Closure Completion Notification for Closure by Removal

February 20, 2025
Closure Completion Notification
Mountaineer Plant
Bottom Ash Pond Complex

On February 20, 2025, the Mountaineer Power Plant's Bottom Ash Pond Complex transitioned to closed status in accordance with 40 CFR 257.102(c)(2). This notice of completion of closure is being placed in the operating record in accordance with 40 CFR 257.102(h).

Effective with the Closure Completion Notification, the former ash storage site is no longer a CCR unit. The following relevant operating record documents are no longer required going forward:

- Hazard Potential Classification
- Emergency Action Plan
- Face to Face Meeting Documentation for EAP
- History of Construction and Revisions for Surface Impoundments
- Structural Stability Assessments
- Safety Factor Assessments
- Fugitive Dust Plan
- Run on and Run off Plan
- Inflow Design Flood System Control Plan

CLOSURE CERTIFICATION BY QUALIFIED PROFESSIONAL ENGINEER

I certify that the Mountaineer Bottom Ash Pond Complex has been closed in accordance with the most recent written closure plan specified by paragraphs §257.102(c)(2)(iv) and the requirements of section §257.102.

David Anthony Miller
____
Printed Name of Licensed Professional Engineer

____
Signature

22663	West Virginia	02.20.2025
License Number	Licensing State	Date

VERDANTAS CERTIFICATION

Based on the construction observations performed by Verdantas representatives and confirmation laboratory analyses conducted, I hereby certify that the Bottom Ash Pond East Basin at the Mountaineer Plant in New Haven, West Virginia, as shown on the record drawing located in Appendix D, has achieved removal of all CCR material and soil with constituent concentrations above relevant background standards (i.e. closed by removal) in substantial compliance with the Mountaineer BAP Written Closure Plan (November 30, 2020), Construction Quality Assurance Plan for Pond Closure and Repurposing, Construction Drawings for the CCR/ELG closure by removal project, Bottom Ash Pond Closure and Repurposing Contract as provided by Worley (December 3, 2021), as per 40 CFR 257.102(c), and as clarified herein. The groundwater monitoring and compliance aspect of CCR Unit closure by removal criteria, as required by 40 CFR 257.102(c), will be certified under a separate report. The Contractor (R.B. Jergens) obtained the survey data used to develop the record drawing. R.B. Jergens verified that the elevations met the closure requirements, and Verdantas also reviewed the survey data.

Trent S. Hathaway, PE
Quality Assurance Officer/CQA Manager

Daniel P. Duffy, PE
Certifying Engineer
25332

12/6/2022

VERDANTAS CERTIFICATION

Based on the construction observations performed by Verdantas representatives and confirmation laboratory analyses conducted, I hereby certify that the Bottom Ash Pond West Basin at the Mountaineer Plant in New Haven, West Virginia, as shown on the record drawing located in Appendix D, has achieved removal of all CCR material and at least an additional one foot of underlying non-CCR material. Soil testing of the underlying non-CCR soil validate that the residual soil concentrations are below relevant de minimis remedial standards presented in the West Virginia Department of Environmental Protection's Voluntary Remediation and Redevelopment Rule (60CSR9, effective 12/2/2021) (i.e. closed by removal) in substantial compliance with the Mountaineer Bottom Ash Pond Written Closure Plan (August 31, 2023), Construction Quality Assurance Plan for Pond Closure and Repurposing, Construction Drawings for the CCR/ELG closure by removal project, Bottom Ash Pond Closure and Repurposing Contract as provided by Worley (December 3, 2021), as per 40 CFR 257.102(c), and as clarified herein. The groundwater monitoring and compliance aspect of CCR Unit closure by removal criteria, as required by 40 CFR 257.102(c), will be certified under a separate report. The Contractor (R.B. Jergens) obtained the survey data used to develop the record drawing. R.B. Jergens verified that the elevations met the closure requirements, and Verdantas also reviewed the survey data and relies upon R.B. Jergens' verification for the data's validity.

Trent S. Hathaway, PE
Quality Assurance Officer/CQA Manager

Daniel P. Duffy, PE
Certifying Engineer
25332

DANIEL P. DUFFY
REGISTERED
25332
STATE OF
WEST VIRGINIA
PROFESSIONAL ENGINEER

1/3/2024

HISTORY OF CONSTRUCTION

CFR 257.73(c)(1)

Bottom Ash Complex

Mountaineer Plant
New Haven, West Virginia

October, 2016

Prepared for : Appalachian Power Company

New Haven, West Virginia

Prepared by: American Electric Power Service Corporation

1 Riverside Plaza

Columbus, OH 43215

GERS-16-069

Table of CONTENTS

Attachments

1.0 OBJECTIVE

This report was prepared by AEP- Geotechnical Engineering Services (GES) section to fulfill requirements of CFR 257.73(c)(1).

2.0 DESCRIPTION OF CCR THE IMPOUNDMENT

The Mountaineer Power Plant is located near the City of New Haven, Mason County, West Virginia. It is owned and operated by Appalachian Power Company (APCo). The facility operates one surface impoundment for storing CCR called the Bottom Ash Complex.

The Bottom Ash Complex is comprised of diked embankments on the north, east, and west sides. The south side of the Bottom Ash Complex is incised. There are six main ponds within the Bottom Ash Complex as listed below. The Bottom Ash Ponds and Wastewater Ponds were designed in tandem; one Bottom Ash Pond and one Wastewater Pond are in service at a given time.

List of Main Ponds within the Bottom Ash Complex
East Bottom Ash Pond
West Bottom Ash Pond
East Wastewater Pond
West Wastewater Pond
Reclaim Pond
Clearwater Pond

3.0 SUMMARY OF OWNERSHIP 257.73(c)(1)(i)

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

The Bottom Ash Pond Complex is part of the Mountaineer Plant which is owned and operated by APCo. The Mountaineer Power Plant is located at 1347 Graham Station Road, Letart, WV, 25253 near the City of New Haven, Mason County, West Virginia. The Plant operates one surface impoundment for storing CCR called the Bottom Ash Complex. The State of West Virginia inventory ID number is #05307.

4.0 LOCATION OF THE CCR UNIT 257.73 (c)(1)(ii)

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

A location map is included in Attachment A.

5.0 STATEMENT OF PURPOSE 257.73 (c)(1)(iii)

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

The Bottom Ash Pond Complex is a surface impoundment for storing CCR. The Bottom Ash Ponds within the complex are used for primary settling and storage of bottom ash. The Wastewater Ponds provide secondary settling. Additional facility wastewaters (non-ash) are also discharged to the Wastewater and Clearwater Ponds.

6.0 NAME AND SIZE OF WATERSHED THE CCR UNIT IS LOCATED

257.73 (c)(1)(ıv)

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

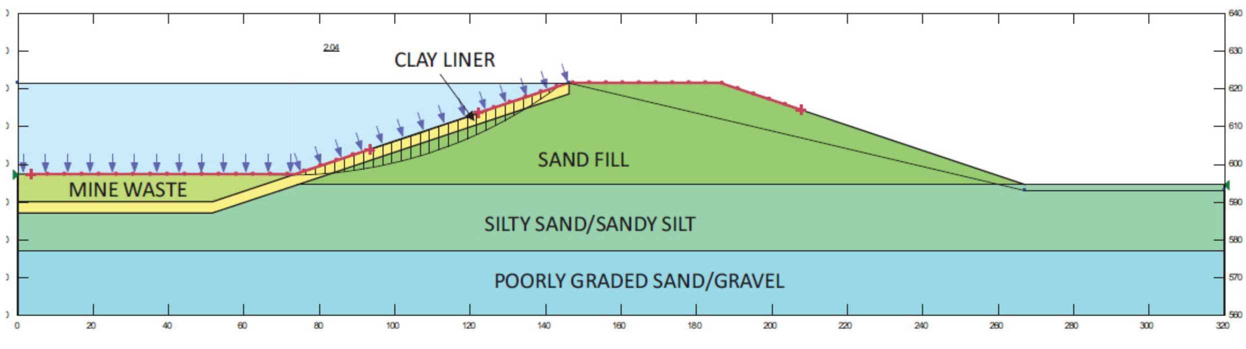
The Bottom Ash Pond Complex is located in the Upper Ohio-Shade watershed (HUC: 05030202) which has a listed acreage of approximately 897,312 acres. The Mountaineer Bottom Ash Complex is comprised of diked embankments on three sides which direct stormwater away from the impoundment and limit runoff to that which falls directly on the water surface. The land area to the south is open field area that is not generally graded toward the Bottom Ash Complex. Therefore, the area south of the impoundment does not contribute any runoff. The contributing watershed to the Bottom Ash Pond Complex is approximately 78 acres.

7.0 DESCRIPTION OF THE FOUNDATION AND ABUTMENT MATERIALS

257.73(c)(1)(v)

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

The foundation materials of the Bottom Ash Complex consist of Silty Sand / Sandy Silt – Very Loose to Loose (SM) materials overlaying Poorly Graded Sand/Gravel – Dense to Very Dense (SP or GP). See figure and material properties below:



Material	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (°)
Clay Liner	125	0	33
Mine Waste	140	0	36
Sand Fill	115	0	33
Silty Sand/Sandy Silt	115	0	28
Poorly Graded Sand/Gravel	120	0	34

8.0 DESCRIPTION OF EACH CONSTRUCTED ZONE OR STAGE OF THE CCR UNIT 257.73 (c)(1)(vi)

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

The impoundment was designed by Casagrande Consultants in 1977. The original dikes were constructed of homogeneous material from soil borrowed from the site. The soil used to construct the embankments as determined from soil borings and lab testing is dense to very dense sand with ϕ angle of 33° and cohesion of 0 psf. The impoundment was also constructed with a clay liner to control seepage. Construction records are unavailable however; the original design report and geotechnical details of the original dike system are included in Attachment B.

In 2006, the north and west embankments were modified to accommodate a gypsum conveyor system. The following is a summary of the 2006 modifications. A detailed engineering report describing these modifications is included in Attachment B.

- Additional fill was placed along the length of the downstream side of the north embankment to accommodate the conveyor and an access road
- Additional fill was placed at the toe of the northwest corner of the Bottom Ash Complex to accommodate a transfer house.
- Approximately 1300' linear feet of the downstream side of the west embankment was modified to accommodate the conveyor and access road. During construction of the conveyor, the cut areas were reinforced using geotextile, compacted soil and rip rap.

9.0 ENGINEERING STRUCTURES AND APPURTENANCES, 257.73 (c)(1)(vii)

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

The perimeter dike is approximately 7600 L.F. with a crest width of approximately 30' wide and inboard and outboard slopes of 2.5 to 1. A summary of the crest elevations of each pond is listed below.

	Crest Elevation
East Bottom Ash Pond	620.0
West Bottom Ash Pond	620.0
East Wastewater Pond	612.0
West Wastewater Pond	612.0
Reclaim Pond	610.0
Clearwater Pond	610.0

The outlet works for the Bottom Ash Pond cells consists of a reinforced concrete drop inlet structure with weir openings on three sides which include slide stop logs approximately 3-feet wide. A wooded surface skimming structure is constructed around the weir box. The outlet works of the Wastewater Pond cells consist of a 250-feet long concrete weir. The weir discharges into a concrete chute which transitions into a box structure leading to a junction chamber. The chamber controls flows from the Wastewater Ponds into the Reclaim Pond and/or Clearwater Pond. The outlet works for the Clearwater pond consists of a 185-feet long concrete weir. The weir discharges into a concrete structure and into a discharge pipe to the Ohio River. The engineering drawings of the engineering structures and appurtenances are included in Attachment C.

Drainage is diverted around the Bottom Ash Pond Complex by natural drainage channels and grass lined ditches.

Slope protection along the inboard and outboard slope consists primarily grass vegetation and portions that are rip rapped.

A map with instrumentation locations in provided in Attachment D.

10.0 SUMMARY OF POOL SURFACE ELEVATIONS, AND MAXIMUM DEPTH OF CCR, 257.73 (c)(1)(vii)

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

The table below describes the normal pool elevations and maximum pool elevations as well as maximum depth of CCR within the impoundment.

	Bottom Ash Pond (East and West)	**Wastewater Pond (East and West)**	**Clearwater Pond**
Normal Pool Elevation	612.0	609.0	603.0
Maximum Pool Elevation following peak discharge from inflow design flood	613.3	609.3	603.6
Expected Maximum depth of CCR within impoundment	30 ft	Minimal	Minimal

11.0 FEATURES THAT COULD ADVERSELY AFFECT OPERATION DUE TO MALFUNCTION OR MIS-OPERATION (257.73 (c)(1)(vii))

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

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

12.0 DESCRIPTION OF THE TYPE, PURPOSE AND LOCATION OF EXISTING INSTRUMENTATION 257.73 (c)(1)(viii)

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

The Bottom Ash Pond Complex has 3 piezometers located within the structure of the dam. These piezometers are read on a minimum of every 30 days for the purpose of determining the phreatic water level within the dike. A location map is provided in Attachment D.

13.0 AREA – CAPACITY CURVES FOR THE CCR UNIT 257.73 (c)(1)(ix)

[Area-capacity curves for the CCR unit.]

The area capacity curves for the Bottom Ash Pond Complex are included in the Hydrology and Hydraulic Analysis Report by Terrecon, September 2015 in Attachment E.

14.0 DESCRIPTION OF EACH SPILLWAY AND DIVERSION 257.73 (c)(1)(x)

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

The CCR and stormwater are pumped into the facility through a series of pipes designed to handle the various required capacities. The pipes discharge into the facility through concrete vaults to handle the inflows. The inflow from the Bottom Ash Ponds flows into the Wastewater Ponds through a reinforced concrete drop inlet structure with weir openings on three sides connected to a 48 inch diameter steel pipe located in the southern dikes of the Bottom Ash Ponds. The Wastewater Ponds drain either to the Reclaim Water Pond or the Clearwater Pond through a gated distribution structure. A 36 inch diameter steel pipe connects the Reclaim Pond to the Clearwater Pond. Effluent from the impoundment facility is discharged through an outlet structure located in the Clearwater Pond. The outlet structure consists of a concrete overflow channel leading to a vault/riser with a 30-inch diameter metal outflow pipe. The outflow pipe leads to a dissipation structure and another 30 inch steel pipe from the dissipation structure to an outfall at the Ohio River. Complete details of each spillway structure are included with the design drawings in Attachment C. Hydrology and Hydraulic Analysis which include calculations for each spillway structure are included in Attachment E.

The Mountaineer Bottom Ash Complex is comprised of diked embankments on three sides which direct stormwater away from the impoundment and limit runoff to that which falls directly on the water surface. The land area to the south is an open field area that is not generally graded toward the Bottom Ash Complex. Therefore no formal diversions are present for this facility.

15.0 SUMMARY CONSTRUCTION SPECIFICATIONS AND PROVISIONS FOR SURVEILLANCE, MAINTENANCE AND REPAIR 257.73 (c)(1)(xi)

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

Construction of the Bottom Ash Complex was completed around 1979. A Geotechnical Report by Casagrade Consultants completed in 1977 provided recommendations for construction of the Bottom Ash Pond. This report has been provided in Attachment E.

As required by the CCR rules the Bottom Ash Pond Complex is inspected at least every 7 days by a qualified person. Also as a requirement of the CCR rules the impoundment is also inspected annual by a professional engineer. Additionally, as a requirement by the State of West Virginia the impoundment is inspected once a month.

An impoundment maintenance plan is provided in Attachment F. If repairs are found to be necessary during any inspection they will be completed as needed.

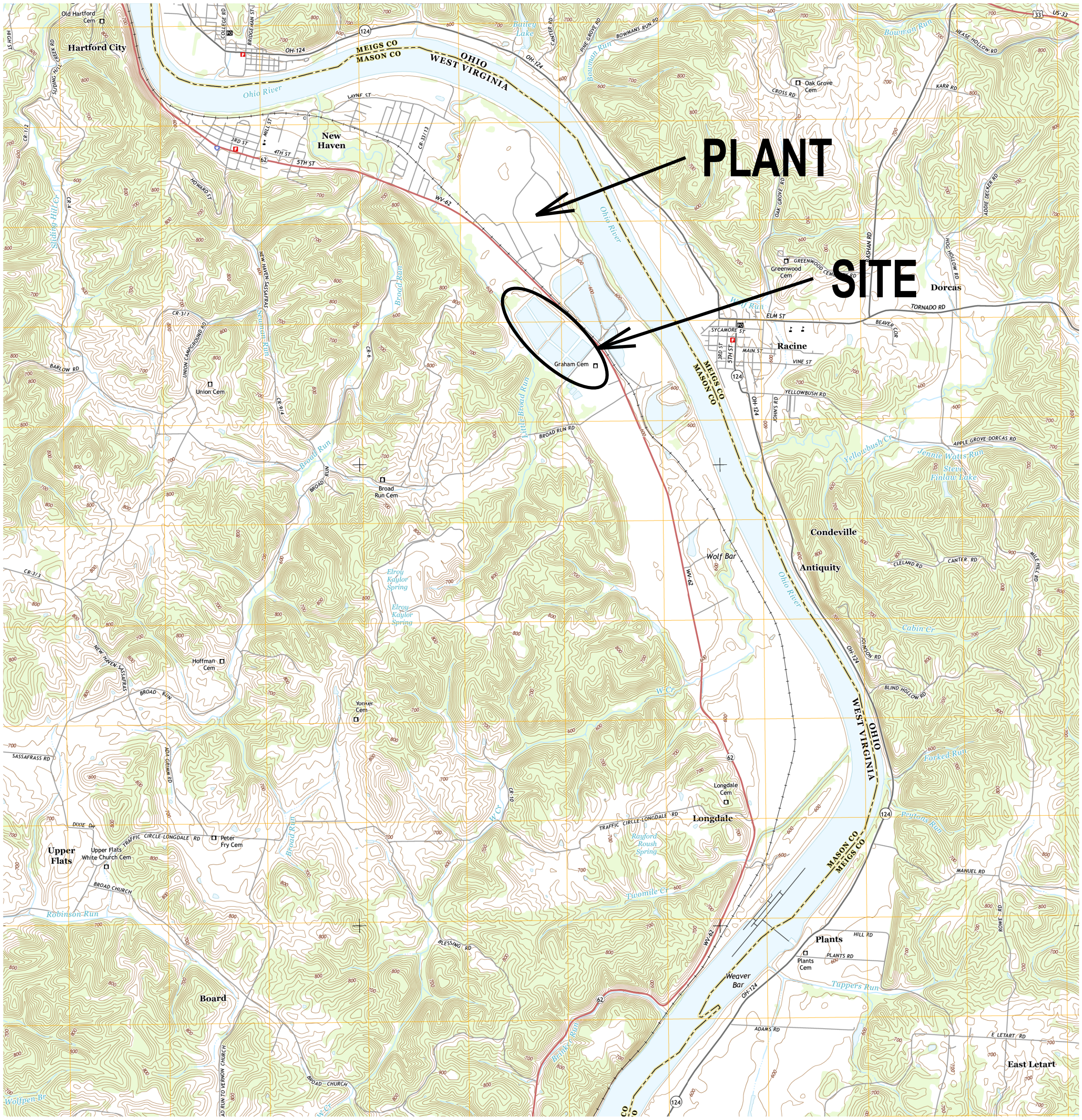
16.0 RECORD OR KNOWLEDGE OF STRUCTURAL INSTABILITY 257.73 (c)(1)(xii)

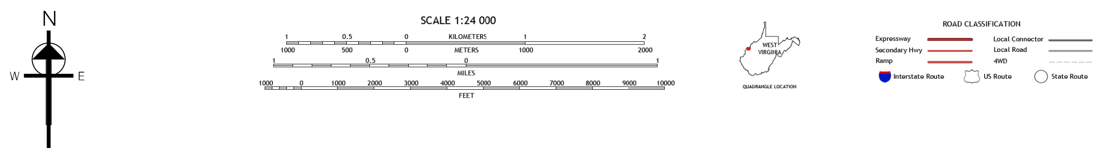
[Any record or knowledge of the structural instability of the CCR unit.]

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

ATTACHMENT A

LOCATION MAP





THIS DRAWING IS CLASSIFIED AS:

REFERENCE AEP's CORPORATE INFORMATION SECURITY POLICY

APPALACHIAN POWER COMPANY

MOUNTAINEER PLANT

NEW HAVEN WEST VIRGINIA

UNIT:

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USGS TOPO MAP

7.5-MINUTE SERIES

AEP AMERICAN ELECTRIC POWER

AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

BY: s259464

PLOT TIME: 2:02:56 PM

PLOT DATE: 10/4/2016

CROSS REFS:

A (8.5"x11")

ATTACHMENT B

DESIGN REPORTS

Arthur Casagrande
Leo Casagrande
Dirk R. Casagrande

CASAGRANDE CONSULTANTS FOUNDATIONS & EARTHWORKS

April 18, 1977

4/19

Mr. John R. Struyk
Asst Vice President and Chief Civil Engineer
American Electric Power Service Corp.
2 Broadway
New York, N.Y. 10004

Subject: Project 1301
Bottom Ash Ponds

Dear Mr. Struyk:

We transmit herewith five copies of our report on the proposed bottom ash ponds for Project 1301. Please let us know if you should require additional copies.

Sincerely yours,

D. R. Casagrande

40 Massachusetts Avenue, Arlington, Massachusetts 02174 Tel (617) 648-3630
Pierce Hall, Cambridge, Massachusetts 02138 Tel (617) 495-2843 or 648-3630

Arthur Casagrande
Leo Casagrande
Dirk R. Casagrande

CASAGRANDE CONSULTANTS FOUNDATIONS & EARTHWORKS

4/19

April 15, 1977

Mr. John R. Struyk
Asst Vice President and Chief Civil Engineer
American Electric Power Service Corporation
2 Broadway
New York, N.Y. 10004

Subject: Project 1301
Bottom Ash Ponds

Dear John:

In response to Paul Anderson's letter of March 1, we submit below the results of our investigations regarding

(1) the existing subsurface conditions in the proposed pond area;
(2) the suitability of the clay from the coal storage area for lining of the ash ponds;
(3) the proposed cross-section of dikes;
(4) stability and settlement analyses, and seepage and underseepage studies, as required by the Department of Natural Resources, State of West Virginia; and
(5) supports for the pipeline and truck bridges over Route 33.

Subsurface Conditions in Area of Bottom Ash Ponds

The locations of 15 exploratory borings which were made in the area of the proposed bottom ash ponds, are shown in Fig. 1. The borings were made by the AEP Civil Engineering Laboratory during the period October 1976 to March 1977. The logs of these borings are contained in Appendix II. The elevation of the existing ground surface in the area of the proposed bottom ash ponds ranges between about El. 593 and 615.

40 Massachusetts Avenue, Arlington, Massachusetts 02174 Tel. (617) 648-3630
Pierce Hall, Cambridge, Massachusetts 02138 Tel. (617) 495-2843 or 648-3630

Our description of the split-spoon samples and the results of classification tests are contained in Tables 1 to 15 in Appendix I. The results of the liquid and plastic limit tests are also plotted on the plasticity chart in Fig. 2.

At 8 of the 15 borings (401 to 404, 406, 409, 412 and 415), clayey or silty fine sand extends from the ground surface to a depth of 10 to 20 ft. At 5 borings (407, 408, 410, 411 and 413) the top stratum consists of clean fine sand and/or fine to medium sand, which extends to a depth of 30 to 60 ft. At 2 borings (405 and 414) the upper approximately 5 ft consist of silty and sandy clay, underlain by 15 to 20 ft of clean fine sand or fine to medium sand.

Grain size distributions of representative samples from the top 15 ft of overburden are plotted in Fig. 3. At all borings the granular soils become coarser with depth, and at 13 of the 15 borings sand-gravel was found at depths ranging from 18 to 58 ft.

The ground water level during drilling was found to range between 47 ft and 60 ft below ground surface.

Suitability of Clay from 1301 Coal Storage Area for Lining of Ponds

Four split-spoon borings were made in the coal storage area at Project 1301, to investigate the suitability of the clay for lining of the ponds against seepage. The logs of these borings, 505, 506, 513 and 514, are included in Appendix II. We did not receive a boring location plan.

Three of the borings disclose clay to depths ranging from about 5 ft to 20 ft, but there was apparently no clay at Boring 506. As shown in Tables 16 to 19 of Appendix I, and in the plasticity chart in Fig. 2, the clay ranges from very sandy, with a liquid limit of 30, to relatively plastic clay with a liquid limit of 51.

We performed one permeability test to establish whether the most pervious of the clay samples, i.e. the very sandy clay from a depth of about 4 ft in Boring 505, would be acceptable for lining the ponds. For the test, the clay was compacted at the natural water content into a 4 cm long cylindrical specimen with a diameter of 3.6 cm. During compaction it was noticed that the natural water content is considerably above standard optimum. The specimen was saturated, consolidated and tested for permeability in a triaxial chamber under an effective confining pressure of 0.5 kg/cm^2. During consolidation, the water content decreased from 21.4% to 17.3% The computed coefficient of permeability was $k = 2.2 \times 10^{-8}$ cm/sec. Because the more plastic clays are less pervious than the very sandy clay, it can be concluded that all clays from the coal storage area are suitable for lining ash ponds, provided (1) that they are compacted within $\pm$ 2% of standard optimum water content and (2) that the thickness of the clay lining is not less than 3 ft.

Proposed Cross-Section of Dikes

AEP proposes to construct the dikes using the soils excavated from within the pond area. The required depth of excavation to reach grade elevation within the ponds increases from about 7 ft within the area of the north ponds, to about 16 ft in the area of the south ponds. The two borings which were made within the areas of the north ponds, and the borings along the alignment of the dikes indicate that most of the soils to be used for the dikes range from silty and clayey fine sand to fine to medium sand. In compacted state, such soils have satisfactory strength properties, but are very susceptible to erosion by runoff during rain and due to leakage from the pipes along the crest. Therefore, the crest and downstream slope of the dike must be adequately protected against erosion.

The height of the dikes above original ground surface decreases from about 27 ft at the northeast corner of the area, to zero at the southeast corner. A typical cross-section is shown in Fig. 4, which includes a layer of mine waste (1) on the outside slope for protection against erosion, (2) on the inside slope for protection of the clay lining against damage and (3) on the crest for erosion protection and as a road base. Mine waste is available at the nearby Philip Sporn coal mine. The grain size curve of a sample of this material, shipped to us by the AEP Civil Engineering Laboratory, is plotted in Fig. 5. This well-graded material would be suitable for the proposed uses.

The mine waste on the crest of the dikes should be covered with a layer of compacted crushed stone. Where heavy equipment and trucks will be operating on the crest of the dikes, the thickness of crushed stone should be at least 18 in. A plastic filter fabric on the crest, as recommended in our letter of January 31, will not be required if the mine waste is used.

For surface drainage, the crest must be sloped not less than 3% in downstream direction, and the interface between mine waste and underlying fine sand should have a parallel slope.

Stability, Settlement and Seepage Analyses

1. Stability - To obtain an indication of the strength of the materials to be used for the main portion of the dikes, we performed one triaxial S (consolidated-drained) test on a compacted specimen of silty fine sand. Because the individual split-spoon samples did not contain sufficient material to form a test specimen, Sample 1 from Boring 406 was mixed with Sample 1 from Boring 415. These samples have similar grain size curves, as shown in Fig. 3. The results of this test, plotted in Fig. 6, show that the angle of internal friction of this compacted specimen is ϕ = 40.4 degrees. Therefore, the stability of these dikes

with the proposed 1 on 2.5 slopes (Fig. 4) is not controlled by the angle of internal friction of the compacted dike material, but rather by the strength of the foundation strata.

