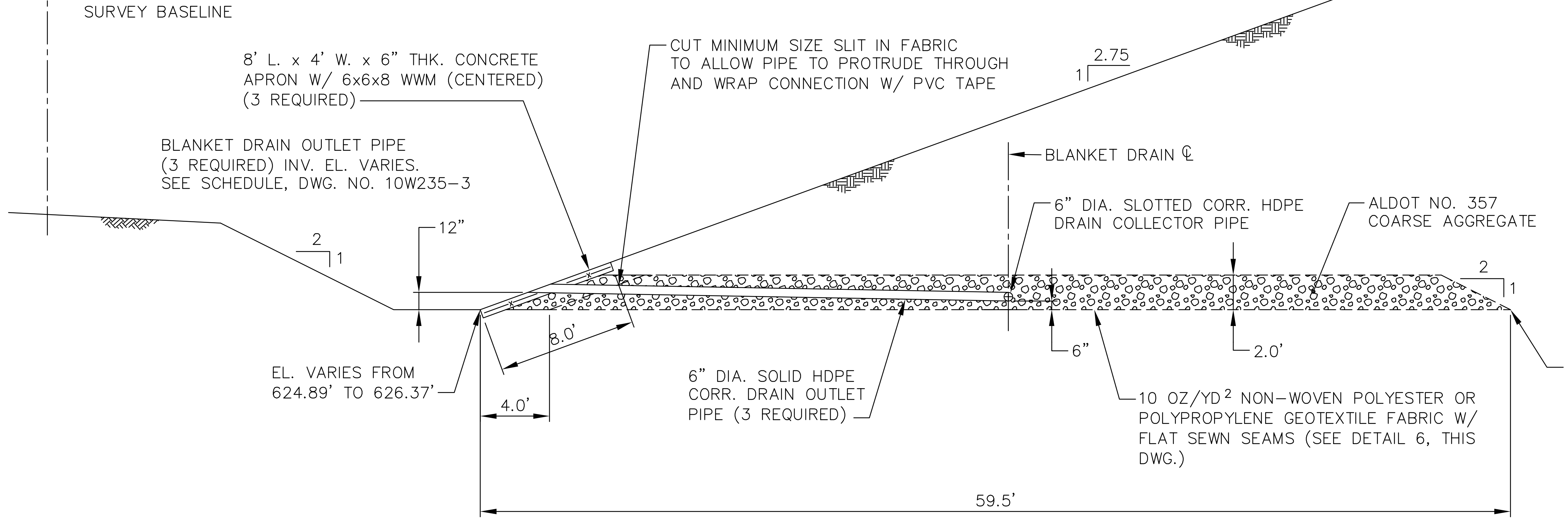
AUTOCAD R 2K	DATE	34	C	10W235-12	R 0

PLOT FACTOR:30
W_TVA

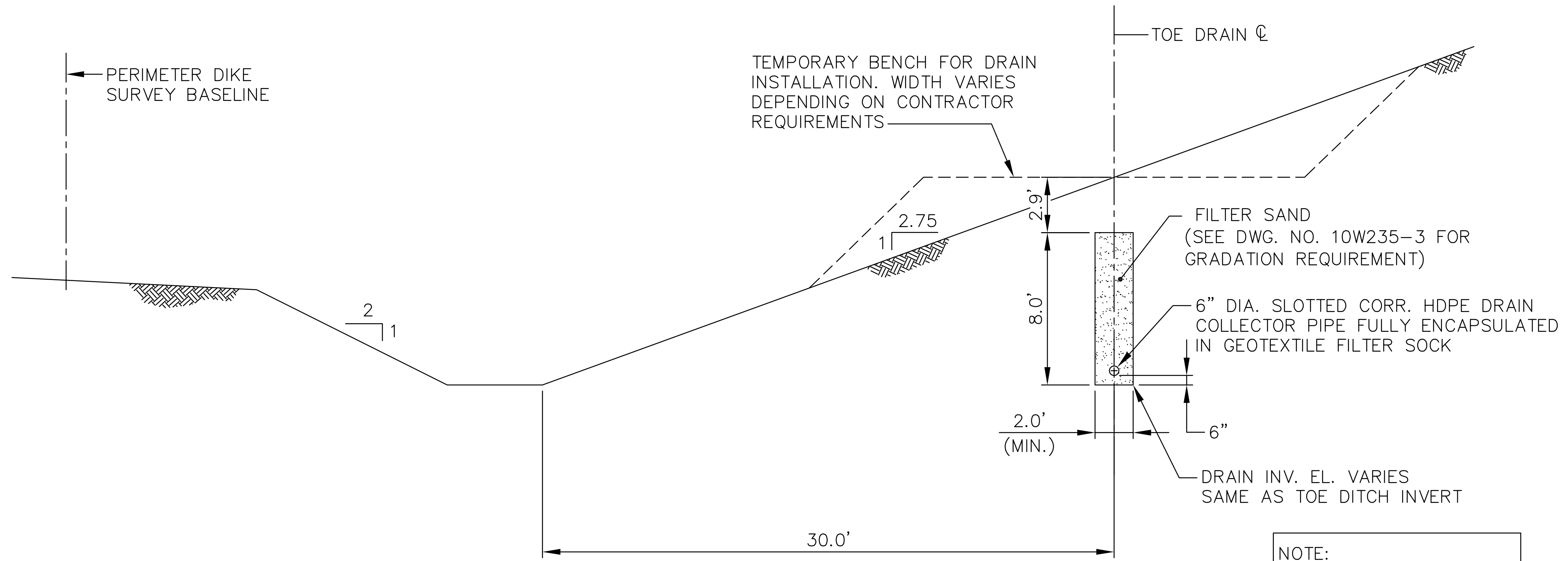
C.A.D. DRAWING
DO NOT ALTER MANUALLY

TASK COMPLETED BY: REV NO.

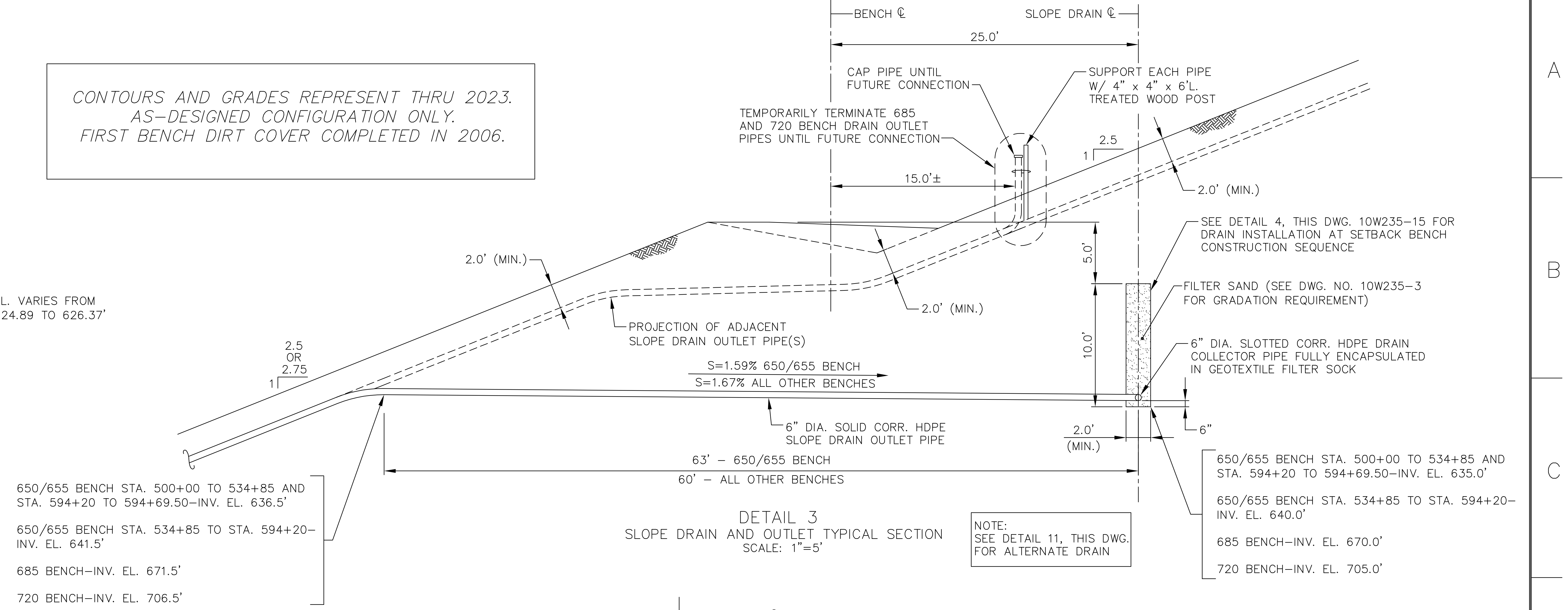
CONTOURS AND GRADES REPRESENT THRU 2023.
AS-DESIGNED CONFIGURATION ONLY.
FIRST BENCH DIRT COVER COMPLETED IN 2006.



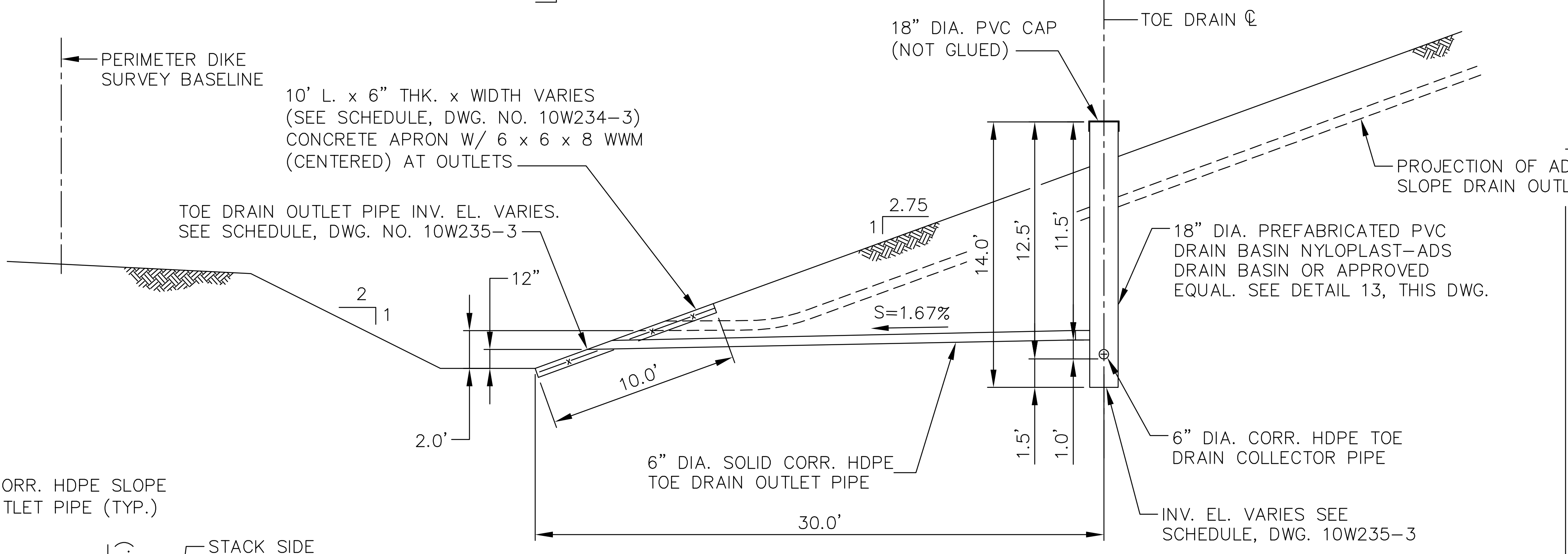
DETAIL 1
BLANKET DRAIN AND OUTLET TYPICAL SECTION
SCALE: 1"=5'



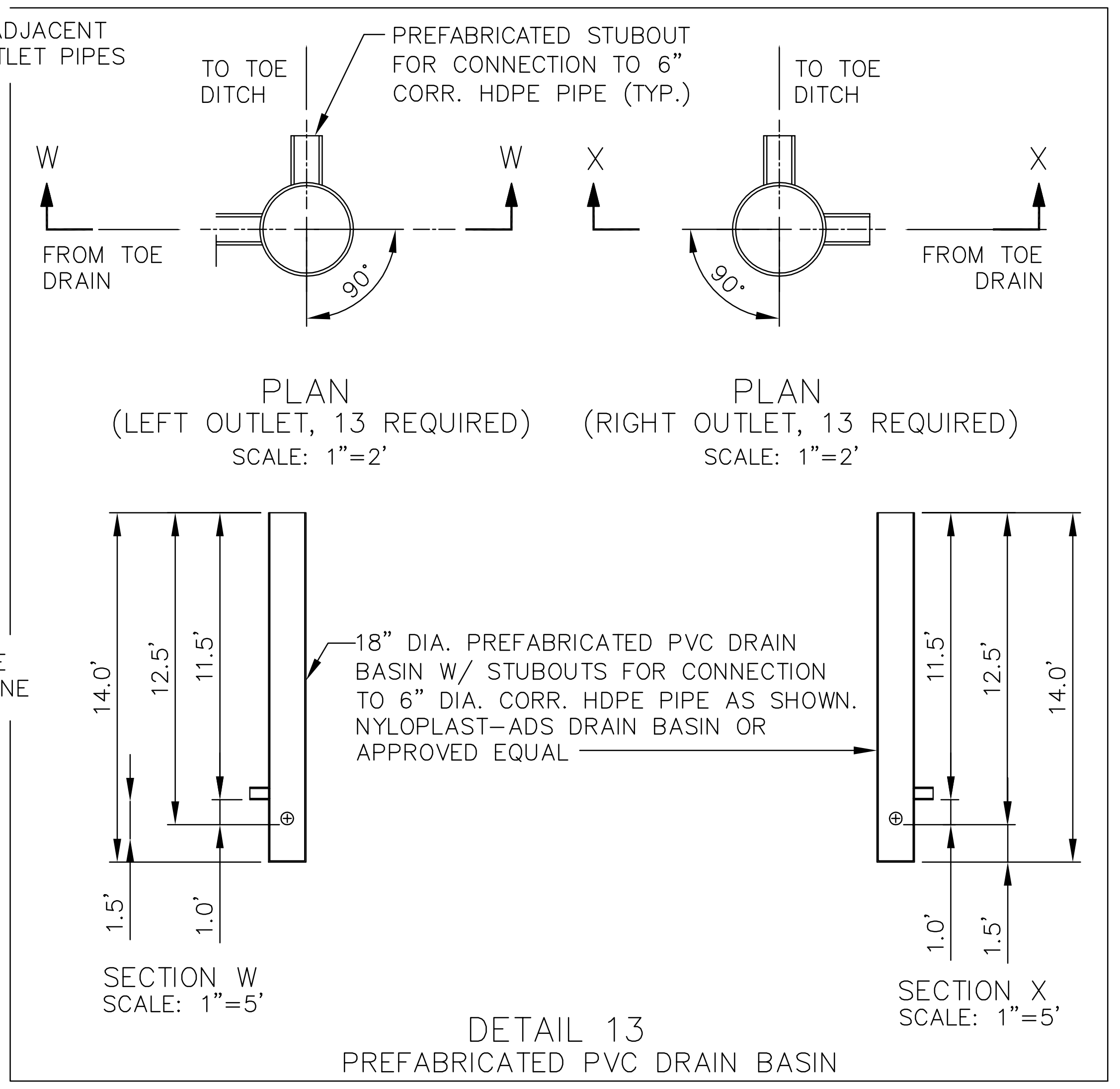
DETAIL 2
TOE DRAIN TYPICAL SECTION
SCALE: 1"=5'



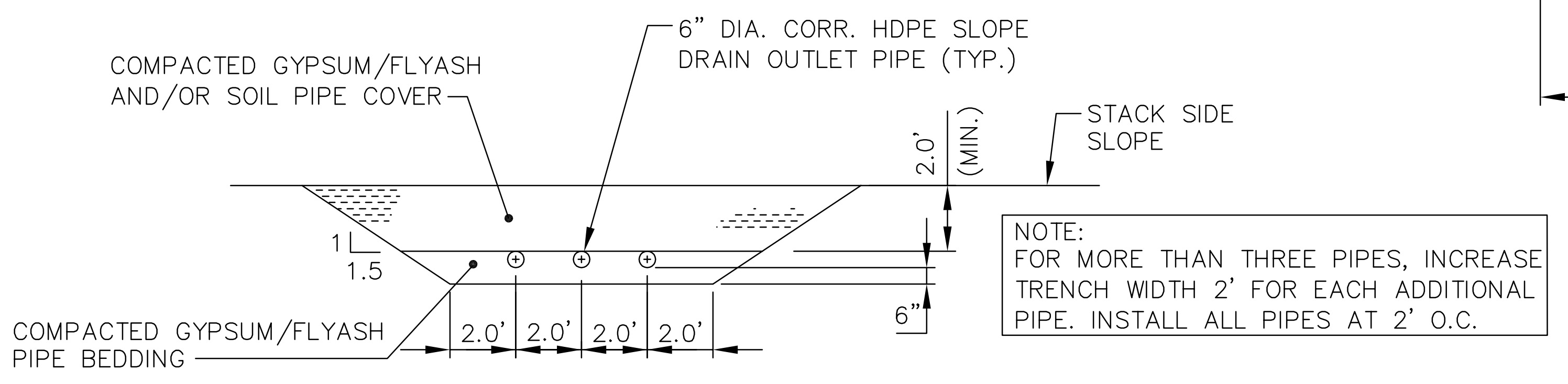
DETAIL 3
SLOPE DRAIN AND OUTLET TYPICAL SECTION
SCALE: 1"=5'



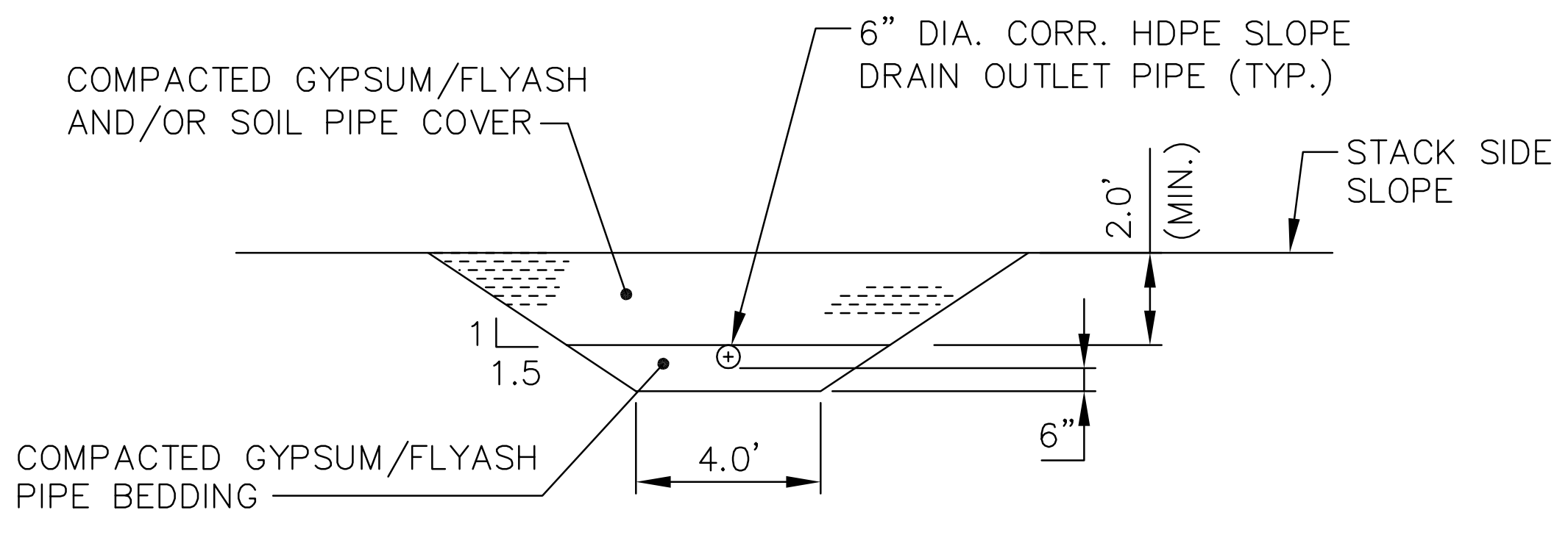
SECTION V-V
TOE DRAIN OUTLET TYPICAL SECTION
SCALE: 1"=5'



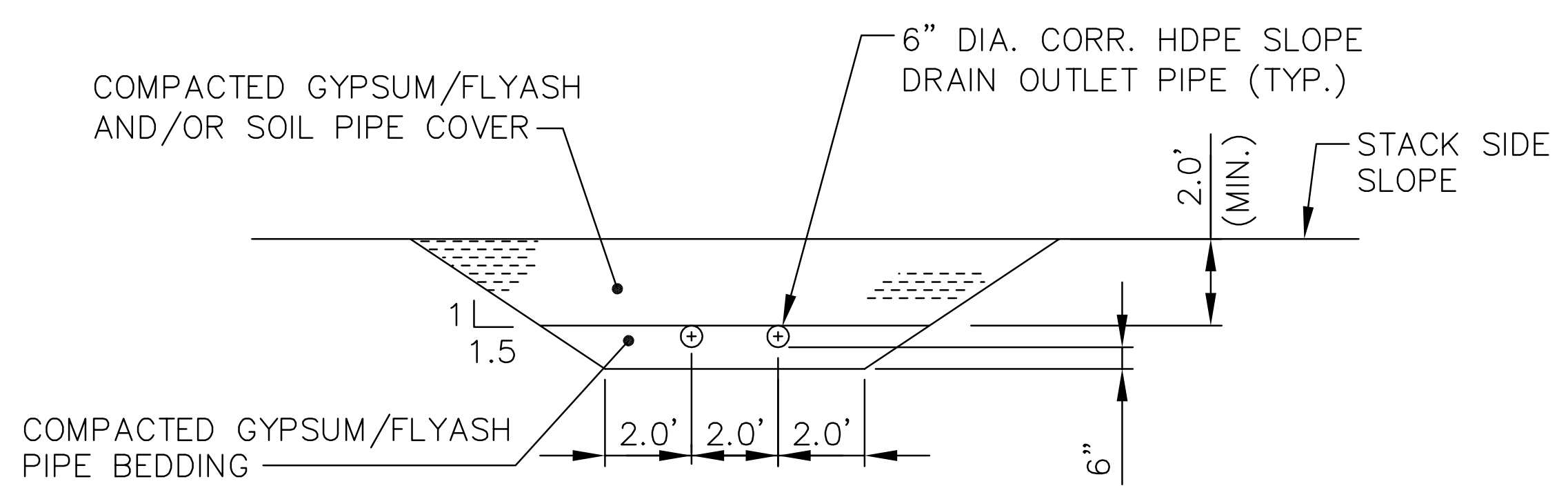
DETAIL 13
PREFABRICATED PVC DRAIN BASIN



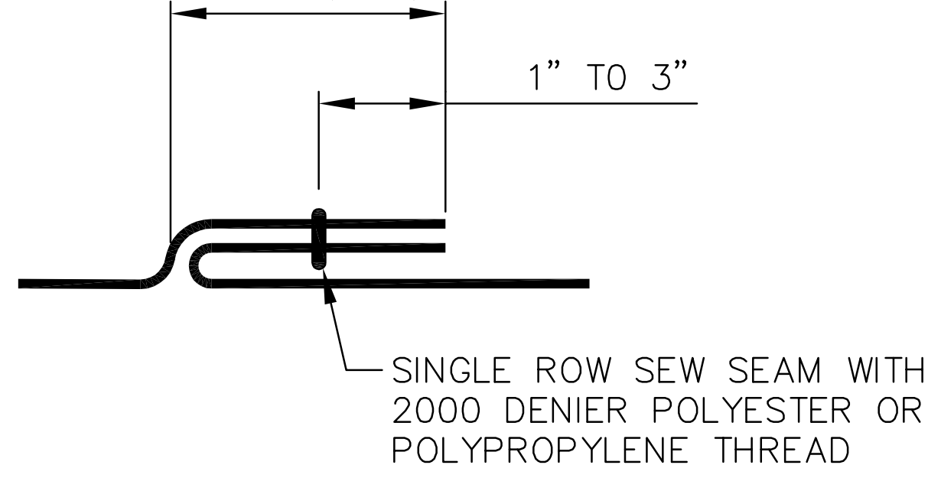
SECTION T3-T3
THREE OR MORE OUTLET PIPES TRENCH TYPICAL SECTION
SCALE: 1" = 4'



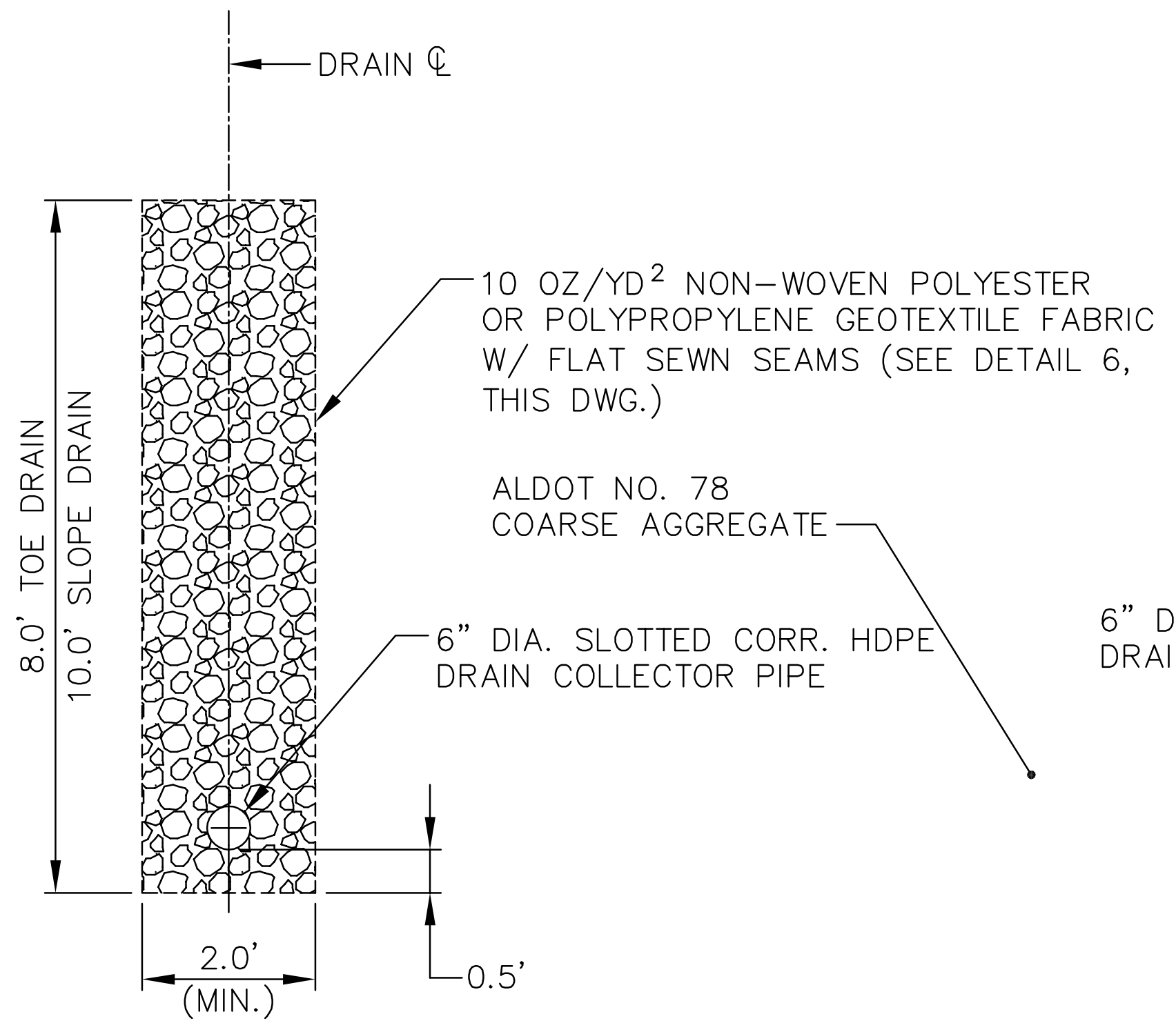
SECTION T1-T1
ONE OUTLET PIPE TRENCH TYPICAL SECTION
SCALE: 1" = 4'



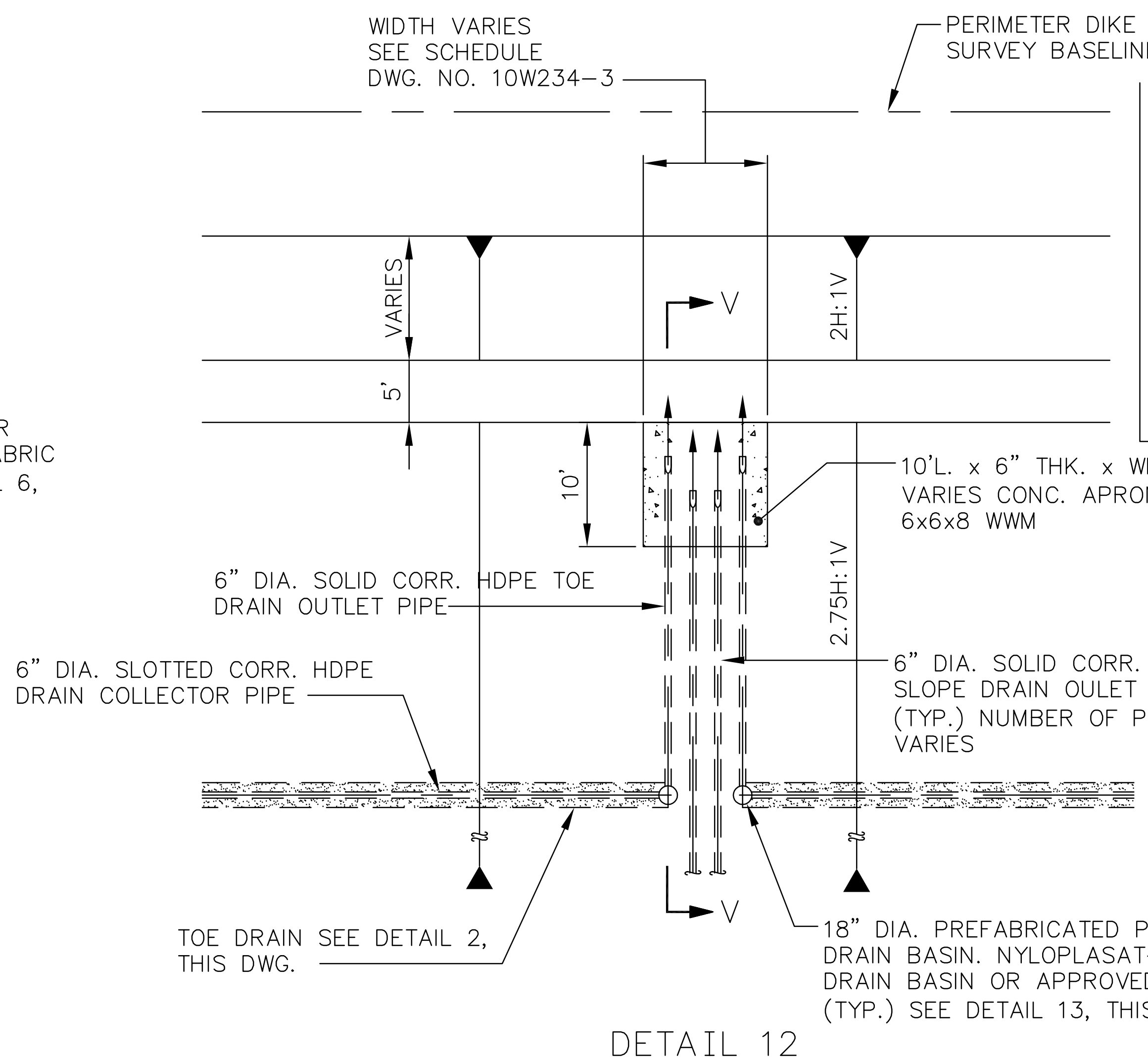
SECTION T2-T2
TWO OUTLET PIPES TRENCH TYPICAL SECTION
SCALE: 1" = 4'



DETAIL 6
FLAT SEWN SEAM DETAIL
NTS



DETAIL 11
ALTERNATE DRAIN DETAIL
NTS



DETAIL 12
TOE DRAIN OUTLET
SCALE: 1"=10'

R												
R 0	12/3/07	CWH	SEL	DRD	SRC	LJP	JCK		WCF408		J
INITIAL ISSUE PER DCN WCF-04-1016-013											
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD

DISCIPLINE INTERFACE
1
2
3
4

SCALE: AS NOTED EXCEPT AS NOTED

YARD
UNITS 7 & 8

FORCED OXIDATION GYPSUM STACKING
PHASE 1 & 2
SLOPE DRAIN DETAILS

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
			Samuel R. Cathey	Leonard J. Peterson	L.J. Peterson for John C. Kammeyer	

WIDOWS CREEK FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R2K	DATE	34	C	10W235-13	R 0

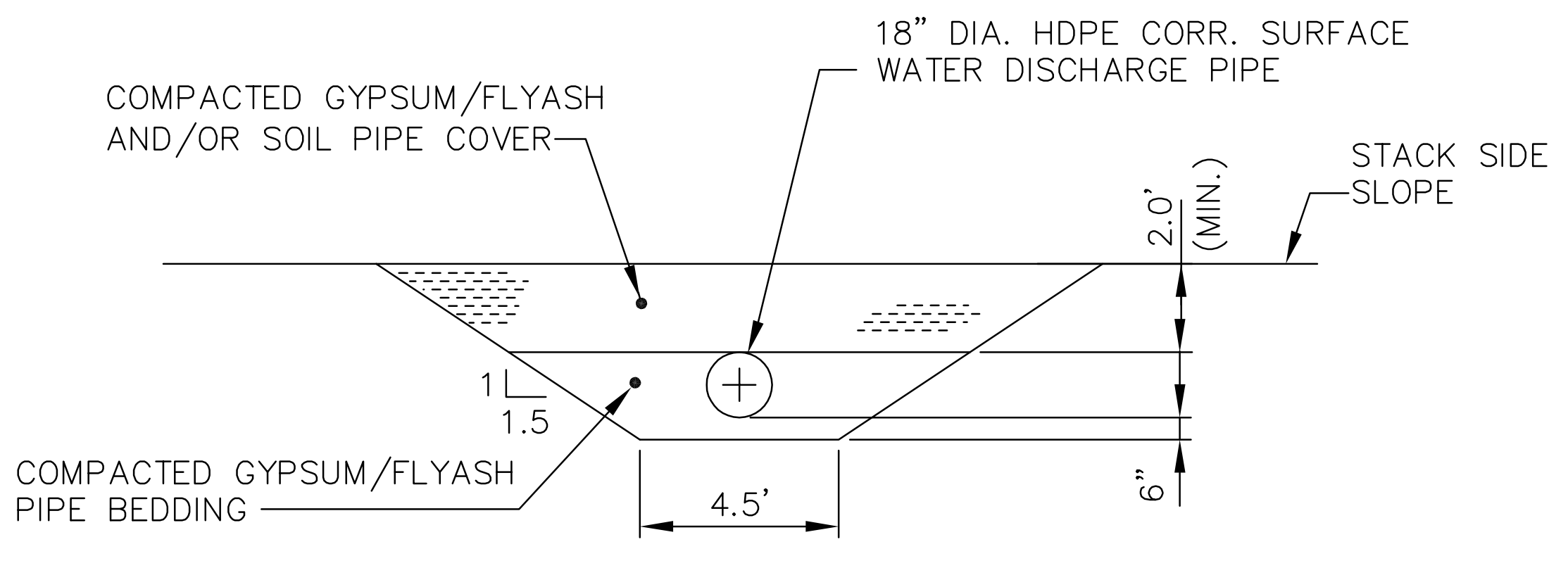
PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

TASK COMPLETED BY: REV NO.

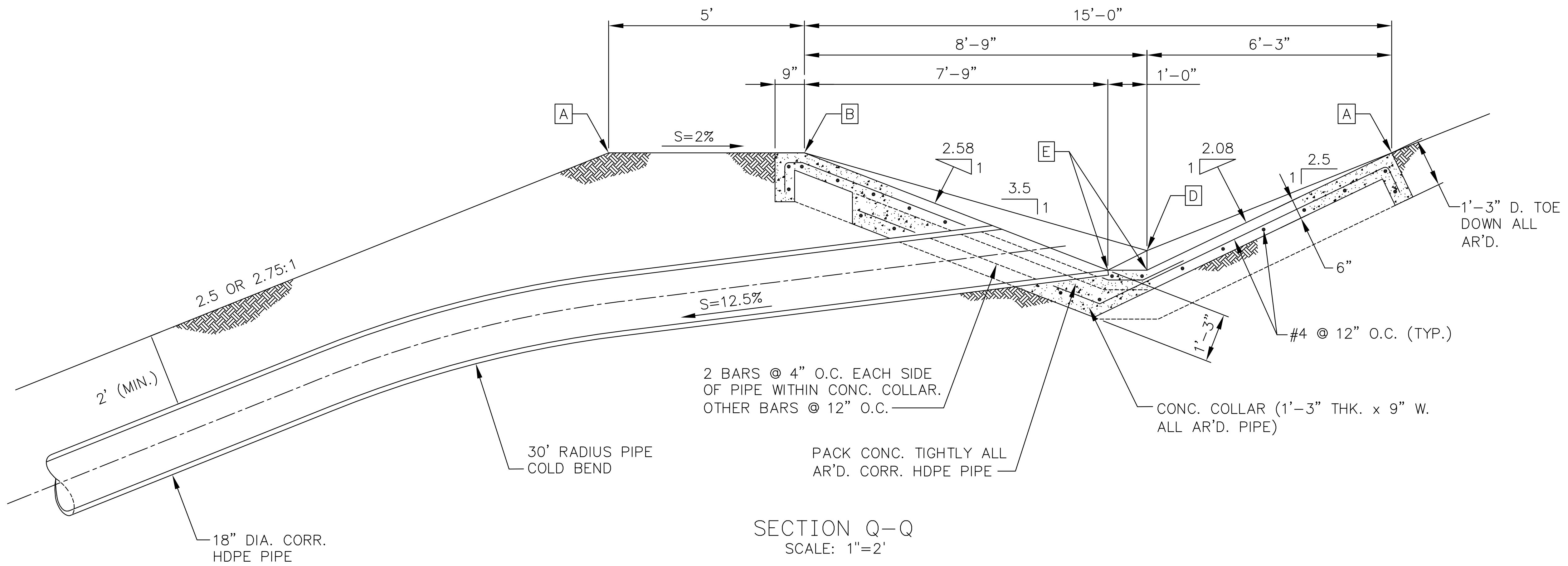
DETAIL 7

TYPICAL BENCH GRADING
NOT TO SCALE



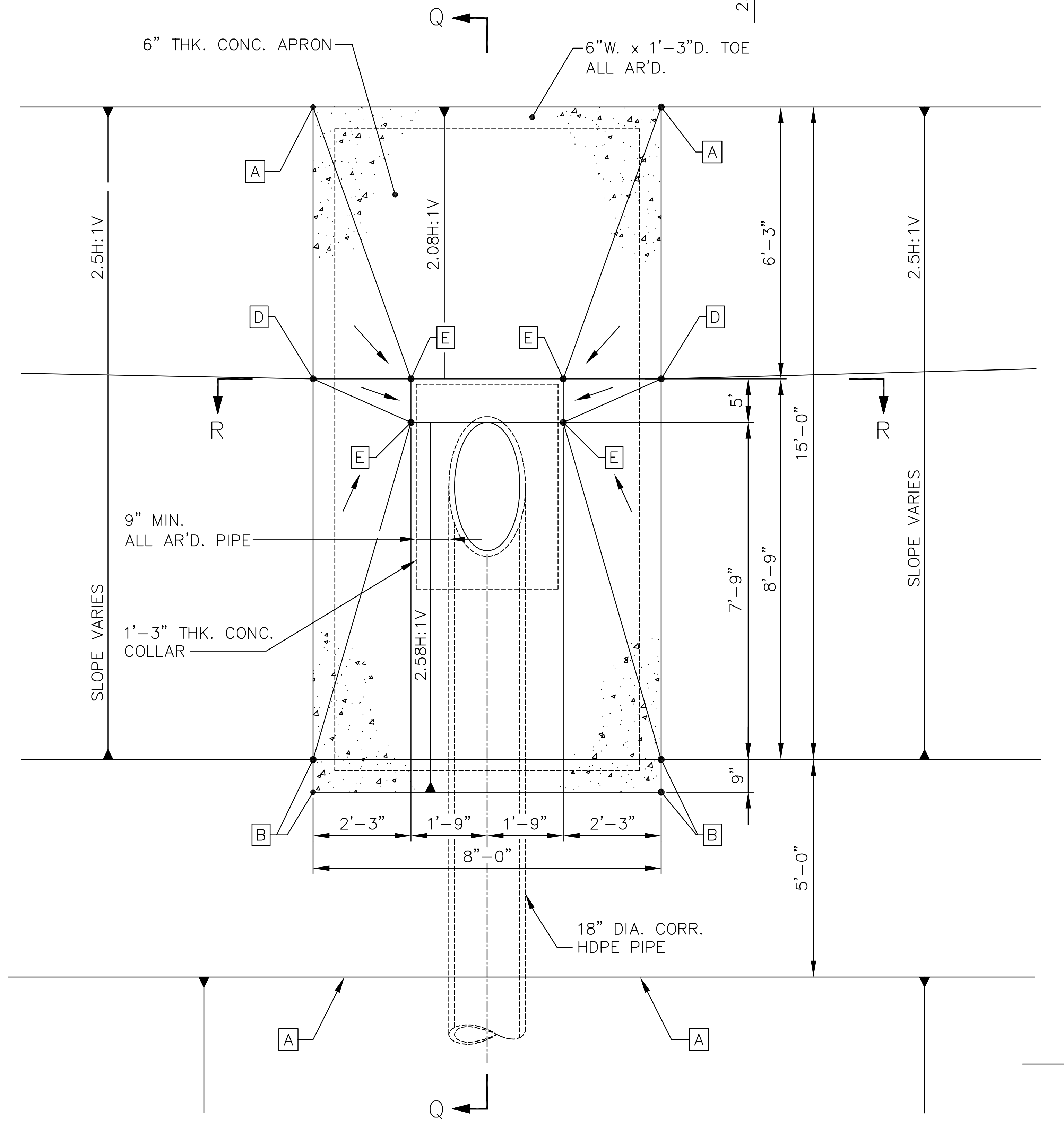
SECTION T4–T4

18" SURFACE WATER DISCHARGE PIPE TYPICAL SECTION
SCALE: 1" = 4'



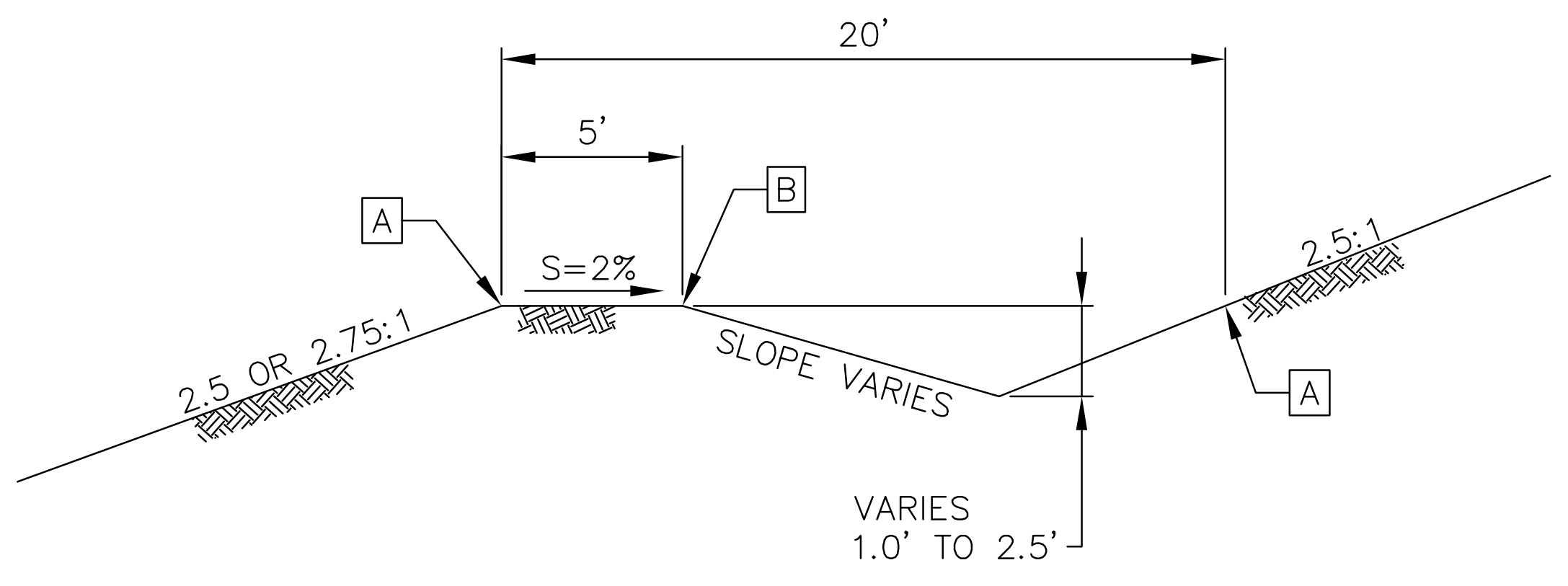
SECTION Q–Q

SCALE: 1"=2'



DETAIL 8

CONCRETE INLET
SCALE: 1"=2'



SECTION P–P

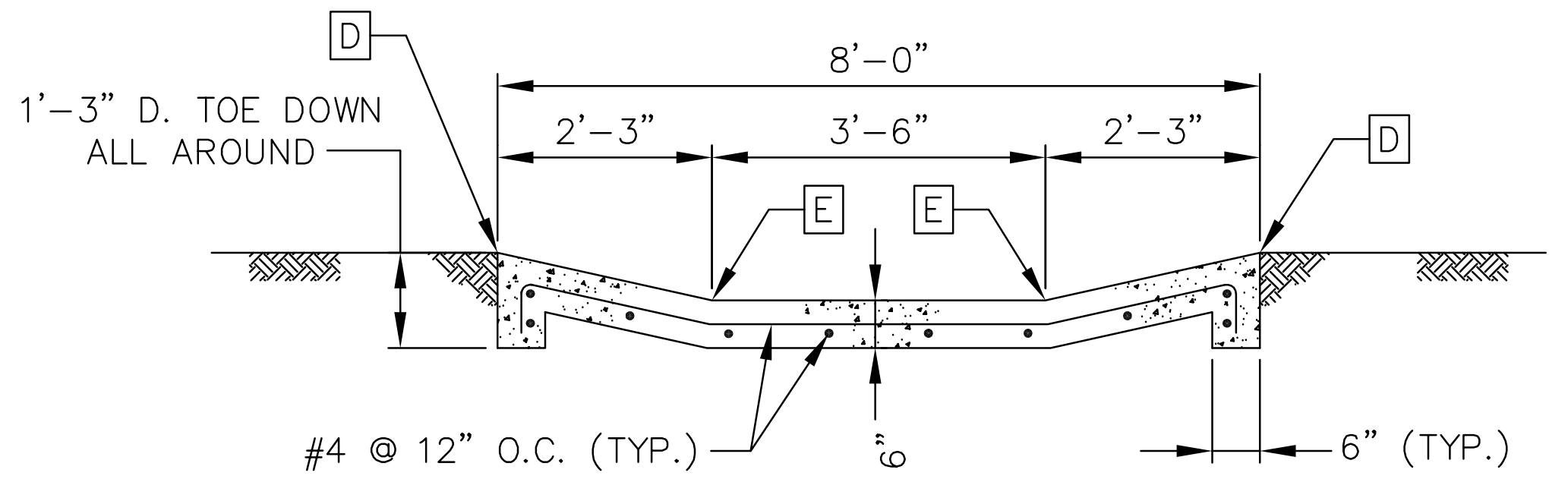
SCALE: 1"=5'

CONTOURS AND GRADES REPRESENT THRU 2023.
AS-DESIGNED CONFIGURATION ONLY.
FIRST BENCH DIRT COVER COMPLETED IN 2006.

BENCH ELEVATION SCHEDULE
(FEET NGVD)

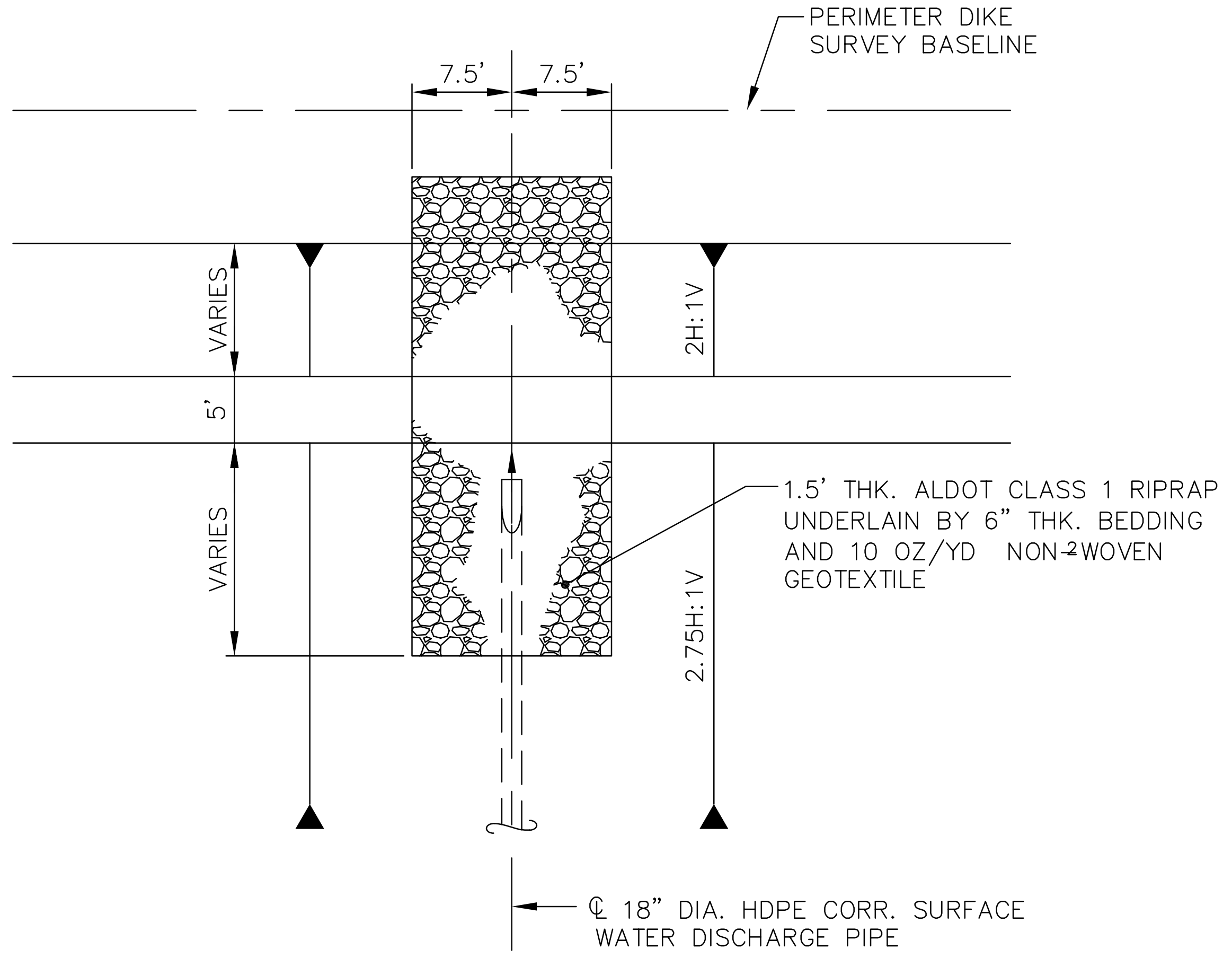
	A	B	C	D	E	F
650/655 BENCH STA. 500+00 TO STA. 512+00	650.0	649.9	649.0	647.5	647.0	649.5
650/655 BENCH STA. 535+33.86 TO STA. 594+69.50	655.0	654.9	654.0	652.5	652.0	654.5
685 BENCH	685.0	684.9	684.0	682.5	682.0	684.5
720 BENCH	720.0	719.9	719.0	717.5	717.0	719.5

NOTE: EXISTING SURFACE WATER COLLECTION PIPES AND INLETS BETWEEN STATIONS 512+00 AND 534+00 TO REMAIN.

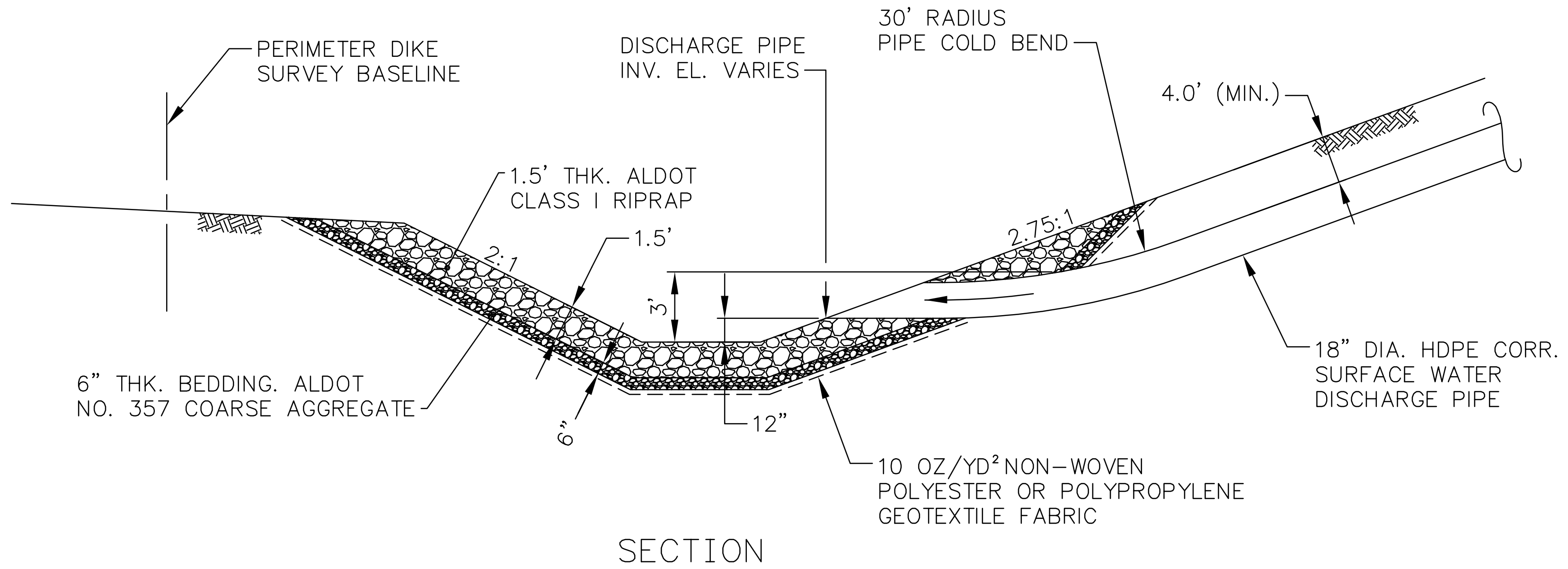


SECTION R–R

SCALE: 1"=2'



PLAN
SCALE: 1"=10'



SECTION
SCALE: 1"=5'

DETAIL 9

SURFACE WATER RUNOFF COLLECTION PIPE OUTLET

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R											
R 0	12/3/07	CWH	SEL	DRD	SRC	LJP	JCK		WCF408		J

INITIAL ISSUE PER DCN WCF–04–1016–014

DISCIPLINE INTERFACE
1
2
3
4

SCALE: AS NOTED EXCEPT AS NOTED

YARD
UNITS 7 & 8

FORCED OXIDATION GYPSUM STACKING PHASE 1 & 2 – SURFACE WATER COLLECTION DETAILS

DESIGNED BY:
DRAWN BY:
CHECKED BY:
SUPERVISED BY: Samuel R. Cathey
REVIEWED BY: Leonard J. Peterson
APPROVED BY: L.J. Peterson for John C. Kammeyer
ISSUED BY:

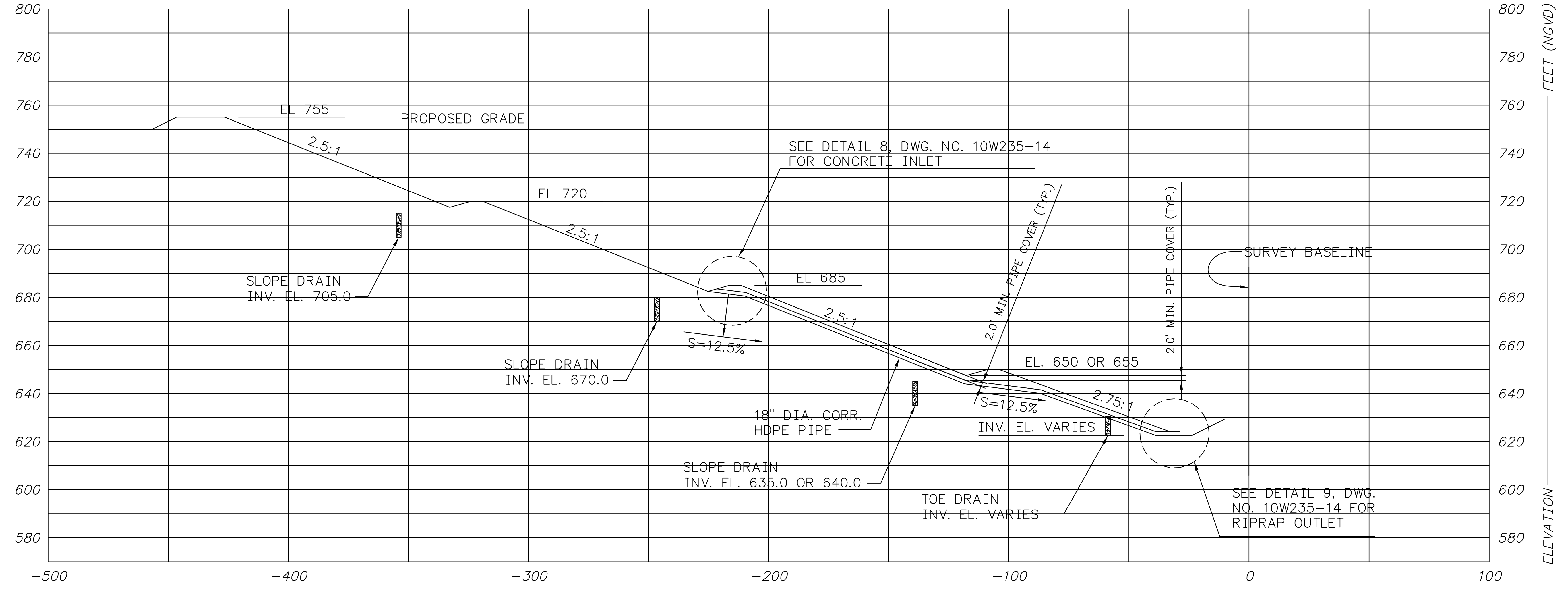
WIDOWS CREEK FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R2K | DATE | 34 | C | 10W235–14 | R 0

PLOT FACTOR:10
W_TVA

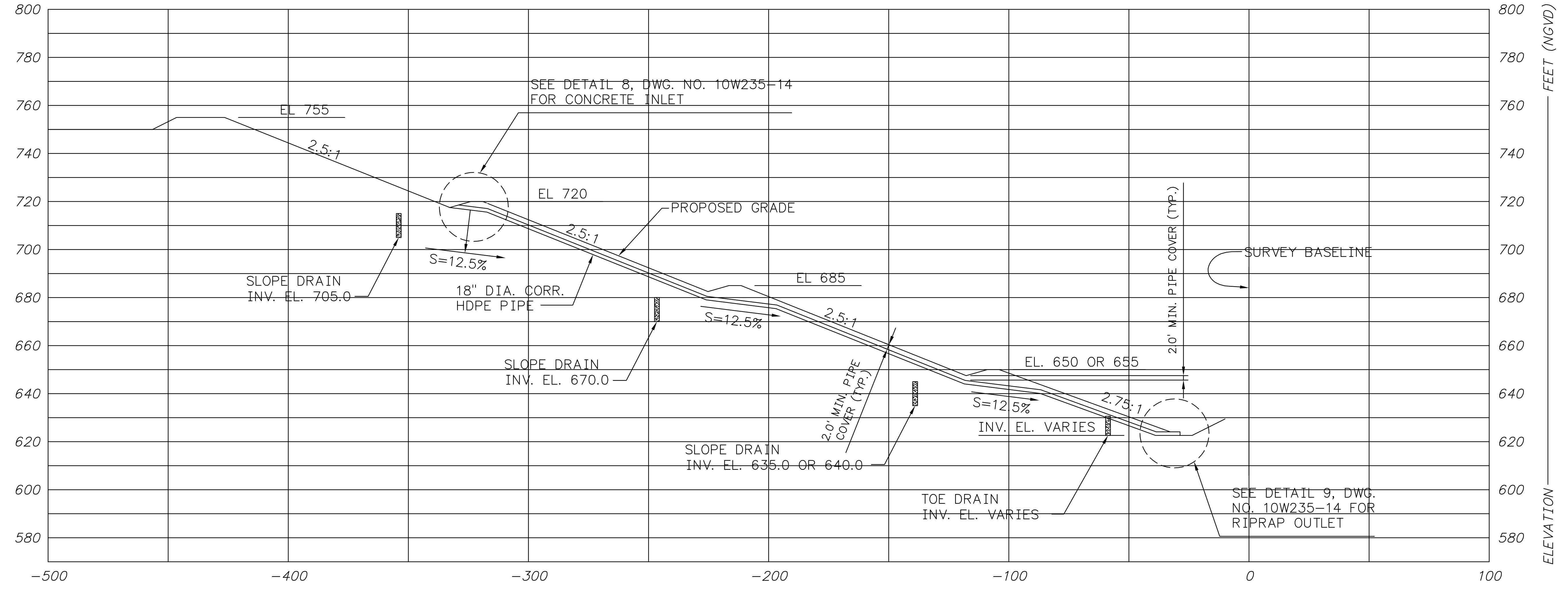
C.A.D. DRAWING
DO NOT ALTER MANUALLY

TASK COMPLETED BY: | REV NO.