The weakest soil encountered in the borings was a silty clay from a depth of 3.5 to 5.0 ft in Boring 405. As received, the split-spoon sample was very soft. However, the N-value of 7 blows/ft indicates that the in situ consistency is firm to stiff. The log of Boring 405, in Appendix II, does not give the thickness of this layer. Its in situ consistency, thickness and lateral extent should be investigated before the dikes are constructed.

The areas under the dikes should be proofrolled, after stripping, with a loaded scraper or dump truck. Areas where weaving is noticed should be investigated and any soft to firm clay should be excavated.

For the stability analysis, we have assumed that locally some firm clay is overlooked, and is not excavated from the foundation of the dikes. In addition, the following assumptions were made:

1. The maximum height of dike (27 ft) is directly underlain by firm clay with a shear strength of 0.5 ton/sq ft.
2. The upstream and downstream slopes of the dikes are 1 on 2.5.
3. The minimum crest width of the dike is 30 ft.
4. The end-of-construction condition, with no water or ash in the ponds.
5. The unit weight of the dike materials is 130 pcf.
6. At-rest coefficient of earth pressure in the dikes, $K_o = 0.5$.
7. The seismic coefficient during an earthquake is 0.1.

For these assumptions, the factor of safety during an earthquake, computed as shown in Fig. 7, is FS = 3.2. This factor of safety corresponds to a mobilized friction angle of 25°, which is reasonable for a silty clay. Where the dikes are underlain only by granular soils, the factor of safety would be greater because even loose sand would have an angle of friction larger than 25°. The condition where the pond is filled with water and ash does not govern the stability because the at-rest earth pressure acting in upstream direction at the center of the dike is greater than the pressure of the ash and water acting in downstream direction.

2. Settlement - With some local exceptions, the dikes will be underlain only by granular soils. The majority of the standard penetration resistances within 20 ft of the ground surface exceed 10 blows/ft which, for sand, indicates a relative density of at least 50%. However, some of the penetration resistances were less than 10 blows/ft, with the lowest value of 6 blows/ft in fine sand at a depth of 9 ft in Boring 407, 19 ft in Boring 408 and 29 ft in Boring 412, and such relatively loose sands will contribute to settlements.

The settlements of the higher portions of the dikes due to compression of the top 20 ft of fine sand may range between 2 and 4 in., and will develop during construction. Any differential settlements will be very gradual and will also be completed by the time the dikes are finished. Settlements due to compression of a well compacted fill in the dike and due to the lower foundation strata will be less than 1 in., and will be completed as soon as the dikes reach crest elevation.

Because all soft to firm clay will have to be excavated from the foundation of the dikes, such clay will not contribute to settlements. Any stiff clay has been preconsolidated to loads in excess of the load applied by the highest portion of the dikes and would, therefore, not contribute significantly to settlements.

3. <u>Seepage and Underseepage Analyses</u> - If the ponds are lined with a layer of well compacted clay at least 3 ft thick, seepage from the pond will be very small. For the conservative assumptions of the sandy clay lining with a coefficient of permeability $k = 2.2x10^{-8}$ cm/sec and of the maximum 22 ft depth of water in the pond, the rate of leakage through the lining in the bottom of the pond will be

$$q = k.i.A.t = 0.003 \text{ gallon/sq ft/day}$$

where

i = hydraulic gradient = 22/3

A = area

t = time

Therefore, for one of the larger ponds, the total seepage through the lining will be at the rate of about one gal/min.

The water seeping through the bottom lining will percolate vertically through the underlying relatively pervious strata to the ground water table at a depth of 47 to 60 ft below existing ground surface.

Because the granular soils in the dikes will be much more pervious than the clay lining on the inside slopes of the dikes, all water which seeps through the lining will also flow vertically to the base of the dike. Where the dikes are underlain only by granular soils, this water will then continue vertically through the in situ soil toward the ground water table. However, where clay directly underlies the dikes, the water will in part flow horizontally toward the downstream toe of the dike. With full pond, the rate of seepage through the clay blanket on the inside slope of the dikes will vary from about 0.003 gal/sq ft/day at the bottom of the slope to zero at pond level.

If the bottom lining is seriously damaged during reclaiming operations, the seepage through the "windows" in the lining will flow down to the ground water table and there will be no underseepage beneath the dikes.

Supports for Pipeline Bridge and Truck Bridge

Together with the logs of the borings made in the coal storage area, we received the logs of Borings 701 and 703 which were made for the proposed pipeline bridge, and Borings 801, 802 and 803 for the truck crossing bridge. However, we did not receive a location plan for these borings, nor any samples. The logs of these borings are included in Appendix II.

According to the boring logs the top 5 to 8 ft at Boring 701 consist of stiff to v. stiff clay, which is underlain by granular soils down to bedrock at a depth of 80.5 ft. At Boring 703, the clay stratum appears to be 15 to 18 ft thick, of which the top 10 ft are probably stiff to very stiff and the lower 5 to 8 ft may be only of firm consistency. The clay stratum at Boring 703 overlies granular soils which extend to bedrock at a depth of 83 ft.

In Boring 801, at the proposed truck bridge, approximately 8 ft of compact ash and gravel fill are underlain by about 10 ft clayey and sandy silt which gradually becomes coarser with depth. At Borings 802 and 803, the fill is absent; and the clayey silt at Boring 802 is approximately 13 ft thick, and about 7 ft thick at Boring 803.

Without detailed information on the design of the bridges and loads involved, we can only offer the following tentative opinion:

1. If the bridge structures are designed so as to permit differential settlements of a least one inch between neighboring piers, spread foundations are feasible.
2. The allowable bearing capacity of the upper stiff to very stiff clay and clayey silt may be of the order of 1 to 2 tsf. The ash and gravel fill would probably permit greater unit loads.
3. If spread footings are contemplated, determination of the allowable design load and resulting settlements would require testing of undisturbed samples of clay and clayey silt.

Conclusions and Recommendations

1. All topsoil and soft to firm clay should be removed from the area of all dikes.
2. The local silty or clayey fine sands may be used for construction of dikes with sideslopes of 1 on 2.5, provided these materials are compacted in lifts not exceeding 6 in., measured after spreading, and provided the slopes and crest are protected against erosion.
3. Judging from experience, we believe that topsoil and vegetation would not offer adequate protection against erosion of slopes constructed of such fine sand. The outside slopes should be covered, as shown in Fig. 4, with well-graded crushed stone or mine waste of the type available at the Sporn mine. The slope surface could then be covered with topsoil and seeded, except for the bottom 2 ft to permit free drainage at the downstream toe.
4. The clay from the coal storage area is well suited for lining the ponds. The bottom of the ponds and the inside dike slopes should be lined with 3 ft of this clay, compacted in thin lifts at water contents within $\pm$ 2% of standard optimum.

The total loss of water by seepage from one of the larger ponds, with maximum pond level, would be about one gallon per minute. There will be no underseepage beneath the dikes.

5. In order to reduce the danger of severe damage to the lining on the inside slope of the dikes during dragline excavation of bottom ash, a protective cover of mine waste or crushed stone, as shown in Fig. 4, is recommended. During reclaiming, a protective layer of bottom ash should be left at the bottom of the ponds, to prevent damage to the bottom lining.

6. Dikes subjected to heavy traffic loads will require an 18 in. layer of crushed stone, on top of a 3 ft layer of mine waste.

7. The crest of the dikes should be sloped transversely toward the outside edge of the crest, not less than 3%.

8. The total settlements of the highest portions of the dikes may range between 2 and 4 in. These settlements will develop almost entirely during construction.

9. The factor of safety against failure of the highest portion of the dikes is 3.2 if underlain by clay, and greater where underlain by granular soils.

10. If the pipeline bridge and truck bridge are to be supported on spread footings, the allowable bearing capacity of the clay and the magnitude of settlements should be investigated by means of undisturbed samples.

Sincerely yours,

L. Casagrande

L. Casagrande

LC:wc

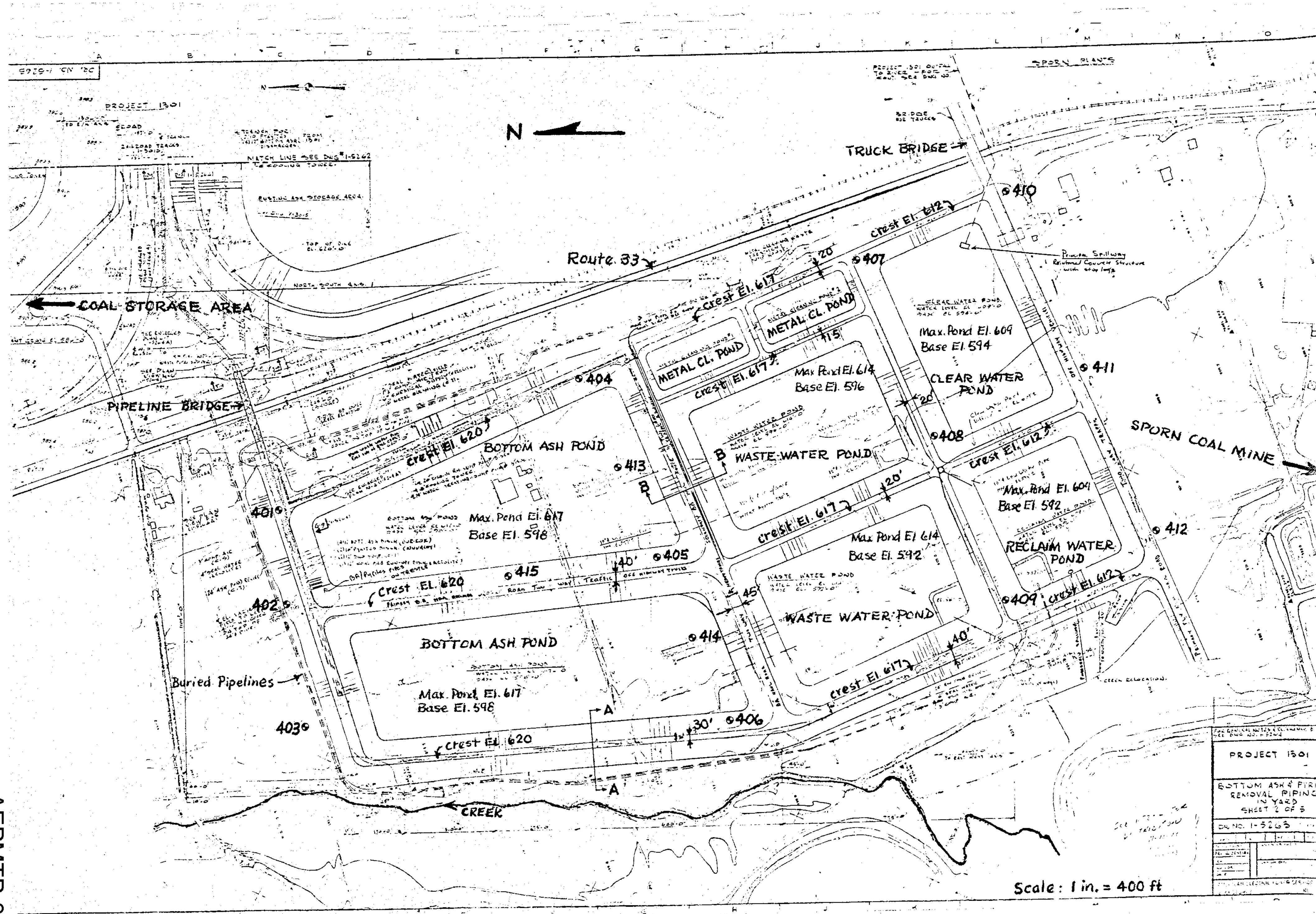


FIG. 1 - LOCATIONS OF BORINGS IN AREA OF BOTTOM ASH PONDS

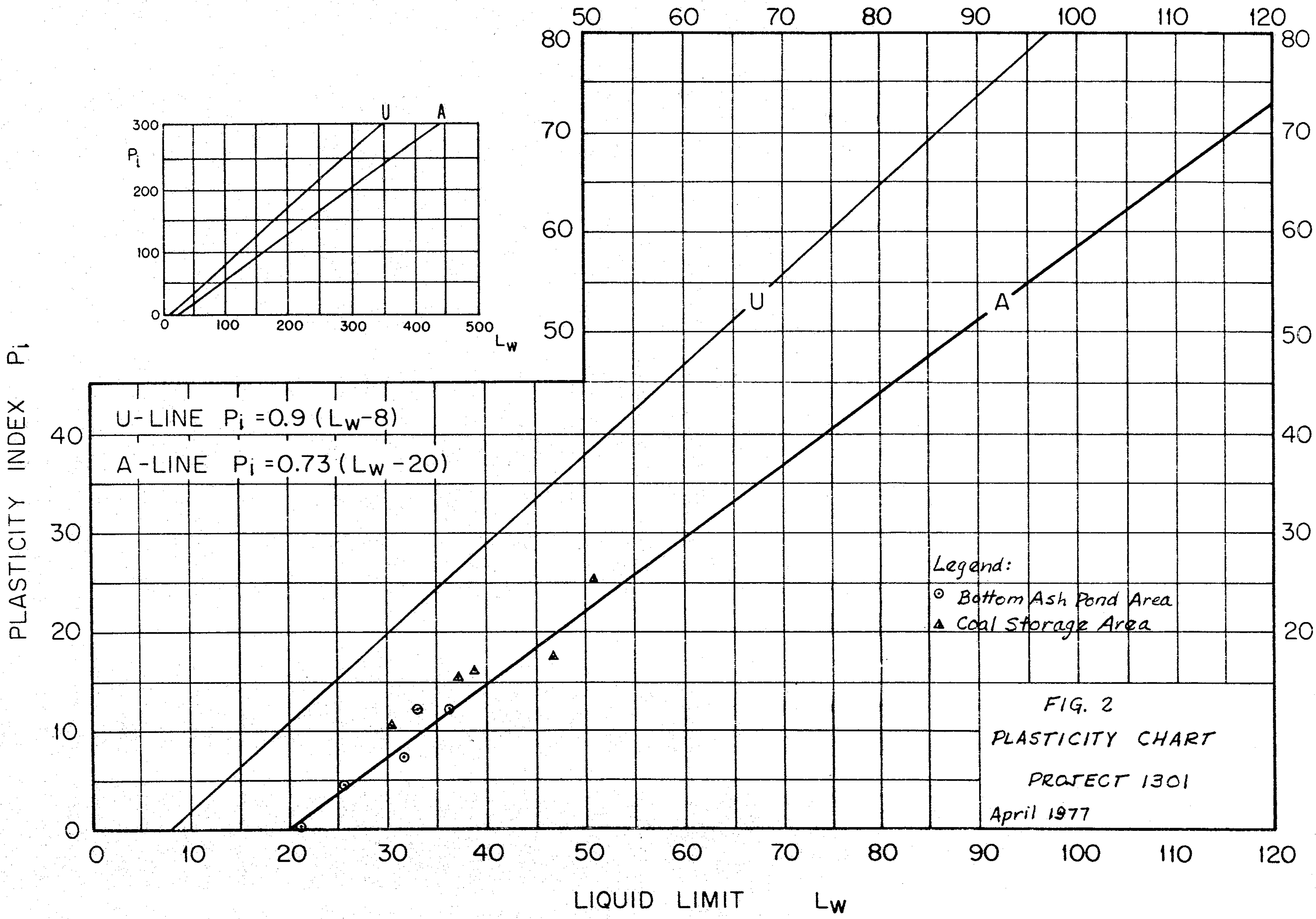
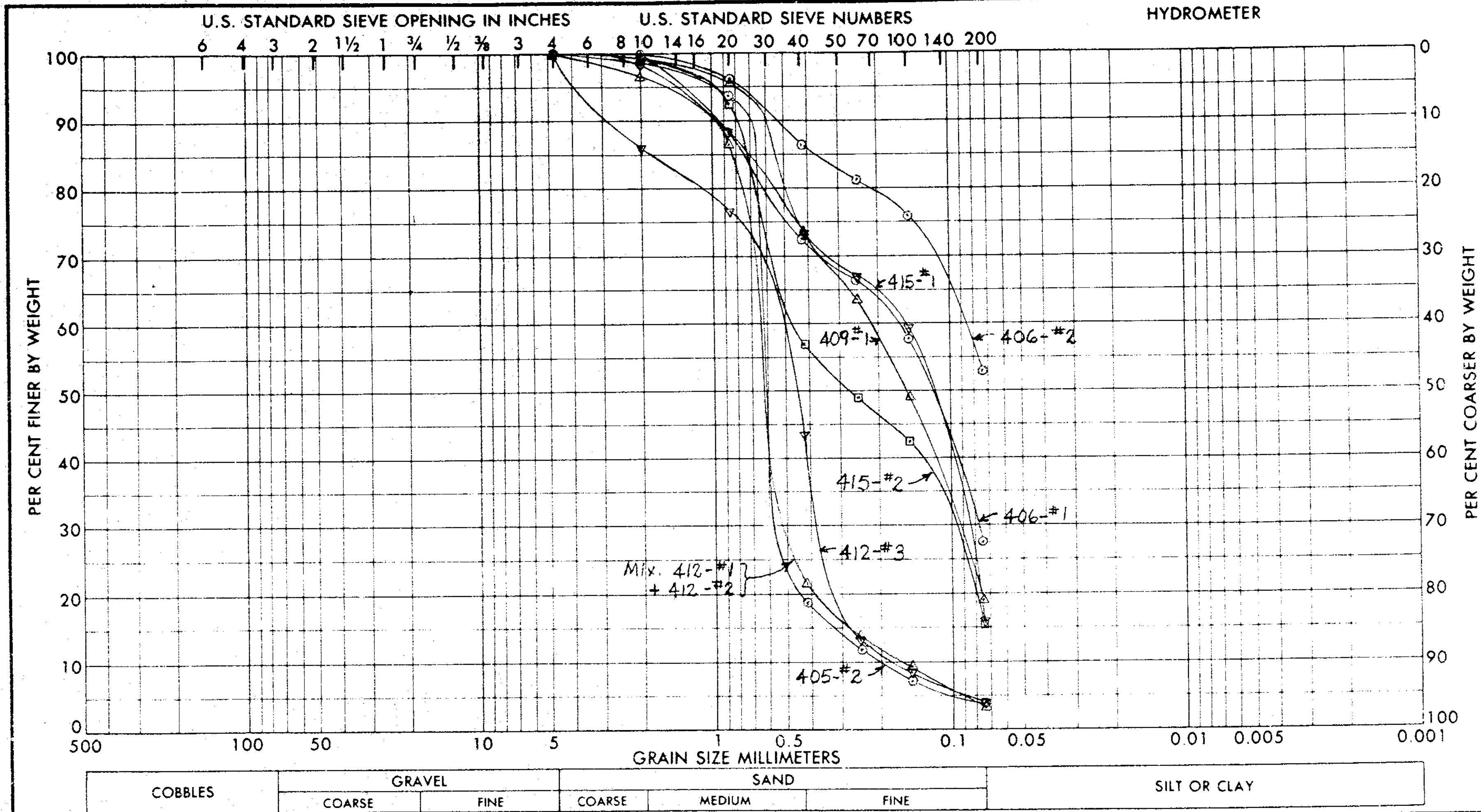


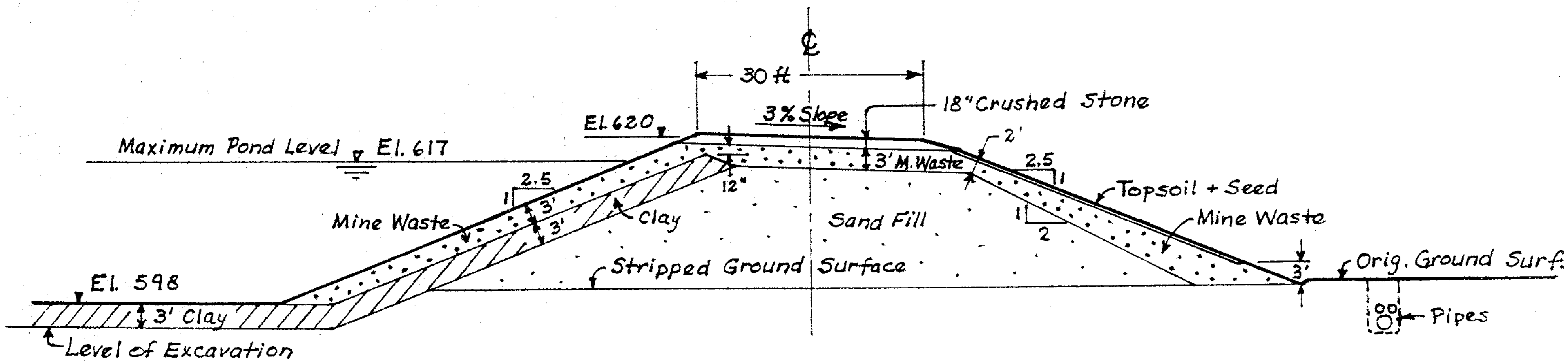
FIG. 2
PLASTICITY CHART
PROJECT 1301
April 1977



BOR. + SAMP. No.	DEPTH, ft	CLASSIFICATION	NAT W%	LL	PL	PI
405-#2	8.5-10.0	Brown silty fine to medium sand				
406-#1	3.5-5.0	Brown, very silty fine to medium sand				
406-#2	8.5-10.0	Brown fine sandy silt				
409-#1	3.5-5.0	Brown silty fine sand				
412-#1 + #2	3.5-10.0	Brown clayey fine to medium sand				
412-#3	13.5-15.0	Brown clayey fine to coarse sand				
415-#1	3.0-4.5	Brown clayey fine to medium sand				
415-#2	8.0-9.5	Brown clayey fine to medium sand				

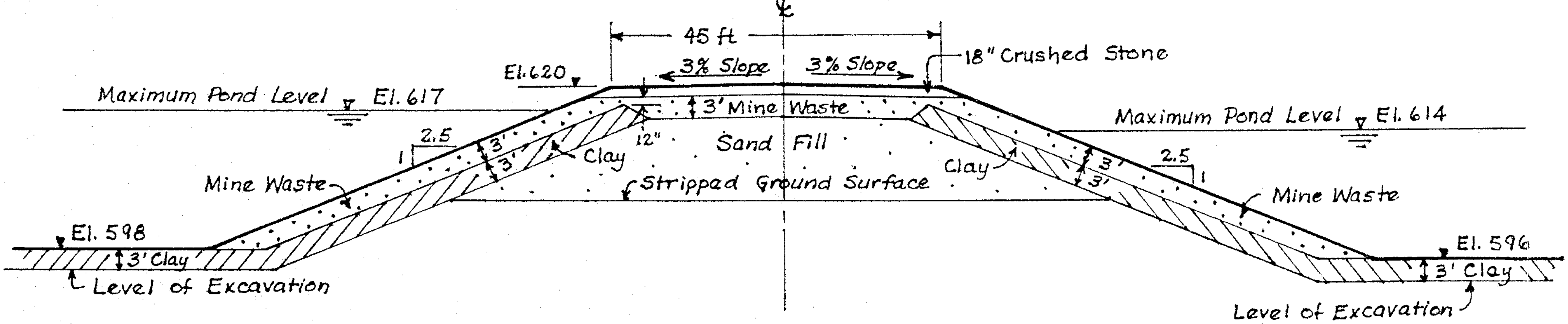
PROJECT	PROJECT 1301
	BOTTOM ASH PONDS
AREA	
BORING NO.	
DATE	April 1977

FIG. 3 - GRAIN SIZE CURVES OF SAND FROM ASH POND AREA



SECTION A-A THROUGH PERIMETER DIKE

Scale: 1 in. = 20 ft



SECTION B-B THROUGH INTERIOR DIKE

FIG. 4 - PROPOSED CROSS-SECTIONS THROUGH DIKES

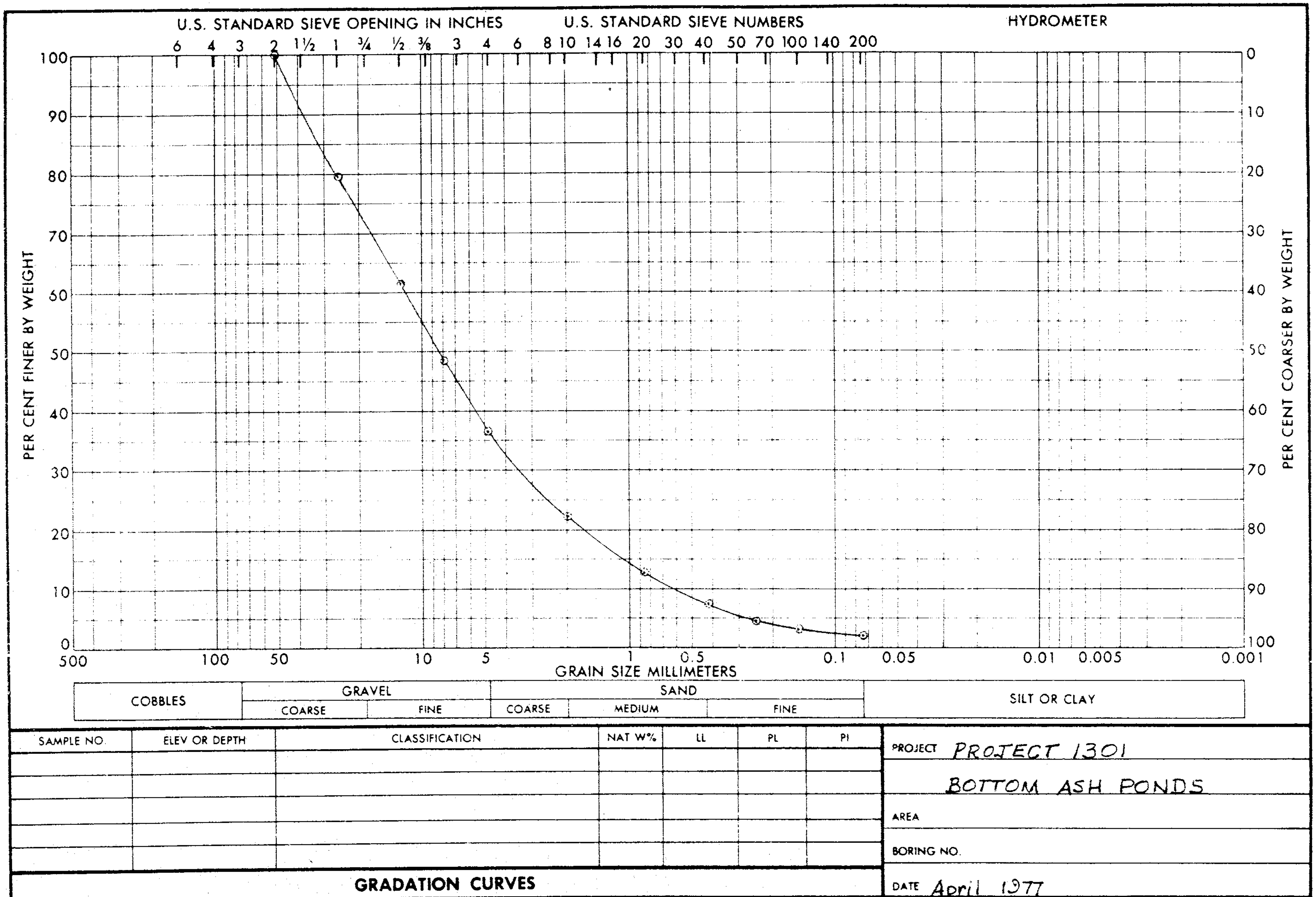


FIG. 5 - GRAIN SIZE CURVE OF MINE WASTE FROM SPORN COAL MINE

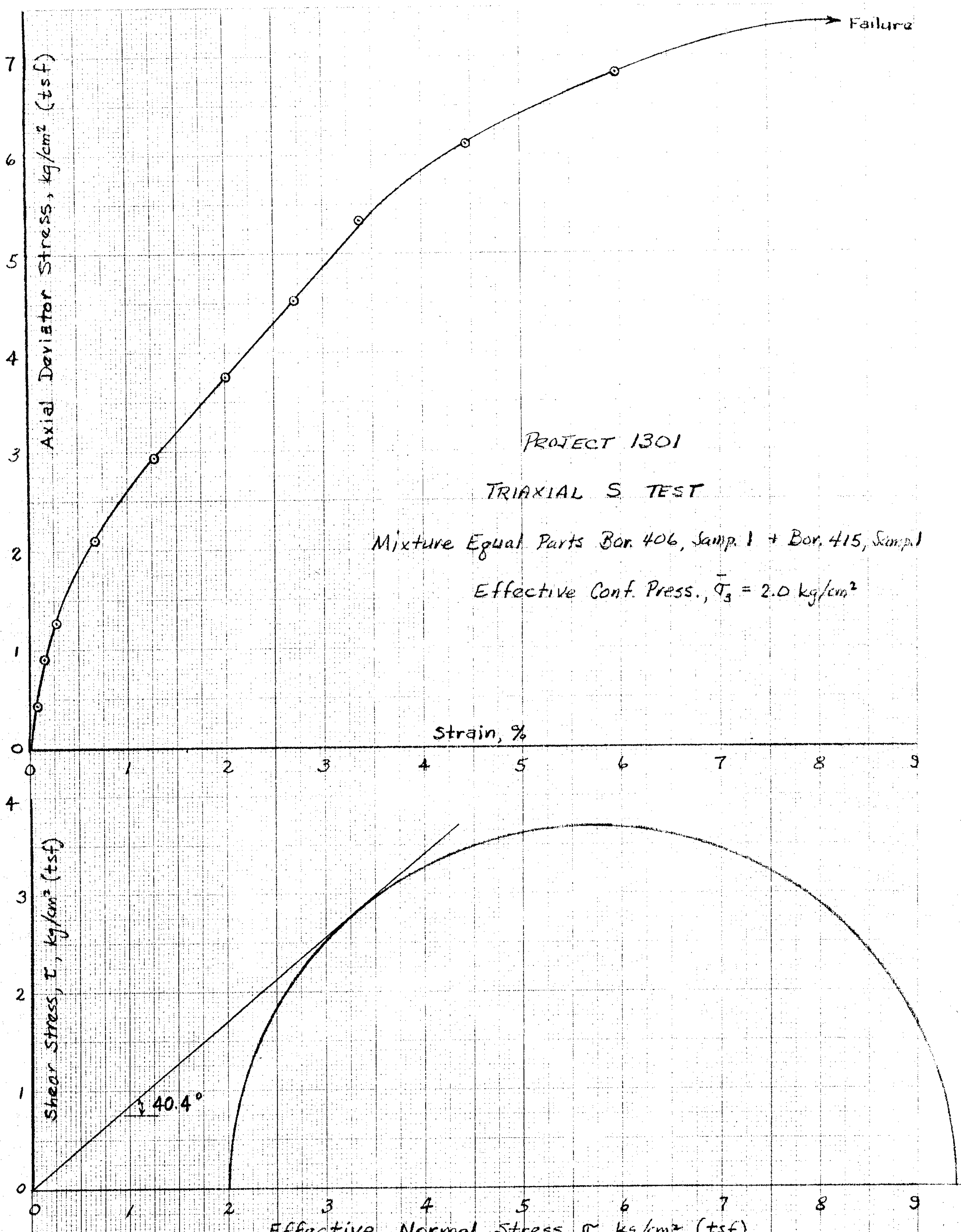
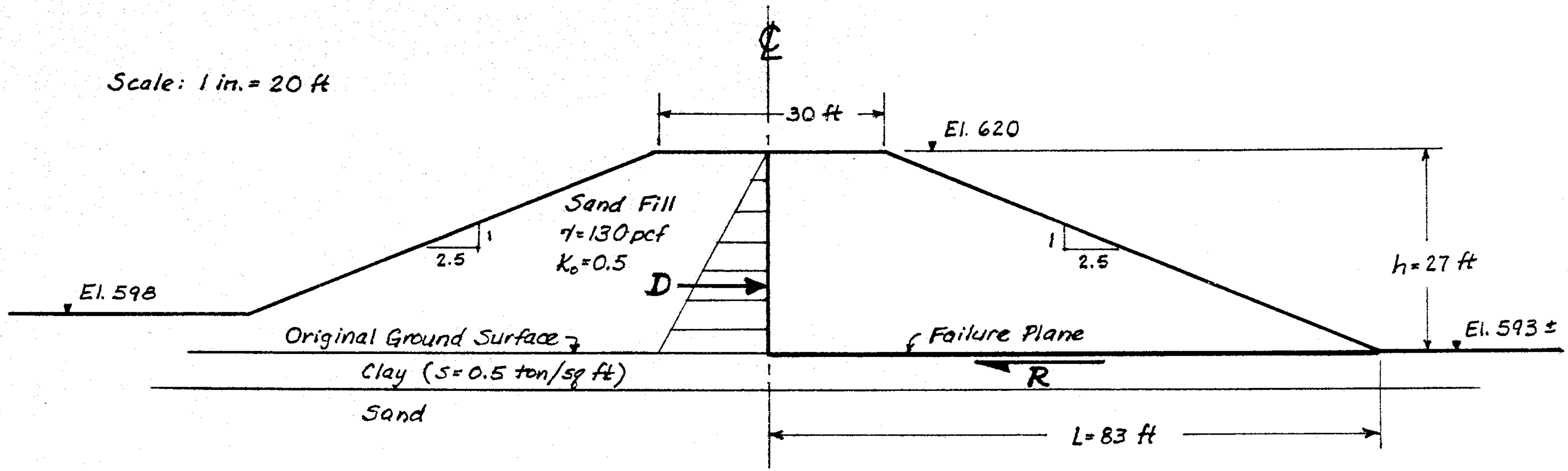


FIG. 6 - TRIAXIAL S TEST ON SILTY FINE SAND

Scale: 1 in. = 20 ft



SIMPLIFIED CROSS-SECTION

DRIVING FORCE

Static Condition: At-Rest Earth Pressure, $D = K_o \frac{\gamma h^2}{2} = 0.5 \frac{(130)(27)^2}{2} = 23{,}690$ lb/ft

Earthquake Condition: $D_E = D + 0.1D = 23{,}690 + 2{,}370 = 26{,}060$ lb/ft

RESISTING FORCE

Shearing Resistane along Failure Plane, $R = L \cdot s = (83)(0.5 \times 2000) = 83{,}000$ lb/ft

FACTOR OF SAFETY

Static Condition: $FS = \frac{R}{D} = \frac{83{,}000}{23{,}690} = 3.5$

Earthquake Condition: $FS = \frac{R}{D_E} = \frac{83{,}000}{26{,}060} = 3.2$

FIG. 7 - STABILITY ANALYSIS FOR HIGHEST PORTION OF DIKES (Northeast Corner)

APPENDIX I

DESCRIPTIONS OF SAMPLES AND RESULTS OF CLASSIFICATION TESTS

Table Nos.	Boring Numbers	Location
1 to 15	401 to 405	Bottom Ash Storage Ponds
16 to 19	505, 506, 513 and 514	Project 1301 Coal Storage Area

Table 1

Exploratory Boring No. 401

Ground El. 596.1

Depth to Water Level: 47 ft

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency		Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
				As Received	Remolded					
1	3.5-5.0	5-6-10	Brown clayey fine sand.							
2	8.5-10.0	5-5-5	Brown silty fine sand.							
3	13.5-15.0	5-6-6	Brown fine sand.							
4	18.5-20.0	16-17-18	Brown silty sand and some gravel.							
5	23.5-25.0	19-25-24	Similar to sample 4.							
6	28.5-29.5	45-60	Brown silty sand and gravel.							
7	33.5-35.0	14-17-21	Brown sand and some gravel.							

Table 1 (cont'd)

Exploratory Boring No. 401

Ground El.

Depth to Water Level:

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency		Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
				As Received	Remolded					
8	38.5-40.0	13-16-17	Brown medium sand with some coarser particles.							
9	43.5-45.0	15-19-25	Brown sand and gravel.							
10	48.5-50.0	15-20-21	Brown fine sand with few coarser particles.							
11	53.5-55.0	16-23-29	Brown fine to medium sand.							
12	58.5-60.0	22-16-23	Brown sand and gravel.							

Table 2

Exploratory Boring No. 402

Ground El. 597.4

Depth to Water Level: 45.5 ft

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency		Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
				As Received	Remolded					
1	3.0-4.5	4-4-6	Brown clayey fine sand.			22.9	25.7	21.1	4.6	
2	8.0-9.5	3-4-5	Brown silty fine sand.			21.1	21.9	21.8	0.1	
3	13.0-14.5	3-4-4	Brown silty fine sand.							
4	18.0-19.5	3-9-10	Brown silty fine sand.							
5	23.0-24.5	7-7-5	Brown, well-graded sand and some gravel.							
6	28.0-29.5	7-8-10	Similar to sample No. 5.							
7	33.0-34.5	10-14-17	Similar to Sample No. 5.							

Table 2 (cont'd)

Exploratory Boring No. 402

Ground El.

Depth to Water Level:

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency		Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
				As Received	Remolded					
8	38.0-39.5	9-15-13	Similar to Sample No. 5.							
9	43.0-44.5	9-6-8	No recovery.							
10	48.0-49.5	6-9-11	Brown medium sand.							
11	53.0-54.5	7-8-10	Brown medium sand with few coarser particles.							
12	58.0-59.5	8-11-12	Similar to Sample No. 11.							

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Table 3

Exploratory Boring No. 403

Ground El. 591.1

Depth to Water Level: 50.5 ft

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency As Received	Consistency Remolded	Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
1	3.0-4.5	4-5-7	Brown silty fine sand.							
2	8.0-9.5	4-3-4	Brown silty fine sand.							
3	13.0-14.5	6-7-6	Brown, well-graded sand and some gravel.							
4	18.0 19.5	4-5-5	Brown fine to medium sand.							
5	23.0-24.5	5-5-4	Similar to sample No. 4.							
6	28.0-29.5	4-5-7	Similar to sample No. 4.							
7	33.0-34.5	6-6-8	Brown sand and some gravel.							

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Table 3 (cont'd)

Exploratory Boring No. 403

Ground El.

Depth to Water Level:

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency		Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
				As Received	Remolded					
8	38.0-39.5	5-8-12	Similar to sample No. 7.							
9	43.0-44.5	8-13-14	Brown fine sand.							
10	48.0-49.5	9-15-19	Brown sand and gravel.							
11	53.0-54.5	7-10-13	No recovery.							
12	58.0-59.5	8-11-12	Dark brown sand and with some coal particles.							

Table 4

Exploratory Boring No. 404

Ground El. 600.3

Depth to Water Level: 47.0 ft

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency		Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
				As Received	Remolded					
1	3.0-4.5	3-4-6	Brown silty fine sand.							
2	8.0-9.5	3-6-8	Brown silty fine sand.							
3	13.0-14.5	3-4-6	Brown silty fine sand.							
4	18.0-19.5	6-5-8	Brown, well-graded sand and some gravel.							
5	23.0-24.5	5-9-9	Similar to sample No. 4.							
6	28.0-29.5	7-6-5	Similar to sample No. 4.							
7	33.0-34.5	4-5-5	Brown fine sand.							

Table 4 (cont'd)

Exploratory Boring No. 404

Ground El.

Depth to Water Level:

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency		Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
				As Received	Remolded					
8	38.0-39.5	12-12-11	Brown sand and some gravel.							
9	43.0-44.5	5-8-13	Brown fine sand.							
10	48.0-49.5	4-6-9	Brown fine to medium sand.							
11	53.0-54.5	3-4-6	Similar to sample No. 4.							
12	58.0-59.5	4-7-8	No recovery.							

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Table 5

Exploratory Boring No. 405

Ground El. 603.1

Depth to Water Level: 51 ft

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency		Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
				As Received	Remolded					
1	3.5-5.0	2-4-3	Brown silty clay. Disturbed.	v. soft	v. soft	44.6	36.4	24.3	12.1	168
2	8.5-10.0	5-6-7	Brown silty fine to medium sand.							
3	13.5-15.0	7-8-9	Brown fine sand.							
4	18.5-20.0	4-4-7	Brown fine sand.							
5	23.5-25.0	4-4-8	Brown fine sand.							
6	28.5-30.0	6-8-7	Brown fine to medium sand with few coarser particles.							
7	33.5-35.0	8-11-11	Similar to sample 6.							

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Table 5 (cont'd)

Exploratory Boring No. 405

Ground El.

Depth to Water Level:

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency		Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
				As Received	Remolded					
8	38.5-40.0	11-11-15	Brown sand and some gravel.							
9	43.5-45.0	4-7-6	Similar to sample 8.							
10	48.5-50.0	9-9-11	Similar to sample 8.							
11	53.5-55.0	4-7-8	Brown fine to medium sand.							
12	58.5-60.0	4-4-7	Similar to sample 11.							

Table 6

Exploratory Boring No. 406

Ground El. 603.1

Depth to Water Level: 51 ft

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency As Received	Consistency Remolded	Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
1	3.5-5.0	3-5-7	Brown, very **silty** fine to medium sand.			24.1				
2	8.5-10.0	3-4-5	Brown, fine sandy silt.							
3	13.5-15.0	5-6-7	Brown fine sand.							
4	18.5-20.0	4-4-6	Brown fine sand with few coarser particles.							
5	23.5-30.0	5-6-7	Similar to sample 5.							
6	28.5-30.0	5-6-7	Similar to sample 5.							
7	33.5-35.5	10-12-12	Brown fine to medium sand with some coarser particles.							

Table 6 (cont'd)

Exploratory Boring No. 406

Ground El.

Depth to Water Level:

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency		Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
				As Received	Remolded					
8	38.5-40.0	8-12-16	Similar to sample 7.							
9	43.5-45.0	18-18-22	Similar to sample 7.							
10	48.5-50.0	10-17-32	Similar to sample 7.							
11	53.5-55.0	10-14-12	Brown sand and some gravel.							
12	58.5-60.0	14-16-17	Similar to sample 11.							

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Table 7

Exploratory Boring No. 407

Ground El. 613.3

Depth to Water Level: dry

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency		Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
				As Received	Remolded					
1	3.0-4.5	3-4-5	Brown fine to medium sand and some coarser particles.							
2	8.0-9.5	3-3-3	Brown fine sand.							
3	13.0-14.5	3-4-5	Brown fine sand.							
4	18.0-19.5	7-7-6	Brown fine to medium sand.							
5	23.0-24.5	6-6-7	Brown fine sand.							
6	28.0-29.5	6-7-9	Brown fine sand.							
7	33.0-34.5	9-10-15	Brown, well-graded sand and some gravel.							

Table 7 (cont'd)

Exploratory Boring No. 407

Ground El.

Depth to Water Level:

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency		Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
				As Received	Remolded					
8	38.0-39.5	17-19-16	Similar to sample No. 7.							
9	43.0-43.7	30-50/2"	Similar to sample No. 7.							
10	48.0-49.5	15-20-24	Brown fine to medium sand and some gravel.							
11	53.0-54.5	13-20-18	Similar to sample No. 10.							
12	58.0-59.5	20-18-22	Similar to sample No. 10.							

Table 8

Exploratory Boring No. 408

Ground El. 608.1

Depth to Water Level: 59.5 ft

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency		Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
				As Received	Remolded					
1	3.0-4.5	3-4-4	Brown fine sand with some coarser particles.							
2	8.0-9.5	3-4-4	Similar to sample No. 1.							
3	13.0-14.5	3-3-5	Similar to sample No. 1.							
4	18.0-19.5	4-3-3	Similar to sample No. 1.							
5	23.0-24.5	3-4-5	Brown fine sand.							
6	28.0-29.5	8-12-14	Brown fine sand with some coarser particles.							
7	33.0-34.5	12-14-20	Brown medium sand with some coarser particles.							

Table 8 (cont'd)

Exploratory Boring No. 408

Ground El.

Depth to Water Level:

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency		Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
				As Received	Remolded					
8	38.0-39.5	8-8-6	Brown, well-graded sand and some gravel.							
9	43.0-44.5	15-30-34	Similar to sample No. 8.							
10	48.0-49.5	20-29-21	Similar to sample No. 8.							
11	53.0-54.5	10-11-10	Brown fine sand.							
12	58.0-59.5	5-6-6	Brown, well-graded sand and some gravel.							

Table 9

Exploratory Boring No.409

Ground El.

Depth to Water Level:

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency		Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
				As Received	Remolded					
1	3.5-5.0	6-7-8	Brown silty fine sand.							
2	8.5-10.0	3-4-5	3 in. of brown clayey silt. 1.4 in. of brown fine sand.	firm & brittle	crumbly	25.0	31.8	24.5	7.3	7
3	13.5-15.0	3-3-5	Brown fine to medium sand.							
4	18.5-20.0	4-5-7	Brown fine sand.							
5	23.5-25.0	4-6-6	Brown fine to medium sand with few coarser particles.							
6	28.5-30.0	7-8-8	Brown fine sand.							
7	33.5-35.0	6-7-8	Brown fine sand.							

Table 9 (cont'd)

Exploratory Boring No. 409

Ground El.

Depth to Water Level:

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency		Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
				As Received	Remolded					
8	38.5-40.0	5-7-8	Brown fine to medium sand with few coarser particles.							
9	43.5-45.0	8-9-10	Brown fine sand.							
10	48.5-50.0	14-19-22	Brown sand and gravel.							
11	53.5-55.0	14-11-15	Brown fine sand.							
12	58.5-60.0	16-20-22	Brown fine sand and some coarser particles.							

Table 10

Exploratory Boring No. 410

Ground El. 604.7

Depth to Water Level: 51.5 ft

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency		Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
				As Received	Remolded					
1	3.0-4.5	2-4-4	Brown fine sand.							
2	8.0-9.5	3-4-5	Brown fine sand.							
3	13.0-14.5	5-5-6	Brown fine sand.							
4	18.0-19.5	6-7-8	Brown fine to medium sand.							
5	23.0-24.5	8-10-11	Similar to sample No. 4.							
6	28.0-29.5	8-8-8	Brown fine to medium sand and some coarser particles.							
7	33.0-34.5	6-9-12	Similar to sample No. 6.							

Table 10 (cont'd)

Exploratory Boring No. 410

Ground El.

Depth to Water Level:

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency		Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
				As Received	Remolded					
8	38.0-39.5	6-10-12	Similar to sample No. 6.							
9	43.0-45.5	12-17-16	Brown fine sand with some coarser particles.							
10	48.0-49.5	5-10-14	Brown fine to medium sand and few coarser particles.							
11	53.0-54.5	7-10-19	Similar to sample No. 10.							
12	58.0-59.5.	14-13-13	Similar to sample No. 11.							

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Table 11

Exploratory Boring No. 411

Ground El. 607.3

Depth to Water Level: 55.0 ft

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency		Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
				As Received	Remolded					
1	3.0-4.5	3-4-4	Brown fine sand and some coarser particles.							
2	8.0-9.5	3-4-4	Similar to sample No. 1.							
3	13.0-14.5	9-3-5	Similar to sample No. 1.							
4	18.0-19.5	5-5-5	Brown fine sand.							
5	23.0-24.5	7-5-4	Brown fine sand.							
6	28.0-29.5	5-4-5	Brown fine sand.							
7	33.0 34.5	6-8-5	Brown fine to coarse sand.							

Table 11 (cont'd)

Exploratory Boring No. 411

Ground El.

Depth to Water Level:

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency		Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
				As Received	Remolded					
8	38.0-39.5	4-5-5	Brown fine sand.							
9	43.0-44.5	8-9-13	Brown medium sand and some coarser particles.							
10	48.0-49.5	5-6-11	Similar to sample No. 9.							
11	53.0-54.5	6-9-12	Similar to sample No. 9.							
12	58.0-59.5	8-6-6	Brownish-gray sand and some gravel.							

Table 12

Exploratory Boring No. 412

Ground El. 600.5

Depth to Water Level: 52 ft

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency As Received	Consistency Remolded	Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
1	3.5-5.0	10-11-15	Brown, clayey fine to medium sand.							
2	8.5-10.0	7-8-8	Similar to sample 1.							
3	13.5-15.0	3-4-7	Brown, clayey fine to coarse sand.							
4	18.5-20.0	3-4-3	Brown, clayey sand and gravel.							
5	23.5-25.0	7-7-7	Brown fine to medium sand with some coarser particles.							
6	28.5-30.0	4-3-3	Brown fine sand.							
7	33.5-35.0	6-6-6	Brown fine sand.							

Table 12 (cont'd)

Exploratory Boring No. 412

Ground El.

Depth to Water Level:

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency		Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
				As Received	Remolded					
8	38.5-40.0	8-11-10	Brown fine to medium sand and few coarser particles.							
9	43.5-45.0	10-9-15	Similar to sample 8.							
10	48.5-50.0	19-12-13	Similar to sample 8.							
11	53.5-55.0	8-9-8	Similar to sample 8.							

Table 13

Exploratory Boring No. 413

Ground El.

Depth to Water Level: 50 ft

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency		Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
				As Received	Remolded					
1	3.5-5.0	5-5-6	Brown fine to medium sand.							
2	8.5-10.0	4-3-4	Brown fine sand.							
3	13.5-15.0	5-3-4	Brown fine sand.							
4	18.5-20.0	4-7-8	Brown fine sand and some coarser particles.							
5	23.5-25.0	7-6-7	Brown fine sand.							
6	28.5-30.0	6-7-6	Brown fine sand.							
7	33.5-35.0	9-12-12	Brown sand and some gravel.							

Table 13 (cont'd)

Exploratory Boring No. 413

Ground El.

Depth to Water Level:

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency As Received	Consistency Remolded	Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
8	38.5-40.0	6-8-11	Similar to sample 7.							
9	43.5-45.0	12-15-14	Brown fine to medium sand.							
10	48.5-50.0	18-26-24	Brown sand and some gravel.							
11	53.5-55.0	10-12-11	Brown fine sand.							
12	58.5-60.0	5-8-10	Gray fine sand.							

Table 14

Exploratory Boring No. 414

Ground El.

Depth to Water Level: 48 ft

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency		Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
				As Received	Remolded					
1	3.5-5.0	4-7-10	Brown sandy clay. q_p = 2.6 to 2.8 tsf	v. stiff	crumbly	20.8	33.5	21.1	12.4	-2
2	8.5-10.0	4-4-5	Brown fine sand.							
3	13.5-15.0	5-4-4	Brown fine sand.							
4	18.5-20.0	6-5-5	Brown fine sand.							
5	23.5-25.0	7-8-8	Brown medium to coarse sand.							
6	28.5-30.0	8-8-7	Brown fine sand.							
7	33.5-35.0	8-8-10	Brown medium to coarse sand.							

Table 14 (cont'd)

Exploratory Boring No. 414

Ground El.

Depth to Water Level: 48 ft

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency		Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
				As Received	Remolded					
8	38.5-40.0	8-10-10	Brown sand and some gravel.							
9	43.5-	5-6-8	Brown medium sand and few coarser particles.							
10	48.5-50.0	10-13-14	Similar to sample 9.							
11	53.5-55.0	7-8-10	Brown sand gravel.							
12	58.5-60.0	15-19-20	Brown medium sand.							

Table 15

Exploratory Boring No. 415

Ground El.

Depth to Water Level:

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency		Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
				As Received	Remolded					
1	3.0-4.5	2-4-4	Brown clayey fine sand.							
2	8.0-9.5	4-5-7	Brown clayey fine to medium sand.							
3	13.0-14.5	3-4-6	Brown fine sand.							
4	18.0-19.5	2-3-5	Brown fine sand.							
5	23.0-24.5	3-4-7	Brown fine sand and some coarser particles.							
6	28.0-29.5	5-8-8	Brown sand and some gravel.							
7	33.0-34.5	6-10-12	Similar to sample 6.							

Table 15 (cont'd)

Exploratory Boring No. 415

Ground El.

Depth to Water Level:

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency		Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
				As Received	Remolded					
8	38.0-39.5	10-22-28	Brown sand and gravel.							
9	43.0-44.5	10-12-14	Brown sand and gravel.							
10	48.0-49.5	11-13-15	Brown sand and some gravel.							
11	53.0-54.5	10-12-13	Similar to sample 10.							
12	58.0-59.5	11-12-15	Brown sand and gravel.							

Table 16

Exploratory Boring No. 505

Ground El. 586.9

Depth to Water Level:

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency As Received	Consistency Remolded	Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
1	3.0-4.5	2-3-6	Brown very sandy clay. q_p = 1.7 tsf	stiff & brittle	firm to crumbly	21.4	30.3	19.8	10.5	15
2	8.0-9.5	3-4-5	Brown fine sand with one 1 inch layer of sandy clay.	soft	soft	27.0				
3	13.0-14.5	2-2-5	Brown fine sand with several thin layers of clay.							
4	18.0-19.5	15-17-23	Brown sand and gravel.							
5	23.0-24.5	16-18-22	Brown sand and gravel.							
6	28.0-29.5	15-17-18	Brown sand and gravel.							
7	33.0-34.5	13-11-12	Brown sand and some gravel.							

Table 16 (cont'd)

Exploratory Boring No. 505

Ground El.

Depth to Water Level:

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency		Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
				As Received	Remolded					
8	38.0-39.5	13-14-18	Similar to sample 7.							
9	43.0-44.5	13-18-15	Brown sand and gravel in matrix of clay.							
10	48.0-49.5	11-13-11	Brown medium sand and some coarser particles.							
11	53.0-54.5	7-11-13	Brown sand and gravel.							
12	58.0-59.5	11-13-15	Brown sand and some gravel.							
13	63.0-64.5	11-22-36	Brown medium sand.							
14	68.0-69.5	11-12-13	Brown sand and gravel.							

Table 17

Exploratory Boring No. 506

Ground El. 579.4

Depth to Water Level: 37.5 ft

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency		Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
				As Received	Remolded					
1	3.0-4.5	2-4-4	Brown silty fine sand.							
2	8.0-9.5	6-2-3	Brown fine sand and few coarser particles.							
3	13.0-14.5	14-18-21	Brown sand and some gravel.							
4	18.0-19.5	15-23-24	Similar to sample 3.							
5	23.0-24.5	24-31-39	Brown sand and gravel.							
6	28.0-29.5	26-56-50/4"	Brown sand and gravel.							
7	33.0-34.5	28-30-33	Brown sand and gravel.							

Table 17 (cont'd)

Exploratory Boring No. 506

Ground El.