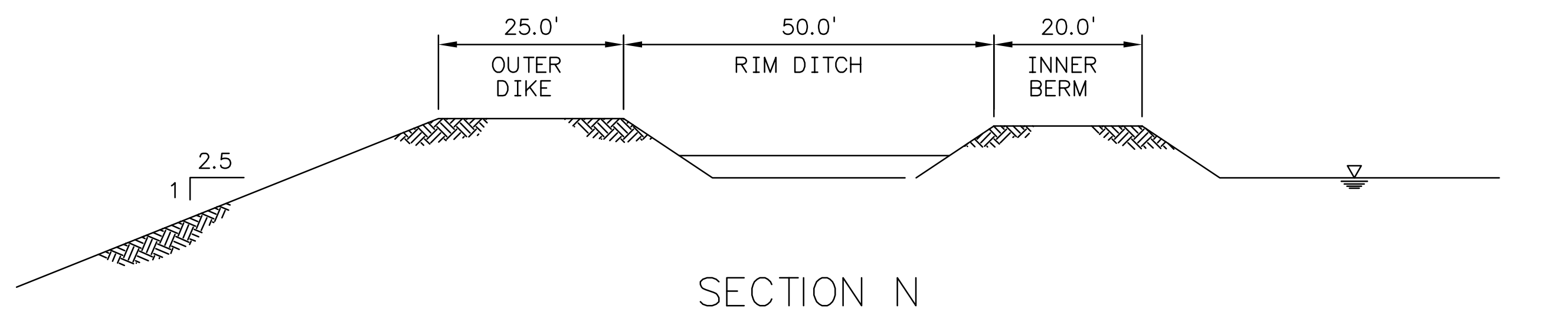


SECTION T
SURFACE WATER COLLECTION PIPE FROM 685 BENCH TYPICAL SECTION
SCALE: 1"=30'

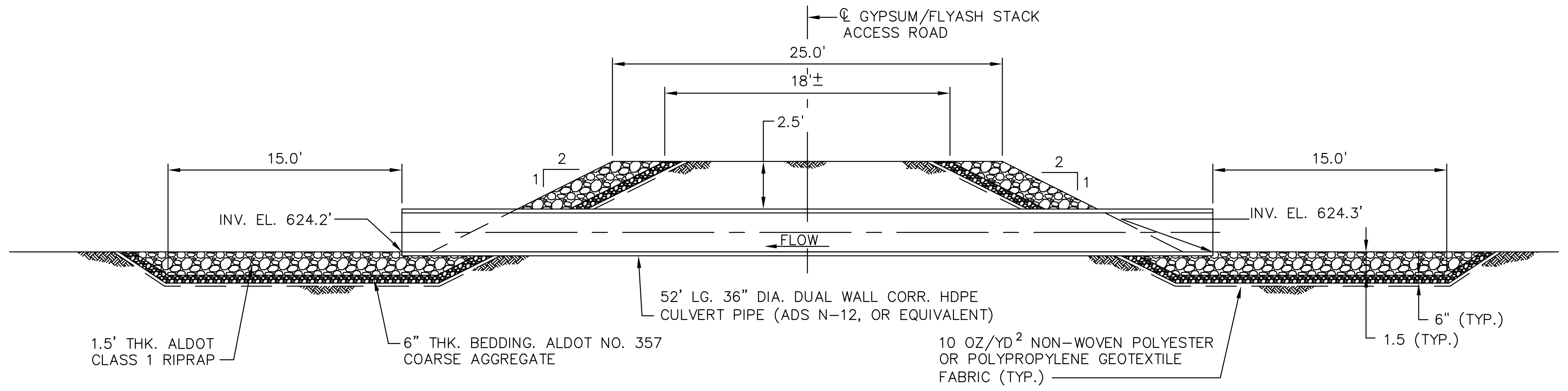
CONTOURS AND GRADES REPRESENT THRU 2023.
AS-DESIGNED CONFIGURATION ONLY.
FIRST BENCH DIRT COVER COMPLETED IN 2006.



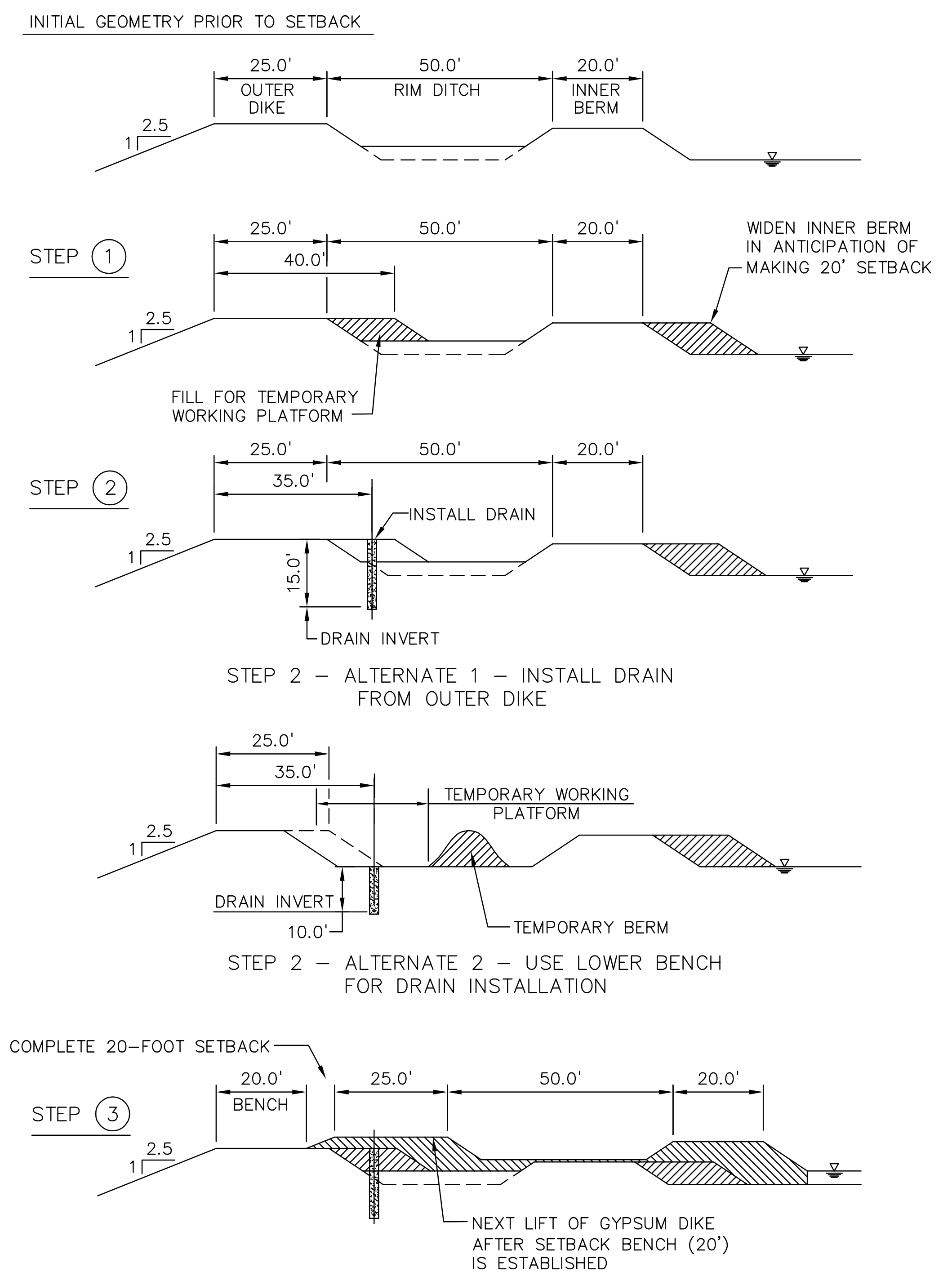
SECTION U
SURFACE WATER COLLECTION PIPE FROM 720 BENCH TYPICAL SECTION
SCALE: 1"=30'



SECTION N
TYPICAL RIM DITCH SECTION
SCALE: 1"=20'



CROSS SECTION S
TOE DITCH CULVERT PIPE AT ACCESS RAMP
SCALE: 1"=5'



STEP 2 – ALTERNATE 1 – INSTALL DRAIN FROM OUTER DIKE

STEP 2 – ALTERNATE 2 – USE LOWER BENCH FOR DRAIN INSTALLATION

DETAIL 4
CONSTRUCTION SEQUENCE FOR
DRAIN INSTALLATION AT SETBACK BENCH
NOT TO SCALE

NOTES

1. MAINTAIN INNER BERM CREST MINIMUM 1' LOWER THAN OUTER DIKE CREST ELEVATION.
2. CONSTRUCT INNER BERM AND OUTER DIKE USING WET CAST MATERIAL EXCAVATED FROM RIM DITCH.
3. DIMENSIONS SHOWN ARE MINIMUM RECOMMENDED WIDTHS.

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R											
R 0	12/3/07	CWH	SEL	DRD	SRC	LJP	JCK		WCF408		J
INITIAL ISSUE PER DCN WCF-04-1016-015											

DISCIPLINE INTERFACE
1
2
3
4

SCALE: AS NOTED EXCEPT AS NOTED

YARD
UNITS 7 & 8

FORCED OXIDATION GYPSUM STACKING
PHASE 1 & 2
MISCELLANEOUS SECTIONS

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
			[redacted] Samuel R. Cathey	[redacted] Leonard J. Peterson	[redacted] L.J. Peterson for John C. Kammeyer	

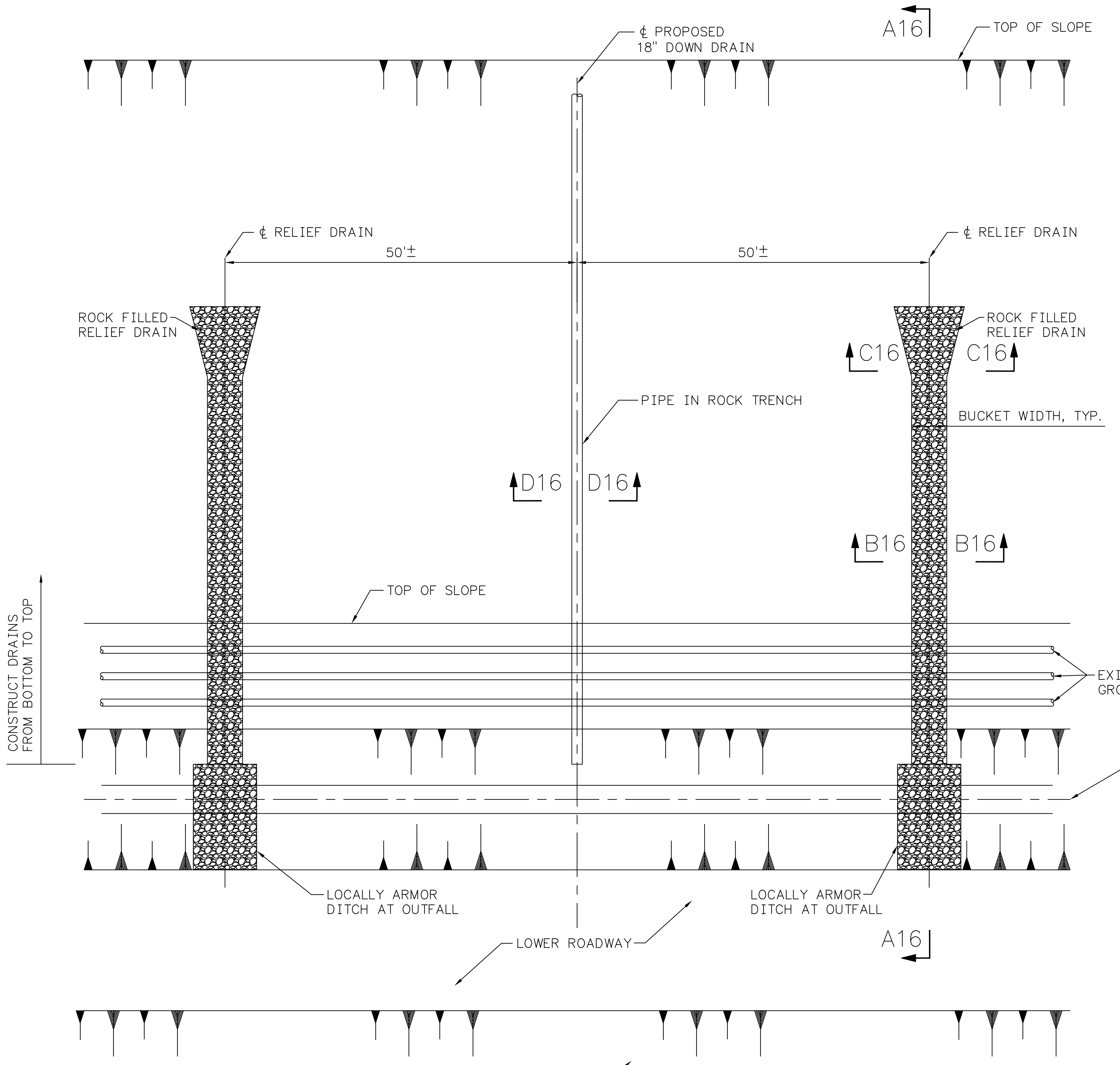
WIDOWS CREEK FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2K	DATE	34	C	10W235-15	R 0

PLOT FACTOR:30
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

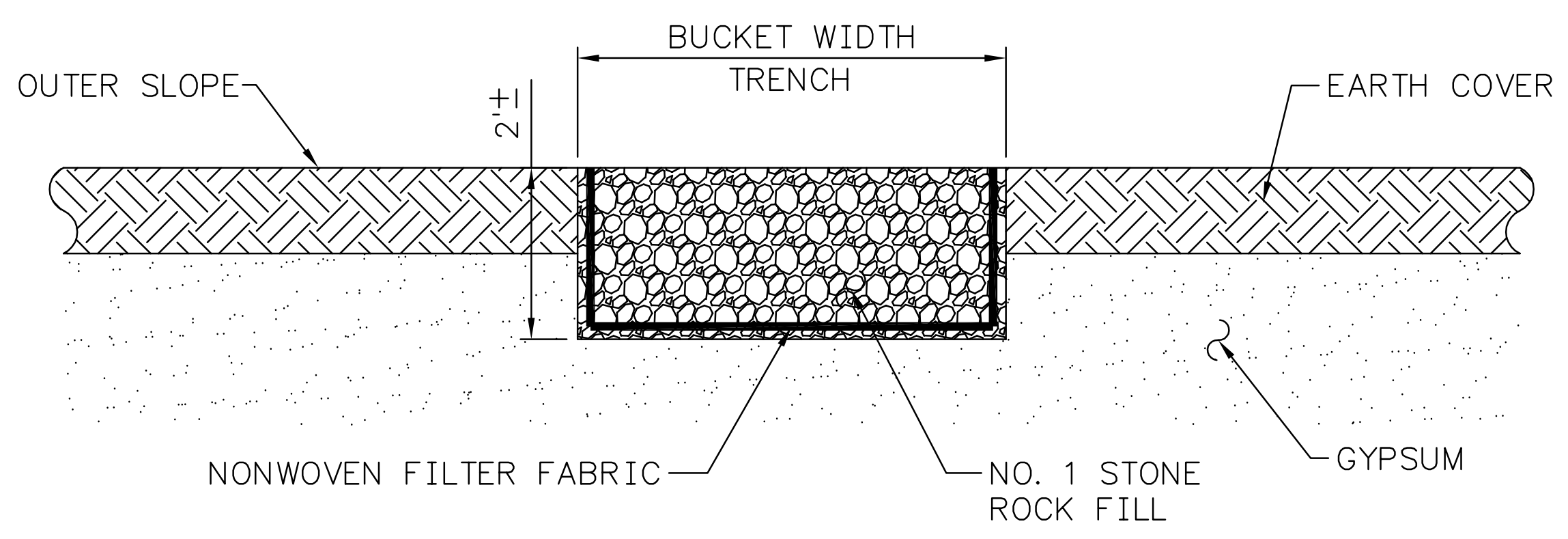
TASK COMPLETED BY:	REV NO.



PLAN

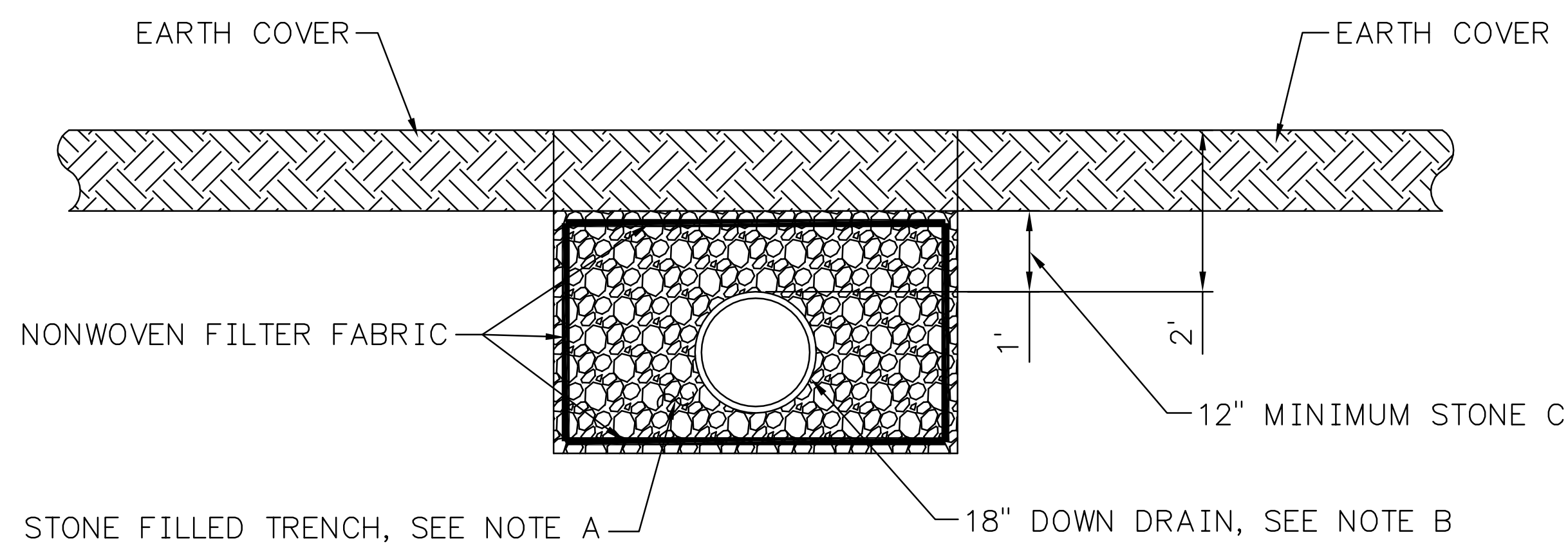
SCALE: NTS

NOTE: STOCK PILE MATERIAL
WITHIN REACH OF EQUIPMENT
DURING CONSTRUCTION



SECTION B16–B16

SCALE: NTS

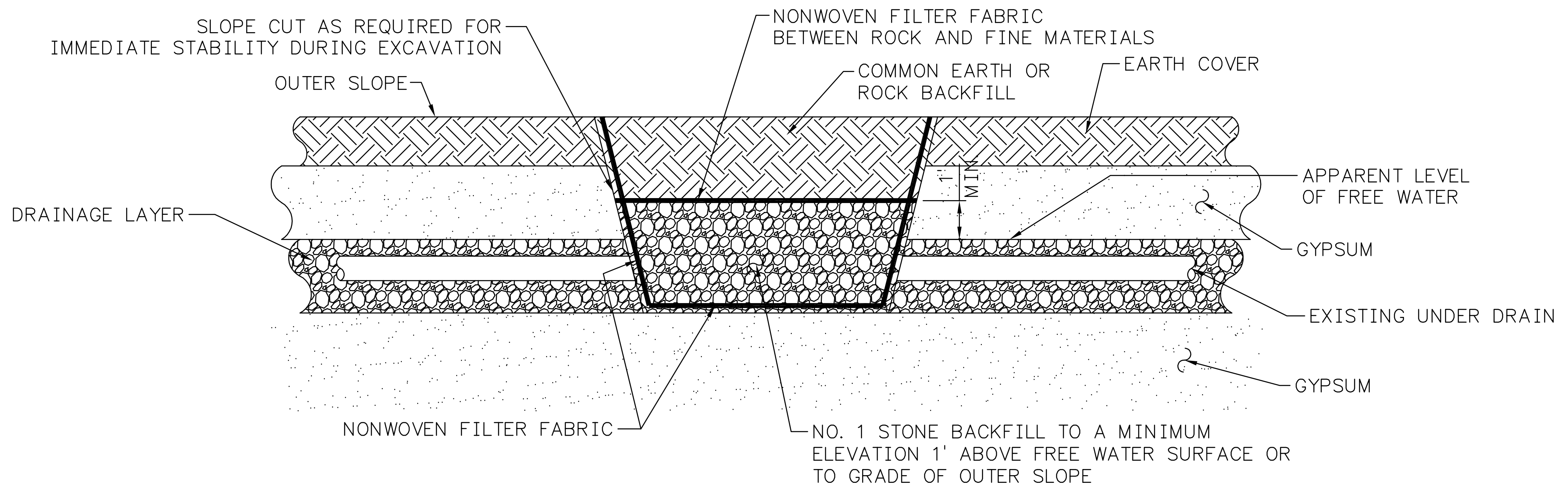


NOTE A: STONE BACKFILL SHALL BE NO. 1 (3 1/2" – 1 1/2") STONE
ON SLOPES, AND SMALLER STONE (#57, #67, OR #7) AT ROADWAYS.

NOTE B: DOWN DRAIN CONSTRUCTION TO BE IN ACCORDANCE WITH
10W235-14 EXCEPT AS SHOWN HERE.

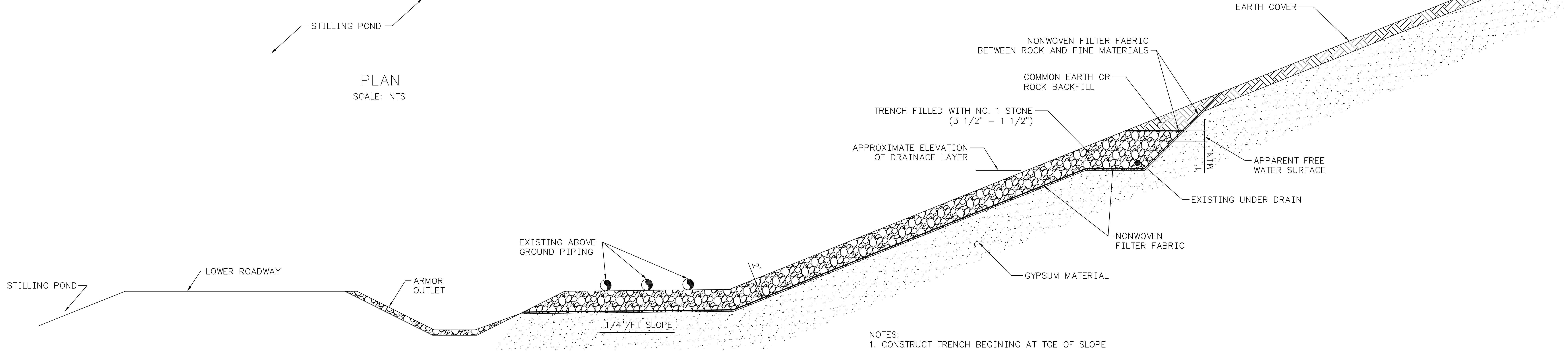
SECTION D16–D16

SCALE: NTS



SECTION C16–C16

SCALE: NTS



NOTES:
1. CONSTRUCT TRENCH BEGINING AT TOE OF SLOPE AND PROCEED UP THE SLOPE, COMPLETELY FILLING TRENCH WITH STONE AS THE TRENCH IS ADVANCED UP THE SLOPE.
2. STAGE ADEQUATE QUANTITY OF MATERIAL AT WORKSITE FOR IMMEDIATE ACCESS DURING TRENCH CONSTRUCTION.

SECTION A16–A16

SCALE: NTS

NOTE:
1. FOR GENERAL PLAN, SECTIONS, AND DETAILS SEE 10W235–SERIES.

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R											
R 0	12/3/07	CWH	SEL	DRD	SRC	LJP	JCK		WCF408		J
INITIAL ISSUE PER DCN WCF–04–1016–016											

DISCIPLINE INTERFACE
1
2
3
4

SCALE: NTS EXCEPT AS NOTED

YARD
UNITS 7 & 8

FORCED OXIDATION GYPSUM STACKING
PHASE 1 & 2 – SURFACE
WATER COLLECTION DETAIL MODIFIED

DESIGNED BY:
DRAWN BY:
CHECKED BY:
SUPERVISED BY: Samuel R. Cathey
REVIEWED BY: Leonard J. Peterson
APPROVED BY: L.J. Peterson for John C. Kammeyer
ISSUED BY:

WIDOWS CREEK FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R2K	DATE	34	C	10W235–16	R 0

PLOT FACTOR:10
W_TVA

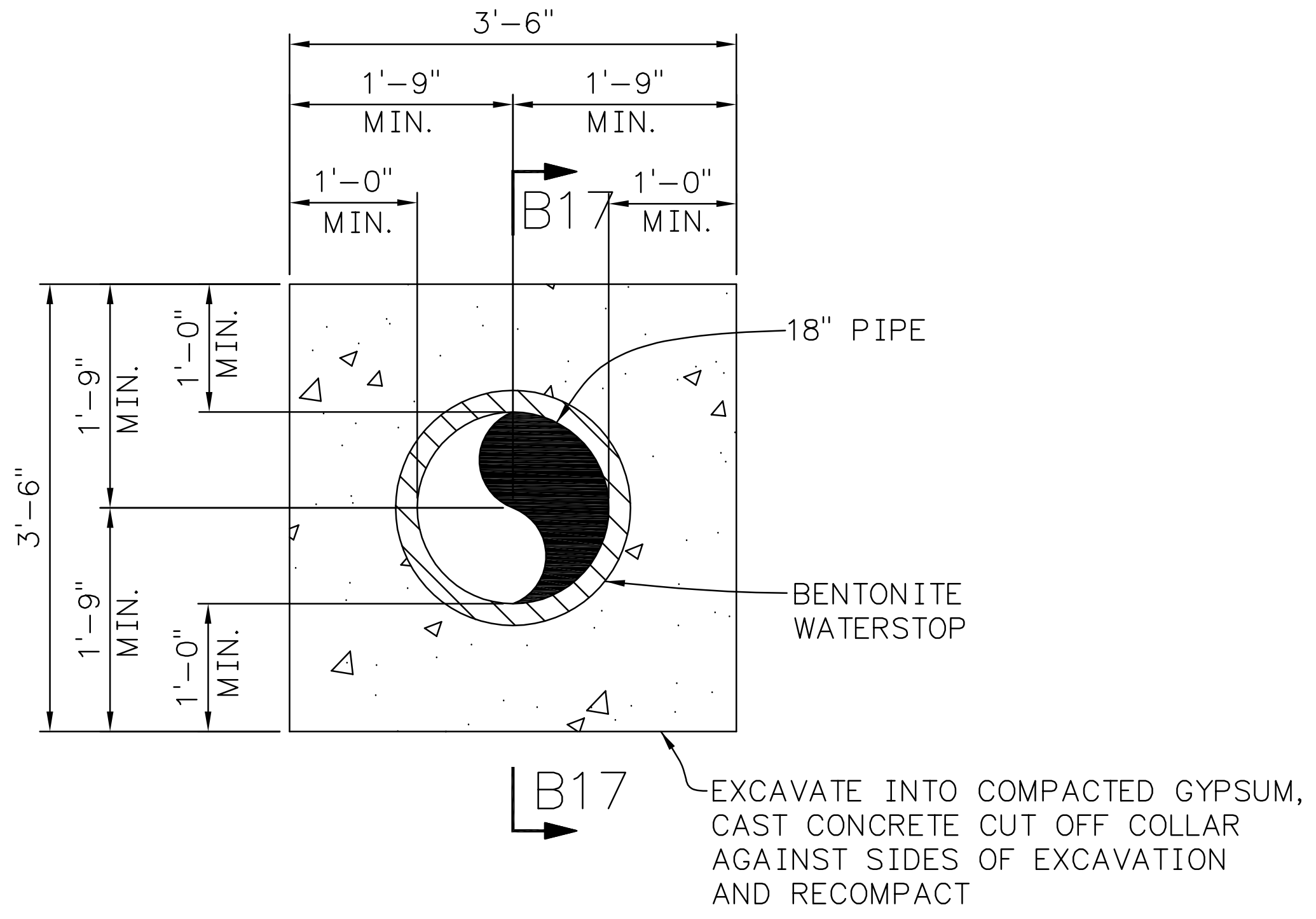
C.A.D. DRAWING
DO NOT ALTER MANUALLY

TASK COMPLETED BY:
REV NO.

SECTION A17–A17

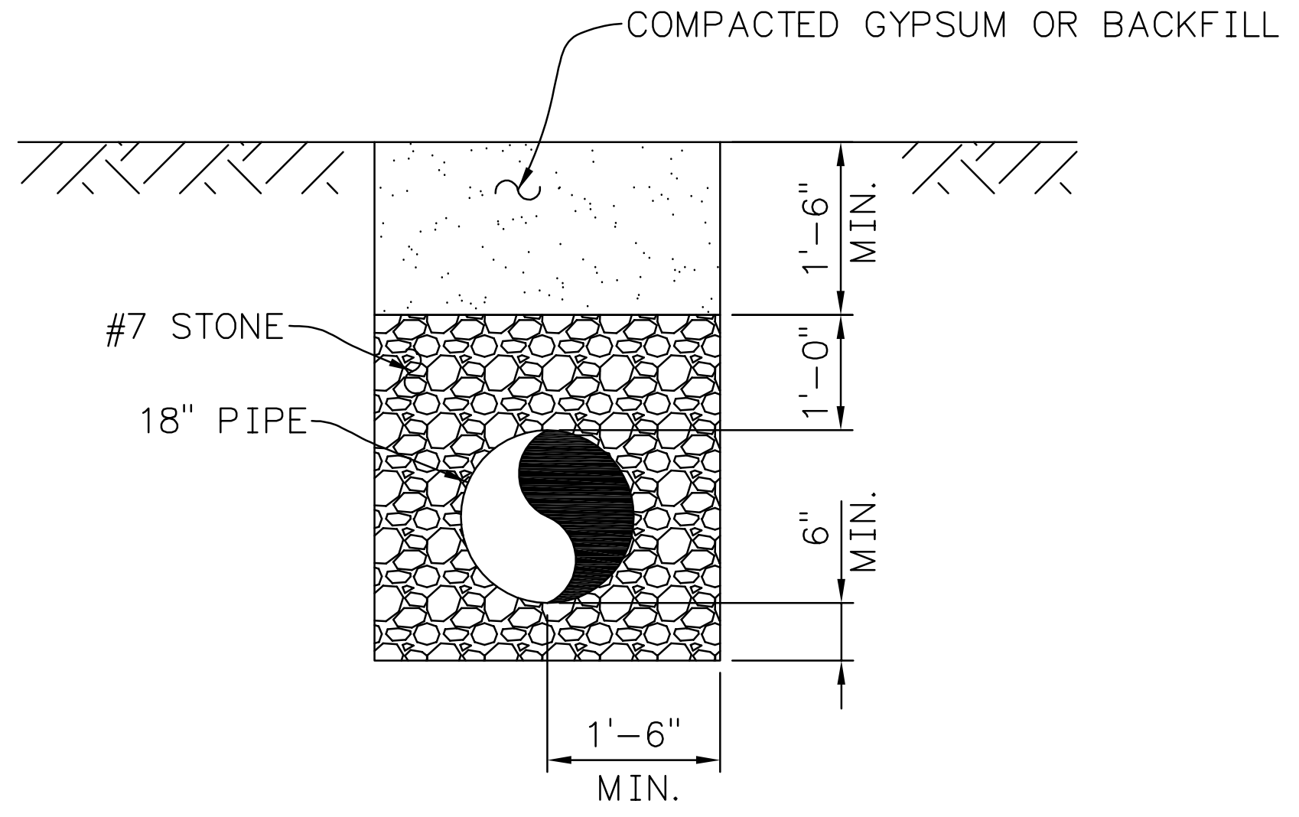
STAGE DECANT SPILLWAY SYSTEM

SCALE: 1"=10'



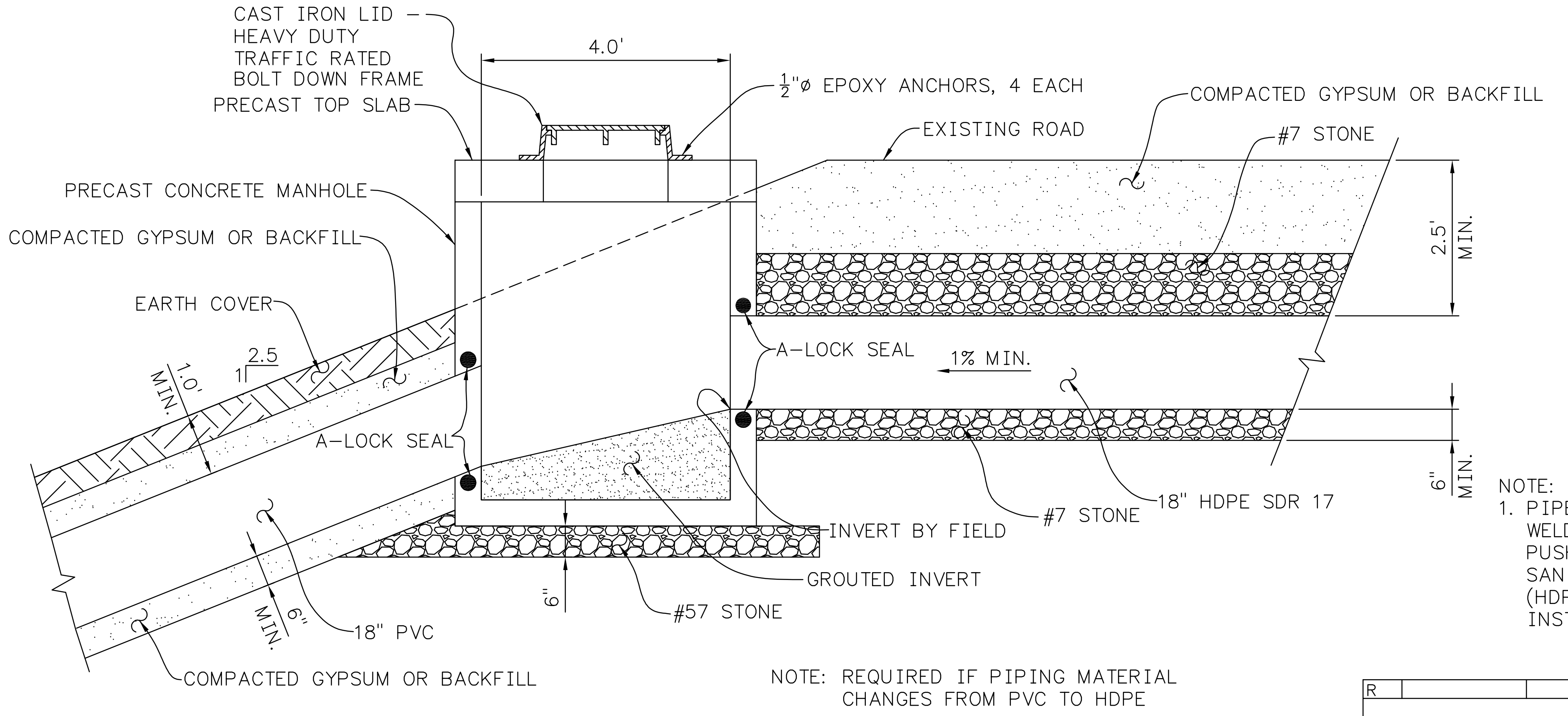
ANTI SEEP COLLAR

SCALE: NTS



TRAFFIC/ROADWAY TRENCH DETAIL

SCALE: NTS

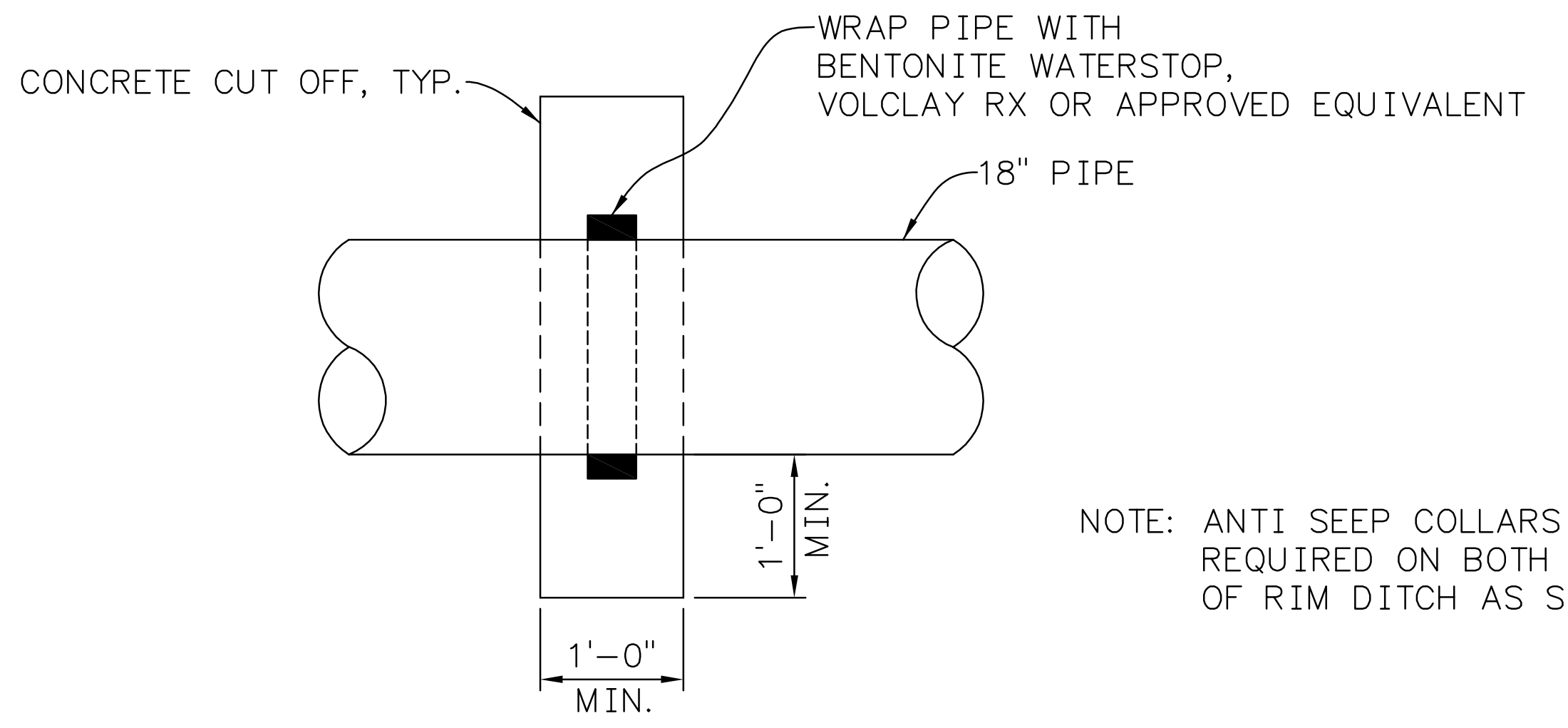


NOTE:
1. PIPE SHALL BE HDPE SDR 17 WITH BUTT FUSION WELDED JOINTS –OR– CORRUGATED PVC (CONTECH A2000), PUSH ON JOINTS WITH RUBBER GASKETS SUITABLE FOR SANITARY SEWER USAGE. FUTURE MIXED CONFIGURATION (HDPE AND PVC) IS ACCEPTABLE PROVIDED THAT THE INSTALLATION IS AS DETAILED ON DRAWING.

NOTE: REQUIRED IF PIPING MATERIAL CHANGES FROM PVC TO HDPE

DETAIL C17
PVC–HDPE JUNCTION

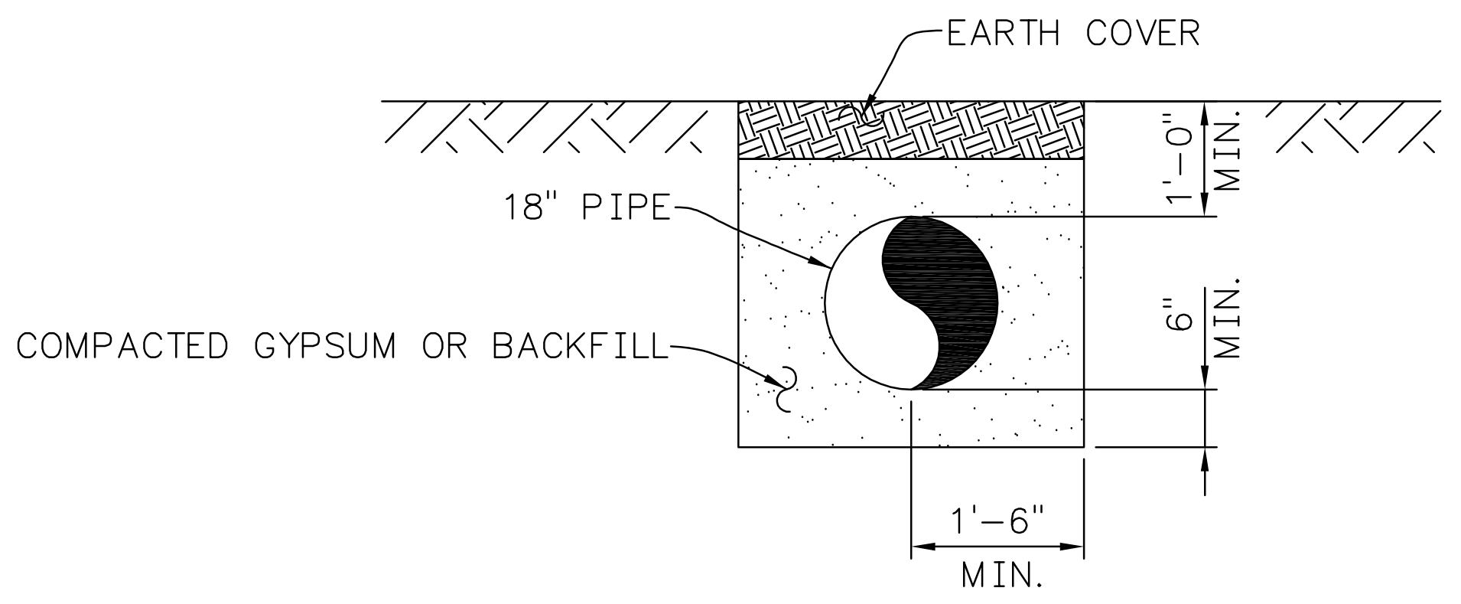
SCALE: NTS



NOTE: ANTI SEEP COLLARS REQUIRED ON BOTH SIDES OF RIM DITCH AS SHOWN

SECTION B17–B17

SCALE: NTS



NON–TRAFFIC/SLOPE TRENCH DETAIL

SCALE: NTS

COMPANION DRAWINGS: 10W235–18 & 10W235–19

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R											
R 0 INITIAL ISSUE		RLP	CWH	RLP	HLP	HLP	BAK				D

DISCIPLINE INTERFACE

SCALE: 1"=10' EXCEPT AS NOTED

YARD UNITS 7 & 8

GYPSUM STACK
SECTIONS & DETAILS

DESIGNED BY: DRAWN BY: CHECKED BY: SUPERVISED BY: REVIEWED BY: APPROVED BY: ISSUED BY:

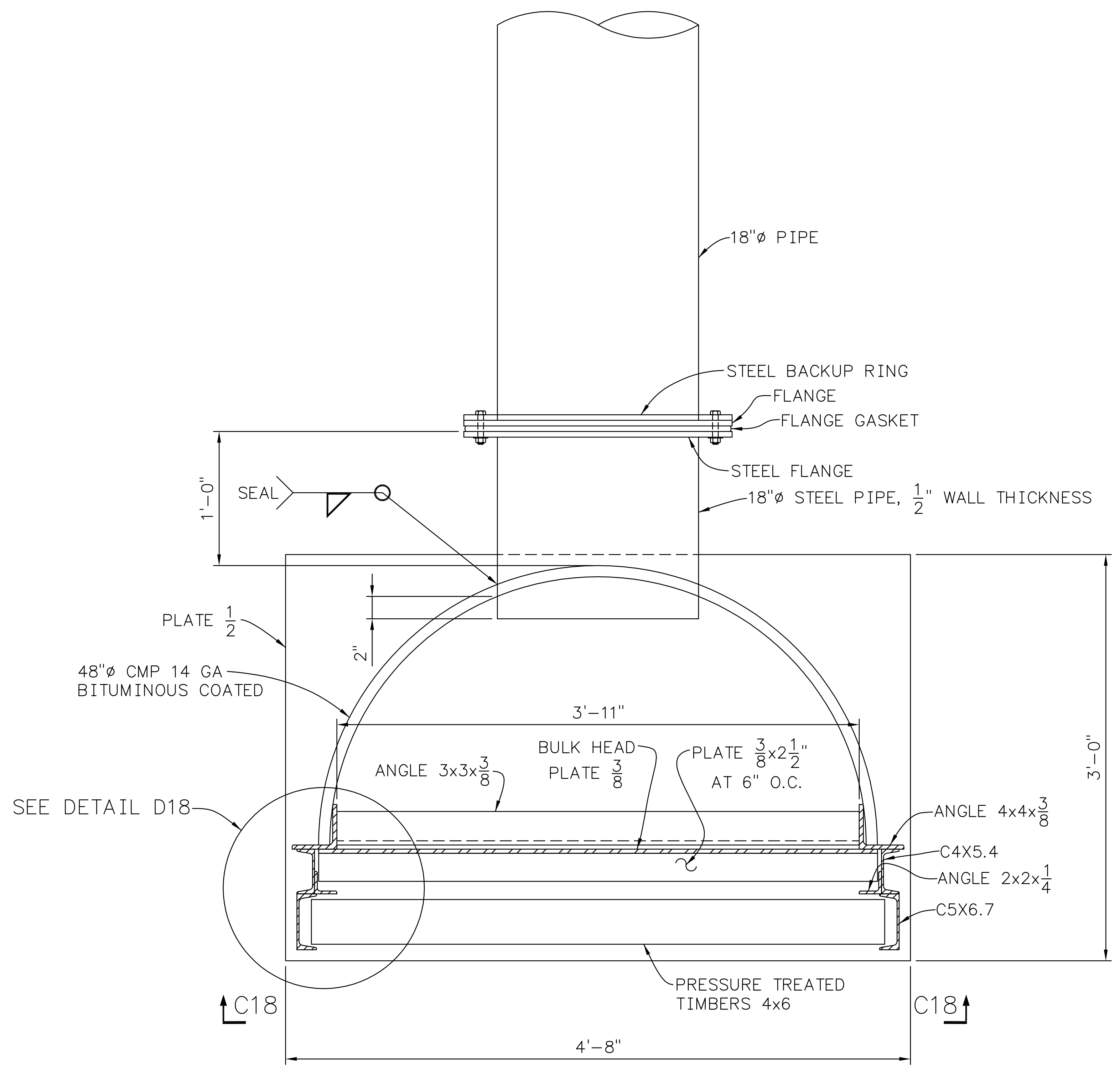
WIDOWS CREEK FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 DATE 34 C 10W235–17 R 0

TASK COMPLETED BY: REV NO.

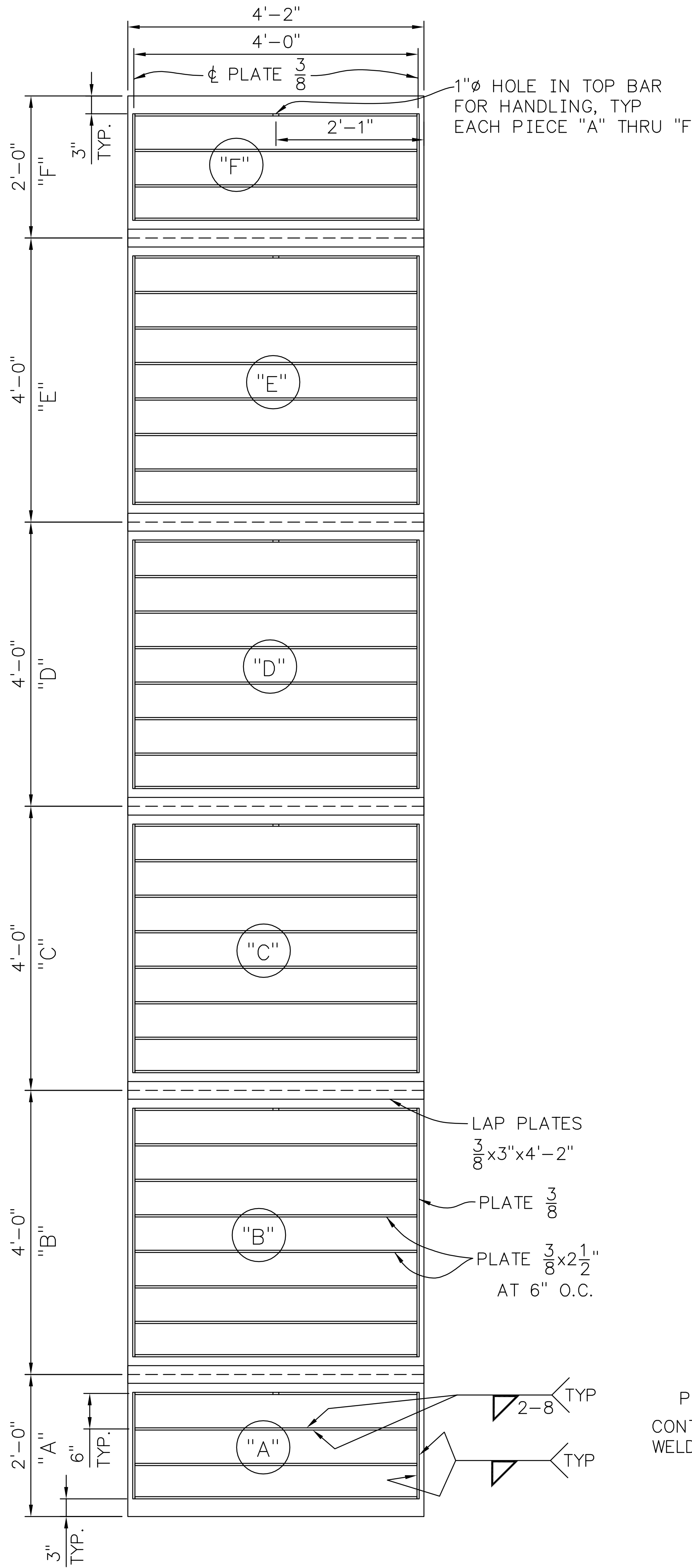
PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



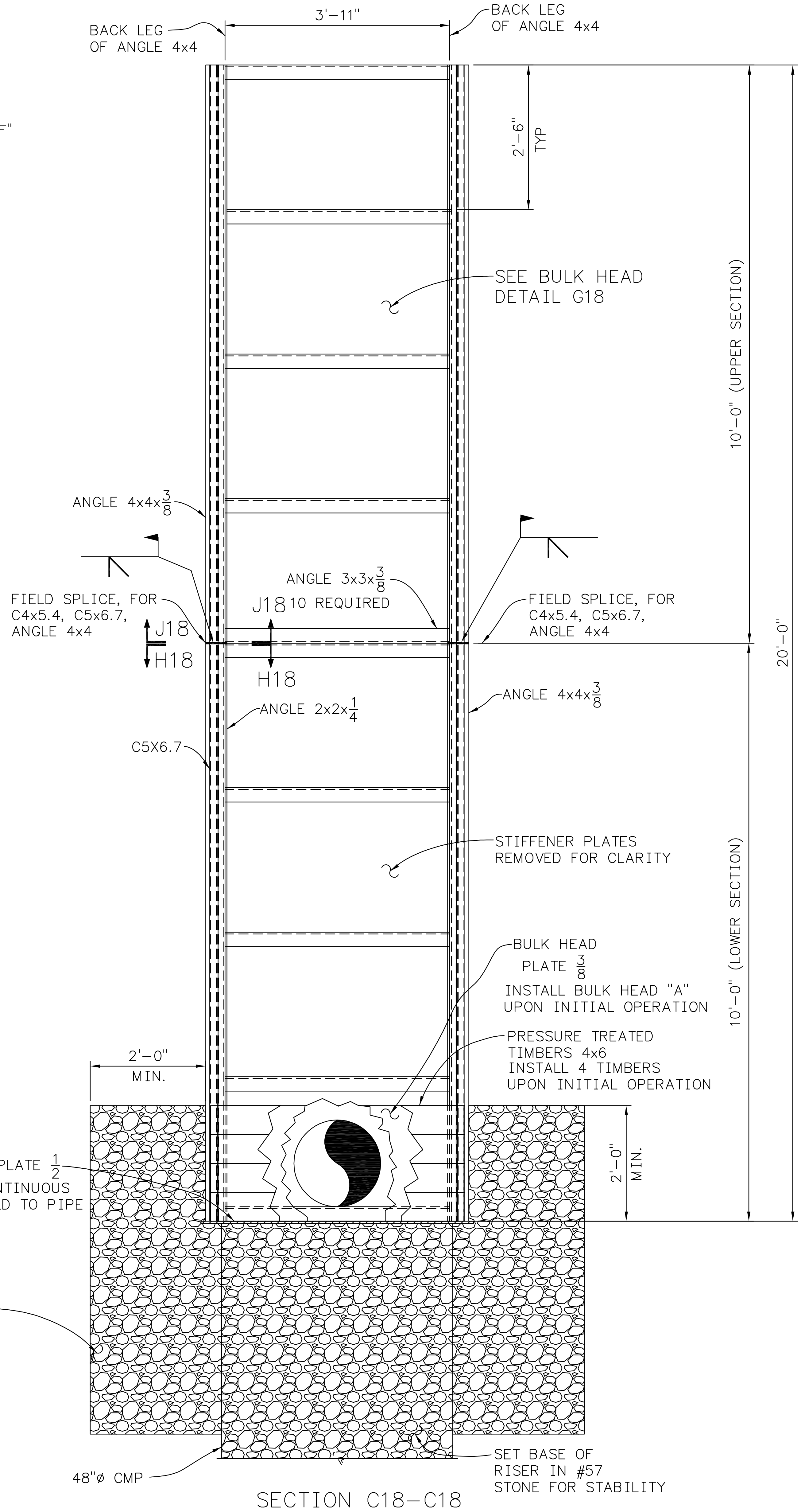
PLAN

SCALE: 1 1/2"=1'-0"



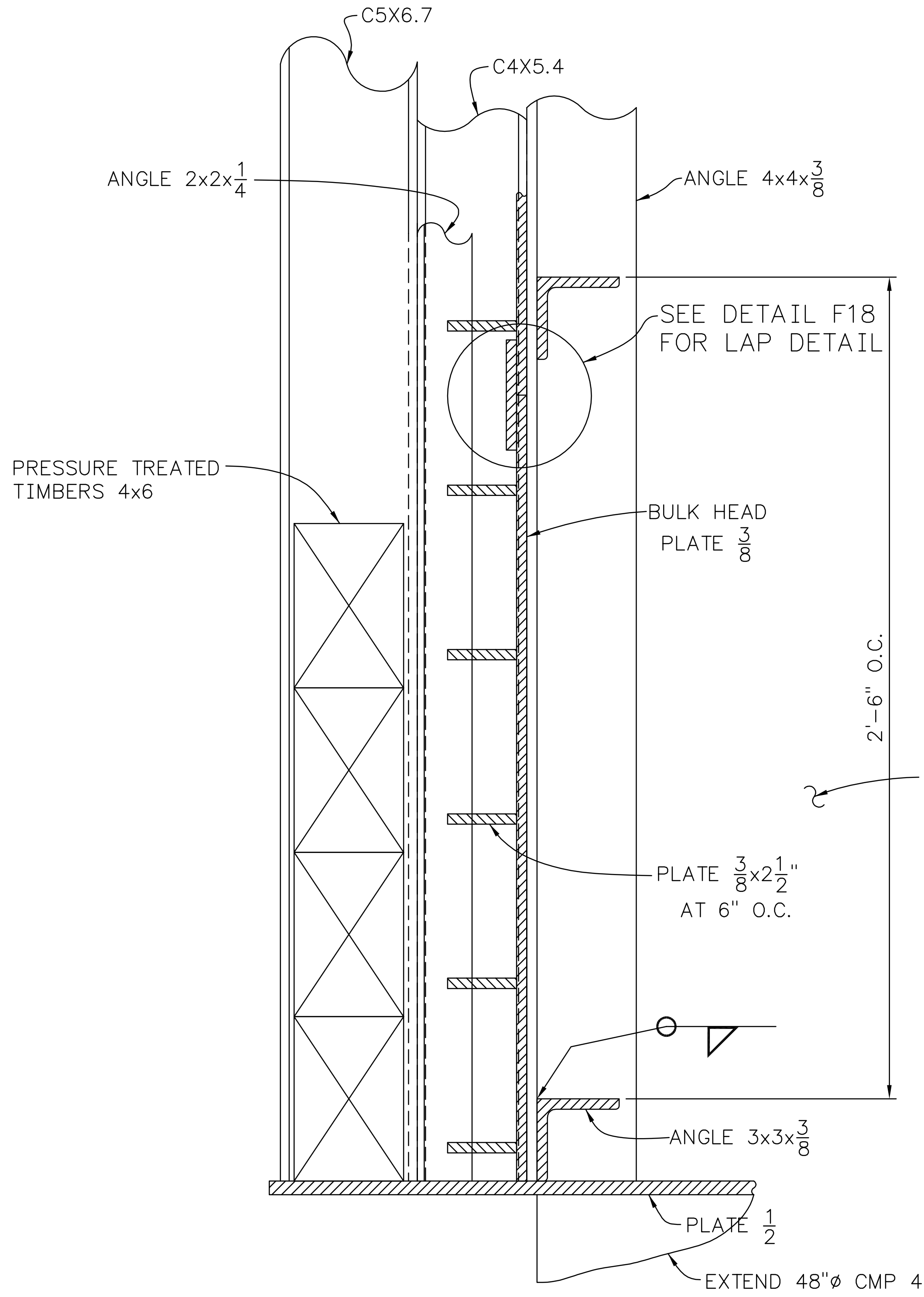
DETAIL G18
BULK HEAD

SCALE: 3/4"=1'-0"