Depth to Water Level:

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency		Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
				As Received	Remolded					
8	38.0-39.5	16-10-10	Brown sand and gravel.							
9	43.0-44.5	11-10-13	Brown sand and gravel.							
10	48.0-49.5	10-22-34	Dark brown sand and gravel.							
11	53.0-54.5	13-15-18	Brown sand and gravel.							
12	58.0-59.5	17-13-14	Brown sand and some gravel.							
13	63.0-64.5	15-24-30	Brown sand and gravel.							
14	68.0-69.5	12-19-23	Brown sand and gravel.							

Table 17 (cont'd)

Exploratory Boring No. 506

Ground El.

Depth to Water Level:

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency		Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast Ratio %
				As Received	Remolded					
15	73.0-74.5	17-26-24	Brown sand and gravel.							

Table 18

Exploratory Boring No. 513

Ground El. 573.7

Depth to Water Level: 33.5 ft

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency		Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
				As Received	Remolded					
1	3.5-5.0	5-6-8	Brown clay with dark brown specks. q_p = 4.1 to 4.4 tsf	hard & brittle	crumbly	25.4	50.8	25.5	25.3	-0.4
2	8.5-10.0	5-12-17	Similar to sample 1. $q_p > 4.5$ tsf	hard & brittle	crumbly	20.8	46.7	23.9	22.8	-14
3	13.5-15.0	5-9-12	Similar to sample 1. $q_p > 4.5$ tsf	hard & brittle	crumbly	20.6	37.0	21.5	15.5	-6
4	18.5-20.0	4-8-12	Similar to sample 1. q_p = 3.5 to 3.7 tsf	v. stiff & brittle	crumbly	22.1				
5	23.5-25.0	3-4-5	Brown clayey fine sand.							
6	28.5-30.0	23-24-25	Brown sand and gravel.							
7	33.5-35.0	8-12-11	Brown sand and gravel.							

Table 18 (cont'd)

Exploratory Boring No. 513

Ground El.

Depth to Water Level:

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency As Received	Consistency Remolded	Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
8	38.5-40.0	1-1-4	Brown sand and some gravel.							
9	43.5-45.0	5-7-9	No recovery.							
10	48.5-50.0	5-9-11	Brown sand and gravel.							
11	53.5-55.0	9-14-16	Brown sand and some gravel.							
12	58.5-60.0	12-20-25	Similar to sample 11.							
13	63.5-65.0	13-23-27	Similar to sample 11.							
14	68.5-70.0	11-18-60	Similar to sample 11.							

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Table 19

Exploratory Boring No. 514

Ground El. 573.1

Depth to Water Level: 34 ft

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency		Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
				As Received	Remolded					
1	3.5-5.0	5-9-13	Marbled brown and gray sandy clay. $q_p >$ 4.5 tsf	hard & brittle	crumbly	19.6	38.9	22.7	16.2	-19
2	8.5-10.0	11-22-27	Brown sand and gravel in matrix of clay.							
3	13.5-15.0	15-20-19	Brown sand and gravel.							
4	18.5-20.0	15-16-20	Brown sand and gravel.							
5	23.5-25.0	19-19-20	Brown sand and gravel.							
6	28.5-30.0	7-9-15	Brown sand and gravel.							
7	33.5-35.0	12-15-13	Brown sand and gravel.							

Table 19 (cont'd)

Exploratory Boring No. 514

Ground El.

Depth to Water Level:

Project No. 771

Sample No.	Depth ft	No. of Blows per 6 in.	Description	Consistency As Received	Consistency Remolded	Nat. Water Cont. %	Liquid Limit	Plastic Limit	Plast. Index	Water Plast. Ratio %
8	38.5-40.0	4-6-7	Brown sand and gravel.							
9	43.5-45.0	7-14-15	No recovery.							
10	48.5-50.0	11-18-21	Brown sand and gravel.							
11	53.5-55.0	6-8-12	Brown medium sand.							
12	58.5-60.0	13-25-17	No recovery.							
13	63.5-65.0	12-22-23	No recovery.							
14	68.5-70.0	24-30-80/5"	Brown sand and gravel.							

APPENDIX II

LOGS OF BORINGS

Boring Numbers	Location
401 to 415	Bottom Ash Storage Ponds
505, 506, 513 and 514	Project 1301 Coal Storage Area
701 and 703	Pipeline Bridge Supports
801, 802 and 803	Truck Crossing Bridge Supports

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No.

Company Appalachian Power Company

Project Project 1301 - Ash Ponds

Location of Boring:	
Water Level	47'
Time	
Date	1-24-77

Boring No. 401 Date 1-21-77 Sheet 1 of 3

Type of Boring Auger Rig B-50

Casing used ______ Size ______ Drilling mud used ______

Boring begun 1-21-77 Boring completed 1-24-77

Ground Elevation 596.14' referred to ______ Datum

Field Party: King and Smithson

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					0		
					1		
					2		
					3		
	1	3.5-5	5/6/10	14"	4–5		Medium brown clayey silty sand.
					6		
					7		
					8		
	2	8.5-10	5/5/5	6"	9–10		Same as sample number 1.
					11		
					12		
					13		
	3	13.5-15	5/6/6	6"	14–15		Same as sample number 1 but more sandy.
					16		
					17		
					18		
	4	18.5-20	16/17/18	4"	19–20		Sand and gravel. Large gravel in end of spoon.
					1		

Engineer ______

AEPMTP-000448

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AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

Job No. ______

Company ______

Project ______

Boring No. 401 Date 1-24-77 Sheet 2 of 3

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______ Datum

Field Party: King and Smithson

Location of Boring:	
Water Level	
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					20		
					21		
					22		
					23		
					24		
	5	23.5-25	19/25/24	10"	25		Medium brown coarse sand and gravel.
					26		
					27		
					28		
					29		
	6	28.5-29.5	45/60	6"	30		Dense sand and gravel.
					31		
					32		
					33		
					34		
	7	33.5-35	14/17/21	10"	35		More sand.
					36		
					37		
					38		
					39		
	8	38.5-40	13/16/17	12"	40		Same as sample number 7.
					1		

Engineer ______

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company ______

Project ______

Boring No. 401 Date 1-24-77 Sheet 3 of 3

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______

______ Dat

Field Party: King and Smithson

Location of Boring:	
Water Level	
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					40		
					41		
					42		
					43		
					44		
	9	43.5-45	15/19/25	14"	45		Wet medium brown sand and gravel.
					46		
					47		Water
					48		
					49		
	10	48.5-50	15/20/21	16"	50		More sandy.
					51		
					52		Washed out 3' plug in augers.
					53		
					54		
	11	53.5-55	16/23/29	8"	55		Same as sample number 10.
					56		
					57		Washed out 2' plug in augers.
					58		
					59		
	12	58.5-60	32/16/23	10"	60		Medium brown sand and gravel w/sandstone fragments. Stopped hole at 60.0' 1-24-77
					1		

Engineer ______

AEPMTP-000450

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company: Appalachian Power Company

Project: Project 1301 - Proposed Ash Pond Area

Boring No. 402 Date 10-28-76 Sheet 1 of 3

Type of Boring: Auger Rig: B-61

Casing used ______ Size ______ Drilling mud used ______

Boring begun 10-28-76 Boring completed 10-28-76

Ground Elevation 597.40' referred to ______ Datum

Field Party: Roush and Reitmire

Location of Boring:	
Water Level	45.5'
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
	1	3-4.5	4/4/6	17"	3–4.5		Medium brown clayey silt.
	2	8-9.5	3/4/5	13"	8–9.5		Same as sample number 1.
	3	13-14.5	3/4/4	13"	13–14.5		Medium brown clayey fine sand.
	4	18-19.5	3/9/10	14"	18–19.5		Same as sample number 3

Engineer ______

AEPMTP-000451

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LOG OF BORING

Job No. ______

Company ______

Project ______

Boring No. 402 Date 10-28-76 Sheet 2 of 3

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______ Datum

Field Party: Roush and Reitmire

Location of Boring:	
Water Level	45.5'
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					20		
					21		
					22		
	5	23-24.5	7/7/5	12"	23–24		Medium brown sand and gravel.
					25		
					26		
					27		
	6	28-29.5	7/8/10	13"	28–29		Medium brown sand w/trace of gravel.
					30		
					31		
					32		
	7	33-34.5	10/14/17	14"	33–34		Same as sample number 6 w/more gravel.
					35		
					36		
					37		
	8	38-39.5	9/15/13	1"	38–39		Same as sample number 6 - Large gravel in end of spoon.
					40		
					1		

Engineer ______

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company ______

Project ______

Boring No. 402 Date 10-28-76 Sheet 3 of 3

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______ Datum

Field Party: Roush and REitmire

Location of Boring:	
Water Level	45.5
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					40		
					41		
					42		
	9	43-44.5	9/6/8	-	43–44		No recovery.
					45		Water
					46		
					47		
	10	48-49.5	6/9/11	13"	48–49		Medium brown sand w/trace of gravel.
					50		
					51		
					52		
	11	53-54.5	7/8/10	12"	53–54		Same as sample number 10.
					55		
					56		
					57		
	12	58-59.5	8/11/12	11"	58–59		Same as sample number 10 Stopped hole at 59.5' 10-28-76
					60		
					1		

Engineer ______

AEPMTP-000453

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company Appalachian Power Company

Project Project 1301 - Proposed Ash Pond Area

Boring No. 403 Date 10-29-76 Sheet 1 of 3

Type of Boring Auger Rig B-61

Casing used ______ Size ______ Drilling mud used ______

Boring begun 10-29-76 Boring completed 10-29-76

Ground Elevation 591.09 referred to ______ Datum

Field Party: Roush and Reitmire

Location of Boring:	
Water Level	50.5
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
	1	3-4.5	4/5/7	17"	3–4.5		Medium brown clayey silt.
	2	8-9.5	4/3/4	13"	8–9.5		Same as sample number 1.
	3	13-14.5	6/7/6	13"	13–14.5		Same as sample number 1. Medium brown, medium grain sand and gravel.
	4	18-19.5	4/5/5	12"	18–19.5		Same as sample number 3 w/less gravel.

Engineer ______

AEPMTP-000454

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No.

Company

Project

Boring No. 403 Date 10-29-76 Sheet 2 of 3

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______ Datum

Field Party: Roush and Keitmire

Location of Boring:	
Water Level	50.5
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					20		
					21		
					22		
	5	23-24.5	5/5/4	12"	23–24	//////	Medium brown, medium grain sand w/trace of gravel.
					25		
					26		
					27		
	6	28-29.5	4/5/7	12"	28–29	//////	Same as sample humber 5 w/medium and fine grain gravel.
					30		
					31		
					32		
	7	33-34.5	6/6/8	12"	33–34	//////	Same as sample number 5 w/more gravel.
					35		
					36		
					37		
	8	38-39.5	5/8/12	13"	38–39	//////	Same as sample number 7.
					40		
					1		

Engineer ______

AEPMTP-000455

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ____

Company ____

Project ____

Boring No. 403 Date 10-29-76 Sheet 3 of 3

Type of Boring ____ Rig ____

Casing used ____ Size ____ Drilling mud used ____

Boring begun ____ Boring completed ____

Ground Elevation ____ referred to ____ Datum

Field Party: Roush and Reitmire

Location of Boring:	
Water Level	50.5
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					40		
					41		
					42		
	9	43-44.5	8/13/14	14"	43–44		Light brown.medium grain sand w/trace of gravel.
					45		
					46		
					47		
	10	48-49.5	9/15/19	15"	48–49		Medium brown sand and gravel.
					50		Water
					51		
					52		
	11	53-54.5	7/10/13	0	53–54		No recovery.
					55		
					56		
					57		
	12	58-59.5	8/11/12	13"	58–59		Medium and dark brown sand and gravel. Stopped hole at 59.5 10-29-76
					60		
					1		

Engineer ____

AEPMTP-000456

FORM CE-5
REV. 3/74

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company: Appalachian Power Company

Project: Project 1301 - Proposed Ash Pond Area

Location of Boring:	
Water Level	47.0'
Time	
Date	

Boring No. 404 Date 10-28-76 Sheet 1 of 3

Type of Boring: Auger Rig: B-61

Casing used ___ Size ___ Drilling mud used ___

Boring begun 10-28-76 Boring completed 10-28-76

Ground Elevation 600.27' referred to ______ Datum

Field Party: Roush and Reitmire

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					0		Boring off set about 15' east because of corn field.
					1		
					2		
	1	3-4.5	3/4/6	17"	3–4		Medium brown silty clay.
					5		
					6		
					7		
	2	8-9.5	3/6/8	13"	8–9		Same as sample number 1.
					10		
					11		
					12		
	3	13-14.5	3/4/6	7"	13–14		Medium brown clayey sand.
					15		
					16		
					17		
	4	18-19.5	6/5/8	12"	18–19		Medium brown sand and gravel.
					20		
					1		

Engineer ______

AEPMTP-000457

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company ______

Project ______

Boring No. 404 Date 10-28-76 Sheet 2 of 3

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______ Datum

Field Party: Roush and Reitmire

Location of Boring:	
Water Level	47.0'
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION: Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					20		
					21		
					22		
					23		
	5	23-24.5	5/9/9	12"	24		Medium brown fine sand and gravel.
					25		
					26		
					27		
					28		
	6	28-29.5	7/6/5	11"	29		Same as sample number 5.
					30		
					31		
					32		
					33		
	7	33-34.5	4/5/5	7"	34		Medium brown fine sand w/trace of gravel.
					35		
					36		
					37		
					38		
	8	38-39.5	12/12/11	14"	39		Same as sample number 7 w/light brown sand
					40		
					1		

Engineer ______

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company ______

Project ______

Location of Boring:	
Water Level	47.0'
Time	
Date	

Boring No. 404 Date 10-28-76 Sheet 3 of 3

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______ Datum

Field Party: Roush and Reitmire

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					40		
					41		
					42		
					43		
	9	43-44.5	5/8/13	13"	44		Medium brown fine sand w/trace of gravel.
					45		
					46		
					47		Water
					48		
	10	48-49.5	4/6/9	14"	49		Same as sample number 9.
					50		
					51		
					52		
					53		
	11	53-54.5	3/4/6	18"	54		Same as sample number 9 w/medium grain sand.
					55		
					56		
					57		
					58		
	12	58-59.5	4/7/8	–	59		No recovery.
					60		Stopped hole at 59.5' 10-28-76
					1		

Engineer ______

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company: Appalachian Power Company

Project: Project 1301 - Ash Pond

Boring No. 405 Date 1-24-77 Sheet 1 of 3

Type of Boring: Auger Rig: B-50

Casing used ______ Size ______ Drilling mud used ______

Boring begun 1-24-77 Boring completed 1-25-77

Ground Elevation 603.14 referred to ______ Datum

Field Party: King and Smithson

Location of Boring:	
Water Level	51.0'
Time	
Date	1-24-77

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
	1	3.5-5	2/4/3	5"	4–5		Fragments of clay with silt.
	2	8.5-10	5/6/7	8"	9–10		Brown sand.
	3	13.5-15	7/8/9	7"	14–15		Same as sample number 2 w/some larger grains.
	4	18.5-20	4/4/7	6"	19–20		Same as sample number 3.

Engineer ______

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company ______

Project ______

Boring No. 405 Date 1-24-77 Sheet 2 of 3

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______ Datum

Field Party: King and Smithson

Location of Boring:	
Water Level	
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					20		
					21		
					22		
					23		
					24		
	5	23.5-25	4/4/8	6"	25		Light brown sand.
					26		
					27		
					28		
					29		
	6	28.5-30	6/8/7	5"	30		Larger grain sand with small gravel light brown.
					31		
					32		
					33		
					34		
	7	33.5-35	8/11/11	6"	35		Medium grain sand - light brown.
					36		
					37		
					38		
					39		
	8	38.5-40	11/11/15	6"	40		Gravely sand - light brown.
					1		

Engineer ______

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ____________

Company ____________

Project ____________

Boring No. 405 Date 1-25-77 Sheet 3 of 3

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______ Datum

Field Party: King and Smithson

Location of Boring:	
Water Level	
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					40		
					41		
					42		
					43		
					44		
	9	43.5-45	4/7/6	5"	45		Same as sample number 8 with more gravel.
					46		
					47		
					48		
					49		
	10	48.5-50	9/9/11	8"	50		Small gravel with some sand.
					51		Water
					52		
					53		
					54		
	11	53.5-55	4/7/8	10"	55		Brown medium grain sand.
					56		
					57		
					58		
					59		
	12	58.5-60	4/4/7	8"	60		Fine medium brown sand.
							Stopped hole at 60.0'
					1		1-25-77

Engineer ____________

AEPMTP-000462

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company: Appalachian Power Company

Project: Project 1301 - Ash Pond

Boring No. 406 Date 1-25-77 Sheet 1 of 3

Type of Boring: Auger Rig B-50

Casing used ______ Size ______ Drilling mud used ______

Boring begun 1-25-77 Boring completed 1-25-77

Ground Elevation 603.14 referred to ______ Datum

Field Party: King and Smithson

Location of Boring:	
Water Level	51.0'
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
	1	3.5-5	3/5/7	18"	3.5-5	(hatched)	Silty clay.
	2	8.5-10	3/4/5	8"	8.5-10	(hatched)	Same as sample number 1.
	3	13.5-15	5/6/7	6"	13.5-15	(hatched)	Light brown sand.
	4	18.5-20	4/4/6	8"	18.5-20	(hatched)	Medium grain sand with trace of small gravel.

Engineer ______

AEPMTP-000463

REV. 3/74

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company ______

Project ______

Boring No. 406 Date 1-25-77 Sheet 2 of 3

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______ Dat

Field Party: King and Smithson

Location of Boring:	
Water Level	
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					20		
					21		
					22		
					23		
					24		
	5	23.5-25	5/6/7	9"	25		Light brown medium grain sand.
					26		
					27		
					28		
					29		
	6	28.5-30	5/6/7	6"	30		Same as sample number 5 w/larger grain.
					31		
					32		
					33		
					34		
	7	33.5-35	10/12/12	6"	35		Light brown to light gray sand.
					36		
					37		
					38		
					39		
	8	38.5-40	8/12/16	10"	40		Same as sample number 7.
					1		

Engineer ______

AEPMTP-000464

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REV. 3/74

AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

Job No. ______
Company ______
Project ______

Location of Boring:	
Water Level	
Time	
Date	

Boring No. 406 Date 1-25-77 Sheet 3 of 3
Type of Boring ______ Rig ______
Casing used ______ Size ______ Drilling mud used ______
Boring begun ______ Boring completed ______
Ground Elevation ______ referred to ______ Dat
Field Party: King and Smithson

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					40		
					41		
					42		
					43		
					44		
	9	43.5-45	18/18/22	9"	45		Same as sample number 8.
					46		
					47		
					48		
					49		
	10	48.5-50	10/17/32	6"	50		Medium brown sand w/trace of coal.
					51		Water
					52		
					53		
					54		
	11	53.5-55	10/14/12	5"	55		Grayish gravely sand.
					56		
					57		
					58		
					59		
	12	58.5-60	14/16/17		60		Small gravely sand (dark)
					1		Stopped hole at 60'

Engineer ______

FORM CE-5
REV. 3/74

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company: Appalachian Power Company

Project: Project 1301 - Proposed Ash Pond Area

Boring No. 407 Date 10-27-76 Sheet 1 of 3

Type of Boring: Auger Rig: B-61

Casing used ____ Size ____ Drilling mud used ____

Boring begun 10-27-76 Boring completed 10-27-76

Ground Elevation 613.27' referred to ______ Datum

Field Party: Roush and Reitmire

Location of Boring:	
Water Level	Dry
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
	1	3-4.5	3/4/3	8"	3-4.5	Medium coarse and brown sand.
	2	8-9.5	3/3/3	8"	8-9.5	Same as sample number 1.
	3	13-14.5	3/4/6	12"	13-14.5	Same as sample number1.
	4	18-19.5	7/7/6	14"	18-19.5	Same as sample number 1.

Engineer ______

AEPMTP-000466

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No.

Company

Project

Location of Boring:

Water Level

Time

Date

Boring No. 407 Date 10-27-76 Sheet 2 of 3

Type of Boring Rig

Casing used Size Drilling mud used

Boring begun Boring completed

Ground Elevation referred to Datum

Field Party: Roush and Reitmire

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					20		
					21		
					22		
					23		
	5	23-24.5	6/6/7	10"	24		Medium brown and medium coarse sand.
					25		
					26		
					27		
					28		
	6	28-29.5	6/7/9	12"	29		Fine medium brown sand.
					30		
					31		
					32		
					33		
	7	33-34.5	9/10/15	12"	34		First six tenths fine sand. Second six tenths sand with small gravel.
					35		
					36		
					37		
					38		
	8	38-39.5	17/19/16	12"	39		Sand and small gravel.
					40		
					1		

Engineer

AEPMTP-000467

FORM CE-5
REV. 3/74

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company ______

Project ______

Location of Boring:	
Water Level	
Time	
Date	

Boring No. 407 Date 10-27-76 Sheet 3 of 3

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______ Datum

Field Party: Roush and Reitmire

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					40		
					41		
					42		Ran through bolder.
					43		
	9	43-44.5	30/50/2	6"	44		Sand with larger gravel.
					45		
					46		
					47		
					48		
	10	48-49.5	15/20/24	12"	49		First six tenths sand. Second six tenths sand and gravel.
					50		
					51		
					52		
					53		
	11	53-54.5	13/20/18	14"	54		Sand with small gravel.
					55		
					56		
					57		
					58		
	12	58-59.5	20/18/22	14"	59		Same as sample number 11. Stopped hole at 59.5' 10-27-76
					60		
					1		

Engineer ______

FORM CE-5
REV. 3/74

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ____________

Company: Appalachian Power Company

Project: Project 1301 - Proposed Ash Pond Area

Boring No. 408 Date 10-27-76 Sheet 1 of 3

Type of Boring: Auger Rig: B-61

Casing used ____ Size ____ Drilling mud used ____

Boring begun 10-27-76 Boring completed 10-28-76

Ground Elevation 608.06' referred to ____________ Datum

Field Party: Roush and Reitmire

Location of Boring:	
Water Level	59.5
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					0		Boring offset about 40' because of corn field
	1	3-4.5	3/4/4	8"	3-4.5	hatched	Medium brown fine sand w/trace of gravel.
	2	8-9.5	3/4/4	18"	8-9.5	hatched	Same as sample number 1.
	3	13-14.5	3/3/5	14"	13-14.5	hatched	Same as sample number 1.
	4	18-19.5	4/3/3	12"	18-19.5	hatched	Same as sample number 1.

Engineer ____________

AEPMTP-000469

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REV. 3/74

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company ______

Project ______

Location of Boring:

Water Level	
Time	
Date	

Boring No. 408 Date 10-27-76 Sheet 2 of 3

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______ Datum

Field Party: Roush and Reitmire

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					20		
					21		
					22		
	5	23-24.5	3/4/5	8"	23–24	▨	Medium brown fine sand.
					25		
					26		
					27		
	6	28-29.5	8/12/14	14"	28–29	▨	Light brown fine sand w/some gravel.
					30		
					31		
					32		
	7	33-34.5	12/14/20	18"	33–34	▨	Light brown coarse sand w/some gravel.
					35		
					36		
					37		
	8	38-39.5	8/8/6	14"	38–39	▨	Light brown coarse sand and gravel.
					40		
					1		

Engineer ______

AEPMTP-000470

FORM CE-5
REV. 3/74

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company ______

Project ______

Boring No. 408 Date 10-27-76 Sheet 3 of 3
Type of Boring ______ Rig ______
Casing used ______ Size ______ Drilling mud used ______
Boring begun ______ Boring completed ______
Ground Elevation ______ referred to ______ Datum
Field Party: Roush and Reitmire

Location of Boring:	
Water Level	
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					40		
					41		
					42		
					43		
	9	43-44.5	15/30/34	18"	44		Light brown sand and gravel.
					45		
					46		
					47		
					48		
	10	48-49.5	20/29/21	18"	49		Light brown coarse sand w/some gravel.
					50		
					51		
					52		
					53		
	11	53-54.5	10/11/10	14"	54		Light brown fine sand.
					55		
					56		
					57		
					58		
	12	58-59.5	5/6/6	12"	59		Coarse medium brown sand. Water
					60		Stopped hole at 59.5 10-28-76
					1		

Engineer ______

FORM CE-5
REV. 3/74

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company: Appalachian Power Company

Project: Project 1301 - Proposed Ash Pond Area

Location of Boring:	
Water Level	51.5
Time	
Date	

Boring No. 410 Date 10-26-76 Sheet 1 of 3
Type of Boring: Auger Rig: B-61
Casing used ______ Size ______ Drilling mud used ______
Boring begun 10-26-76 Boring completed 10-26-76
Ground Elevation 604.65 referred to ______ Datum
Field Party: Roush and Retimire

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					0		Boring offset 5' east.
	1	3-4.5	2/4/4	5"	3-4.5		Medium brown fine sand.
	2	8-9.5	3/4/5	12"	8-9.5		Same as sample number 1 w/light colored sand.
	3	13-14.5	5/5/6	14"	13-14.5		Same as sample number 2.
	4	18-19.5	6/7/8	14"	18-19.5		Same as sample number 2 w/some gravel.

Engineer ______

AEPMTP-000472

FORM CE-5
REV. 3/74

AMERICAN ELECTRIC ...

AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

Job No. ______

Company ______

Project ______

Boring No. 410 Date 10-22-76 Sheet 2 of 3

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______

______ Datum

Field Party: Roush and REitmire

Location of Boring:	
Water Level	
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					20		
					21		
					22		
	5	23-24.5	8/10/11	14"	23–24		Medium brown sand and gravel.
					25		
					26		
					27		
	6	28-29.5	8/8/8	13"	28–29		Same as sample number 5.
					30		
					31		
					32		
	7	33-34.5	6/9/12	15"	33–34		Same as sample number 5.
					35		
					36		
					37		
	8	38-39.5	6/10/12	13"	38–39		Same as sampl e number 5.
					40		
					1		

Engineer ______

FORM CE-5
REV. 3/74

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company ______

Project ______

Location of Boring:	
Water Level	51.5'
Time	
Date	

Boring No. 410 Date 10-26-76 Sheet 3 of 3

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______ Datum

Field Party: Roush and Reitmire

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					40		
					41		
					42		
					43		
	9	43-44.5	12/17/16	8"	44		Medium brown sand w/trace of gravel.
					45		
					46		
					47		
					48		
	10	48-49.5	5/10/14	13"	49		Same as sample number 9.
					50		
					51		Water
					52		
					53		
	11	53-54.5	7/10/19	17"	54		Same as sample number 9 w/more gravel.
					55		
					56		
					57		
					58		
	12	58-59.5	14/13/13	16"	59		Same as sample number 11. Stopped hole at 59.5 10-26-76
					60		
					1		

Engineer ______

FORM CE-5
REV. 3/74

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company: Appalachian Power Comapny

Project: Project 1301 - Proposed Ash Pond Area

Location of Boring:	
Water Level	55'
Time	
Date	

Boring No. 411 Date 10-27-76 Sheet 1 of 3

Type of Boring Auger Rig B-61

Casing used ______ Size ______ Drilling mud used ______

Boring begun 10-22-76 Boring completed 10-26-76

Ground Elevation 607.25 referred to ______ Datum

Field Party: Roush and Reitmire

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					0		Moved boring 5' north
	1	3-4.5	3/4/4	14"	3-4.5		Medium brown fine sand.
	2	8-9.5	3/4/4	12"	8-9.5		Same as sample number 1.
	3	13-14.5	8/3/5	14"	13-14.5		Same as sample number 1.
	4	18-19.5	5/5/5	12"	18-19.5		Same as sample number 1.

Engineer ______

AEPMTP-000475

FORM CE-5
REV. 3/74

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company ______

Project ______

Boring No. 411 Date 10-26-76 Sheet 2 of 3

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______ Datum

Field Party: Roush and Reitmire

Location of Boring:	
Water Level	55'
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					20		
					21		
					22		
					23		
	5	23-24.5	7/5/4	8"	24		Medium brown fine sand.
					25		
					26		
					27		
					28		
	6	28-29.5	5/4/5	5"	29		Light brown fine sand.
					30		
					31		
					32		
					33		
	7	33-34.5	6/8/5	8"	34		~~Medium brown sand w/trace of gravel.~~
					35		
					36		
					37		
					38		
	8	38-39.5	4/5/5	10"	39		Light brown fine sand.
					40		
					1		

Engineer ______

AEPMTP-000476

FORM CE-5
REV. 3/74

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company ______

Project ______

Location of Boring:	
Water Level	55'
Time	
Date	

Boring No. 411 Date 10-26-76 Sheet 3 of 3

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______ Datum

Field Party: Roush and Reitmire

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					40		
					41		
					42		
					43		
	9	43-44.5	8/9/13	14"	44		Medium brown sand and gravel.
					45		
					46		
					47		
					48		
	10	48-49.5	5/6/11	13"	49		Same as sample number 9 w/less gravel.
					50		
					51		
					52		
					53		
	11	53-54.5	6/9/12	13"	54		Same as sample number 9
					55		Water
					56		
					57		
					58		
	12	58-59.5	8/6/6	15"	59		Same sample number 9.
					60		Stopped hole at 59.5' 10-26-76
					1		

Engineer ______

AEPMTP-000477

FORM CE-5
REV. 3/74

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company: Appalachian Power Company

Project: Project 1301 - Ash Ponds

Boring No. 412 Date 1-26-77 Sheet 1 of 3

Type of Boring: Auger Rig: B-50

Casing used ____ Size ____ Drilling mud used ____

Boring begun 1-26-77 Boring completed 1-27-77

Ground Elevation 600.49' referred to ______ Datum

Field Party: King and Smithson

Location of Boring:	
Water Level	52.0'
Time	
Date	1-26-77

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
	1	3.5-5	10/11/15	18"	5		Sandy, silty clay.
	2	8.5-10	7/8/8	8"	10		Red sand - medium grain.
	3	13.5-15	3/4/7	9"	15		Medium grain brown sand.
	4	18.5-20	3/4/3	5"	20		Fine grain brown sand

Engineer ______

AEPMTP-000478

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company ______

Project ______

Location of Boring:	
Water Level	
Time	
Date	

Boring No. 412 Date 1-26-77 Sheet 2 of

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______

Field Party: King and Smtihson

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving note blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					20		
					21		
					22		
					23		
	5	23.5-25	7/7/7	6"	24		Medium grain sand - light brown.
					25		
					26		
					27		
					28		
	6	28.5-30	4/3/3	9"	29		Medium to fine grain sand.
					30		
					31		
					32		
					33		
	7	33.5-35	6/6/6	8"	34		Same as sample number 6.
					35		
					36		
					37		
					38		
	8	38.5-40	8/11/10	6"	39		Medium grain sand w/one large gravel.
					40		
					1		

Engineer ______

AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

Job No. ______

Company ______

Project ______

Location of Boring:	
Water Level	
Time	
Date	

Boring No. 412 Date 1-27-77 Sheet 3 of

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______

Field Party: King and Smithson

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					40		
					41		
					42		
					43		
	9	43.5-45	10/9/15	7"	44		
					45		Medium grain sand - light brown Trace of coal.
					46		
					47		
					48		
	10	48.5-50	9/12/15	7"	49		
					50		Same as sample number 9 w/no coal.
					51		
					52		Water
					53		
	11	53.5-55	8/9/8	12"	54		
					55		Medium grain sand.
					56		
					57		
					58		
	12	58.5-60	16/9/11	-0-	59		
					60		No recovery. Stopped hole at 60.0' 1-27-77
					1		

Engineer ______

AEPMTP-000480

FORM CE-5
REV. 3/74

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company: Appalachian Power Company

Project: Project 1301 - Ash Pond Area

Location of Boring:	
Water Level	50'
Time	
Date	

Boring No. 413 Date 3-3-77 Sheet 1 of 3
Type of Boring Auger Rig B-50
Casing used ______ Size ______ Drilling mud used ______
Boring begun 3-3-77 Boring completed 3-3-77
Ground Elevation ______ referred to ______ Datum

Field Party: Smithson and Smith

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
	1	3.5-5	5/5/6	6"	4		Medium brown sand w/small pea gravel.
	2	8.5-10	4/3/4	7"	9		Same as sample number 1.
	3	13.5-15	5/3/4	9"	14		Medium brown sand w/legnite.
	4	18.5-20	4/7/8	10"	19		Medium brown sand w/some pea gravel.

Engineer ______

AEPMTP-000481

FORM CE-5
REV. 3/74

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company ______

Project ______

Boring No. 413 Date 3-3-77 Sheet 2 of 3

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______ Datum

Field Party: Smithson and Smith

Location of Boring:	
Water Level	
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					20		
					21		
					22		
					23		
	5	23.5-25	7/6/7	8"	24		Medium brown sand w/trace of pea gravel.
					25		
					26		
					27		
					28		
	6	28.5-30	6/7/6	7"	29		Same as sample number 5.
					30		
					31		
					32		
					33		
	7	33.5-35	9/12/12	11"	34		Medium brown medium coarse sand and gravel.
					35		
					36		
					37		
					38		
	8	38.5-40	6/8/11	12"	39		Same as sample number 7.
					40		
					1		

Engineer ______

AEPMTP-000482

AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

Job No. ______

Company ______

Project ______

Location of Boring:	
Water Level	
Time	
Date	

Boring No. 413 Date 3-3-77 Sheet 3 of 3
Type of Boring ______ Rig ______
Casing used ______ Size ______ Drilling mud used ______
Boring begun ______ Boring completed ______
Ground Elevation ______ referred to ______ Datum
Field Party: Smithson and Smith

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					40		
					41		
					42		
					43		
	9	43.5-45	12/15/14	15"	44		Light brown sand and gravel. Very small claylike seam. Light brown sand and gravel.
					45		
					46		
					47		
					48		
	10	48.5-50	18/26/24	10"	49		Dark brown silty sand and gravel.
					50		~~Water~~
					51		
					52		
					53		
	11	53.5-55	10/12/11	12"	54		Light brown fine sand w/trace of gravel.
					55		
					56		
					57		
					58		
	12	58.5-60	5/8/10	9"	59		Dark brown silty sand.
					60		Stopped hole at 60.0' 3-3-77
					1		

Engineer ______

FORM CE-5
REV. 3/74

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ________

Company: Appalachian Power Company

Project: Project 1301 - Ash Pond AREa

Boring No. 414 Date 3-3-77 Sheet 1 of 3

Type of Boring Auger Rig B-50

Casing used ____ Size ____ Drilling mud used ____

Boring begun 3-3-77 Boring completed 3-3-77

Ground Elevation ____ referred to ____ Datum

Field Party: Smithson and Smith

Location of Boring:	
Water Level	48'
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION: Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					0		
					1		
					2		
					3		
	1	3.5-5	4/7/10	12"	4		Light brown silty clay.
					5		
					6		
					7		
					8		
	2	8.5-10	4/4/5	8"	9		Medium brown, medium silty sand.
					10		
					11		
					12		
					13		
	3	13.5-15	5/4/4	7"	14		Same as sample number 2 w/trace of pea gravel.
					15		
					16		
					17		
					18		
	4	18.5-20	6/5/5	10"	19		Same as sample number 3.
					20		
					1		

Engineer ________

FORM CE-5
REV. 3/74

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company ______

Project ______

Boring No. 414 Date 3-3-77 Sheet 2 of 3

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______ Datum

Field Party: Smithson and Smith

Location of Boring:	
Water Level	
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					20		
					21		
					22		
					23		
	5	23.5-25	7/8/8	11"	24		Medium brown coarse sand and pea gravel.
					25		
					26		
					27		
					28		
	6	28.5-30	8/8/9	9"	29		Light brown fine sand.
					30		
					31		
					32		
					33		
	7	33.5-35	8/8/10	13"	34		Medium brown coarse sand and gravel (pea)
					35		
					36		
					37		
					38		
	8	38.5-40	8/10/10	8"	39		Same as sample number 7.
					40		
					1		

Engineer ______

AEPMTP-000485

FORM CE-5
REV. 3/74

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company ______

Project ______

Boring No. 414 Date 3-3-77 Sheet 3 of 3

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______ Datu

Field Party: Smithson and Smith

Location of Boring:	
Water Level	
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					40		
					41		
					42		
					43		
	9	43.5-45	5/6/8	10"	44		Dark brown medium to coarse sand and pea gravel.
					45		
					46		
					47		
					48		Water
	10	48.5-50	10/13/14	14"	49		Medium brown silty sand and pea gravel.
					50		
					51		
					52		
					53		
	11	53.5-55	7/8/10	4"	54		Medium silty sand w/gravel.
					55		
					56		
					57		
					58		
	12	58.5-60	15/19/20	10"	59		Medium brown fine to medium coarse sand.
					60		Stopped hole at 60.0'
							3-3-77
					1		

Engineer ______

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company: Appalachian Power Company

Project: Project 1301 - ASh Pond Area

Location of Boring:

Water Level	
Time	
Date	

Boring No. 415 Date 3-8-77 Sheet 1 of ___

Type of Boring Auger Rig B-61

Casing used ___ Size ___ Drilling mud used ___

Boring begun ___ Boring completed ___

Ground Elevation 3-8-77 referred to 3-8-77 Datu

Field Party: Roush and Reitmire

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
	1	3-4.5	2/4/4	14"	3–4.5		Medium brown clayey silt.
	2	8-9.5	4/5/7	13"	8–9.5		Medium brown clayey silt.
					9.5–		Medium brown sand.
	3	13-14.5	3/4/6	8"	13–14.5		Medium brown, medium grain sand
	4	18-19.5	2/3/5	8"	18–19.5		Medium brown sand.

Engineer ______

AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

Job No. ______

Company ______

Project ______

Location of Boring:	
Water Level	
Time	
Date	

Boring No. 415 Date 3-8-77 Sheet 2 of 3

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______

______ Dat

Field Party: Roush and Reitmire

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					20		
					21		
					22		
					23		
	5	23-24.5	3/4/7	15"	24		Medium brown sand w/trace of pea gravel.
					25		
					26		
					27		
					28		
	6	28-29.5	5/8/8	13"	29		Same as sample number 5 w/more pea gravel.
					30		Medium brown coarse sand and pea gravel.
					31		
					32		
					33		
	7	33-34.5	6/10/12	14"	34		Medium brown sand and pea gravel.
					35		
					36		
					37		
					38		
	8	38-39.5	10/22/28	16"	39		Medium and medium brown coarse sand and gravel.
					40		Medium brown medium coarse sand and pea gravel w/trace of large gravel.
					1		

Engineer ______

AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

Job No. ______

Company ______

Project ______

Boring No. 415 Date 3-8-77 Sheet 3 of __

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______ Da

Field Party: Roush and Reitmire

Location of Boring:	
Water Level	
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					40		
					41		
					42		
	9	43-44.5	10/12/14	13"	43–44	▨	Medium brown gravely sand.
					45		
					46		
					47		
	10	48-49.5	11/13/15	14"	48–49	▨	Medium brown sand and pea gravel. Water
					50		
					51		
					52		
	11	53-54.5	10/12/13	10"	53–54	▨	Medium brown sand with pea gravel and lignite.
					55		
					56		
					57		
	12	58-59.5	11/12/15	11"	58–59	▨	Medium brown coarse sand and pea gravel.
					60		Stopped hole at 59.5' 3-8-77
					1		

Engineer ______

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company: Appalachian Power Company

Project: Project 1301 - Conveyor

Boring No. 505 Date 11-17-76 Sheet 1 of 4

Type of Boring: Auger Rig: B-61

Casing used ____ Size ____ Drilling mud used ____

Boring begun 11-17-76 Boring completed 11-18-76

Ground Elevation 586.9' referred to ______ Datum

Field Party: Roush and Reitmire

Location of Boring:	
Water Level	
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
	1	3-4.5	2/3/6	10"	3–4.5		Medium brown clay silt.
	2	8-9.5	2/3/5	8"	8–9.5		Top .3 medium brown silt remainder medium brown very wet pure silt.
	3	13-14.5	2/2/5	6"	13–14.5		Same as sample number 2.
	4	18-19.5	15/17/23	8"	18–19.5		Medium grain brown sand with gravel some broken gravel.

Engineer ______

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AMERICAN ELECTRIC POWER SERVICE

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ____________

Company ____________

Project ____________

Location of Boring:	
Water Level	
Time	
Date	

Boring No. 505 Date 11-17-76 Sheet 2 of 4

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______ Datum

Field Party: Roush and Reitmire

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					20		
					21		
					22		
	5	23-24.5	16/ 18/22	10"	23–24		Sand and gravel with more smaller gravel.
					25		
					26		
					27		
	6	28-29.5	15/ 17/18	10"	28–29		Light to medium brown sand with medium amount of gravel.
					30		
					31		
					32		
	7	33-34.5	13/ 11/12	8"	33–34		Same as sample number 6.
					35		
					36		
					37		
	8	38-39.5	13/ 14/18	10"	38–39		Fine to medium grain sand with gravel. Some broken gravel.
					40		
					1		

Engineer ____________

AEPMTP-000491

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No.

Company

Project

Boring No. 505 Date 11-17-76 Sheet 3 of 4

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______ Datum

Field Party: Roush & Reitmire

Location of Boring:	
Water Level	
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					40		
					41		
					42		Water
	9	43-44.5	13/18/15	6"	43–44		Sand with small amount of small gravel.
					45		
					46		
					47		
	10	48-49.5	11/13/11	6"	48–49		Large grain sand with traces of larger gravel.
					50		
					51		
					52		
	11	53-54.5	7/11/13	6"	53–54		Top.3 large grain sand Remainder small to medium grain sand.
					55		
					56		
					57		
	12	58-59.5	11/13/15	10"	58–59		Medium to dark sand with small amount of gravel with traces of coal in the top of spoon.
					60		
					1		

Engineer ______

AEPMTP-000492

AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

Job No. ______________

Company ______________

Project ______________

Location of Boring:	
Water Level	
Time	
Date	

Boring No. 505 Date 11-18-76 Sheet 4 of 4
Type of Boring ______ Rig ______
Casing used ______ Size ______ Drilling mud used ______
Boring begun ______ Boring completed ______
Ground Elevation ______ referred to ______ Datum
Field Party: Roush and Reitmire

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					60		
					61		
					62		
					63		
	13	63-64.5	11/22/36	6"	64		Medium brown and grain sand with a few gravels.
					65		
					66		
					67		
					68		
	14	68-69.5	11/12/13	6"	69		Medium brown with large grain sand with some gravel.
					70		
					71		
					72		
					73		
	15	73-74.5	11/12/14	0	74		No recovery.
					75		
					76		
					77		
					78		
	16	78-79.5	65/2	0	79		Large gravel in end of spoon
					80		Rock Stopped hole at 80.6'
					1		

Engineer ______________

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company: Appalachian Power Company

Project: Project 1301 - Conveyor

Boring No. 506 Date 11-17-76 Sheet 1 of 4

Type of Boring Auger Rig B-61

Casing used ____ Size ____ Drilling mud used ____

Boring begun 11-17-76 Boring completed 11-17-76

Ground Elevation 579.43' referred to ______ Datum

Field Party: Roush and REitmire

Location of Boring:	
Water Level	37.5
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION: Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					0		Elevation changed about 1' lower.
	1	3-4.5	2/4/4	6"	3-4.5		Dark brown pure silt.
	2	8-9.5	6/2/3	6"	8-9.5		Top.2 dark brown silt Remainder medium grain brown sand with small pieces of gravel.
	3	13-14.5	14/18/21	8"	13-14.5		Fine grain light brown sand with some small gravel.
	4	18-19.5	15/23/24	2"	18-19.5		Gravel with medium grain dark brown sand - one fragments of broken sandstone.

Engineer ______

AEPMTP-000494

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ____

Company ____

Project ____

Location of Boring:	
Water Level	
Time	
Date	

Boring No. 506 Date 11-17-76 Sheet 2 of 4

Type of Boring ____ Rig ____

Casing used ____ Size ____ Drilling mud used ____

Boring begun ____ Boring completed ____

Ground Elevation ____ referred to ____ Datum

Field Party: Roush and Reitmire

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					20		
					21		
					22		
					23		
	5	23-24.5	24/31/39	12"	24		Medium and light brown sand and gravel.
					25		
					26		
					27		
					28		
	6	28-29.5	26/56/50/.3	12"	29		Same as sample number 5 w/large gravels in spoon.
					30		
					31		
					32		
					33		
	7	33-34.5	28/30/33	13"	34		Same as sample number 5.
					35		
					36		
					37		Water
					38		
	8	38-39.5	16/10/10	4"	39		Medium brown sand and gravel.
					40		
					1		

Engineer ____

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______
Company ______
Project ______

Location of Boring:	
Water Level	
Time	
Date	

Boring No. 506 Date 11-17-76 Sheet 3 of 4
Type of Boring ______ Rig ______
Casing used ______ Size ______ Drilling mud used ______
Boring begun ______ Boring completed ______
Ground Elevation ______ referred to ______ Datum
Field Party: Roush and Reitmire

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					40		
					41		
					42		
					43		
	9	43-44.5	11/10/13	7"	44		Medium brown sand and gravel.
					45		
					46		
					47		
					48		
	10	48-49.5	10/22/34	6"	49		Medium brown, dark brown sand and small gravel w/traces of coal.
					50		
					51		
					52		
					53		
	11	53-54.5	13/15/18	5"	54		Medium brown sand and gravel.
					55		
					56		
					57		
					58		
	12	58-59.5	17/13/14	7"	59		Same as sample number 11 w/small gravel.
					60		
					1		

Engineer ______

AEPMTP-000496

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company ______

Project ______

Boring No. 506 Date 11-17-76 Sheet 4 of 4
Type of Boring ______ Rig ______
Casing used ______ Size ______ Drilling mud used ______
Boring begun ______ Boring completed ______
Ground Elevation ______ referred to ______ Datum

Field Party: Roush and Reitmire

Location of Boring:	
Water Level	
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					60		
					61		
					62		
	13	63 -64.5	15/24/30	14"	63–64		Medium brown sand and gravel.
					65		
					66		
					67		
	14	68-69.5	12/19/23	9"	68–69		Same as sample number 13.
					70		
					71		
					72		
	15	73-74.5	17/26/24	6"	73–74		Same as sample number 13.
					75		Stopped hole at 75.6' 11-17-76
					76		
					77		
					78		
					79		
					80		
					1		

Engineer ______

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AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

Job No. ____

Company: Appalachian Power Company

Project: Project 1301 - Coal Handling

Boring No. 513 Date 2-3-77 Sheet 1 of 4

Type of Boring: Auger Rig: B-50

Casing used ____ Size ____ Drilling mud used ____

Boring begun 2-3-77 Boring completed 2-3-77

Ground Elevation 573.73 referred to ____ Datum

Field Party: King and Smithson

Location of Boring:	
Water Level	33.5
Time	
Date	2-3-77

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
	1	3.5-5	5/6/8	13"	3.5-5		Medium light and medium brown mottled silty clay.
	2	8.5-10	5/12/17	18"	8.5-10		Very stiff mottled brown silty clay.
	3	13.5-15	5/9/12	18"	13.5-15		Very stiff mottled brown silty clay.
	4	18.5-20	4/8/12	18"	18.5-20		Same as sample number 3.

Engineer ____

AEPMTP-000498

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AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

Job No. ______
Company ______
Project ______

Boring No. 513 Date 2-3-77 Sheet 2 of 4
Type of Boring Auger Rig B-50
Casing used ______ Size ______ Drilling mud used ______
Boring begun ______ Boring completed ______
Ground Elevation ______ referred to ______ Datum
Field Party: King and Smithson

Location of Boring:	
Water Level	33.5
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					20		
					21		
					22		
					23		
	5	23-24.5	3/4/5	18"	24		Loose medium brown silty sand.
					25		
					26		
					27		
					28		
	6	25-29.5	23/24/25	14"	29		Dense medium brown gray sand w/trace of silt.
					30		
					31		
					32		
					33		Water
	7	33.5-35	8/12/11	10"	34		Medium brown to medium gray sand w/trace of silt.
					35		
					36		
					37		
					38		
	8	38.5-40	1/1/4	6"	39		Loose medium brown and gray sand w/trace of silt.
					40		
					1		

Engineer ______

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AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

Job No. ____________

Company ____________

Project ____________

Location of Boring:	
Water Level	33.5
Time	
Date	2-3-77

Boring No. 513 Date 2-3-77 Sheet 3 of 4
Type of Boring Auger Rig B-50
Casing used ____ Size ____ Drilling mud used ____
Boring begun ____ Boring completed ____
Ground Elevation ____ referred to ____ Datum
Field Party: King and Smithson

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					40		
					41		
					42		
					43		
	9	43.5-45	5/7/9	0	44		Sand and gray wash water.
					45		
					46		
					47		
					48		
	10	48.5-50	5/9/11	4"	49		Medium brown sand and gravel.
					50		
					51		
					52		
					53		
	11	53.5-55	9/14/16	8"	54		Dense medium brown gray sand w/trace of silt.
					55		
					56		
					57		
					58		
	12	58.5-60	12/20/25	10"	59		Dense medium brown, gray sand.
					60		
					1		

Engineer ____________

AEPMTP-000500

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company ______

Project ______

Boring No. 513 Date 2-3-77 Sheet 4 of 4
Type of Boring Auger Rig B-50
Casing used ____ Size ____ Drilling mud used ____
Boring begun ____ Boring completed ____
Ground Elevation ____ referred to ____ Datum
Field Party: King and Smithson

Location of Boring:	
Water Level	33.5
Time	
Date	2-3-77

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					60		
					61		
					62		
					63		
	13	63.5-65	13/23/27	6"	64		Very dense medium brown and gray sand w/trace of silt.
					65		
					66		
					67		
					68		
	14	68.5-70	11/18/60	12"	69		Same as sample number 13. .2 gray sandstone in end of tube.
					70		
					1		Stopped hole at 70.0' 2-3-77
					2		
					3		
					4		
					5		
					6		
					7		
					8		
					9		
					0		
					1		

Engineer ______

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AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

Job No. ____________

Company: Appalachian Power Company

Project: Project 1301- Coal Yard

Location of Boring:

Water Level	
Time	
Date	

Boring No. 514 Date 2-4-77 Sheet 1 of 4

Type of Boring: Auger Rig: B-50

Casing used ____ Size ____ Drilling mud used ____

Boring begun 2-4-77 Boring completed 2-4-77

Ground Elevation 573.09 referred to ________ Datum

Field Party: King and Smithson

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
	1	3.5-5	5/9/13	12"	5		Mottled light brown and rusty sandy silty clay w/rock fragments. Very stiff - dry -
	2	8.5-10	11/22/27	14"	10		Medium brown silty clayey sand w/gravel. dense-dry
	3	13.5-15	15/20/19	12"	15		Medium brown coarse sand and gravel. - dense-dry-
	4	18.5-20	15/16/20	10"	20		Medium brown coarse sand and gravel. dense - dry

Engineer ____________

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ____________

Company ____________

Project ____________

Boring No. 514 Date 2-4-77 Sheet 2 of 4

Type of Boring Auger Rig B-50

Casing used ____ Size ____ Drilling mud used ____

Boring begun ____ Boring completed ____

Ground Elevation ____ referred to ____ Datum

Field Party: King and Smithson

Location of Boring:	
Water Level	
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					20		
					21		
					22		
					23		
					24		
	5	23.5-25	19/19/20	8"	25		Medium brown sand and gravel dense and dry
					26		
					27		
					28		
					29		
	6	28.5-30	7/9/15	6"	30		Medium brown damp sand and gravel - medium -
					31		
					32		
					33		
					34		Water
	7	33.5-35	12/15/13	6"	35		Medium brown wet - sand and gravel. - medium -
					36		
					37		
					38		
					39		
	8	38.5-40	4/6/7	5"	40		Medium brown gravelly sand - wet -
					1		

Engineer ____________

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company ______

Project ______

Location of Boring:	
Water Level	
Time	
Date	

Boring No. 514 Date 2-4-77 Sheet 3 of 4
Type of Boring Auger Rig B-50
Casing used ___ Size ___ Drilling mud used ___
Boring begun ___ Boring completed ___
Ground Elevation ___ referred to ___ Datum
Field Party: King and Smithson

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					40		
					41		
					42		
					43		
					44		Washed out plug 2'
	9	43.5-45	7/14/15	-0-	45		- Lost sample -
					46		
					47		
					48		
					49		
	10	48.5-50	11/18/21	7"	50		Medium brown sand and gravel Dense - wet
					51		
					52		
					53		
					54		
	11	53.5-55	6/8/12	12"	55		Medium brown fine to medium sand
					56		
					57		
					58		
					59		Washed out plug 2'
	12	58.5-60	13/25/17	-0-	60		Lost sample
					1		

Engineer ______

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company ______

Project ______

Boring No. 514 Date 2-4-77 Sheet 4 of 4

Type of Boring Auger Rig B-50

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______ Datum

Field Party: King and Smithson

Location of Boring:	
Water Level	
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					60		
					61		Augers settled down after drilling 6"
					62		
					63		
					64		
	13	63.5-65	12/22/23	-0-	65		No recovery. * Used stiff spring.
					66		
					67		
					68		
					69		
	14	68.5-70	24/30/80/.4	8"	70		Medium brown sand and gravel w/trace of sandstone fragments in end of spoon.
					71		
					72		Stopped hole at 70' 2-4-77
					73		
					74		
					75		
					76		
					77		
					78		
					79		
					80		
					1		

Engineer ______

AMERICAN ELECTRIC POWER SERVICE CORPORATION

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AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company: Appalachian Power Company

Project: Project 1301 - Flyash Pipe Bridge

Location of Boring:

Water Level	40.0'
Time	
Date	2-4-77

Boring No. 701 Date 2-4-77 Sheet 1 of 5

Type of Boring Auger Rig B-50

Casing used ______ Size ______ Drilling mud used ______

Boring begun 2-4-77 Boring completed 2-9-77

Ground Elevation 584.92 referred to ______ Datum

Field Party: King and Smithson

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
	1	3.5-5	6/9/12	15"	4		Silty medium brown to gray clay.
	2	8.5-10	5/5/8	8"	10		Sandy silt.
	3	13.5-15	5/9/7	8"	15		Medium grain brown sand and silt.
	4	18.5-20	15/20/22	11"	20		Medium grain sand w/trace of gravel.