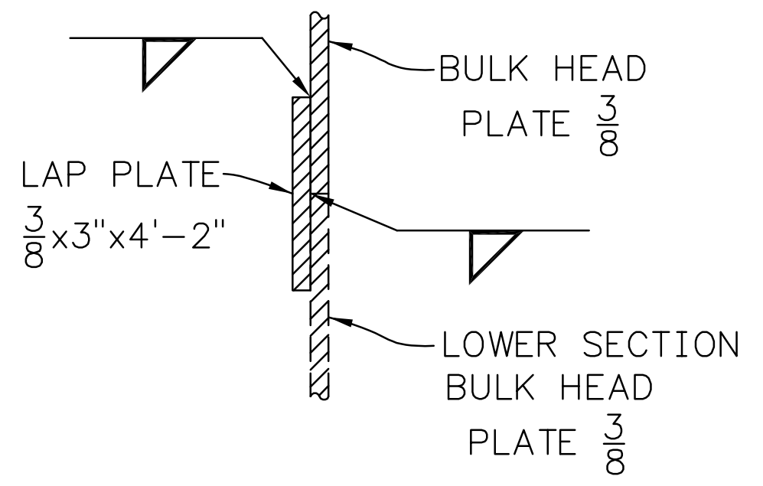
SECTION C18–C18

SCALE: 3/4"=1'-0"



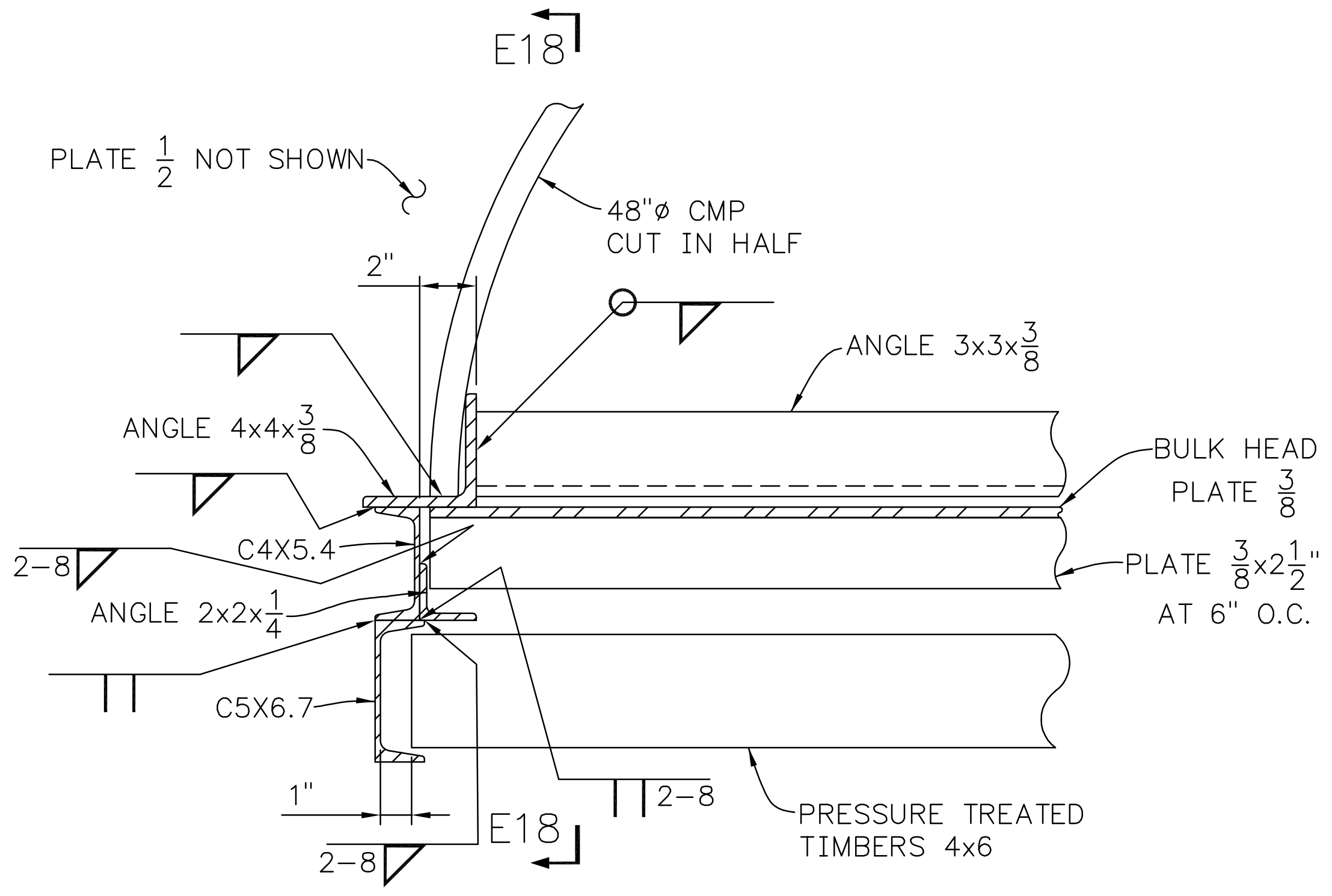
SECTION E18–E18

SCALE: 3"=1'-0"



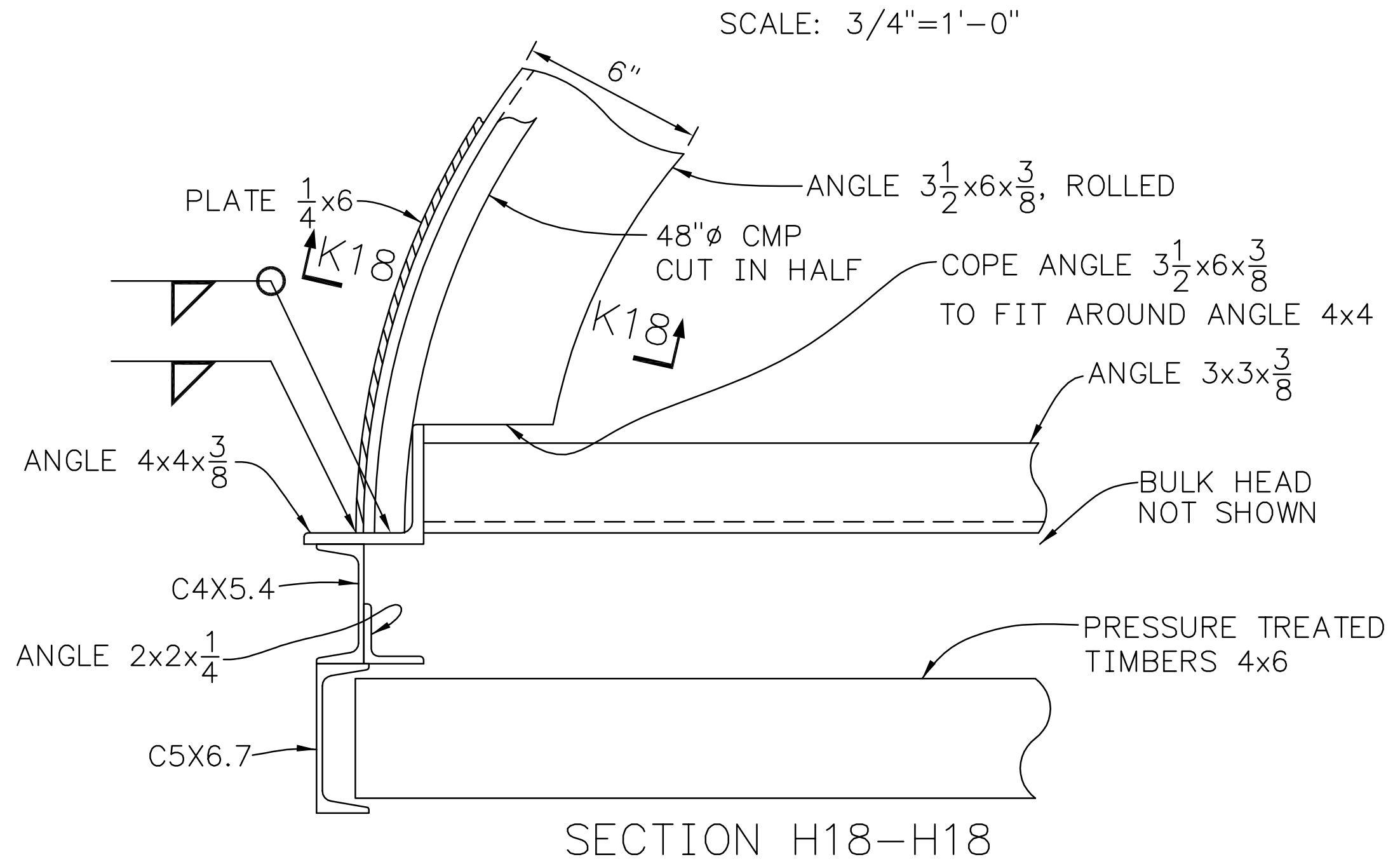
DETAIL F18

SCALE: 3"=1'-0"



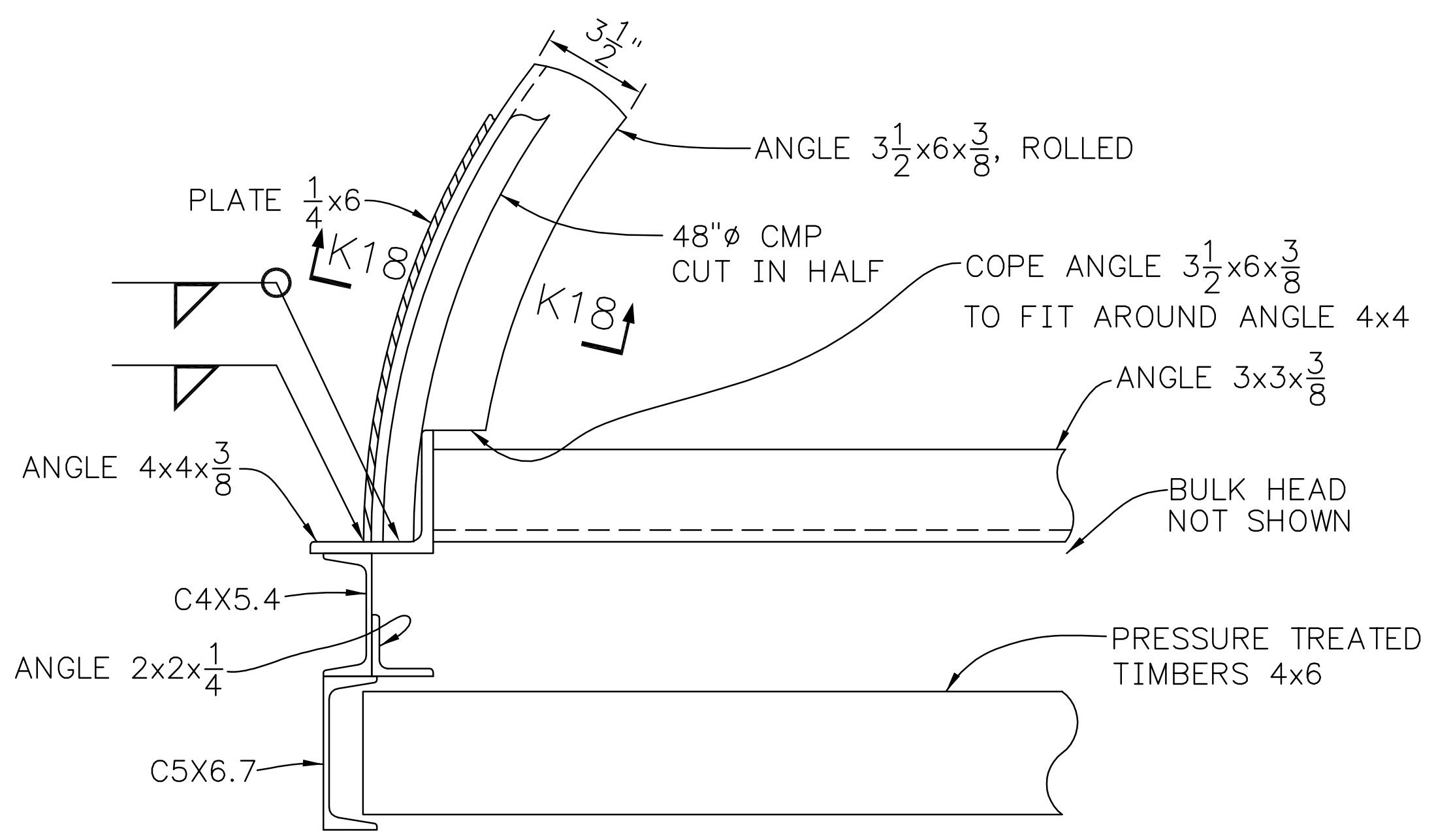
DETAIL D18

SCALE: NTS



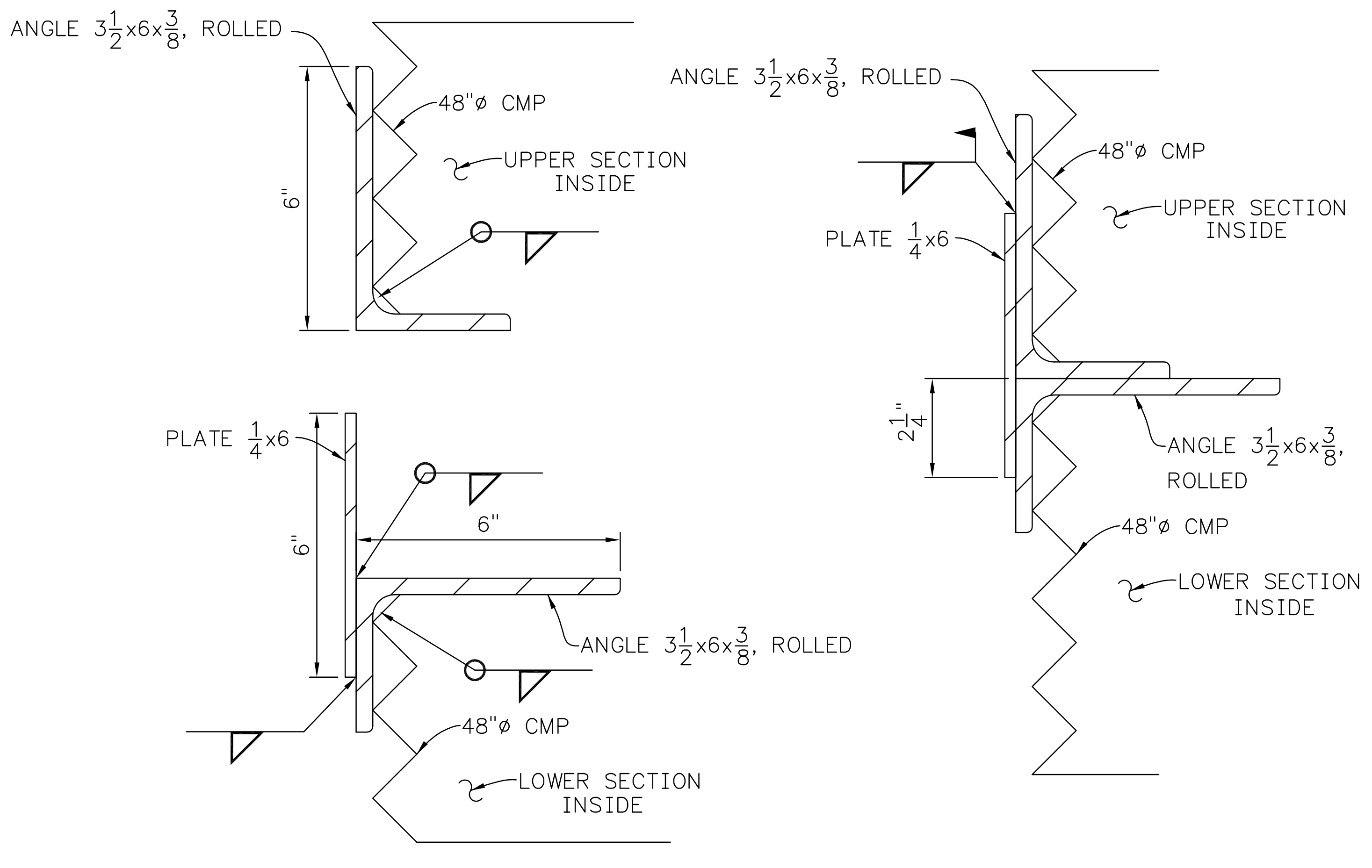
SECTION H18–H18
(LOWER SECTION AT FIELD SPLICE)

SCALE: NTS



SECTION J18–J18
(UPPER SECTION AT FIELD SPLICE)

SCALE: NTS



SECTION K18–K18
FIELD SPLICE TWO SECTIONS OUTSIDE

SCALE: NTS

NOTES:
1. 48" CORRUGATED METAL PIPE (CMP), 14 GAUGE, GALVANIZED AND BITUMINOUS COATED IN ACCORDANCE WITH AASHTO SPECIFICATIONS M36, M190, AND M232.
2. ALL STRUCTURAL STEEL SHALL CONFORM TO ASTM A36.
3. ALL WELDING SHALL UTILIZE E70 SERIES ELECTRODES IN ACCORDANCE WITH AWS D1.1.
4. ASSEMBLY SHALL BE COATED AFTER SHOP FABRICATION WITH 2 COATS COAL TAR EPOXY WITH SURFACE PREP PER COATING MANUFACTURER'S INSTRUCTIONS.

COMPANION DRAWINGS: 10W235-17 & 10W235-19

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R											
R 0		RLP	CWH	RLP	HLP	HLP	BAK				D

INITIAL ISSUE

DISCIPLINE INTERFACE
1
2
3
4

SCALE: 3/4"=1'-0" EXCEPT AS NOTED

YARD UNITS 7 & 8

GYPSUM STACK
WEIR MODIFICATIONS

DESIGNED BY: | DRAWN BY: | CHECKED BY: | SUPERVISED BY: | REVIEWED BY: | APPROVED BY: | ISSUED BY:

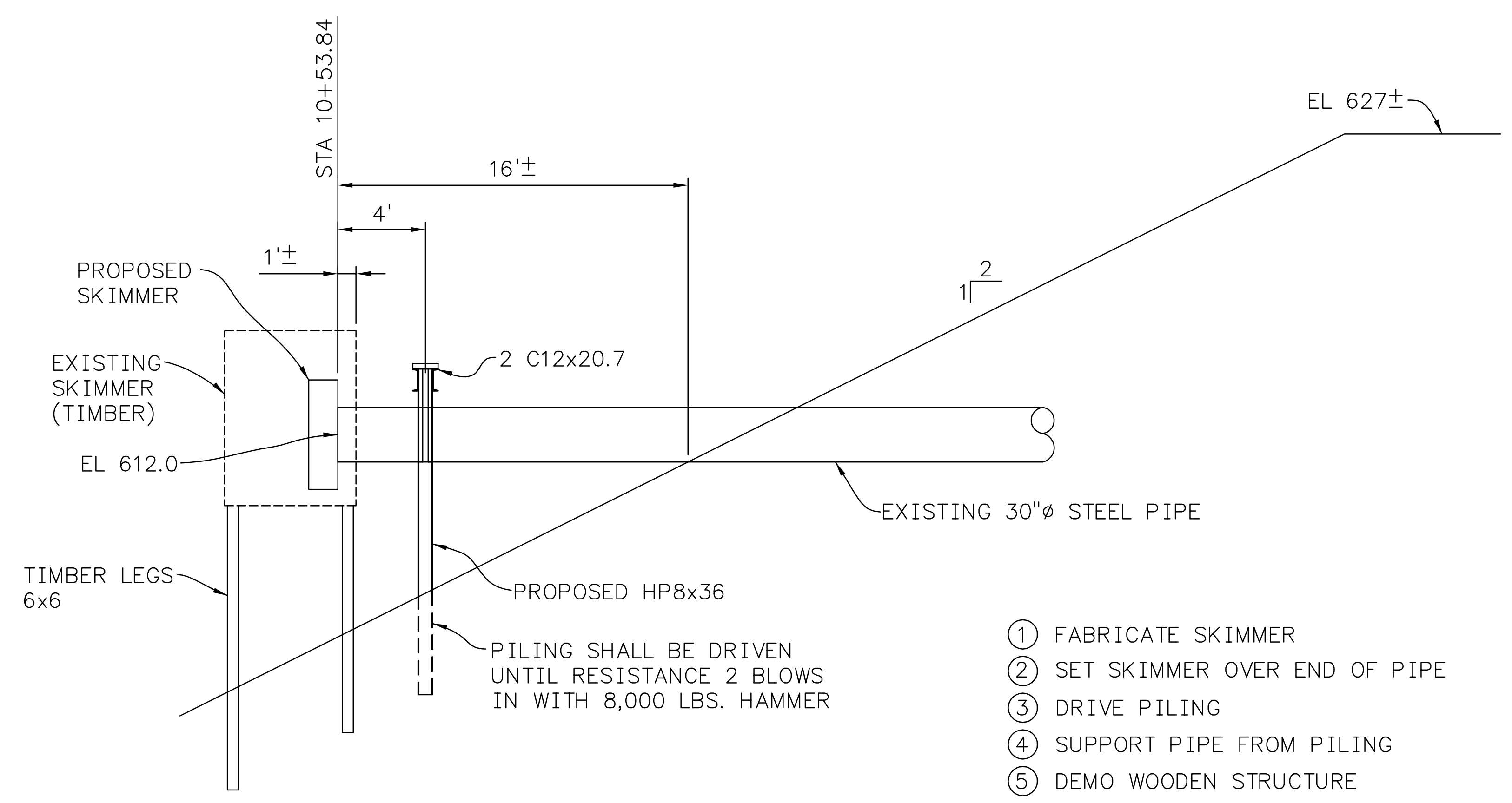
WIDOWS CREEK FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE | 34 | C | 10W235–18 | R 0

PLOT FACTOR:16
W_TVA

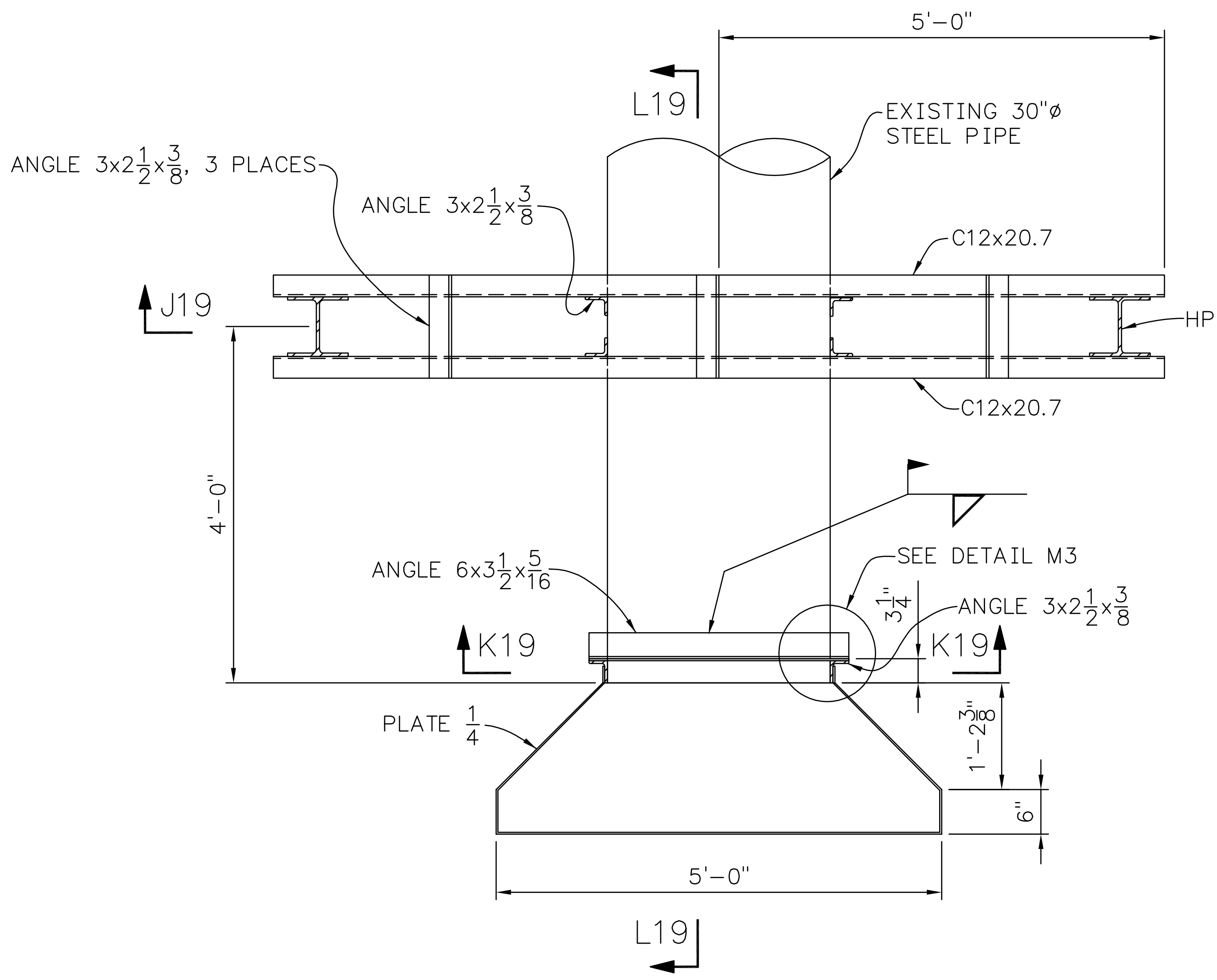
C.A.D. DRAWING
DO NOT ALTER MANUALLY

TASK COMPLETED BY: | REV NO.