Engineer ______

AEPMTP-000506

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AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ____________

Company ____________

Project ____________

Location of Boring:

Water Level	
Time	
Date	

Boring No. 701 Date 2-7-77 Sheet 2 of 5

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______ Datum

Field Party: King and Smithson

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					20		
					21		
					22		
					23		
					24		
	5	23.5-25	8/13/17	9"	25		Fine sand w/trace of coal and some gravel.
					26		
					27		
					28		
					29		
	6	28.5-30	7/8/11	8"	30		Medium grain sand w/small gravel.
					31		
					32		
					33		
					34		
	7	33.5-35	5/6/8	12"	35		Medium grain sand - medium brown
					36		
					37		
					38		
					39		
	8	38.5-40	4/9/11	18"	40		Light brown medium grain sand. Water at 40.0'
					1		

Engineer ____________

AEPMTP-000507

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company ______

Project ______

Boring No. 701 Date 2-8-77 Sheet 3 of 5

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______ Datum

Field Party: King and Smithson

Location of Boring:	
Water Level	
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					40		
					41		
					42		
					43		
					44		
	9	43.5-45	4/6/7	-0-	45	//////	No recovery.
					46		
					47		
					48		
					49		
	10	48.5-50	2/4/7	3"	50	//////	Medium grain sand w/small gravel.
					51		
					52		
					53		
					54		
	11	53.5-55	17/12/15	16"	55	//////	Medium grain sand w/several large gravel.
					56		
					57		
					58		
					59		
	12	58.5-60	6/12/16	8"	60	//////	Medium grain sand w/small gravel.
					1		

Engineer ______

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AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ____

Company ____

Project ____

Boring No. 701 Date 2-8-77 Sheet 5 of 5

Type of Boring ____ Rig ____

Casing used ____ Size ____ Drilling mud used ____

Boring begun ____ Boring completed ____

Ground Elevation ____ referred to ____ Datum

Field Party: King and Smithson

Location of Boring:	
Water Level	
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					80		Auger refusal at 80.5'
					81		Started coring at 80.5'
					82		
					83		
					84		
	Core	80.5-90.5		7.6'	85		Gray coarse grain sandstone.
					86		
					87		
					88		
					89		
					90		Stopped hole at 90.5' 2-8-77
					91		
					92		
					93		
					94		
					95		
					96		
					97		
					98		
					99		
					100		
					1		

Engineer ____

AEPMTP-000509

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AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company: Appalachian Power Company

Project: Project 1301 - Fly ash Pond

Location of Boring:	
Water Level	39.0
Time	
Date	2-1-77

Boring No. 703 Date 2-1-77 Sheet 1 of 5
Type of Boring Auger Rig B-50
Casing used ______ Size ______ Drilling mud used ______
Boring begun 2-1-77 Boring completed 2-2-77
Ground Elevation 567.70 referred to ______ Datum
Field Party: King and Smithson

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					0		
					1		
					2		
					3		
					4		
	1	3.5-5	5/7/7	16"	5		Silty clay.
					6		
					7		
					8		
					9		
	2	8.5-10	3/4/5	12"	10		Sandy, silty clay.
					11		
					12		
					13		
					14		
	3	13.5-15	1/3/3	12"	15		Sandy clay.
					16		
					17		
					18		
					19		
	4	18.5-20	13/22/19	5"	20		Sand and medium large gravel. Trace of coal.
					1		

Engineer ______

AEPMTP-000510

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AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company ______

Project ______

Location of Boring:	
Water Level	39.0
Time	
Date	2-1-77

Boring No. 703 Date 2-1-77 Sheet 2 of 5

Type of Boring Auger Rig B-50

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______ Datum

Field Party: King and Smithson

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					20		
					21		
					22		
					23		
					24		
	5	23.5-25	10/15/18	8"	25		Medium grain sand, light gray.
					26		
					27		
					28		
					29		
	6	28.5-30	7/8/11	5"	30		Medium grain sand w/trace of coal.
					31		
					32		
					33		
	7	33.5-35	5/6/10	7"	34		Medium grain sand, medium brown.
					35		
					36		
					37		
					38		
					39		Water
	8	38.5-40	5/5/5	8"	40		Same as sample number 7.
					1		

Engineer ______

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AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company ______

Project ______

Boring No. 703 Date 2-1-77 Sheet 3 of 5
Type of Boring Auger Rig B-50
Casing used ____ Size ____ Drilling mud used ____
Boring begun ____ Boring completed ____
Ground Elevation ____ referred to ____ Datum
Field Party: King and Smithson

Location of Boring:	
Water Level	
Time	
Date	2-1-77

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					40		
					41		
					42		
					43		
					44		Washed out.
	9	43.5-45	4/6/7	1"	45		Two large gravels and medium grain sand.
					46		
					47		
					48		
	10	48.5-50	5/4/6	10"	49		~~Same as sample number 9.~~
					50		
					51		
					52		
					53		
					54		
	11	53.5-55	8/8/10	10"	55		Smaller gravel - medium grain sand.
					56		
					57		
					58		
					59		
	12	58.5-60	15/20/22	8"	60		Medium brown - medium grain sand.
					1		

Engineer ______

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AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No.

Company

Project

Boring No. 703 Date 2-1-77 Sheet 4 of 5

Type of Boring auger Rig B-50

Casing used ___ Size ___ Drilling mud used ___

Boring begun ___ Boring completed ___

Ground Elevation ___ referred to ___ Datum

Field Party: King and Smithson

Location of Boring:	
Water Level	39.0
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					60		
					61		
					62		
					63		
					64		
	13	63.5-65	7/6/14	5"	65		Several large gravel and medium grain sand.
					66		
					67		
					68		
					69		
	14	68.5-70	15/20/22	10"	70		Medium grain sand w/trace of gravel and shale.
					71		
					72		
					73		
					74		
	15	73.5-75	12/12/14	9"	75		Large grain sand and small gravel.
					76		
					77		
					78		
					79		
	16	78.5-80	56/20/17	10"	80		Same
					1		

Engineer ___

AEPMTP-000513

AMERICAN ELECTRIC ...

AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

Job No. ______

Company ______

Project ______

Location of Boring:	
Water Level	
Time	
Date	

Boring No. 703 Date 2-1-77 Sheet 5 of 5

Type of Boring Auger Rig B-50

Casing used ____ Size ____ Drilling mud used ____

Boring begun ____ Boring completed ____

Ground Elevation ____ referred to ____ Datum

Field Party: King and Smithson

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					80		
					81		
					82		Rock
					83		
					84		
	Run #1	82.7-92.7		10.0	85		82.7' started coring.
					86		
					87		
					88		
					89		
					90		
					91		All sandstone core 100% recovery.
					92		Stopped coring at 92.7' 2-2-77
					93		
					94		
					95		
					96		
					97		
					98		
					99		
					100		
					1		

Engineer ______

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AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ____________

Company: Appalachian Power Company

Project: Project 1301 - Truck Bridge Crossing

Boring No. 801 Date 3-16-77 Sheet 1 of 5

Type of Boring: Auger Rig: B-61

Casing used ______ Size ______ Drilling mud used ______

Boring begun 3-16-77 Boring completed 3-16-77

Ground Elevation 594.95 referred to ____________ Datum

Field Party: Roush and Reitmire

Location of Boring:	
Water Level	
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					0		
					1		
					2		
					3		
	1	2.5-4	21/24/27	15"	4		Black fly ash and dark brown sand and gravel. (Fill)
					5		
					6		
					7		
					8		
	2	7.5-9	7/4/5	13"	9		Dark fill brown sand and gravel.
					10		Medium brown clayey silt.
					11		
					12		
					13		
	3	12.5-14	2/3/4	14"	14		Medium brown clayey, sandy silt.
					15		
					16		
					17		
					18		
	4	17.5-19	3/4/5	16"	19		Medium brown clayey sand.
					20		
					1		

Engineer ____________

AEPMTP-000515

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company ______

Project ______

Boring No. 801 Date 3-16-77 Sheet 2 of 5

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______

______ Datu

Field Party: Roush and Reitmire

Location of Boring:	
Water Level	
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					20		
					21		
					22		
	5	22.5-24	10/15/17	15"	23		Medium brown gravely sand.
					24		
					25		
					26		
					27		
	6	27.5-29	8/13/17	16"	28		Same as sample number 5.
					29		
					30		
					31		
					32		
	7	32.5-34	5/6/9	15"	33		Medium brown sand w/trace of gravel.
					34		
					35		
					36		
					37		
	8	37.5-39	6/8/11	14"	38		Medium brown sand.
					39		Water
					40		
					1		

Engineer ______

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AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ____________________

Company ____________________

Project ____________________

Boring No. 801 Date 3-16-77 Sheet 3 of __

Type of Boring __________ Rig __________

Casing used ______ Size _____ Drilling mud used ______

Boring begun __________ Boring completed __________

Ground Elevation __________ referred to __________

__________ Da

Field Party: __________

Location of Boring:	
Water Level	
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					40		
					41		
					42		
					43		
	9	42.5-44	2/3/4	13"	44		Medium brown sand w/trace of gravel.
					45		
					46		
					47		
					48		
	10	47.5-49	6/7/8	1"	49		Same as sample number 9.
					50		
					51		
					52		
					53		
	11	52.5-54	4/4/7	2"	54		Same as sample number 9.
					55		
					56		
					57		
					58		
	12	57.5-59	7/12/13	14"	59		Medium brown sand.
					60		
					1		

Engineer __________

AEPMTP-000517

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AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ____

Company ____

Project ____

Location of Boring:

Water Level	
Time	
Date	

Boring No. 801 Date 3-16-77 Sheet 4 of 5

Type of Boring ____ Rig ____

Casing used ____ Size ____ Drilling mud used ____

Boring begun ____ Boring completed ____

Ground Elevation ____ referred to ____

____ Datum

Field Party: Roush and Reitimre

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					60		
					61		
					62		
					63		
	13	62.5-64	8/9/13	13"	64		Medium brown sand.
					65		
					66		
					67		
					68		
	14	67.5-69	8/10/12	10"	69		Same
					70		
					71		
					72		
					73		
	15	72.5-74	4/8/13	11"	74		Same
					75		
					76		
					77		
					78		
	16	77.5-79	10/26/27	12"	79		Same
					80		
					1		

Engineer ____

AEPMTP-000518

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company ______

Project ______

Location of Boring:	
Water Level	
Time	
Date	

Boring No. 801 Date 3-16-77 Sheet 5 of 5

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______ Datu

Field Party: Roush and Reitmire

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					80		
					81		
					82		
					83		
	17	82.5-84	12/18/21	6"	84		Medium brown sand and gravel.
					85		
					86		Auger refusal at 86.8'
					87		Stopped hole at 86.8'
							3-16-77
					88		
					89		
					90		
					1		
					2		
					3		
					4		
					5		
					6		
					7		
					8		
					9		
					0		
					1		

Engineer ______

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ____________

Company: Appalachian Power Company

Project: Project 1301 - Truck Bridge Crossing

Location of Boring:	
Water Level	34.5
Time	
Date	

Boring No. 802 Date 3-17-77 Sheet 1 of 4

Type of Boring Auger Rig B-61

Casing used ____ Size ____ Drilling mud used ____

Boring begun 3-17-77 Boring completed 3-17-77

Ground Elevation 588.46 referred to ____________ Datum

Field Party: Roush and Rietmire

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
	1	3.5-5	5/8/8	17"	3.5-5		Medium brown and gray clayey silt.
	2	8.5-10	3/4/5	16"	8.5-10		Medium brown and gray sandy, clayey silt.
	3	13.5-15	2/5/6	14"	13.5-15		Medium brown clayey sand.
	4	18.5-20	7/8/11	8"	18.5-20		Medium brown gravely sand.

Engineer ____________

AEPMTP-000520

FORM CE-5
REV. 3/74

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ____

Company ____

Project ____

Boring No. 802 Date 3-17-77 Sheet 2 of 4

Type of Boring ____ Rig ____

Casing used ____ Size ____ Drilling mud used ____

Boring begun ____ Boring completed ____

Ground Elevation ____ referred to ____ Dat

Field Party: Roush and Reitmire

Location of Boring:	
Water Level	34.5
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					20		
					21		
					22		
					23		
					24		
	5	23.5-25	5/7/10	14"	25		Medium brown sand - fine grain
					26		
					27		
					28		
					29		
	6	28.5-30	3/7/9	14"	30		Same as sample number 5 fine grain.
					31		
					32		
					33		
					34		
	7	33.5-35	13/14/13	15"	35		Same as sample number 5 w/medium and coarse grain sand.
					36		
					37		
					38		
					39		
	8	38.5-40	4/7/8	13"	40		Same as sample number 5 w/medium and coarse grain sand.
					1		

Engineer ____

REV. 3/74

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company ______

Project ______

Location of Boring:	
Water Level	34.5
Time	
Date	

Boring No. 802 Date 3-17-77 Sheet 3 of 4

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______ Datum

Field Party: Roush and Reitmire

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					40		
					41		
					42		
					43		
					44		
	9	43.5-45	37/5/6	13"	45		Medium brown sand - medium and coarse grain.
					46		
					47		
					48		
					49		
	10	48.5-50	6/8/10	14"	50		Same as sample number 9, medium grain.
					51		
					52		
					53		
					54		
	11	53.5-55	5/6/10	12"	55		Same as sample number 10 - medium grain.
					56		
					57		
					58		
					59		
	12	58.5-60	8/10/14	13"	60		Same as sample number 11 - medium grain.
					1		

Engineer ______

FORM CE-5
REV. 3/74

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ____________

Company ____________

Project ____________

Location of Boring:	
Water Level	34.5
Time	
Date	

Boring No. 802 Date 3-17-77 Sheet 4 of 4
Type of Boring ______ Rig ______
Casing used ______ Size ______ Drilling mud used ______
Boring begun ______ Boring completed ______
Ground Elevation ______ referred to ______
______ Dat
Field Party: Roush and Reitmire

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					60		
					61		
					62		
					63		
					64		
	13	63.5-65	13/14/17	13"	65		Medium brown sand - fine grain - medium coarse grain.
					66		
					67		
					68		
					69		
	14	68.5-70	5/8/12	12"	70		Same as sample number 13 - medium and coarse grain.
					71		
					72		
					73		
					74		
	15	73.5-75	8/15/22	15"	75		Same as sample number 13 - medium grain.
					76		
					77		
					78		
					79		
	16	78.5-80	9/14/20	14"	80		Same as sample number 13 - medium and coarse grain.
					1		
							Auger refusal at 82.5'

Engineer ____________

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company: Appalachian Power Company

Project: Project 1301 - Truck Bridge Crossing

Location of Boring:	
Water Level	
Time	
Date	

Boring No. 803 Date 3-15-77 Sheet 1 of 5

Type of Boring Auger Rig B-61

Casing used ______ Size ______ Drilling mud used ______

Boring begun 3-15-77 Boring completed 3-16-77

Ground Elevation ______ referred to ______ Dat

Field Party: Roush and Reitmire

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					0		*Boring offset about 25' east because of power lines.
					1		
					2		
					3		
	1	2.5-4	3/4/6	14"	4		Medium brown clayey silt.
					5		
					6		
					7		
					8		
	2	7.5-9	4/5/5	13"	9		Medium brown, medium grain, gravely sand.
					10		
					11		
					12		
					13		
	3	12.5-14	4/4/5	7"	14		Same as sample number 2 w/fine and medium grain sand.
					15		
					16		
					17		
					18		
	4	17.5-19	5/6/7	14"	19		Medium brown sand and gravel.
					20		
					1		

Engineer ______

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

Job No. ______

Company ______

Project ______

Location of Boring:	
Water Level	
Time	
Date	

Boring No. 803 Date 3-15-77 Sheet 2 of 5

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______ Datum

Field Party: Roush and Reitmire

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					20		
					21		
					22		
					23		
	5	22.5-24	10/11/13	12"	24		Medium brown sand and gravel.
					25		
					26		
					27		
					28		
	6	27.5-29	6/8/6	1"	29		Medium brown gravely sand.
					30		
					31		
					32		
					33		
	7	32.5-34	8/10/5	6"	34		Medium brown, medium grain gravely sand.
					35		
					36		
					37		
					38		
	8	37.5-39	5/6/8	14"	39		Same
					40		
					1		

Engineer ______

AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

Job No. ______

Company ______

Project ______

Boring No. 803 Date 3-15-77 Sheet 3 of 5

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______ Datum

Field Party: Roush and Reitmire

Location of Boring:	
Water Level	
Time	
Date	

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					40		
					41		
					42		
					43		
	9	42.5-44	5/4/6	13"	44		Medium brown, medium coarse grain gravely sand.
					45		
					46		
					47		
					48		
	10	47.5-49	7/8/10	12"	49		Medium brown, coarse grain sand w/some gravel.
					50		
					51		
					52		
					53		
	11	52.5-54	6/8/12	6"	54		Same as sample number 10 w/medium grain sand trace of gravel.
					55		
					56		
					57		
					58		
	12	57.5-59	8/10/12	7"	59		Same
					60		
					1		

Engineer ______

AEPMTP-000526

AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

Job No. ____

Company: Appalachian Power Company

Project: Project 1301 - Truck Bridge Crossing

Boring No. 803 Date 3-15-77 Sheet 4 of ____

Type of Boring ____ Rig ____

Casing used ____ Size ____ Drilling mud used ____

Boring begun ____ Boring completed ____

Ground Elevation ____ referred to ____ Dat

Location of Boring:	
Water Level	
Time	
Date	

Field Party: Roush and Reitmire

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					60		
					61		
					62		
					63		
	13	62.5-64	7/11/15	6"	64		Medium brown coarse grain gravelly sand.
					65		
					66		
					67		
					68		
	14	67.5-69	13/17/25	5"	69		Medium brown fine sand.
					70		
					71		
					72		
					73		
	15	72.5-74	6/9/13	13"	74		Same
					75		
					76		
					77		
					78		
	16	77.5-79	8/13/20	13"	79		Same - medium grain.
					80		
					1		

Engineer ____

AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

Job No. ______

Company ______

Project ______

Location of Boring:	
Water Level	
Time	
Date	

Boring No 803 Date 3-15-77 Sheet 5 of __

Type of Boring ______ Rig ______

Casing used ______ Size ______ Drilling mud used ______

Boring begun ______ Boring completed ______

Ground Elevation ______ referred to ______ Da

Field Party: Roush and Reitmire

Depth of Casing, ft.	Sample No.	Sample depth from-to (in feet)	Standard Penetration Resistance Blows/Foot	Tot. length of recov. sample	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION Soil type, color, texture, consistency, sampler driving notes, blows per foot on casing, depths wash water lost, observed fluctuations in water level, notes on drilling ease, etc.
					80		
					81		
					82		
					83		
	17	82.5-84	8/10/22	1"	84		Medium brown gravelly sand.
					85		
					86		
					87		
					88		
	18	87.3-87.4	50/.1	-	89		Hit rock at 86.8' No recovery Started coring at 87.6'
					90		
					91		100' recovery. 8.0' of +.4 core
					92		
	Run #1	87.6-97.6		10.0	93		10.0' medium gray medium grain hard sandstone.
					94		
					95		
					96		
					97		
					98		Stopped hole at 97.6' 3-16-77
					99		
					100		
					1		

Engineer ______

Appalachian Power Company

Mountaineer Bottom Ash Pond Complex

North and West Dike Modification

ENGINEERING REPORT

March 21, 2006

DS-1
012003

State of West Virginia
Department of Environmental Protection
Division of Water and Waste Management
Dam Safety Section

Identification Number ________ Office Use Only

APPLICATION FOR A CERTIFICATE OF APPROVAL

1. Name of Dam: Mountaineer Bottom Ash Pond (North and West) Dikes
   Popular name: Mountaineer Bottom Ash Pond Complex
   Reservoir name: Mountaineer Bottom Ash Ponds (East and West)
2. Applicant: Appalachian Power Company
   Address: 1 Riverside Plaza
   City: Columbus State: OH Zip: 43215
   Phone (614) 716-2926 Fax (614) 716-2963
3. If the applicant is not the owner, the applicant is acting for the owner as ________
   (agent, lessee, trustee, engineer, etc.)
4. Owner of dam/reservoir: Appalachian Power Company
   1 Riverside Plaza, Columbus, OH 43215
   (address) (phone)
5. Owner is a ☐ Individual ☒ Corporation ☐ Agency ☐ Partnership ☐ Association ☐ Other
6. If owner is other than an individual, list officers or officials of the organization

name	title
Michael G. Morris	Chief Executive Officer
Robert P. Powers	Vice President
Susan Tomasky	Vice President

7. Name of surface landowner(s): Appalachian Power Company
   Address: 1 Riverside Plaza, Columbus, OH 43215
8. Legal right to construct or modify a dam is by ☐ Deed ☒ Approval ☐ Agreement ☐ Other ________
9. Name of design engineer: Pete Smith, Shaw Stone & Webster, Inc.
   Address: 9201 E. Dry Creek Road, Centennial, CO 80112 Phone (614) 863-3113
10. Name of resident or construction engineer: Yogesh Rege, PE w/ H.C. Nutting Co.
    Address: 790 Morrison Road, Columbus, OH 43230-6642 Phone (614) 863-3113

11. Application is for: (check one)

	use form:
☐ New construction	DS1A
☒ Modify/Repair	DS1A
☐ Existing structure	DS1A
☐ Removal	DS1B
☐ Abandonment	DS1B
☐ Breach	DS1B

12. Type of dam: Earth (earth, concrete, rockfill, etc.)
13. Purpose of dam: Bottom Ash Disposal (water supply, recreation, etc.)
14. a. Location of dam
    Mason County (county)
    New Haven, WV (nearest Post Office)
    N38° 58' (Latitude: deg,min,sec)
    W81° 56' 25" (Longitude: deg,min,sec)
    b. Name of stream: Upground Reservoir (on which dam is located)
    Ohio River (tributary of)
15. U.S.G.S. Quadrangle: New Haven (7 ½ minute series)
16. Distance to nearest downstream occupied structure: 1500 feet
17. Nearest downstream community: New Haven, WV (name)
    2,000 (population) 1.7 miles (distance)

DS-1A 012003

APPLICATION FOR A CERTIFICATE OF APPROVAL EXISTING DAM OR CONSTRUCTION / MODIFICATION

Identification Number ______________ Office Use Only

18. Downstream hazard classification 2 (1, 2, 3, or 4) 19. Drainage area east: 17.4 west: 17.7 (acres) ______ (square miles)

Dam and reservoir data (All elevations based upon U.S.G.S. feet above mean sea level)

NOTE: For existing dams, complete first column only. For construction of a new dam, complete second column only. For modification of a dam, complete both columns.

			Existing/Current configurations	Final Design configurations
a.	Height of dam (item n minus item m)	feet	east: 23 ft. west: 18 ft.	east: 23 ft. west: 18 ft.
b.	Crest length of dam	feet	east: 3650 ft. west: 3750 ft.	east: 3650 ft. west: 3750 ft.
c.	Crest width of dam	feet	25 to 40 ft.	25 to 40 ft.
d.	Freeboard (normal pool to crest)	feet	3 ft.	3 ft.
e.	Normal pool surface area	acres	east: 13.9 west: 14.1	east: 13.9 west: 14.1
f.	Max. design pool surface area	acres	east: 15.1 west: 15.3	east: 15.1 west: 15.3
g.	Pool surface area (top of dam)	acres	east: 15.8 west: 16	east: 15.8 west: 16
h.	Normal reservoir volume	ac.ft.	east: 193 west: 152	east: 193 west: 152
i.	Max. design reservoir volume	ac.ft.	east: 266 west: 225	east: 266 west: 225
j.	Reservoir volume (top of dam)	ac.ft.	east: 312 west: 272	east: 312 west: 272
k.	Design point rainfall (six hour duration)	inches	27.5	27.5
l.	Upstream toe (lowest)	elev	west: 600 ft. east: 596 ft.	west: 600 ft. east: 596 ft.
m.	Downstream toe (lowest)	elev	west: 603 ft. east: 598 ft.	west: 603 ft. east: 598 ft.
n.	Top of dam (crest)	elev	620 to 621 ft.	620 to 621 ft.
o.	Principal spillway (low inlet)	elev	NA	NA
p.	Principal spillway (high inlet)	elev	east & west: 611.5 ft.	east & west: 611.5 ft.
q.	Principal spillway capacity	cfs	east: 109 west: 109	east: 109 west: 109
r.	Reservoir drain inlet	elev	NA	NA
s.	Reservoir drain capacity	cfs	NA	NA
t.	Emergency spillway (crest)	elev	NA	NA
u.	Emergency spillway capacity	cfs	NA	NA
v.	Normal pool	elev	612 ft.	612 ft.
w.	Max design pool	elev	617 ft.	617 ft.
x.	Max solids (waste disposal)	elev	617 ft.	617 ft.
y.	Upstream slope of dam		3 H: 1 V	3 H: 1 V
z.	Downstream slope of dam		3 H: 1 V	2.5 H: 1 V

PETER J. SMITH REGISTERED 16139 STATE OF WEST VIRGINIA PROFESSIONAL ENGINEER

21. Included with this application are the maps, plans, specifications, supporting calculations and filing fee of $300 as required by the Dam Safety Rules (47CSR34-18.1).
22. I certify that the application and accompanying plans, specifications, drawings and supporting calculations were prepared under my direct supervision, and are true and correct to the best of my knowledge.

Appalachian Power Company
(print owner's name)

[signature] 3-20-06
(signature of design engineer) (date)

[signature] 3/22/06
(owner signature) (date)

RPE No. 16139 State WEST VIRGINIA

T.O.C.

TABLE OF CONTENTS

Narrative

Accompanying Application for a Dam Safety Certificate of Approval for AEP Mountaineer Bottom Ash Ponds

The Mountaineer East and West Bottom Ash Ponds were designed American Electric Power Service Corporation and its sub-consultants in 1977. The ponds were constructed between 1978 and 1980.

A gypsum conveyor system, which is an ancillary part of the installation of flue gas desulphurization units, or scrubbers, at the Mountaineer plant, is to be constructed at the site. The alignment of the new overland gypsum conveyor #1 lies on the downstream slope of the north side of the Mountaineer West Bottom Ash Pond. Berms will be constructed on the north side of the west pond to accommodate the conveyor and accompanying access road. The alignment of the new overland gypsum conveyor #2 lies on the downstream slope of the west side of the Mountaineer West Bottom Ash Pond. The alignment and grade of conveyors #1 and #2 are shown on the enclosed Drawings 1-30215-2 and 1-30216-2. The enclosed drawings are a subset of a large construction drawing set for the material handling system and are the only drawings of that set that deal with the bottom ash dikes. The grade of conveyor #2 along the west side requires cuts of up to about 6 feet near the toe of the dike as well as fills of several feet. The relevant construction Drawings and the earthwork specification (Shaw Stone & Webster PS-J005) are enclosed with this application.

The stability at three critical sections was analyzed using two-dimensional limit equilibrium methods. Two sections (labeled as sections A and B in Drawing 1-30215-2) are along the north side of the pond and the third (labeled as section C in Drawing 1-30215-2) is at the maximum cut along the west side of the pond. The soil density and strength in the stability model is the same as used for similar soils in the 2001 application for dam safety certification for the North Sporn Dike and is also consistent with the original geotechnical design by Casagrande Consultants. The stability calculations are enclosed (Shaw Stone & Webster calculation 1024690305-G-003).

The following conclusions were reached:

1. The stability analysis of the Mountaineer Bottom Ash Pond perimeter dike along gypsum conveyors #1 and #2 demonstrate that the stability of the downstream slope of the dike meets West Virginia dam safety criteria as outlined in WV Code of State Rules Title 47 Series 34.

2. Parametric studies of the influence of piezometric conditions indicate that the toe of the slope along gypsum conveyor #2 may experience very shallow slumps if allowed to become saturated (see Drawing 1-30215-2). Therefore, a blanket drain will be constructed at the toe and on the face of cut slopes along gypsum conveyor #2.