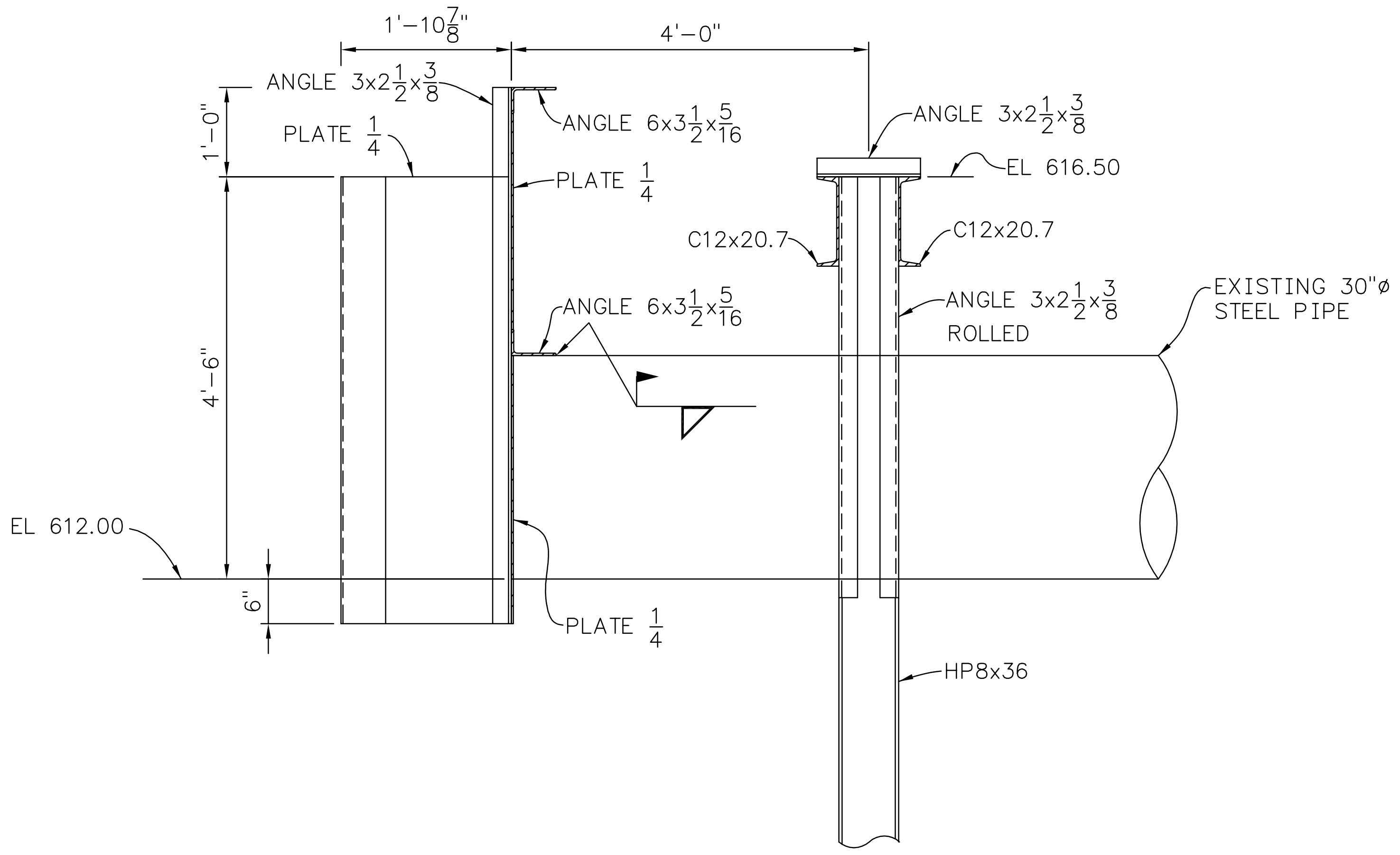


① FABRICATE SKIMMER
② SET SKIMMER OVER END OF PIPE
③ DRIVE PILING
④ SUPPORT PIPE FROM PILING
⑤ DEMO WOODEN STRUCTURE

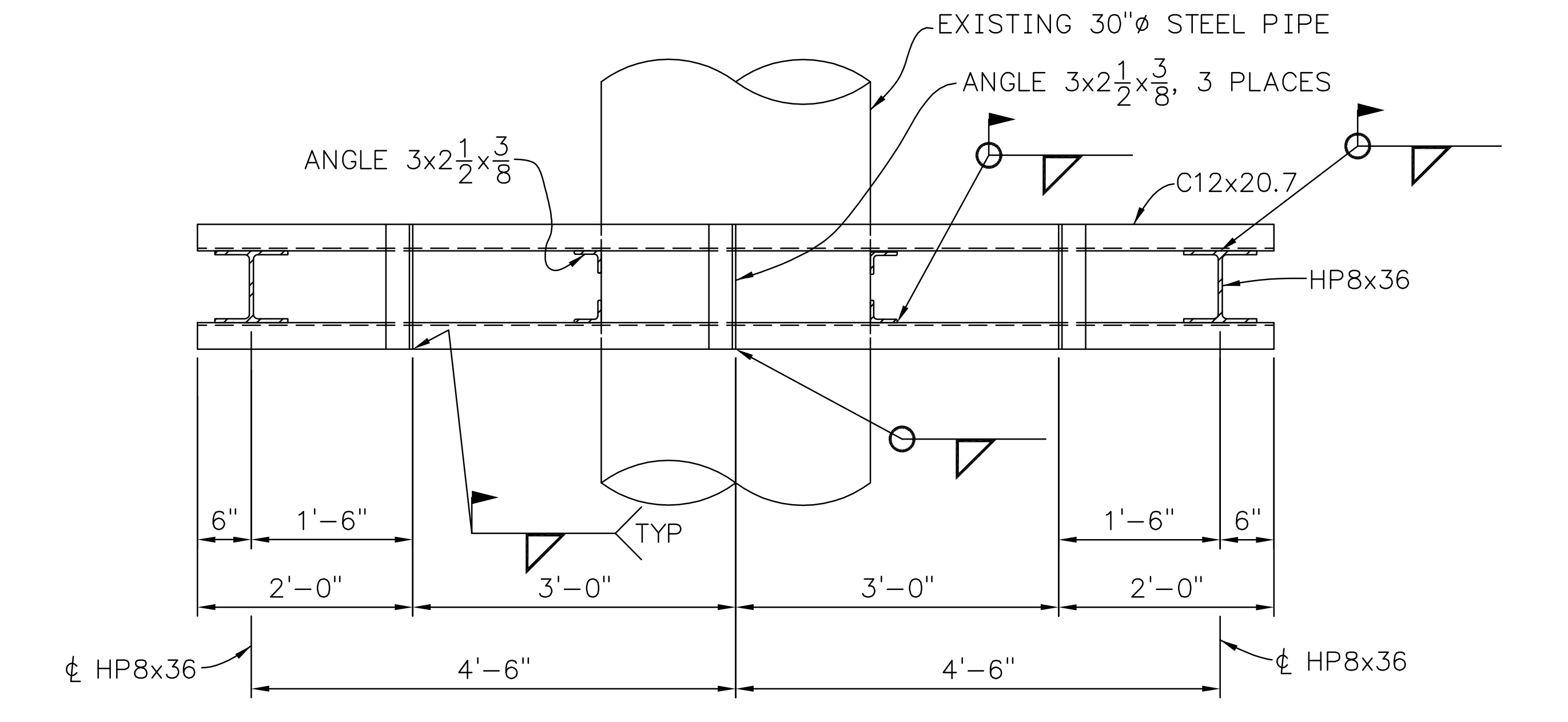
SKIMMER WEIR REPLACEMENT
SCALE: 1/4"=1'-0"



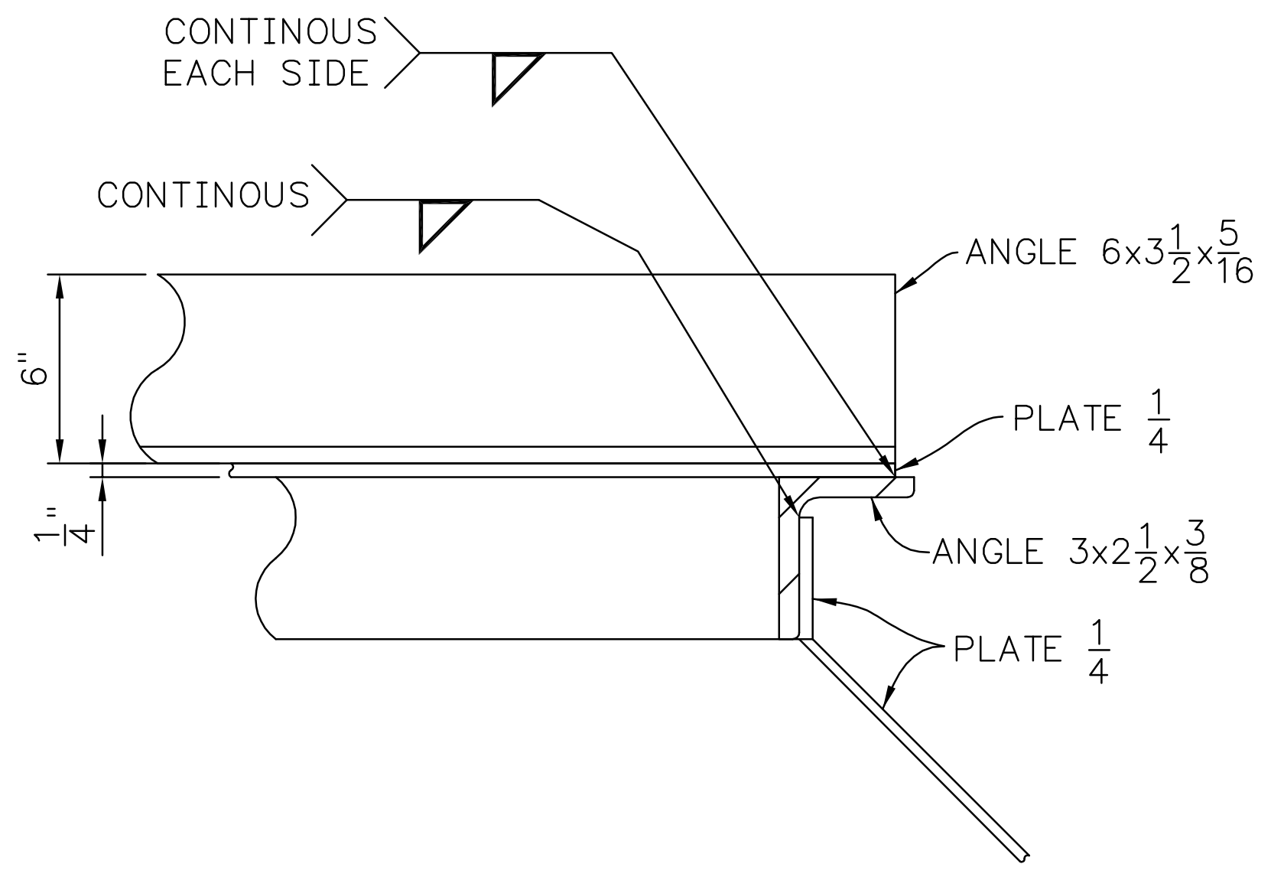
PLAN
PROPOSED SKIMMER
SCALE: 3/4"=1'-0"



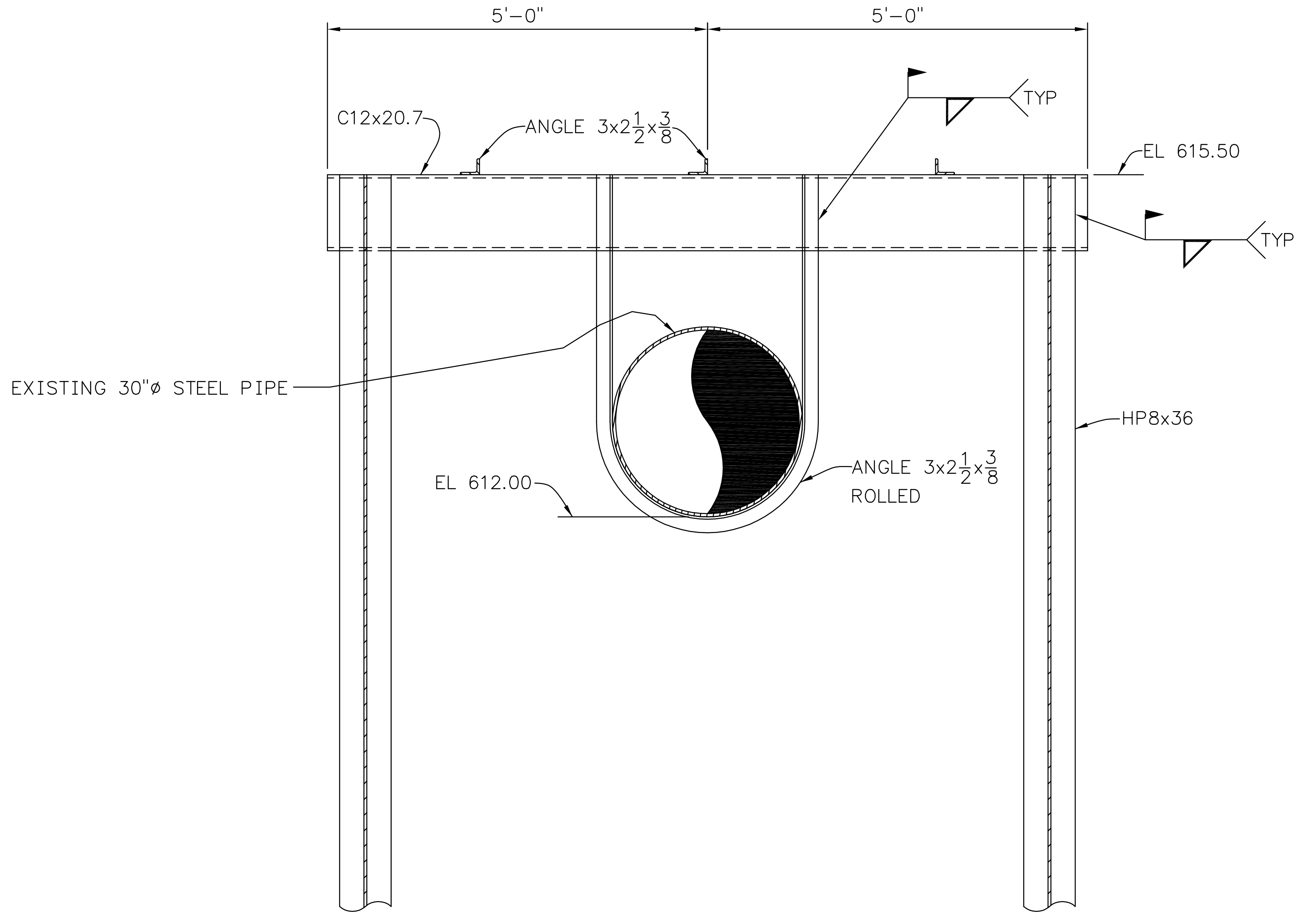
SECTION L19-L19
SCALE: 3/4"=1'-0"



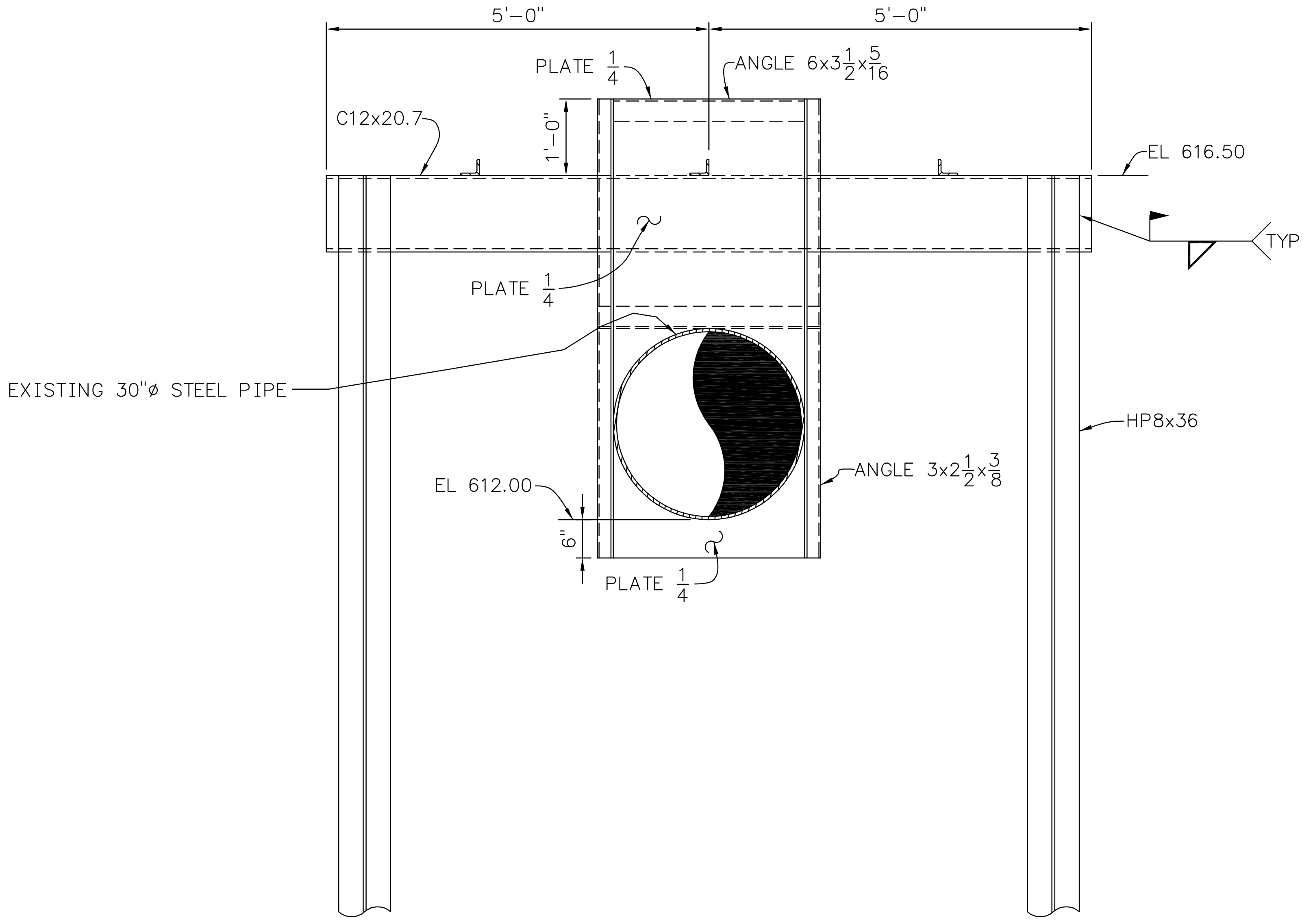
PLAN
SCALE: 3/4"=1'-0"



SECTION M19-M19
SCALE: NTS



SECTION J19-J19
SCALE: 3/4"=1'-0"



SECTION K19-K19
SCALE: 3/4"=1'-0"

NOTES:
1. ALL STRUCTURAL STEEL SHAPES AND PLATE SHALL CONFORM TO ASTM A36.
2. ALL WELDING SHALL UTILIZE E70 ELECTRODES IN ACCORDANCE WITH AWS D1.1
3. ALL STEEL SHALL BE HOT DIPPED GALVANIZED AFTER SHOP FABRICATION. FIELD TOUCH UP AFTER WELDING.

COMPANION DRAWINGS: 10W235-17 & 10W235-18

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R											
R 0		RLP	CWH	RLP	HLP	HLP	BAK				D
INITIAL ISSUE											

DISCIPLINE INTERFACE
1
2
3
4

SCALE: 3/4"=1'-0" EXCEPT AS NOTED

YARD UNITS 7 & 8

GYPSUM STACK
SKIMMER MODIFICATIONS

DESIGNED BY: | DRAWN BY: | CHECKED BY: | SUPERVISED BY: | REVIEWED BY: | APPROVED BY: | ISSUED BY:

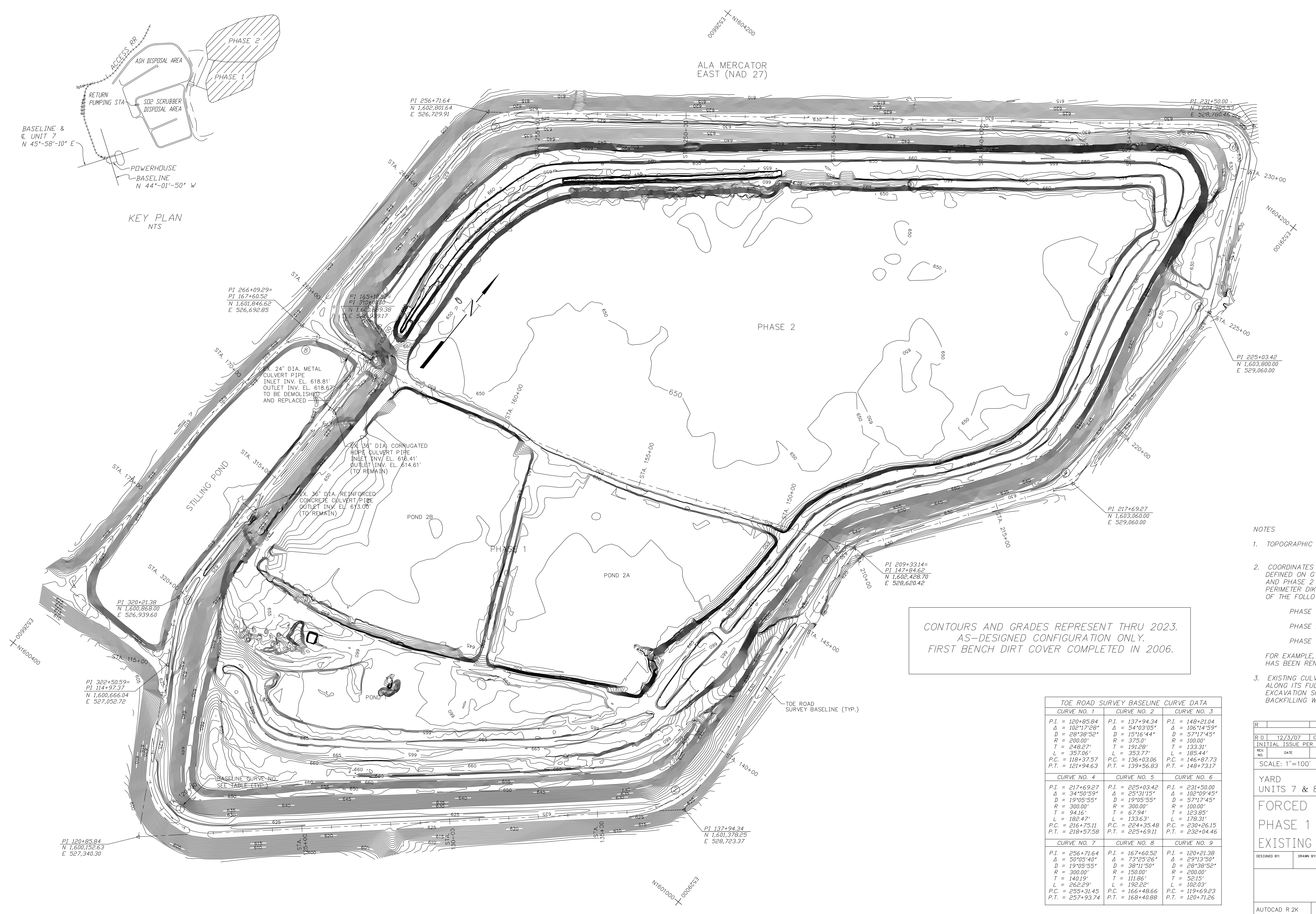
WIDOWS CREEK FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE | 34 | C | 10W235-19 | R 0

PLOT FACTOR:16
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

TASK COMPLETED BY: | REV NO.



CONTOURS AND GRADES REPRESENT THRU 2023.
AS-DESIGNED CONFIGURATION ONLY.
FIRST BENCH DIRT COVER COMPLETED IN 2006.

NOTES

1. TOPOGRAPHIC MAP DATED MARCH 8, 2004

2. COORDINATES OF PI'S ARE GIVEN IN ALABAMA STATE COORDINATES, AS DEFINED ON GYPSUM STACKING PHASE 1 DIKE PLAN SHEET 10W215–01 AND PHASE 2 DIKE PLAN SHEET 10W216–01. PREVIOUSLY DEFINED PERIMETER DIKE STATIONING HAS BEEN MAINTAINED, WITH THE ADDITION OF THE FOLLOWING PREFIXES:

   PHASE 1 PERIMETER DIKE – STA. 1xx+00 SERIES

   PHASE 2 PERIMETER DIKE – STA. 2xx+00 SERIES

   PHASE 1 DIVIDER DIKE – STA. 3xx+00 SERIES

   FOR EXAMPLE, PHASE 1 PERIMETER DIKE ORIGINAL STATION 14+97.37 HAS BEEN RENAMED STATION 114+97.37.

3. EXISTING CULVERT IDENTIFIED FOR DEMOLITION SHALL BE REMOVED ALONG ITS FULL LENGTH AND THE SIDES OF THE RESULTING EXCAVATION SHALL BE SLOPED AT 2H:1V OR FLATTER PRIOR TO BACKFILLING WITH COMPACTED SOIL.

TOE ROAD SURVEY BASELINE CURVE DATA

CURVE NO. 1	CURVE NO. 2	CURVE NO. 3
P.I. = 120+85.84 Δ = 102°17'28" D = 28°38'52" R = 200.00' T = 248.27' L = 357.06' P.C. = 118+37.57 P.T. = 121+94.63	P.I. = 137+94.34 Δ = 54°03'05" D = 15°16'44" R = 375.0' T = 191.28' L = 353.77' P.C. = 136+03.06 P.T. = 139+56.83	P.I. = 148+21.04 Δ = 106°14'59" D = 57°17'45" R = 100.00' T = 133.31' L = 185.44' P.C. = 146+87.73 P.T. = 148+73.17
CURVE NO. 4	**CURVE NO. 5**	**CURVE NO. 6**
P.I. = 217+69.27 Δ = 34°50'59" D = 19°05'55" R = 300.00' T = 94.16' L = 182.47' P.C. = 216+75.11 P.T. = 218+57.58	P.I. = 225+03.42 Δ = 25°31'15" D = 19°05'55" R = 300.00' T = 67.94' L = 133.63' P.C. = 224+35.48 P.T. = 225+69.11	P.I. = 231+50.00 Δ = 102°09'45" D = 57°17'45" R = 100.00' T = 123.85' L = 178.31' P.C. = 230+26.15 P.T. = 232+04.46
CURVE NO. 7	**CURVE NO. 8**	**CURVE NO. 9**
P.I. = 256+71.64 Δ = 50°05'40" D = 19°05'55" R = 300.00' T = 140.19' L = 262.29' P.C. = 255+31.45 P.T. = 257+93.74	P.I. = 167+60.52 Δ = 73°25'26" D = 38°11'50" R = 150.00' T = 111.86' L = 192.22' P.C. = 166+48.66 P.T. = 168+40.88	P.I. = 120+21.38 Δ = 29°13'50" D = 28°38'52" R = 200.00' T = 52.15' L = 102.03' P.C. = 119+69.23 P.T. = 120+71.26

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R											
R 0	12/3/07	CWH	SEL	DRD	SRC	LJP	JCK		WCF408		J
INITIAL ISSUE PER DCN WCF–04–1016–001											

DISCIPLINE INTERFACE
1
2
3
4

SCALE: 1"=100' EXCEPT AS NOTED

YARD
UNITS 7 & 8

FORCED OXIDATION GYPSUM STACKING
PHASE 1 & 2 – BASELINE INFORMATION
EXISTING CONDITIONS AND DEMOLITION PLAN

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
			[redacted]	[redacted]	[redacted]	

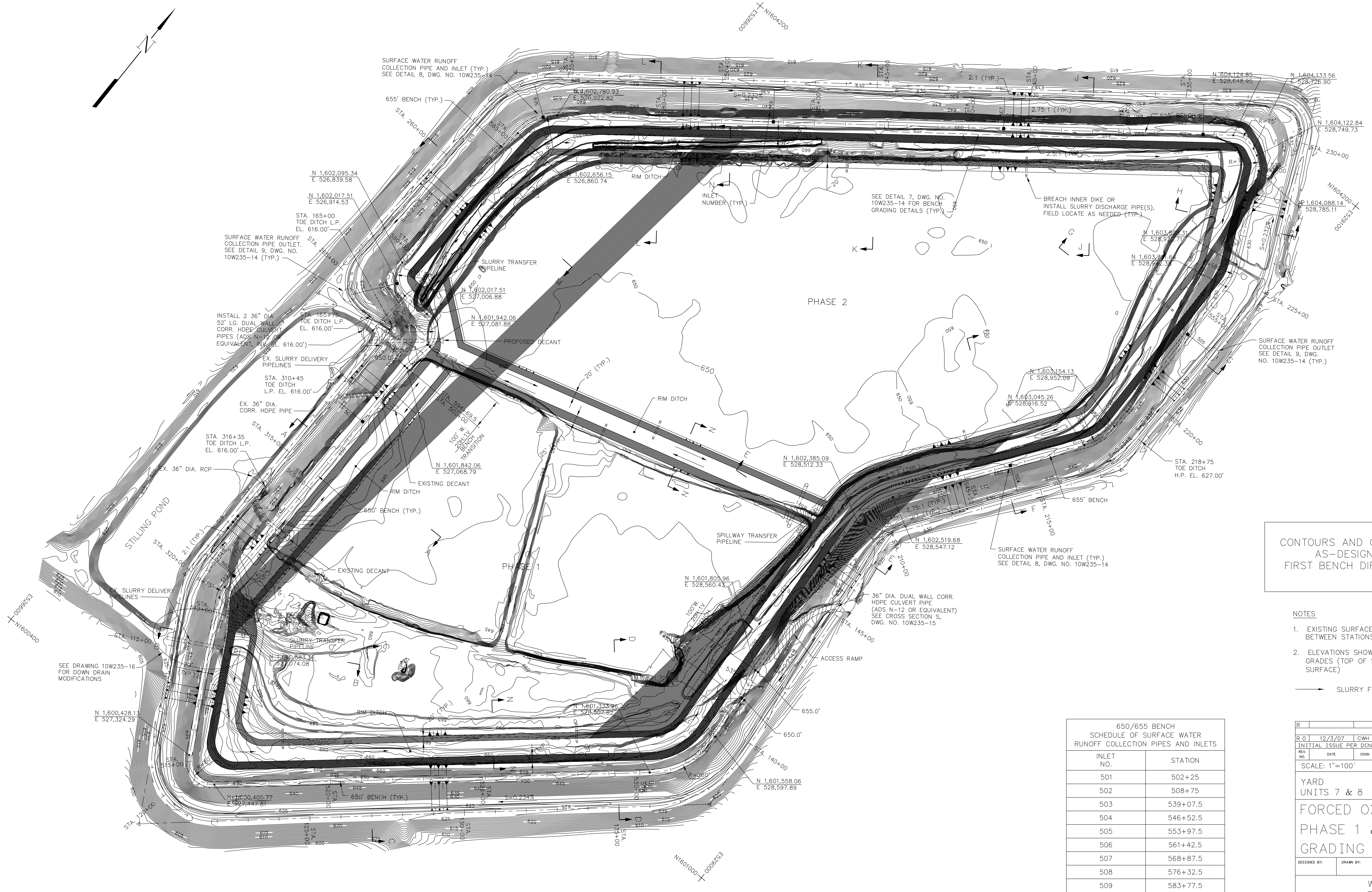
WIDOWS CREEK FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2K	DATE	34	C	10W235–1	R 0

PLOT FACTOR:120
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

TASK COMPLETED BY: | REV NO



CONTOURS AND GRADES REPRESENT THRU 2023.
AS-DESIGNED CONFIGURATION ONLY.
FIRST BENCH DIRT COVER COMPLETED IN 2006.