List of enclosures:

- Drawings: 1-30215-2, 1-30216-2, and 1-30222-2.
- Shaw Stone & Webster calculation: 1024690305-G-003.
- Shaw Stone & Webster specification: PS-J005.

Shaw® Stone & Webster, Inc

CALCULATION COVER SHEET

J.O./W.O. No:	1024690305
CLIENT:	AEP
PROJECT:	Mountaineer FGD Retrofit
LOCATION:	New Haven, West Virginia
TITLE:	Slope Stability Analysis Gypsum Conveyors #1 and #2 along Mountaineer Bottom Ash Perimeter Dike
EQUIP/DWG. No:	Not Applicable
CALCULATION No:	1024690305-G-003

OBJECTIVE:

Evaluate the stability of the downstream slope of the Mountaineer bottom ash pond perimeter dike where the alignment of gypsum conveyors #1 and #2 necessitate geometry changes to the downstream slope.

INPUTS:

ASSUMPTIONS:

1). The internal geometry of the perimeter dike is essentially the same as shown in the 1977 Casagrande report.

2). Fill for gypsum conveyors #1 and #2 will be a well compacted on-site silty sand or gravel with a moist unit weight of 120 lb/ft^3 and an internal friction angle of at least 34°.

3). A gravel blanket drain similar to American Electrical Power Service Corp. shallow slope stabilization detail "A" will be installed at the toe of the dike on the face of cut slopes where cuts are required.

ASSUMPTIONS REQUIRING CONFIRMATION:

BASIS OF CALCULATION, METHOD, OR SOFTWARE TO BE USED:

The stability of the slopes was evaluated using the geotechnical slope stability analysis software Slope/W licensed from Geo-Slope International, Ltd. Calgary, Alberta, Canada.

CONCLUSION:

1. The stability analysis of the Mountaineer Bottom Ash Pond perimeter dike along gypsum conveyors #1 and #2 demonstrate that the stability of the downstream slope of the dike meets WV dam safety criteria.
2. Parametric studies of the influence of piezometric conditions indicate that the toe of the slope along gypsum conveyor #2 may experience very shallow slumps if allowed to become saturated. Therefore, a blanket drain will be required at the toe and on the face of cut slopes along gypsum conveyor #2.

DATA CONFIRMATION REQUIRED Y ☐ N ☒

REVISION	0	1	2	3	4	5	6
PREPARER/ DATE	D. Bentler 3/13/06 David J Bentler						
CHECKER/ DATE	J. Meisenheimer 3/14/06 P J Smith for J. Meisenheimer						

PETER J. SMITH REGISTERED 16139 STATE OF WEST VIRGINIA PROFESSIONAL ENGINEER

Peter J Smith 3-16-06

Shaw® Stone & Webster, Inc **TABLE OF CONTENTS**	J.O. No.	1024690305
	CLIENT:	AEP
	CALCULATION NUMBER:	1024690305-G-003
	REVISION NUMBER:	0

PREPARER:	D. Bentler	CHECKER:	J. Meisenheimer
DATE :	3/13/06	DATE :	3/14/06

TITLE: Slope Stability Analysis Gypsum Conveyors #1 and #2 along Mountaineer Bottom Ash Perimeter Dike	PAGE
Cover Sheet	1
Table of Contents	2
Historical Data	3
Civil / Structural Design Basis	4
References	5
Summary of Calculation	8
Conclusions	10
Attachments:	
A. Plan of stability section locations	A1
B. AEP Shallow Slope Stabilization Detail "A"	B1
C. Reference 3 – Engineering Report for Appalachian Power Company, Philip Sporn Electric Generating Plant, Unit 5 Fly Ash Facility.	C1
D. Excerpts from Reference 4 – Engineering Report for Mountaineer Bottom Ash Ponds by Casagrande Consultants, April 1977.	D1

3A.100B(0892)
C/S-00007.R0 10/93

Shaw® Stone & Webster, Inc HISTORICAL DATA	J.O. No.	1024690305
	CLIENT:	AEP
	CALCULATION NUMBER:	1024690305-G-003
	REVISION NUMBER:	0

PREPARER:	D. Bentler	CHECKER:	J. Meisenheimer
DATE :	3/13/06	DATE :	3/14/06
TITLE:	Slope Stability Analysis Gypsum Conveyors #1 and #2 along Mountaineer Bottom Ash Perimeter Dike		

HISTORICAL DATA

DATE	REV. NO.	REASON FOR CHANGE(S) & SOURCE OF INFORMATION	PREPARER	CHECKER

PAGES AFFECTED

DATE	REV. NO.	PAGES	DESCRIPTION OF CHANGE(S)

3A.100B(0892)
C/S-00007.R0 10/93

Shaw® Stone & Webster, Inc CIVIL/STRUCTURAL DESIGN BASIS		J.O. No.	1024690305
		CLIENT:	AEP
		CALCULATION NUMBER:	1024690305-G-003
		REVISION NUMBER:	0
PREPARER:	D. Bentler	CHECKER:	J. Meisenheimer
DATE :	3/13/06	DATE :	3/14/06
TITLE:	Slope Stability Analysis Gypsum Conveyors #1 and #2 along Mountaineer Bottom Ash Perimeter Dike		

LOAD CONSIDERATIONS		MATERIAL	GRADE/ STRENGTH
DEAD	☒	CONCRETE	
LIVE	☒	REINFORCEMENT	
EQUIPMENT	☒	STRUCTURAL STEEL	
PIPE	☐	HIGH STRENGTH BOLTS	
WIND	☐	COMMON BOLTS	
POSITIVE PRESSURE	☐	WELD RODS	
NEGATIVE PRESSURE	☐	ANCHOR BOLTS	
SEISMIC	☒	STUDS	
THERMAL	☐		
HYDROSTATIC	☒		
EARTH PRESSURE	☐		
CONSTRUCTION	☐	VENDOR NAME	
SNOW AND ICE	☐		
		VENDOR DWG. NO.	DATE/REV.

REFERENCES:

DESIGN

1. Stability Modeling with SLOPE/W: An Engineering Methodology. John Krahn. First Edition, Revision 1, August 2004, GEO-SLOPE/W International Ltd. 1400, 633 – 6th Ave SW, Calgary, Alberta, Canada T2P 2Y5.

PROJECT REFERENCE DOCUMENTS

2. American Electrical Power. Fossil Projects: Structural Design Criteria. AEP-0-DB-024-0002, Rev. A, May 2004.
3. Engineering Report for Appalachian Power Company, Philip Sporn Electric Generating Plant, Unit 5 Fly Ash Facility. Prepared in support of the application for a certification of approval in accordance with Title 47 of the West Virginia Division of Environmental Protection Water Resources – Waste Management, Dam Safety Rule Series 34 by Geotechnical Engineering Section, American Electric Power Service Corporation, July 1998.
4. Engineering Report for American Electrical Power Service Corporation, Bottom Ash Ponds. Prepared by Casagrande Consultants, Arlington, Massachusetts 02174, April 1977.
5. Geotechnical Engineering Services Report for the American Electric Power Mountaineer Station Unit 1 FGD Project – Gypsum Handling Facility New Haven, West Virginia. Prepared for Stone & Webster, Inc. Centennial, CO 80112 by Professional Service Industries, Inc. Pittsburgh, Pennsylvania 15220, October 29, 2004.

REGULATIONS

6. West Virginia Dam Safety Rules. West Virginia Code of State Rules. Title Series 47-34. http://www.wvsos.com/csr/verify.asp?TitleSeries=47-34.

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O NUMBER	DIVISION AND GROUP	CALCULATION NUMBER	OPTIONAL TASK CODE	REV. NO. 0
1024690305	CSA	1024690305-G-003	AEP Mountaineer	PAGE NO. 6

SUMMARY OF CALCULATION

OBJECTIVE

Evaluate the stability of the downstream slope of the Mountaineer bottom ash pond perimeter dike near Gypsum Transfer Tower 6 where the alignment of the new gypsum conveyors #1 and #2 necessitate slope geometry changes.

BACKGROUND

The alignment of the new gypsum conveyors #1 and #2 lie approximately on the toe of the Mountaineer bottom ash pond perimeter dike near Gypsum Transfer Tower 6. Because the dike is subject to WV dam safety regulations, a slope stability analysis is required to support an application for dam safety certification, which must be submitted as a result of the changes to the dike geometry.

APPROACH

Analyze the stability at each location is performed using two-dimensional limit equilibrium analysis. The analysis follows the method outlined in Reference 1. The soil density and strength in the stability model are based on the parameters used in the application for dam safety certification from the state of West Virginia (Reference 3) and in the original engineering design report for the bottom ash ponds by Casagrande Consultants (Reference 4).

METHOD

General

The slope stability analysis method known as Morgenstern and Price (Reference 1) is used. The Morgenstern and Price method, like most two-dimensional stability methods, involves subdividing potential sliding mass into slices with vertical sides such that 1) the base of each slice pass through only one material, and 2) each slice is narrow enough that the portion of the sliding at the base of the slice can be accurately represented as a straight line. In Morgenstern and Price's method horizontal, vertical, and moment equilibrium equations are written for each slice and then solved simultaneously. When the number of slices exceeds one, the problem is statically indeterminate and assumptions are required to solve the problem. The assumption used in Morgenstern and Price's method is that the inclination of the side forces on the slices follows a prescribed pattern, generally a half sine function.

Slope Geometry

Stability cross section were developed at two locations along gypsum conveyor #1 and one location along gypsum conveyor #2 using the project digital terrain model. The sections at stations 24+32 and 25+41 correspond to maximum fill sections of gypsum conveyor #1 on the downstream slope of the north perimeter dike. The section at station 35+00 corresponds to the maximum cut section of gypsum conveyor #2 on the downstream slope of the west perimeter dike. The maximum slope of the downstream dike face of sections 24+32 and 25+41 is about 2H:1V; while the maximum slope of the downstream face at section 35+00 is about 3H:1V. Attachment A shows the location of the stability sections.

The interior dike geometry of these sections is based on the design section shown in Reference 4 (see Figure 4 in Attachment D).

Soil Density and Strength

The density and strength characteristics of the dike and foundation materials in the SLOPE/W models are consistent with that used for similar soils in the application for dam safety certification of the North Sporn Dike (see Reference 3, excerpt enclosed as Attachment C) and the original engineering design of the bottom ash pond dikes (Reference 4, excerpt enclosed as Attachment D).

Soil	Moist Unit Weight (lb/ft^3)	Saturated Unit Weight (lb/ft^3)	Cohesion, c (lb/ft^2)	Internal Friction Angle, ϕ (deg.)
[1][1] Clay Liner (CL)	118	125	0	33
[2] Mine Waste (GW)	135	140	0	36
[3] Crushed Stone (GP)	115	120	0	35
[4] Sand Fill	110	115	0	33
[5] Water	NA	62.4	0	0
[6] Brown Sandy Clay (CL)	112	115	500	22
[7] Brown Gravelly Sand (SP)	NA	120	0	32
[8] Sandy Clayey Silt (ML)	112	115	0	31
[9] New Fill (SM or GM)	115	120	0	34

[1]Numbers inside the square brackets correspond to geometry regions shown on the SLOPE/W sections.

Surcharge loads

The dead and material loads from the gypsum conveyors are applied to the slope as a pressure loading of 180 psf over a 8 foot wide area in the SLOPE/W models. This load is based on 2-foot by 2-foot by 8-foot sleepers supporting the conveyor every 20 feet. The maximum dead and material load on each sleeper is 14.4 kips. The equivalent 2D representation of this loading is taken as 14.4 kips bearing on area 8-feet wide by 10-feet long (i.e. 14,400 lbf/80 ft^2 = 180 psf).

Groundwater

The piezometric conditions used in the SLOPE/W models are estimated based on descriptions of the seepage emerging just downstream of the dike in low areas and water levels observed in geotechnical borings (Reference 5).

Earthquake

Previously, a pseudo-static acceleration of 5.0% of gravity has been used for analysis of slopes at this site (Reference 3). The 2002 USGS NEHRP seismic hazard maps indicate peak horizontal acceleration, a_{max}, value of 7.22% for a mean recurrence interval 2,474 years (i.e. 2%PE in 50 yr.). Current geotechnical earthquake engineering practice is to use ½ a_{max} as the pseudo-static acceleration, which would suggest using a value of 3.6 %g. Because the value of 5.0 %g used previously on this project is slightly more conservative and has precedence it is used for the analysis described herein.

----- ground motion values from 2002 USGS Seismic Hazard Maps -----------

SEISMIC HAZARD: Hazard by Lat/Lon, 2002 (http://eqint.cr.usgs.gov/eq-men/html/lookup-2002-interp-06.html).

LOCATION 38.95 Lat. -81.9167 Long.

The interpolated Probabilistic ground motion values, in %g, at the requested point are:

	10%PE in 50 yr	2%PE in 50 yr
PGA	2.62	7.22
0.2 sec SA	6.14	15.93
1.0 sec SA	2.64	6.24

Critical Failure Surface Search

The slip surface option known as "entry and exit" in SLOPE/W was used to identify a critical circular failure surface. For the entry and exit option SLOPE/W systematically generates and analyzes circular slip surfaces which enter and exit at points of the ground surface specified by the user. The slip surface with the minimum factor of safety of all surfaces analyzed is then reported by the software. When a range is specified a number of increments to subdivide the range is also specified so that multiple entry/exit points are automatically generated. For each combination of entry and exit points, multiple circular slip surfaces passing through those points are generated and analyzed.

The slip surface optimization option was also specified for each SLOPE/W analysis. The optimization routine begins with a specified circular slip surface, e.g. the critical surface from the exit and entry search, converts the surface into a piecewise linear surface and searches for a more critical surface by moving each vertex of the failure surface and subdividing the segments of the surface if necessary. The optimization routine almost always yields a kinematically admissible slip surface with a lower factor of safety than the initial trial slip surface.

Analyses
The new steady state, or long term, condition for each of the stability sections was analyzed for static and earthquake load conditions. The analysis focused on failures of the downstream portion of the dike. For each analysis, between 1,000 and 2,000 trial circular slip surfaces were generated and analyzed using the entry and exit search. The critical slip surface from each analysis was then optimized.

RESULTS

SECTION 24+32

The long term stability analysis for section 24+32 is shown in Figure 1. The minimum factor of safety from the analysis is 1.89 for an optimized non-linear failure surface. The WV regulatory stability criteria for the long term condition is a minimum factor of safety greater than 1.5 (Reference 6).

The earthquake stability analysis for section 24+32 is shown in Figure 2. The minimum factor of safety from the analysis is 1.61 for an optimized non-linear failure surface. The WV regulatory stability criteria for the earthquake condition is a minimum factor of safety greater than 1.2 (Reference 6).

SECTION 25+41

The long term stability analysis for section 25+41 is shown in Figure 3. The minimum factor of safety from the analysis is 1.59 for an optimized non-linear failure surface. The WV regulatory stability criteria for the long term condition is a minimum factor of safety greater than 1.5 (Reference 6).

The earthquake stability analysis for section 25+41 is shown in Figure 4. The minimum factor of safety from the analysis is 1.36 for an optimized non-linear failure surface. The WV regulatory stability criteria for the earthquake condition is a minimum factor of safety greater than 1.2 (Reference 6).

SECTION 35+00

The long term stability analysis for section 35+00 is shown in Figure 5. The minimum factor of safety from the analysis is 1.56 for an optimized non-linear failure surface. The WV regulatory stability criteria for the long term condition is a minimum factor of safety greater than 1.5 (Reference 6).

The earthquake stability analysis for section 35+00 is shown in Figure 6. The minimum factor of safety from the analysis is 1.36 for an optimized non-linear failure surface. The WV regulatory stability criteria for the earthquake condition is a minimum factor of safety greater than 1.2 (Reference 6).

SUMMARY

The results of the stability analysis of the bent locations are summarized in the table below along with the regulatory requirements.

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O NUMBER	DIVISION AND GROUP	CALCULATION NUMBER	OPTIONAL TASK CODE	REV. NO. 0 PAGE NO. 10
1024690305	**CSA**	1024690305-G-003	**AEP Mountaineer**	

Section	**Factor of Safety against Sliding**	
	Steady State	**EQ**
Required FS	***1.5***	***1.2***
Section 24+32	1.9	1.6
Section 25+41	1.6	1.4
Section 35+00	1.6	1.4

CONCLUSIONS

1. The stability analysis show that the factor of safety against sliding for the revised downstream slope of the perimeter dike associated with construction of gypsum conveyors #1 and #2 meet criteria.
2. Parametric studies of the influence of piezometric conditions indicate that the toe of the slope along gypsum conveyor #2 may experience very shallow slumps if allowed to become saturated. To provide positive seepage control, a blanket drain will be constructed at the toe and on the face of cut slopes along gypsum conveyor #2 (see Attachment B).

STONE & WEBSTER, INC./ A SHAW GROUP COMPANY

CALCULATION SHEET

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O NUMBER	DIVISION AND GROUP	CALCULATION NUMBER	OPTIONAL TASK CODE	REV. NO. 0
1024690305	**CSA**	1024690305-G-003	**AEP Mountaineer**	PAGE NO. 11

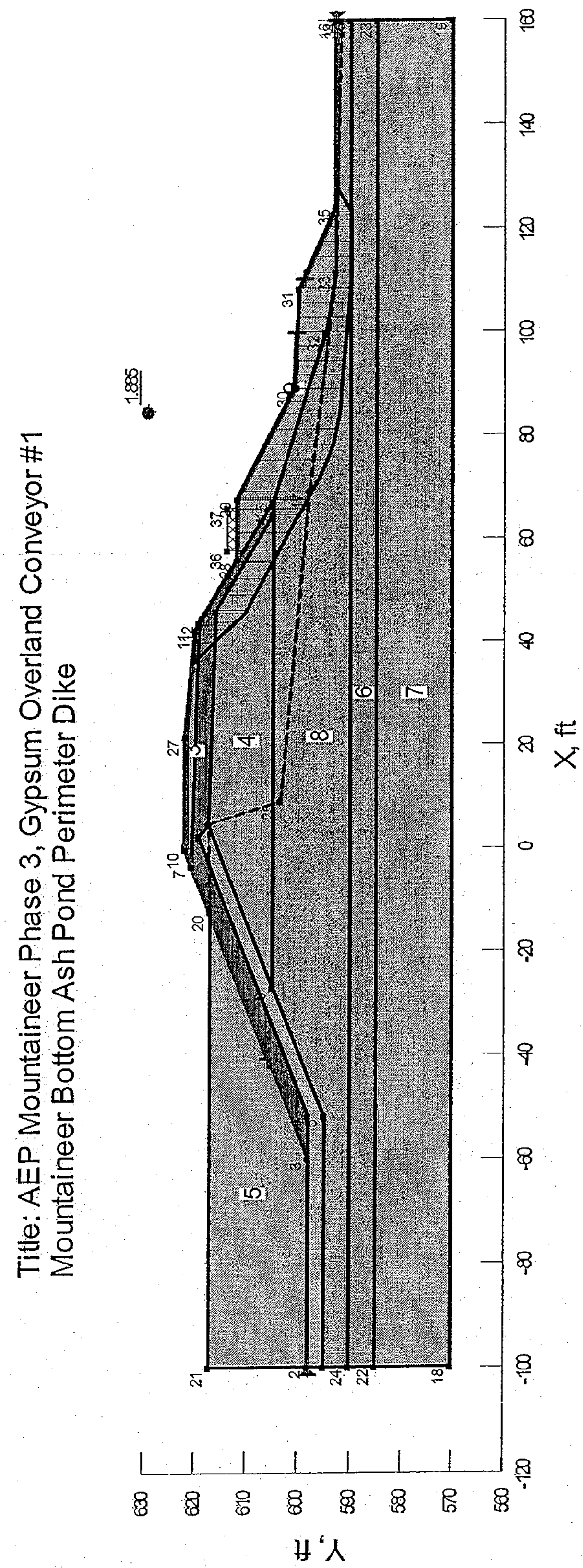


Figure 1. Long Term Stability Analysis of Section 24+32

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O NUMBER	DIVISION AND GROUP	CALCULATION NUMBER	OPTIONAL TASK CODE	REV. NO. 0
1024690305	**CSA**	1024690305-G-003	**AEP Mountaineer**	PAGE NO. 12

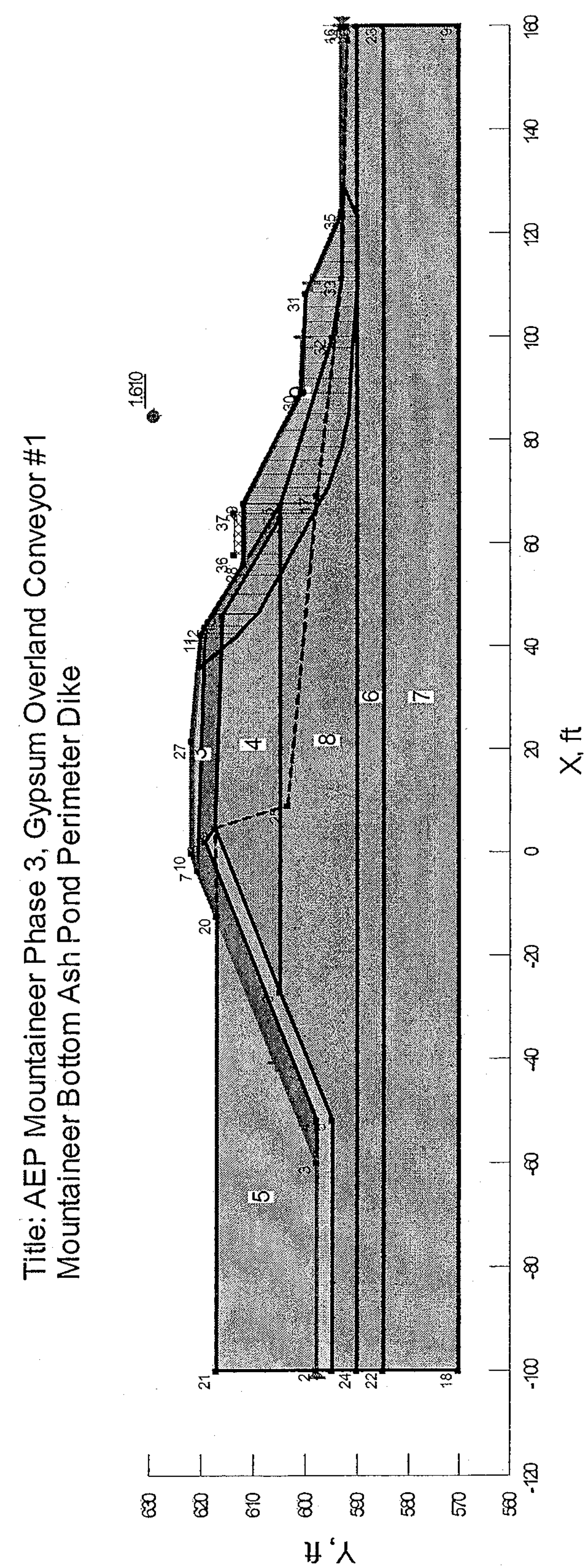


Figure 2. Earthquake Stability Analysis of Section 24+32.

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O NUMBER	DIVISION AND GROUP	CALCULATION NUMBER	OPTIONAL TASK CODE	REV. NO. 0
1024690305	**CSA**	1024690305-G-003	**AEP Mountaineer**	PAGE NO. 13

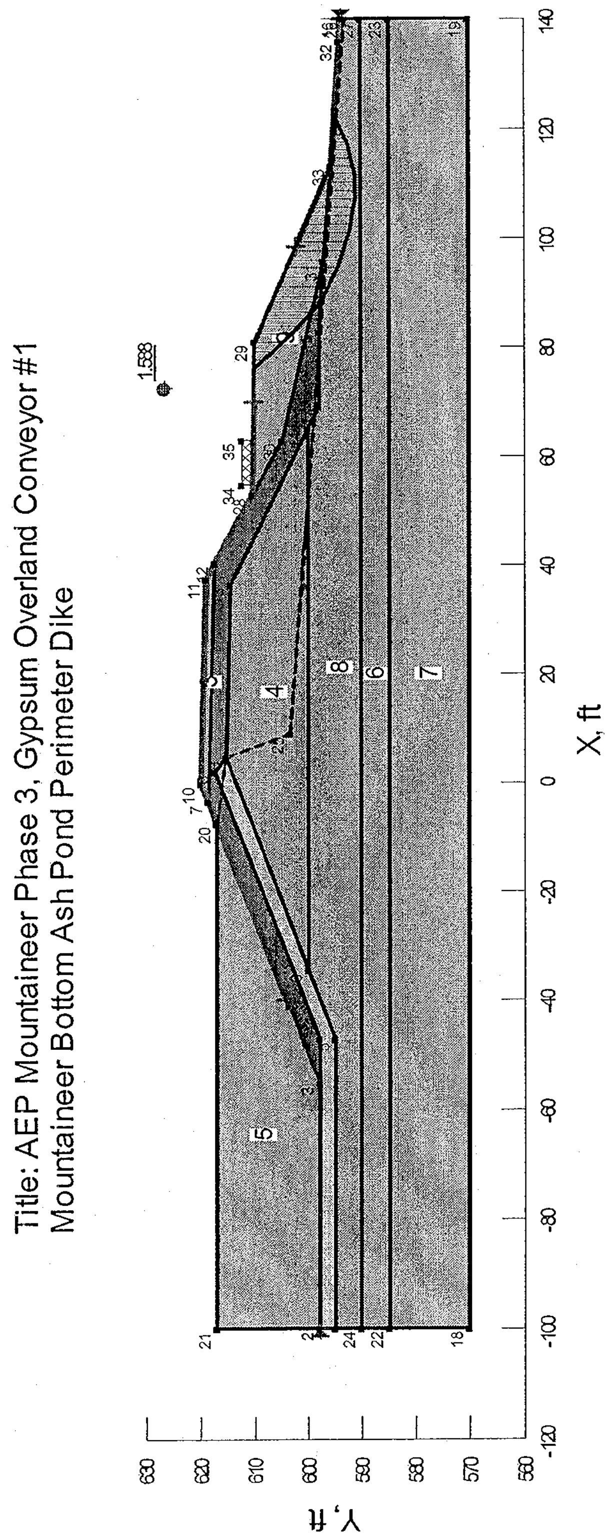


Figure 3. Long Term Stability Analysis of Section 25+41.