NOTES

1. EXISTING SURFACE WATER COLLECTION PIPES AND INLETS BETWEEN STATIONS 512+00 AND 534+00 TO REMAIN.
2. ELEVATIONS SHOWN IN THIS PLAN VIEW INDICATE FINISHED GRADES (TOP OF SOIL COVER OR FINISHED GYPSUM/FLYASH SURFACE)

——→ SLURRY FLOW DIRECTION

650/655 BENCH
SCHEDULE OF SURFACE WATER
RUNOFF COLLECTION PIPES AND INLETS

INLET NO.	STATION
501	502+25
502	508+75
503	539+07.5
504	546+52.5
505	553+97.5
506	561+42.5
507	568+87.5
508	576+32.5
509	583+77.5
510	591+10

R												DISCIPLINE INTERFACE
R 0	12/3/07	CWH	SEL	DRD	SRC	LJP	JCK		WCF408		J	
INITIAL ISSUE PER DCN WCF-04-1016-002												
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD	1 2

SCALE: 1"=100' EXCEPT AS NOTED

YARD
UNITS 7 & 8

FORCED OXIDATION GYPSUM STACKING
PHASE 1 & 2
GRADING PLAN UP TO EL. 655'

DESIGNED BY:
DRAWN BY:
CHECKED BY:
SUPERVISED BY: [redacted] Samuel R. Cathey
REVIEWED BY: [redacted] Leonard J. Peterson
APPROVED BY: [redacted] L.J. Peterson for John C. Kammeyer
ISSUED BY:

WIDOWS CREEK FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2K | DATE | 34 | C | 10W235-2 | R 0

PLOT FACTOR:120
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

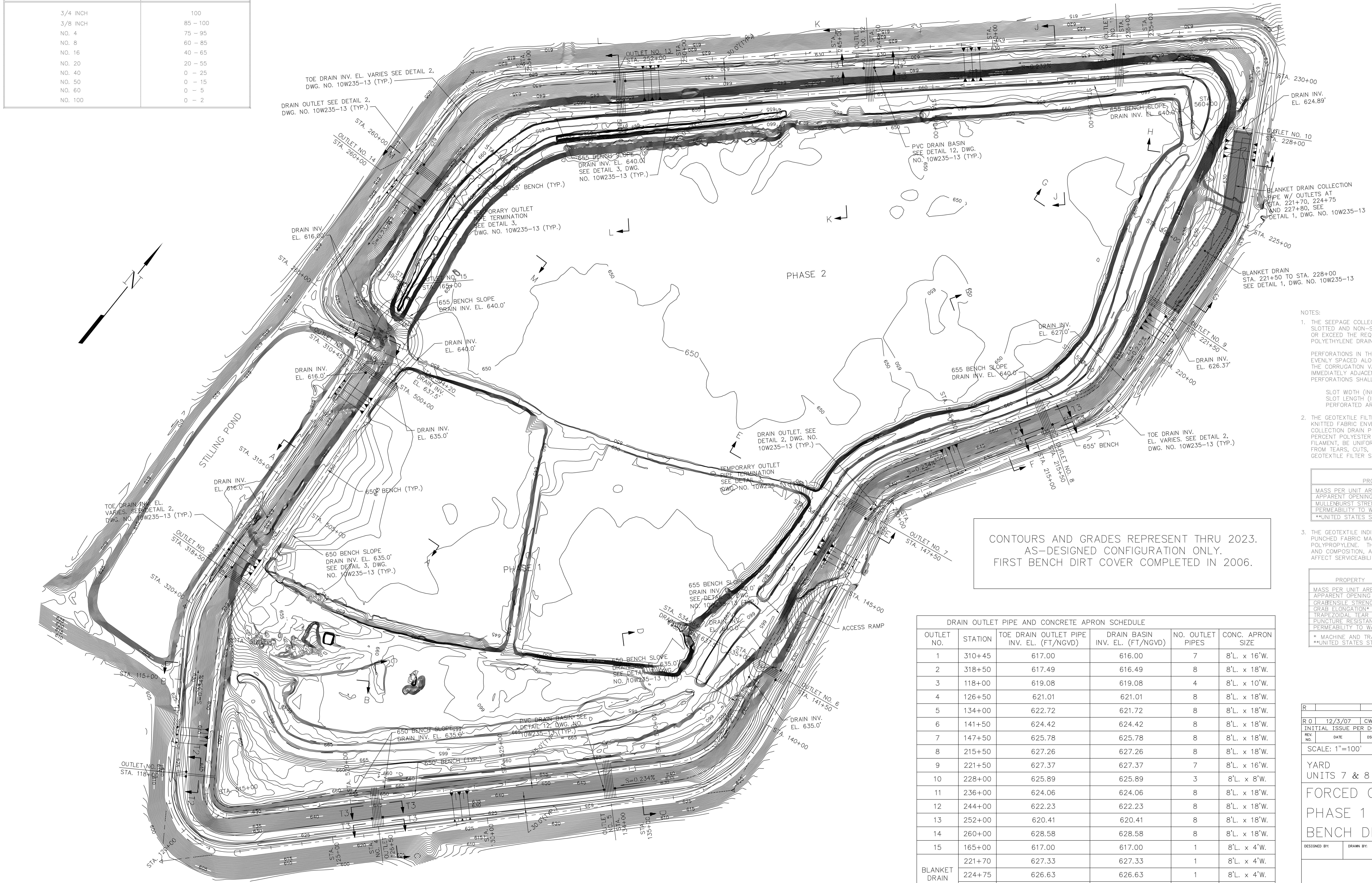
TASK COMPLETED BY: | REV NO.

34 C 10W235-3

NOTES (CONT.):

4. THE FILTER SAND USED IN THE TOE AND SLOPE DRAINS SHALL BE A CLEAN SILICA SAND AND EXHIBIT THE FOLLOWING GRADATION REQUIREMENTS.

U.S. STANDARD SIEVE SIZE	PERCENT PASSING (DRY WEIGHT BASIS)
3/4 INCH	100
3/8 INCH	85 – 100
NO. 4	75 – 95
NO. 8	60 – 85
NO. 16	40 – 65
NO. 20	20 – 55
NO. 40	0 – 25
NO. 50	0 – 15
NO. 60	0 – 5
NO. 100	0 – 2



CONTOURS AND GRADES REPRESENT THRU 2023.
AS–DESIGNED CONFIGURATION ONLY.
FIRST BENCH DIRT COVER COMPLETED IN 2006.

DRAIN OUTLET PIPE AND CONCRETE APRON SCHEDULE

OUTLET NO.	STATION	TOE DRAIN OUTLET PIPE INV. EL. (FT/NGVD)	DRAIN BASIN INV. EL. (FT/NGVD)	NO. OUTLET PIPES	CONC. APRON SIZE
1	310+45	617.00	616.00	7	8'L. x 16'W.
2	318+50	617.49	616.49	8	8'L. x 18'W.
3	118+00	619.08	619.08	4	8'L. x 10'W.
4	126+50	621.01	621.01	8	8'L. x 18'W.
5	134+00	622.72	621.72	8	8'L. x 18'W.
6	141+50	624.42	624.42	8	8'L. x 18'W.
7	147+50	625.78	625.78	8	8'L. x 18'W.
8	215+50	627.26	627.26	8	8'L. x 18'W.
9	221+50	627.37	627.37	7	8'L. x 16'W.
10	228+00	625.89	625.89	3	8'L. x 8'W.
11	236+00	624.06	624.06	8	8'L. x 18'W.
12	244+00	622.23	622.23	8	8'L. x 18'W.
13	252+00	620.41	620.41	8	8'L. x 18'W.
14	260+00	628.58	628.58	8	8'L. x 18'W.
15	165+00	617.00	617.00	1	8'L. x 4'W.
BLANKET DRAIN	221+70	627.33	627.33	1	8'L. x 4'W.
	224+75	626.63	626.63	1	8'L. x 4'W.
	227+80	625.93	625.93	1	8'L. x 4'W.

NOTES:

1. THE SEEPAGE COLLECTION DRAIN AND OUTLET PIPE SHALL CONSIST OF 6 INCH DIAMETER SLOTTED AND NON–SLOTTED CORRUGATED HDPE PIPE. THE PIPE AND FITTINGS SHALL MEET OR EXCEED THE REQUIREMENTS OF AASHTO SPECIFICATION M 252 "CORRUGATED POLYETHYLENE DRAINAGE TUBING."

   PERFORATIONS IN THE CORRUGATED HDPE PIPE SHALL CONSIST OF SLOTS CLEANLY CUT AND EVENLY SPACED ALONG 4 LINES AROUND THE PIPE CIRCUMFERENCE AND CENTERED WITHIN THE CORRUGATION VALLEYS ALONG THE LENGTH OF THE PIPE. PERFORATIONS LOCATED IN IMMEDIATELY ADJACENT CORRUGATION VALLEYS SHALL BE OFFSET BY 45 DEGREES. PERFORATIONS SHALL SATISFY THE FOLLOWING CRITERIA:

SLOT WIDTH (INCHES)	< 0.125
SLOT LENGTH (INCHES)	< 1.0
PERFORATED AREA (IN^2/FOOT)	> 4.0

2. THE GEOTEXTILE FILTER SOCK (NOT USED FOR ALTERNATE DRAIN) SHALL BE A MACHINE KNITTED FABRIC ENVELOPE MANUFACTURED TO FIT SNUGLY OVER THE SPECIFIED SEEPAGE COLLECTION DRAIN PIPE. THE GEOTEXTILE FILTER SOCK SHALL BE MANUFACTURED FROM 100 PERCENT POLYESTER OR POLYPROPYLENE WITH A MINIMUM FIBER SIZE OF 100 DENIER PER FILAMENT, BE UNIFORM AND HOMOGENEOUS IN APPEARANCE AND COMPOSITION, AND FREE FROM TEARS, CUTS, THIN SPOTS, OR ANY DEFECTS THAT MAY AFFECT SERVICEABILITY. THE GEOTEXTILE FILTER SOCK SHALL MEET THE FOLLOWING CRITERIA.

PROPERTY	UNITS	TEST METHOD	CRITERION
MASS PER UNIT AREA	OZ/YD^2	ASTM D 5261	> 6
APPARENT OPENING SIZE	USSS**	ASTM D 4751	> 40
MULLENBURST STRENGTH	PSI	ASTM D 3786	>135
PERMEABILITY TO WATER	CM/SEC	ASTM D 4491	> 02
**UNITED STATES STANDARD SIEVE SIZE			

3. THE GEOTEXTILE INDICATED ON THE DRAWINGS SHALL CONSIST OF A NON – WOVEN, NEEDLE PUNCHED FABRIC MANUFACTURED FROM 100 PERCENT POLYESTER OR 100 PERCENT POLYPROPYLENE. THE GEOTEXTILE SHALL BE UNIFORM AND HOMOGENEOUS IN APPEARANCE AND COMPOSITION, AND FREE FROM TEARS, CUTS, THIN SPOTS, OR ANY DEFECTS THAT MAY AFFECT SERVICEABILITY. THE GEOTEXTILE SHALL MEET THE FOLLOWING CRITERIA.

PROPERTY	UNITS	TEST METHOD	CRITERION
MASS PER UNIT AREA	OZ/YD^2	ASTM D 5261	>10
APPARENT OPENING SIZE	USSS**	ASTM D 4751	>100
GRAB TENSILE STRENGTH*	LBS	ASTM D 4632	>245
GRAB ELONGATION*	%	ASTM D 4632	> 50
TRAPEZOIDAL TEAR STRENGTH*	LBS	ASTM D 4533	> 95
PUNCTURE RESISTANCE	LBS	ASTM D 4833	>120
PERMEABILITY TO WATER	CM/SEC	ASTM D 4491	>0.2
* MACHINE AND TRANSVERSE DIRECTIONS. **UNITED STATES STANDARD SIEVE SIZE			

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R											
R 0	12/3/07	CWH	SEL	DRD	SRC	LJP	JCK		WCF408		J
INITIAL ISSUE PER DCN WCF–04–1016–003											

DISCIPLINE INTERFACE
1
2
3
4

SCALE: 1"=100' EXCEPT AS NOTED

YARD
UNITS 7 & 8

FORCED OXIDATION GYPSUM STACKING
PHASE 1 & 2 – TOP DRAIN, 650/655
BENCH DRAIN AND OUTLET PIPES

DESIGNED BY:
DRAWN BY:
CHECKED BY:
SUPERVISED BY: [redacted] Samuel R. Cathey
REVIEWED BY: [redacted] Leonard J. Peterson
APPROVED BY: [redacted] L.J. Peterson for John C. Kammeyer
ISSUED BY:

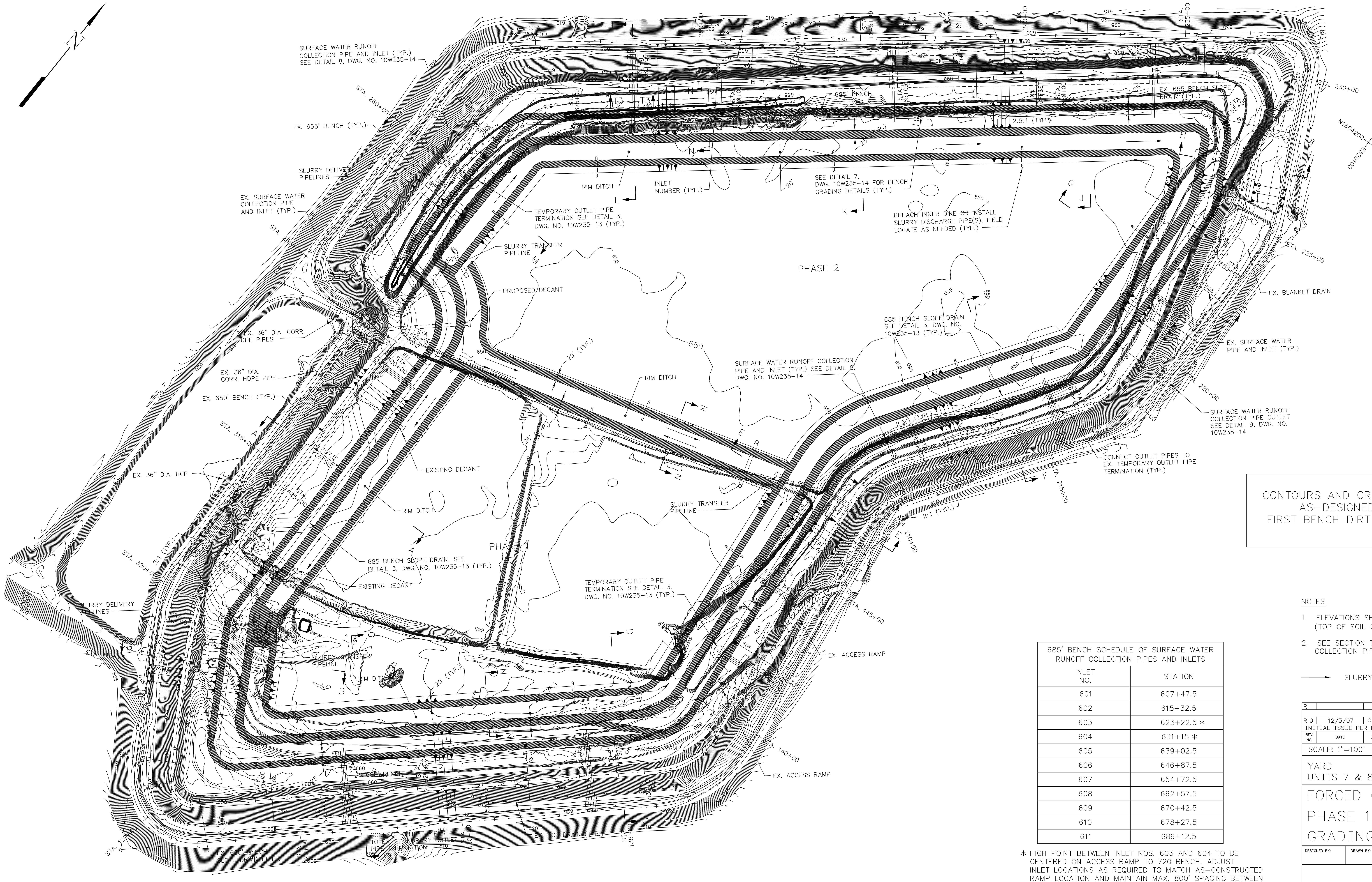
WIDOWS CREEK FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2K | DATE | 34 | C | 10W235–3 | R 0

PLOT FACTOR:120
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

TASK COMPLETED BY: | REV NO.



CONTOURS AND GRADES REPRESENT THRU 2023.
AS-DESIGNED CONFIGURATION ONLY.
FIRST BENCH DIRT COVER COMPLETED IN 2006.

NOTES

1. ELEVATIONS SHOWN IN THIS PLAN VIEW INDICATE FINISHED GRADES (TOP OF SOIL COVER OR FINISHED GYPSUM/FLYASH SURFACE)
2. SEE SECTION T, DWG. NO. 10W235-15 FOR SURFACE WATER COLLECTION PIPE TYPICAL SECTION

→ SLURRY FLOW DIRECTION

685' BENCH SCHEDULE OF SURFACE WATER RUNOFF COLLECTION PIPES AND INLETS

INLET NO.	STATION
601	607+47.5
602	615+32.5
603	623+22.5 *
604	631+15 *
605	639+02.5
606	646+87.5
607	654+72.5
608	662+57.5
609	670+42.5
610	678+27.5
611	686+12.5

* HIGH POINT BETWEEN INLET NOS. 603 AND 604 TO BE CENTERED ON ACCESS RAMP TO 720 BENCH. ADJUST INLET LOCATIONS AS REQUIRED TO MATCH AS-CONSTRUCTED RAMP LOCATION AND MAINTAIN MAX. 800' SPACING BETWEEN ADJACENT INLETS.

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R											
R 0	12/3/07	CWH	SEL	DRD	SRC	LJP	JCK		WCF408		J
INITIAL ISSUE PER DCN WCF-04-1016-004											

DISCIPLINE INTERFACE
1
2
3
4

SCALE: 1"=100' EXCEPT AS NOTED

YARD
UNITS 7 & 8

FORCED OXIDATION GYPSUM STACKING
PHASE 1 & 2
GRADING PLAN UP TO EL.685'

DESIGNED BY:
DRAWN BY:
CHECKED BY:
SUPERVISED BY: Samuel R. Cathey
REVIEWED BY: Leonard J. Peterson
APPROVED BY: L.J. Peterson for John C. Kammeyer
ISSUED BY:

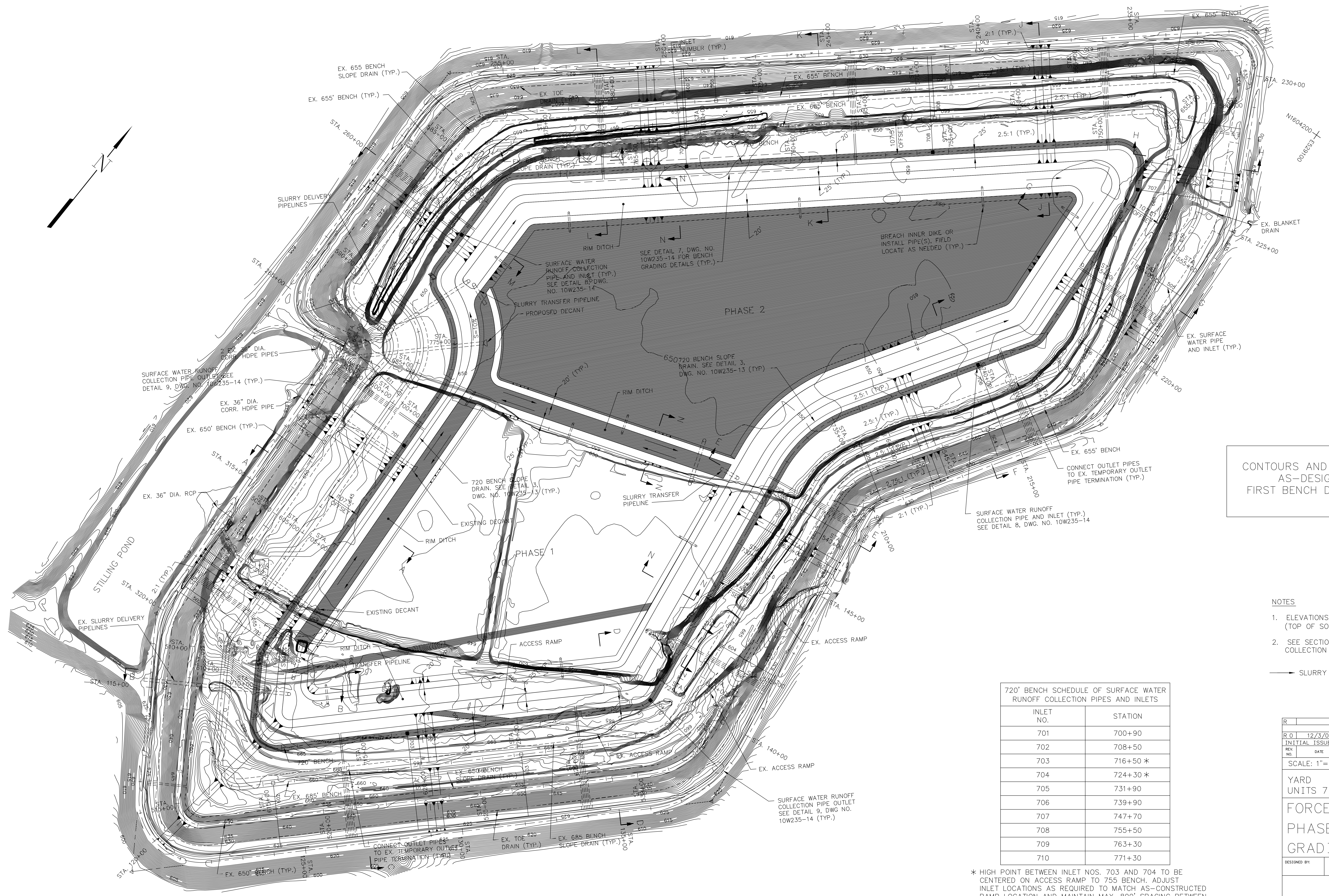
WIDOWS CREEK FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2K | DATE | 34 | C | 10W235-4 | R 0

PLOT FACTOR:120
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

TASK COMPLETED BY: | REV NO.



CONTOURS AND GRADES REPRESENT THRU 2023.
AS-DESIGNED CONFIGURATION ONLY.
FIRST BENCH DIRT COVER COMPLETED IN 2006.

NOTES

1. ELEVATIONS SHOWN IN THIS PLAN VIEW INDICATE FINISHED GRADES (TOP OF SOIL COVER OR FINISHED GYPSUM/FLYASH SURFACE).
2. SEE SECTION U, DWG. NO. 10W235-15 FOR SURFACE WATER COLLECTION PIPE TYPICAL SECTION.

——→ SLURRY FLOW DIRECTION

720' BENCH SCHEDULE OF SURFACE WATER RUNOFF COLLECTION PIPES AND INLETS

INLET NO.	STATION
701	700+90
702	708+50
703	716+50 *
704	724+30 *
705	731+90
706	739+90
707	747+70
708	755+50
709	763+30
710	771+30

* HIGH POINT BETWEEN INLET NOS. 703 AND 704 TO BE CENTERED ON ACCESS RAMP TO 755 BENCH. ADJUST INLET LOCATIONS AS REQUIRED TO MATCH AS-CONSTRUCTED RAMP LOCATION AND MAINTAIN MAX. 800' SPACING BETWEEN ADJACENT INLETS.

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R											
R 0	12/3/07	CWH	SEL	DRD	SRC	LJP	JCK		WCF408		J
INITIAL ISSUE PER DCN WCF-04-1016-005											

DISCIPLINE INTERFACE
1
2
3
4

SCALE: 1"=100' EXCEPT AS NOTED

YARD
UNITS 7 & 8

FORCED OXIDATION GYPSUM STACKING
PHASE 1 & 2
GRADING PLAN UP TO EL. 720

DESIGNED BY:
DRAWN BY:
CHECKED BY:
SUPERVISED BY: Samuel R. Cathey
REVIEWED BY: Leonard J. Peterson
APPROVED BY: L.J. Peterson for John C. Kammeyer
ISSUED BY:

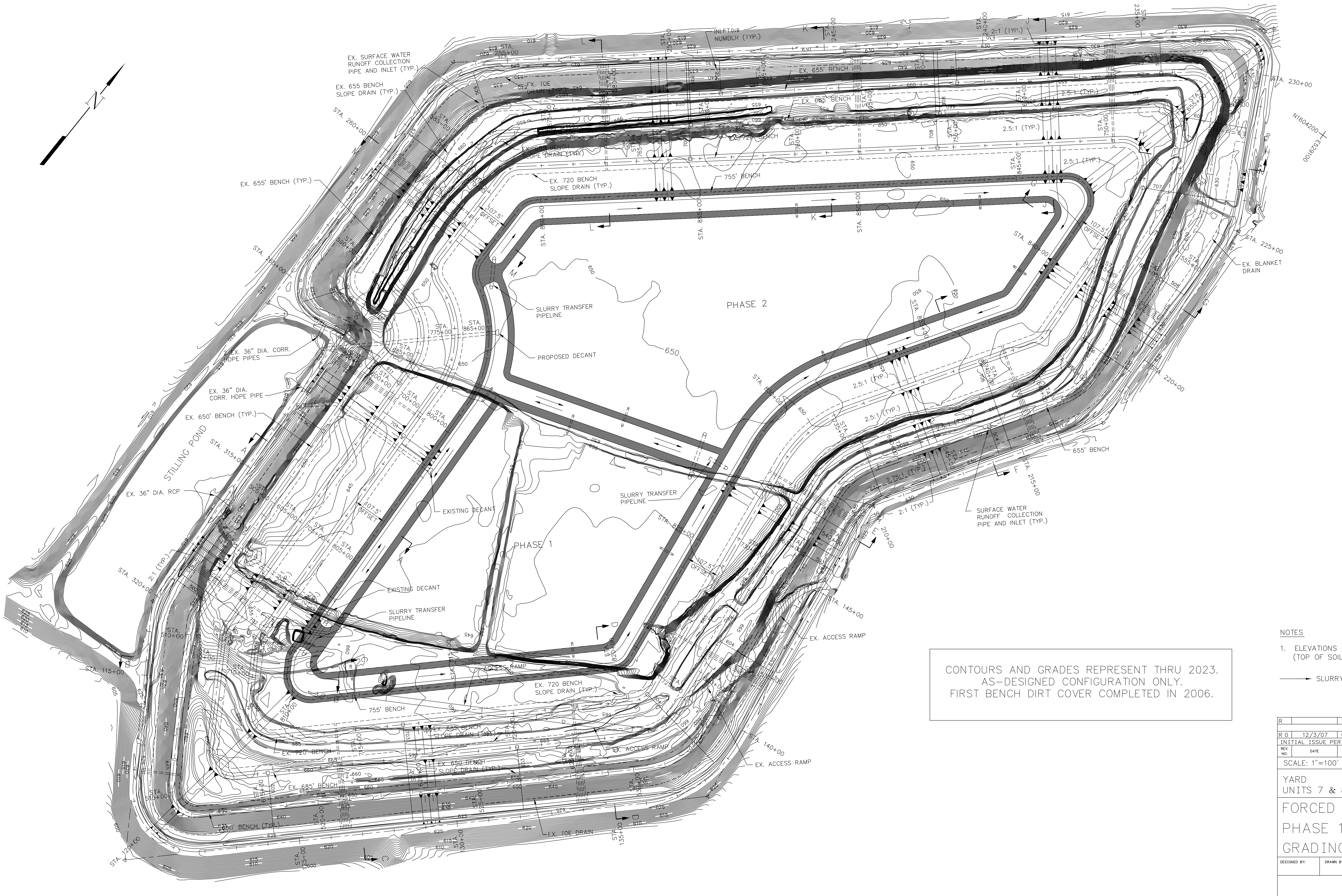
WIDOWS CREEK FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2K
DATE
34 C 10W235-5 R 0

PLOT FACTOR:120
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

TASK COMPLETED BY:
REV NO.



CONTOURS AND GRADES REPRESENT THRU 2023.
AS-DESIGNED CONFIGURATION ONLY.
FIRST BENCH DIRT COVER COMPLETED IN 2006.

NOTES

1. ELEVATIONS SHOWN IN THIS PLAN VIEW INDICATE FINISHED GRADES (TOP OF SOIL COVER OR FINISHED GYPSUM/FLYASH SURFACE)

→ SLURRY FLOW DIRECTION

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R											
R 0	12/3/07	CWH	SEL	DRD	SRC	LJP	JCK		WCF408		J
INITIAL ISSUE PER DCN WCF-04-1016-006											

DISCIPLINE INTERFACE
1
2
3
4

SCALE: 1"=100' EXCEPT AS NOTED

YARD
UNITS 7 & 8

FORCED OXIDATION GYPSUM STACKING
PHASE 1 & 2
GRADING PLAN UP TO FINAL EL. 755'

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
			Samuel R. Cathey	Leonard J. Peterson	L.J. Peterson for John C. Kammeyer	

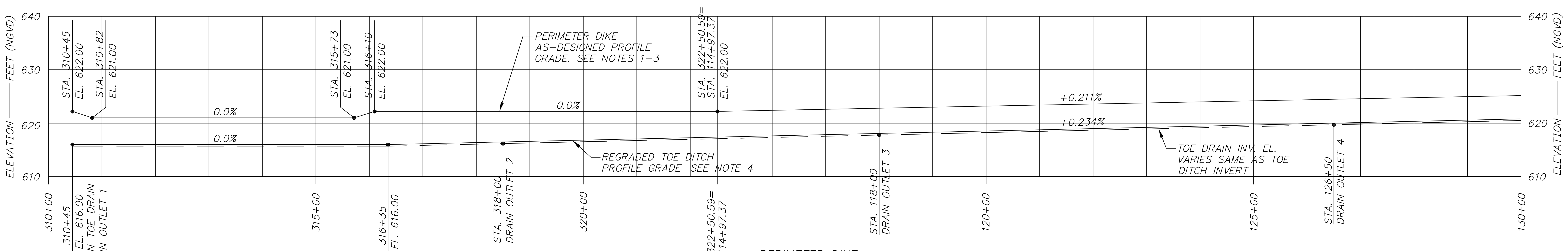
WIDOWS CREEK FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2K | DATE | 34 | C | 10W235-6 | R 0

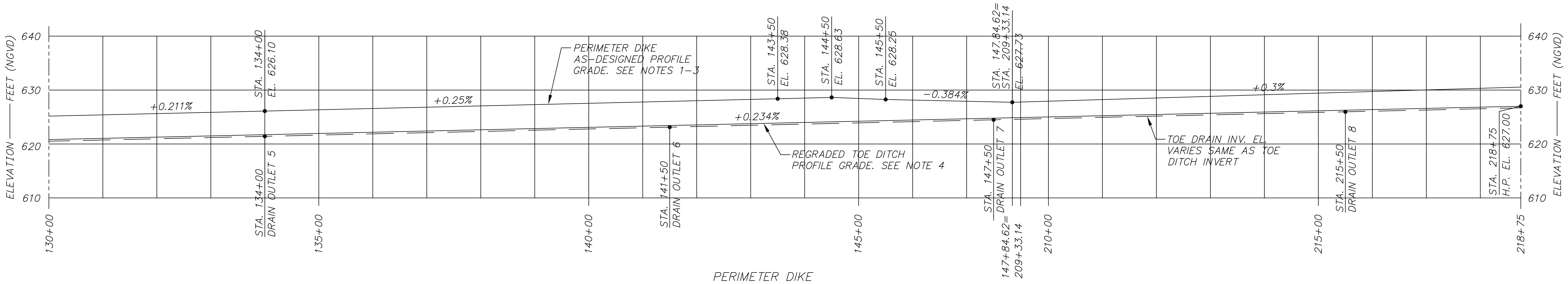
PLOT FACTOR:120
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

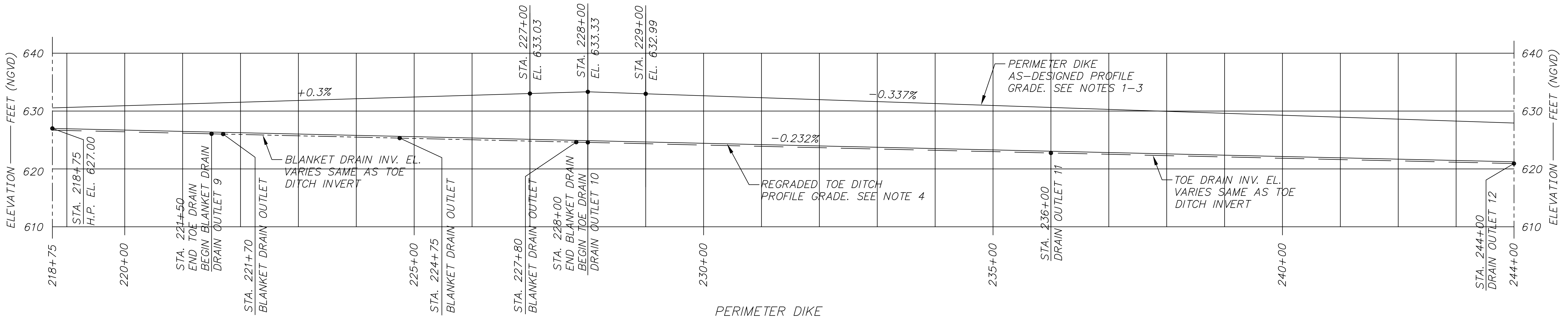
TASK COMPLETED BY: | REV NO.



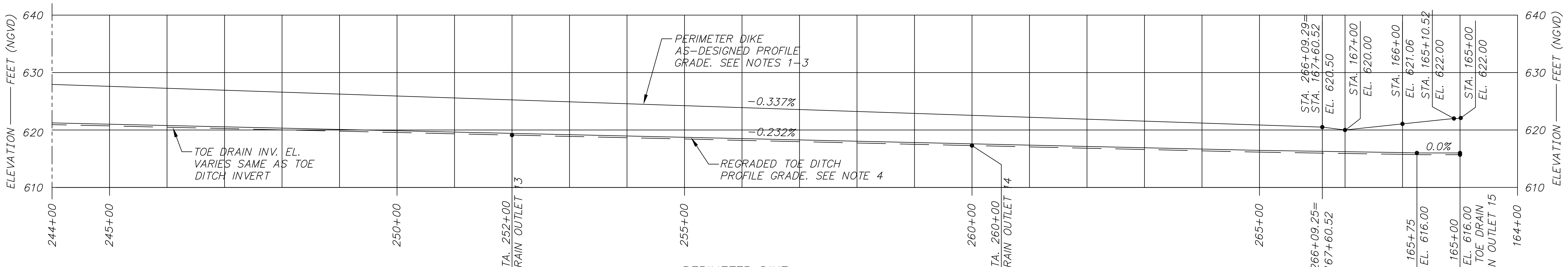
PERIMETER DIKE
STA. 310+45 TO STA. 130+00



PERIMETER DIKE
STA. 130+00 TO STA. 218+75



PERIMETER DIKE
STA. 218+75 TO STA. 244+00



PERIMETER DIKE
STA. 244+00 TO STA. 165+00

CONTOURS AND GRADES REPRESENT THRU 2023.
AS-DESIGNED CONFIGURATION ONLY.
FIRST BENCH DIRT COVER COMPLETED IN 2006.

NOTES

1. PERIMETER DIKE PROFILE GRADES SHOWN ON PROFILE ARE AS DEFINED ON GYPSUM STACKING PHASE 1 PROFILE SHEET 10W215-02 AND GYPSUM STACKING PHASE 2 DIKES PROFILE SHEET 10W216-02.

2. PERIMETER DIKE PROFILE ELEVATIONS SHOWN ON PROFILE AT STATIONS 147+84.62/209+33.14 AND 167+60.52/266+09.29 ARE AS DEFINED ON GYPSUM STACKING PHASE 2 DIKES PROFILE SHEET 10W216-02.

3. PERIMETER DIKE GRADES SHOWN ON PROFILE BETWEEN STATION 310+82 AND STATION 315+73 ARE BASED ON ELEVATIONS SHOWN ON TOPOGRAPHIC MAP ON DRAWING 10W235-1.

4. REGRADED TOE DITCH TO HAVE A CONSTANT GRADE OF +0.234% FROM STATION 316+25 TO STATION 218+75 AND -0.232% FROM STATION 218+75 TO STATION 165+75. REGRADED TOE DITCH GRADE SHOWN ON PROFILE IS DISTORTED TO REFLECT DIFFERENCE IN LENGTHS BETWEEN SURVEY BASELINE AND TOE DITCH CENTERLINE.

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R											
R 0	12/3/07	CWH	SEL	DRD	SRC	LJP	JCK		WCF408		J
INITIAL ISSUE PER DCN WCF-04-1016-007											

DISCIPLINE INTERFACE
1
2
3
4

SCALE: 1"-100' HORIZ & 1"-10' VERT EXCEPT AS NOTED

YARD
UNITS 7 & 8

FORCED OXIDATION GYPSUM STACKING
PHASE 1 & 2 – PERIMETER DIKE
PROFILE SHEET

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
			Samuel R. Cathey	Leonard J. Peterson	L.J. Peterson for John C. Kammeyer	

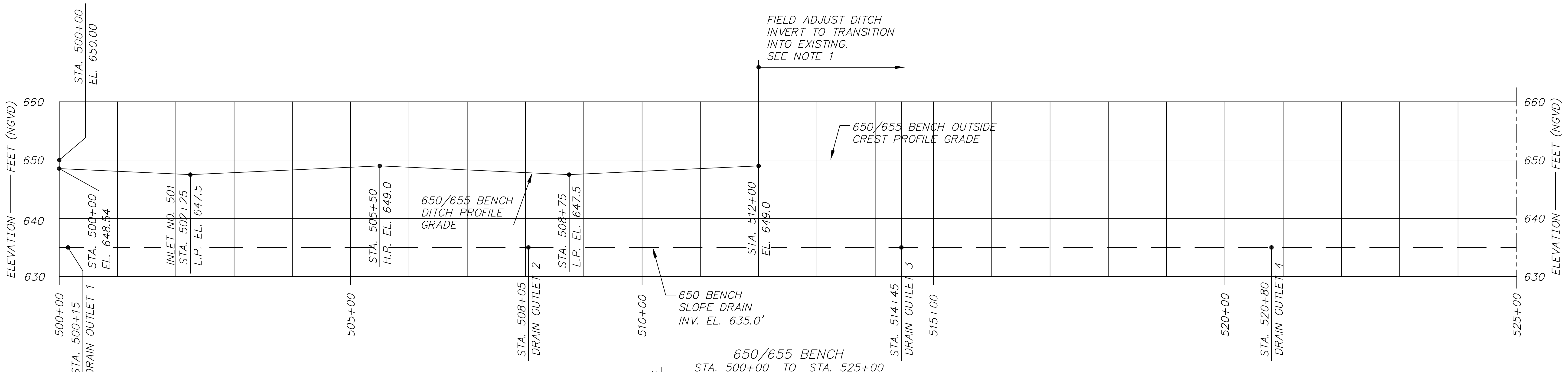
WIDOWS CREEK FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2K | DATE | 34 | C | 10W235-7 | R 0

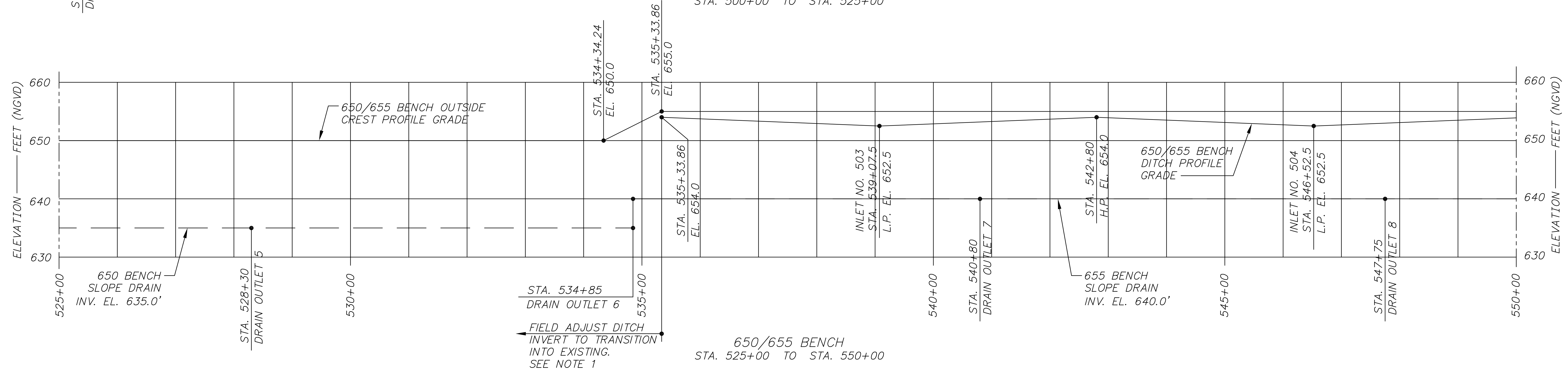
PLOT FACTOR:100
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

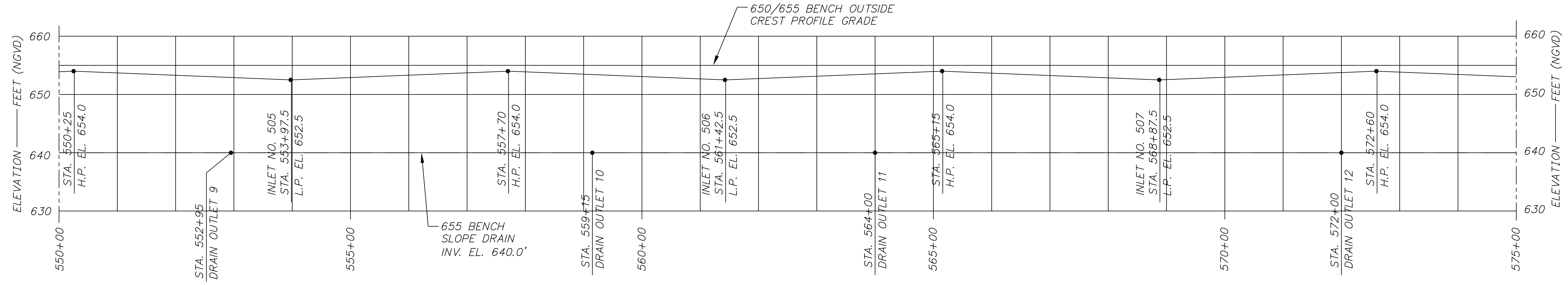
TASK COMPLETED BY: | REV NO.



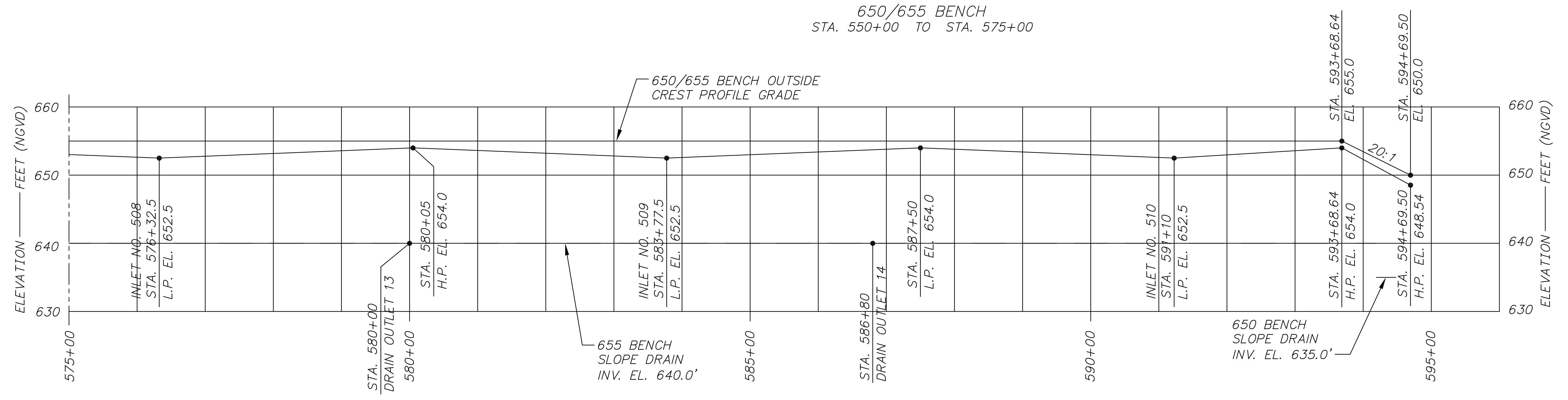
650/655 BENCH
STA. 500+00 TO STA. 525+00



650/655 BENCH
STA. 525+00 TO STA. 550+00



650/655 BENCH
STA. 550+00 TO STA. 575+00



650/655 BENCH
STA. 575+00 TO STA. 594+69.50

CONTOURS AND GRADES REPRESENT THRU 2023.
AS-DESIGNED CONFIGURATION ONLY.
FIRST BENCH DIRT COVER COMPLETED IN 2006.

NOTES

1. EXISTING SURFACE WATER COLLECTION PIPES AND INLETS BETWEEN STATION 512+00 AND 534+00 TO REMAIN.
2. SEE DETAIL 7, DWG. NO. 10235-14 FOR BENCH GRADING DETAILS.

R											
R 0	12/3/07	CWH	SEL	DRD	SRC	LJP	JCK		WCF408		J
INITIAL ISSUE PER DCN WCF-04-1016-008											
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD

DISCIPLINE INTERFACE
1
2
3
4

SCALE: 1"=100' HORIZ & 1"=10' VERT EXCEPT AS NOTED

YARD
UNITS 7 & 8

FORCE OXIDATION GYPSUM STACKING
PHASE 1 & 2 – 650/655 BENCH
PROFILE SHEET

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
			Samuel R. Cathey	Leonard J. Peterson	L.J. Peterson for John C. Kammeyer	

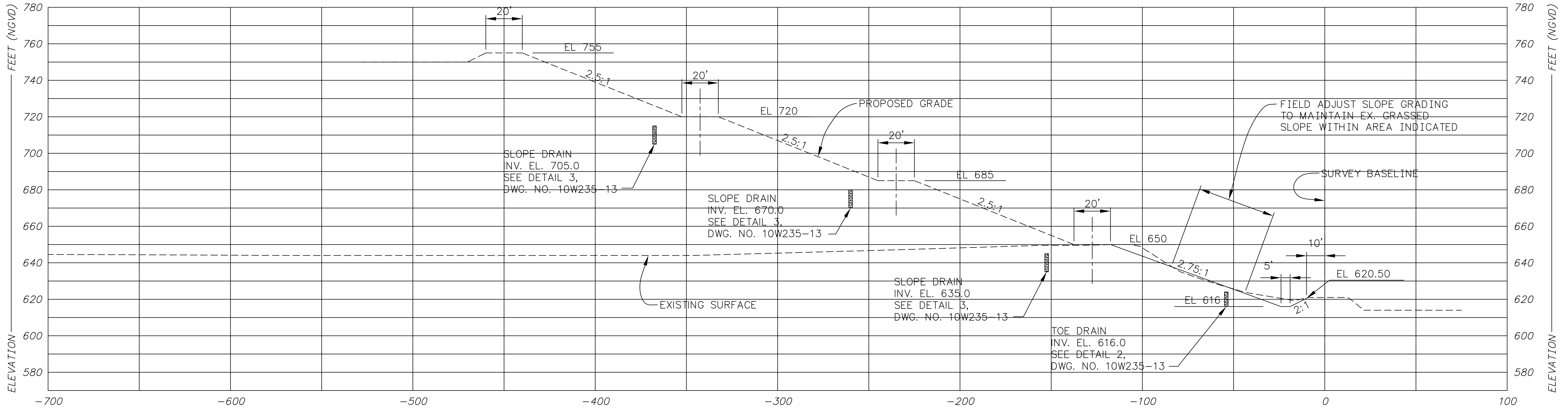
WIDOWS CREEK FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2K	DATE	34	C	10W235-8	R 0

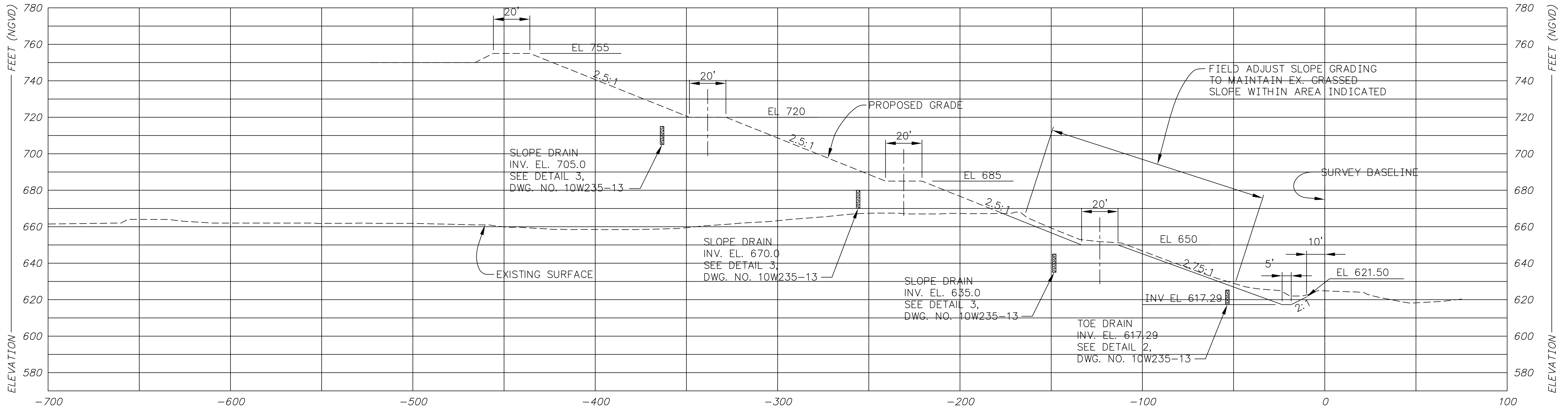
PLOT FACTOR:100
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

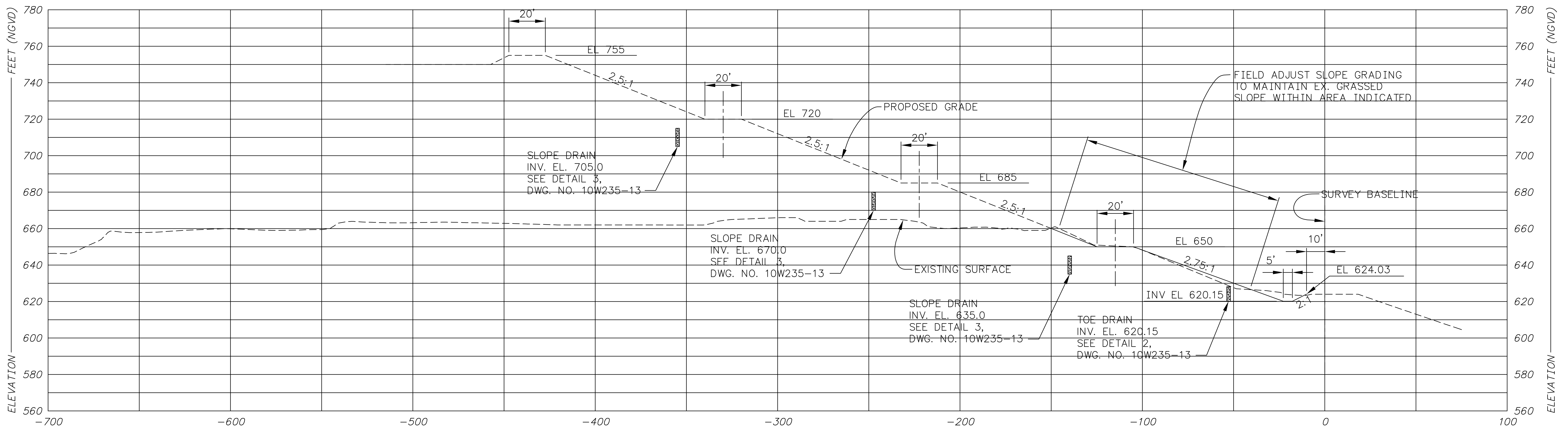
TASK COMPLETED BY:	REV NO.



SECTION A-A
STATION 314+00

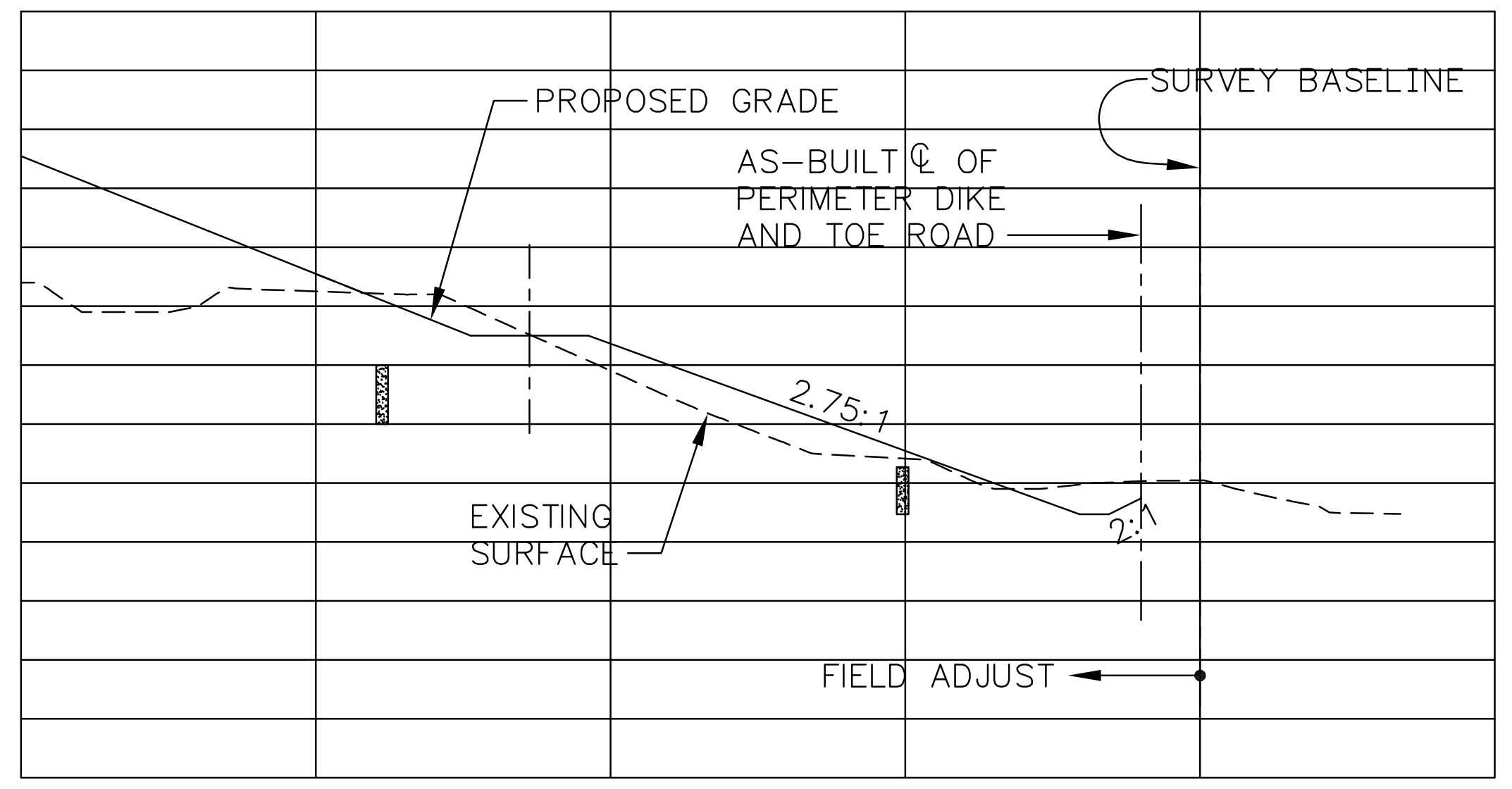


SECTION B-B
STATION 322+00



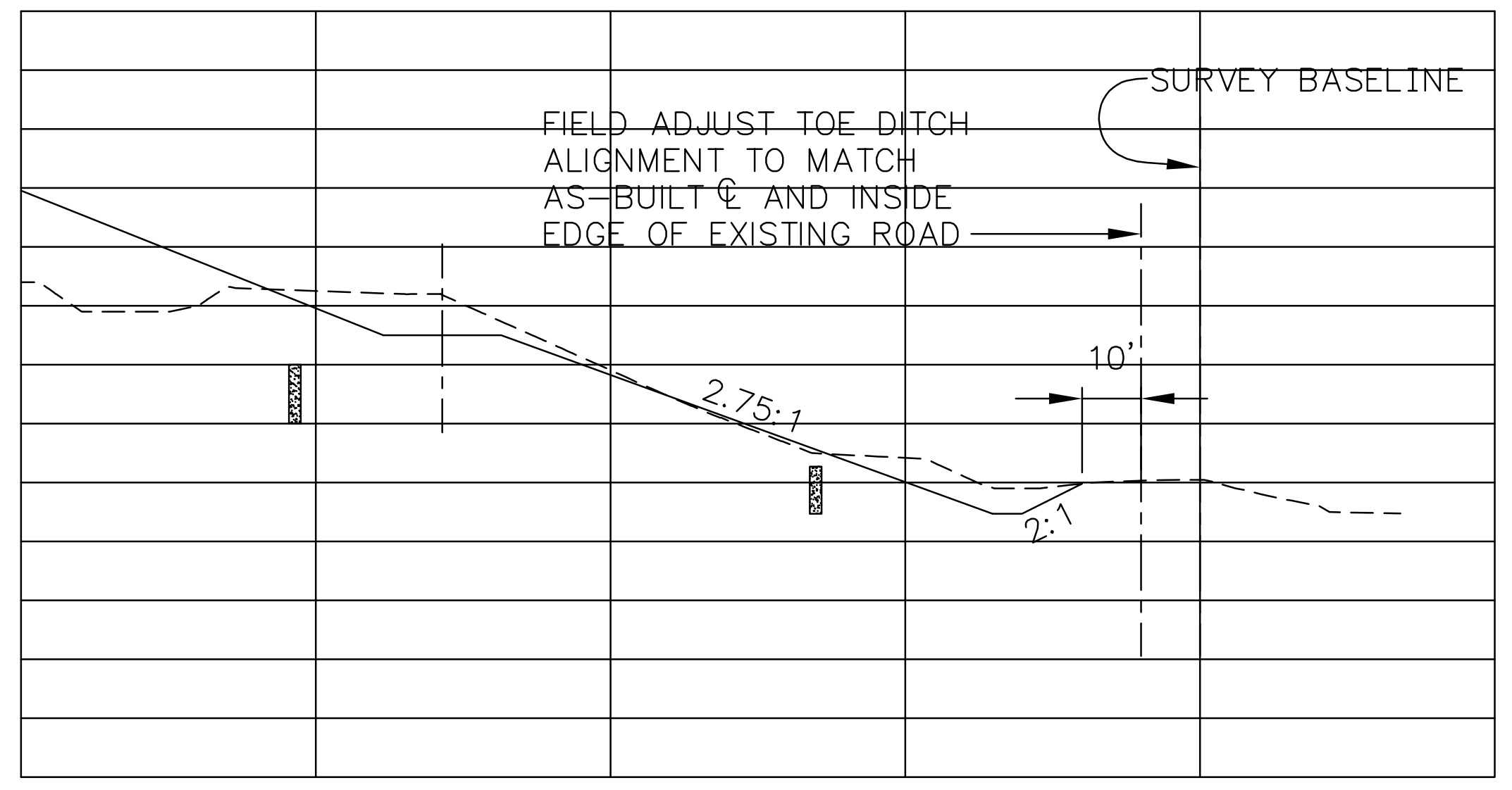
SECTION C-C
STATION 127+00

WHERE SURVEY BASELINE DOES NOT MATCH AS-BUILT TOE ROAD CENTERLINE, FIELD ADJUST TOE DITCH ALIGNMENT AND SLOPE GRADING TO MATCH ACTUAL TOE ROAD CENTRELINE AND INSIDE EDGE OF ROAD SHOWN BELOW.



BASELINE LAYOUT

(NOT CONSISTENT WITH AS BUILT GEOMETRY
FIELD ADJUST AS SHOWN BELOW)



FIELD ADJUSTED LAYOUT

DETAIL 10
SURVEY BASELINE FIELD ADJUSTMENT GUIDE
NOT TO SCALE

CONTOURS AND GRADES REPRESENT THRU 2023.
AS-DESIGNED CONFIGURATION ONLY.
FIRST BENCH DIRT COVER COMPLETED IN 2006.

LEGEND

——— *INITIAL CONSTRUCTION PHASE PROPOSED GRADE*
– – – *FUTURE CONSTRUCTION PHASES PROPOSED GRADE*

NOTES

1. *ELEVATIONS SHOWN ON THESE CROSS SECTIONS INDICATE FINISHED GRADES (TOP OF SOIL COVER OR FINISHED GYPSUM/FLYASH SURFACE)*

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R											
R 0	12/3/07	CWH	SEL	DRD	SRC	LJP	JCK		WCF408		J
INITIAL ISSUE PER DCN WCF-04-1016-009											

DISCIPLINE INTERFACE
1
2
3
4

SCALE: 1"=30' EXCEPT AS NOTED

YARD
UNITS 7 & 8

FORCED OXIDATION GYPSUM STACKING
PHASE 1 & 2
CROSS SECTIONS A THROUGH C

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
			Sam R. Cathey Samuel R. Cathey	LJ Peterson Leonard J. Peterson	LJP for JCK L.J. Peterson for John C. Kammeyer	

WIDOWS CREEK FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2K | DATE | 34 | C | 10W235-9 | R 0

PLOT FACTOR:30
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

TASK COMPLETED BY: | REV NO.