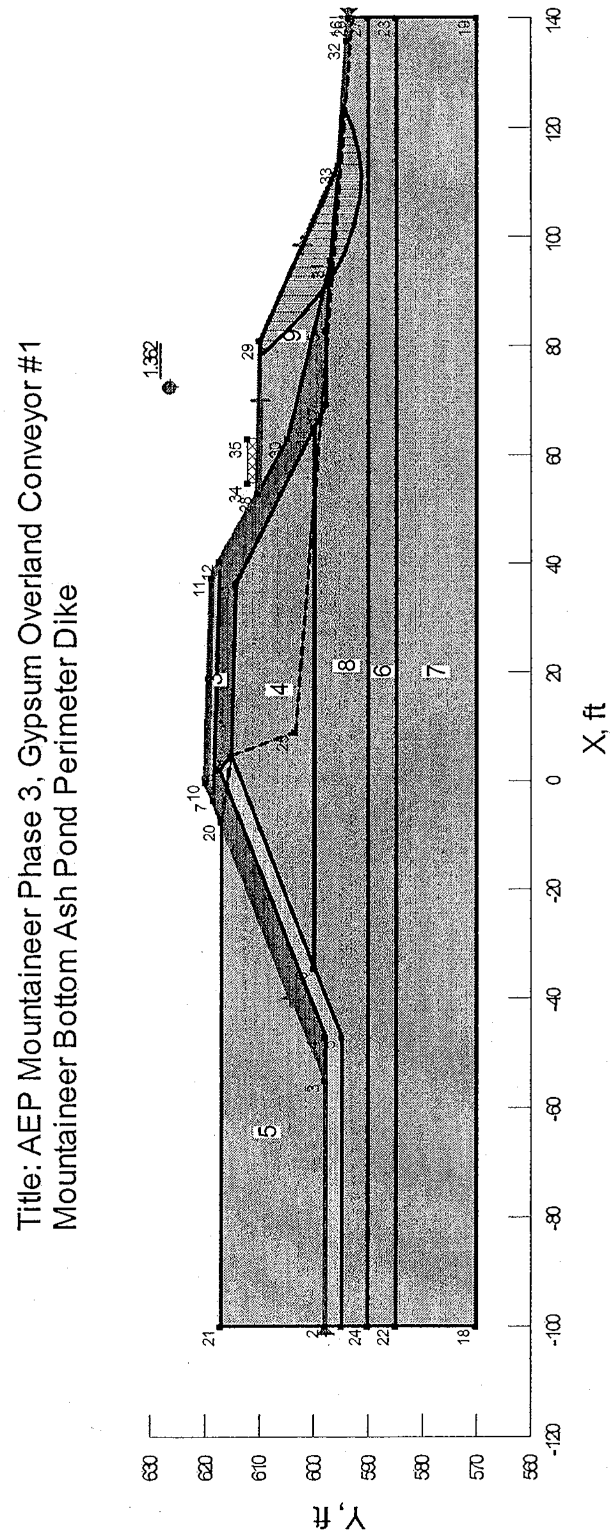


Figure 4. Earthquake Stability Analysis of Section 25+41.

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O NUMBER	DIVISION AND GROUP	CALCULATION NUMBER	OPTIONAL TASK CODE	REV. NO. 0
1024690305	CSA	1024690305-G-003	AEP Mountaineer	PAGE NO. 15

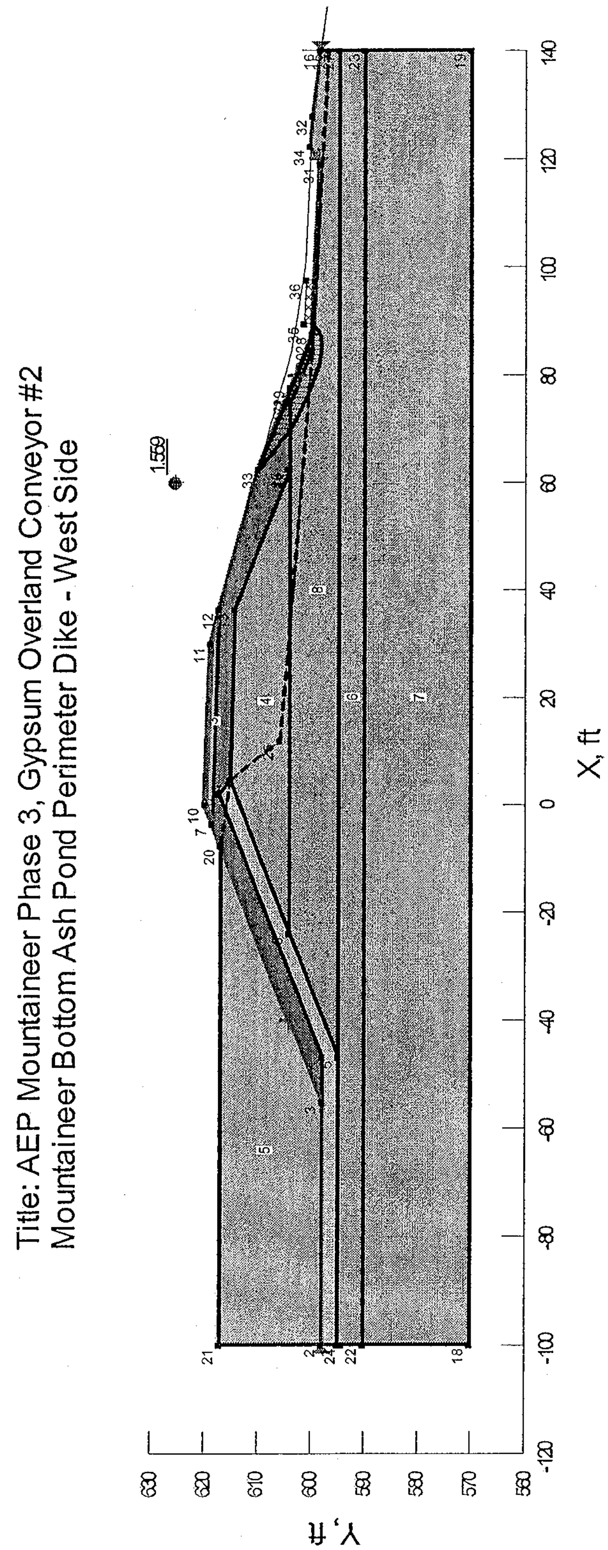


Figure 5. Long Term Stability Analysis of Section 35+00.

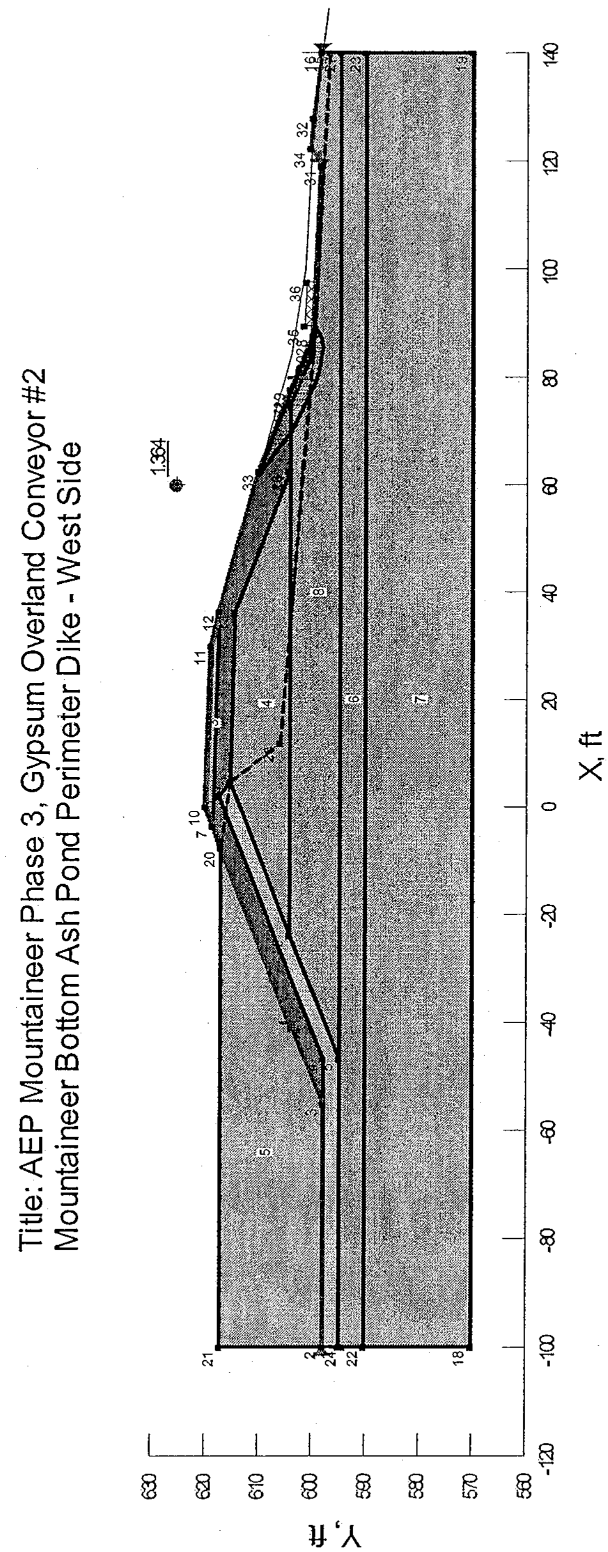
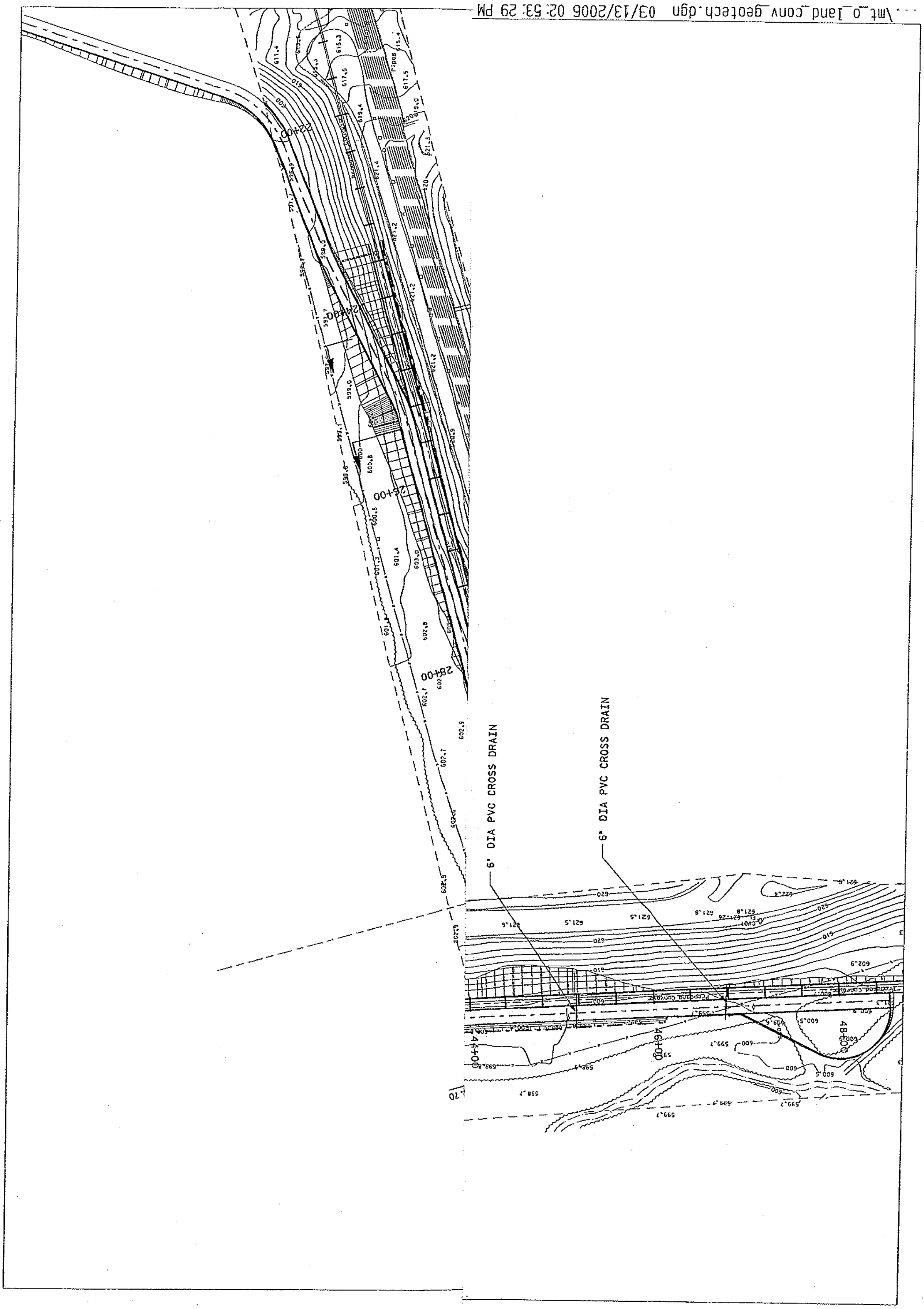


Figure 6. Earthquake analysis Stability Analysis of Section 35+00.


\mt_o_land_conv_geotech.dgn 03/13/2006 02:53:29 PM
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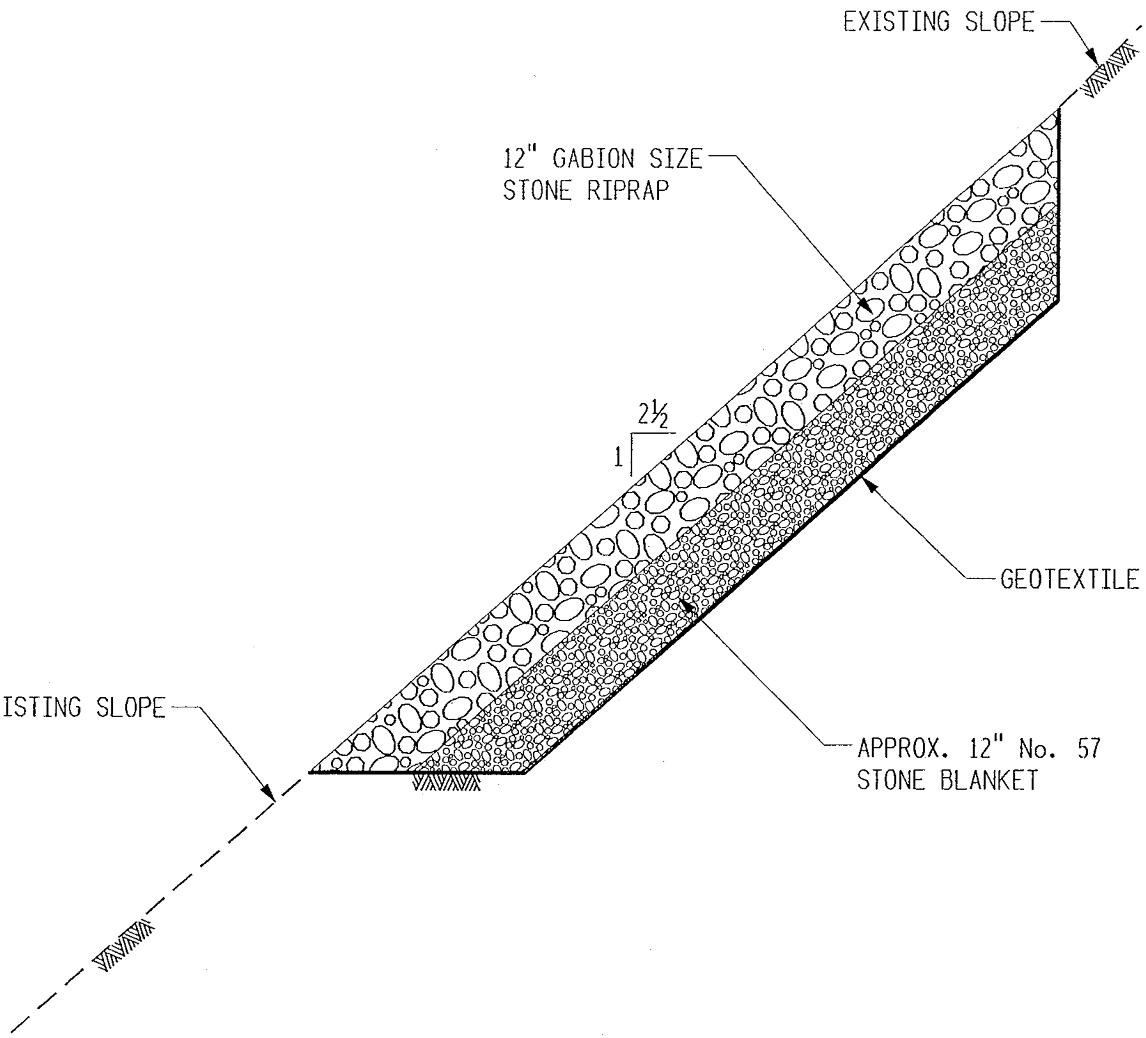
6" DIA PVC CROSS DRAIN
44+00
46+00
48+00

AEP Shallow Slope Stabilization Detail "A"



DETAIL "A"

NOTE:

1. REMOVE SOIL TO A STABLE SUBGRADE (APPROX. 2').
2. PLACE AN 8 Oz. NON-WOVEN GEOTEXTILE OVER THE EXPOSED SUBGRADE.
3. PLACE AND COMPACT No. 57 STONE FILTER BLANKET.
4. PLACE 12" THICK LAYER OF GABION SIZE RIPRAP.

DRN BY: GRS		AMERICAN ELECTRIC POWER	AEP SERVICE CORP. 1 RIVERSIDE PLAZA COLUMBUS, OH 43215
DATE:			
SCALE: N.T.S.	TYPICAL SHALLOW SLOPE STABILIZATION		

APPALACHIAN POWER COMPANY

PHILIP SPORN ELECTRIC GENERATING PLANT

UNIT 5 FLY ASH FACILITY

ENGINEERING REPORT

PREPARED IN SUPPORT OF THE APPLICATION
FOR A CERTIFICATION OF APPROVAL IN
ACCORDANCE WITH TITLE 47 OF
THE WEST VIRGINIA DIVISION OF ENVIRONMENTAL PROTECTION
WATER RESOURCES - WASTE MANAGEMENT
DAM SAFETY RULE
SERIES 34

PREPARED BY
GEOTECHNICAL ENGINEERING SECTION
AMERICAN ELECTRIC POWER SERVICE CORPORATION
JULY, 1998

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PROFESSIONAL ENGINEER

Carl S. Togni
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II. Inspection Program Reports

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IX. Results of Stability Analysis of Proposed Dike Configurations

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1.0 INTRODUCTION

The Philip Sporn Electric Generating Plant is located near the town of New Haven between the Ohio River and US Route 33, in Mason County, West Virginia. A location plan is presented in Appendix 1. Fly ash produced at the Sporn Plant has been sluiced into the fly ash facility since 1959. Currently, however, only Unit 5 discharges fly ash slurry into it. Today's fly ash facility consists of a pond where the fly ash is discharged to allow sedimentation of the fly ash particles before the overflow is discharged into the Ohio River.

The fly ash facility is an above ground impoundment formed by a four sided dike and includes a haul road which wraps about the eastern and southern sides of the dike. The plant's Unit 5 produces an average of 80,000 tons of fly ash per year. In addition to the fly ash slurry, small flows resulting from the plant operations are pumped into impoundment on an intermittent basis. Operations at the fly ash facility are expected to stay unchanged until the year 2010 when the capacity of the pond may be exhausted.

This engineering report and the accompanying set of drawings contain an engineering evaluation of the dikes forming the fly ash facility. Based on this detailed review of the condition of the dikes, modifications to the geometry of the northern, western, and a section of the eastern dike are proposed. The stability analysis of the existing and proposed configurations as well as the design of the proposed modifications are included in the following sections of the report.

1.1 Existing Conditions and Dam History

The fly ash facility is currently formed by four dikes and includes a haul road which runs along the eastern and southern dikes. For ease of presentation, the dike sections will be discussed separately as if each section were an independent structure. The dike will then be referred to as Northern, Eastern, Southern, and Western dike in accordance with its location on the overall setting of the impoundment. Drawing Nos. 15-30032 and 15-30033 (Appendix 1) illustrate the location and construction history of the dikes.

1.1.1 Northern Dike

The northern dike of the fly ash facility is located along AEP's Mountaineer Plant. The eastern section of this dike was a part of the original 1958 impoundment. This dike was extended and raised through the 1962, 1968, and the 1972 expansions of the facility.

Currently the northern dike has a maximum total height of 35 to 40 feet. The grade of the downstream slope is approximately 2 horizontal to 1 vertical, whereas, the grade of the upstream slope may have sections as steep as 1 horizontal to 1 vertical.

1.1.2 Western Dike

The western dike of the fly ash facility is located along West Virginia State Route 33. The dike was initially built as part of the 1968 expansion of the fly ash impoundment and achieved its current configuration during the 1972 expansion.

Currently the western dike has a maximum total height of 30 to 35 feet. The grade of the downstream and upstream slope is in general steeper than 2 horizontal to 1 vertical and at some locations may be as steep as 1 horizontal to 1 vertical.

1.1.3 Southern Dike

The southern dike of the fly ash facility is located along the haul road leading to a fly ash landfill. The eastern section of this dike was initially built as part of the original fly ash impoundment in 1958. Subsequent extensions and raisings of the dike occurred in 1965, 1968 and by 1972, it had reached its present configuration.

Currently, the southern dike has a maximum total height of 20 to 25 feet. In general, the grade of the downstream and upstream slopes is about 2 horizontal to 1 vertical. On the western section of the dike, however, the downstream slope is graded at a slope steeper than 2 horizontal to 1 vertical.

1.1.4 Eastern Dike

The Eastern dike which is located parallel to the Ohio River was constructed to approximately elevation 580 using local overburden soils. At about 1965, the dike was raised to approximately elevation 590 again using local soils. Capacity requirements led to raising the dike to approximately elevation 600 in 1968 using local soils of a granular nature. Some historic information refers to these soils as "dirty" sand and gravel. Additional capacity requirements led to a final raising in 1972. The 1972 raising was placed upstream of the existing dike and was constructed of mostly sand "and" gravel, with a silty clay layer as upstream core and, an isolation layer. In addition, a granular layer was placed at the interface of the then existing fly ash level and the new raising. A silty clay cap was extended on top of the fly ash all across the existing reservoir of the time (1972). The 1972 raising was constructed to a crest elevation of 620. Following this construction, a road was developed on the crest of the 1968 dike extension.

Ever since the haul road was paved in September of 1979, it experienced longitudinal cracks in a 400 ft long section near the beginning of the haul road at Mountaineer Plant. The cracks gave the appearance of their being the manifestation of the upper end of a deep seated landslide towards the Ohio River. By July of 1980 a survey line was set across the most critical section of the potential landslide. Because of the magnitude of surface deformation, both vertical and horizontal, two slope indicators were installed by August, 1981. Subsurface information was obtained from borings drilled at the toe and top of the slide. After reviewing the information collected, stability analyses were performed for potential slip planes. A letter from Casagrande Consultants (CC) is in file for information and background on the analyses. Based on CC recommendations, it was decided in 1982, that the soils on the riverside of the haul road were to be strengthened using electro-osmosis under the direction of Casagrande Consultants. The effects on the electro-osmosis as recorded by the slope indicators and survey are on file at AEP's headquarters in Columbus, Ohio. Towards the end of the electro-osmosis treatment, a new series of borings were drilled to evaluate the effectiveness of the electro-osmosis. CC report associated with the effects of electrosmosis is on file at AEP's Headquarters.

By March, 1983, AEP retained Woodward-Clyde Consultants (WCC) to assist with the evaluation of the effectiveness of the electro-osmosis treatment. After several discussions among all parties, it was decided to discontinue the treatment.

Since that time, nothing serious had happened to this section of the dike. However, cracks continued to develop in each new layer of pavement overlay placed on the haul road. By 1988, new personnel became responsible for this facility and it was noticed that slope indicator S-1 had been damaged. A new slope indicator SI-3 was installed then, near the location of SI-1. In 1993, steps were taken to address the instability associated with the distress observed in the haul road. Thus, additional borings were drilled to supplement file information. In addition a careful review of the file information was undertaken. By the end of 1994, it was concluded that the observed cracking was the result of a slipping of the 1968 materials, riding on the interface of the 1965 down stream slope. By this time, John Lowe III had been retained by AEP to review and assist in the evaluation of the data and proposed remedial actions. The remedial actions were implemented in the fall of 1995. The modifications to this dike were approved by the West Virginia Dam Safety Office on October 6, 1995, prior to their implementation. As part of the present certification effort WCC was again retained to assist in the evaluation of design parameters used in the repair in light of historical data as well as the effects of the implemented repair in the overall factor of safety of this section (M-M) of the eastern dike. WCC report is included in Appendix 2.

Currently the eastern dike has a maximum total height of approximately 60 to 70 feet. The grade of the downstream and upstream slopes is about 2 horizontal to 1 vertical. A few isolated sections of the downstream slope may have grades somewhat steeper than 2 horizontal to 1 vertical.

1.2 Hazard Classification

The hazard potential of the current dikes of the fly ash facility was evaluated in accordance with the guidelines set forth by Title 47 of the West Virginia Division of Environment Protection, Water Resources - Waste Management, Dam Safety Rule series 34, section 3.5.2 which became effective on May 1, 1995. On this basis, the existing dikes of the bottom ash facility are classified as class 1 (high hazard) dams. "Class 1 dams are those dams located where failure may cause loss of human life or major damage to dwellings, commercial or industrial buildings, important public utilities, main railroads, or where high risk highway may be affected or damaged. This classification must be used if failure may result in the loss of human life".

1.3 Normal Operating Procedure

Fly ash is pumped to the pond where it is allowed to settle. The water level at the present time is maintained at approximately elevation 604.5. The overflow of water is then conveyed through a discharge structure to the Ohio River.

After the implementation of the proposed improvements, it is intended to maintain the current operating level that is to say - below a maximum elevation of 605.

2.0 PERFORMANCE EVALUATION

The performance of the fly ash facility dikes is evaluated on the basis of periodic visual inspections and monitoring instrumentation. Routine inspections of the dikes have been conducted as follows:

A. Plant personnel. This inspection will be performed quarterly following the proposed improvements, unless conditions develop which warrant a change in the frequency of the inspections.
B. Representative of the Goetechnical Section of the American Electric Power Service Corporation, experienced in the inspection and evaluation of dams. This inspection will continue at a frequency of once a year.
C. Consultant Inspections.

Copies of reports prepared under each of the above inspection programs are included in Appendix 2 to this report.

In addition, Woodward-Clyde Consultants was retained to evaluate design parameters, factors of safety and overall functionality of the repair undertaken on the northern section of the eastern dike. A copy of their report is also included in Appendix 2.

3.0 FIELD INVESTIGATION

An extensive characterization of the geology at the site was performed by Acres Inc. in 1974. Relevant findings from the 1974 investigation are used as part of this report and are presented in the following section.

3.1 Regional Geology

The State of West Virginia is divided structurally and topographically into eastern and western areas by the northeast-southwest alignment of the Allegheny Front. The Philip Sporn Plant site is in the western area, which is known as the Appalachian Plateau. This area is underlain by relatively flat-lying Pennsylvanian and Mississippian strata, consisting of relatively thin, alternating beds of shale, sandstone, limestone, coal and clay. Locally, however, sandstones thicken and coalesce to form thick units reflecting topographic irregularities prior to their deposition. The rock units in the western area are generally softer and subject to more rapid alternating of the thinner strata than similar units in the astern area.

In the 1996 publication "Groundwater in Mason and Putnam Counties, West Virginia", by Benton M. Wilmoth of the West Virginia Geological and Economic Survey, the bedrock at Graham Station, which is adjacent to the site, is reported to belong to the Monangahela group of the Pennsylvanian system.

The overburden in the Ohio River Valley consists of alluvium of Pleistocene and recent ages. In many areas, the bedrock valley is approximately 1 mile wide and is filled with sediments which range in thickness from 10 feet to over 100 feet and average approximately 85 feet.

Although Pleistocene glaciers did not advance into West Virginia, the outwash materials derived from the meltwater, together with the effects of drainage disruptions, led to an aggravation in the Ohio River Valley of up to approximately 120 feet of sand and gravel above the bedrock floor. Since the Ohio River still flows on the Wisconsin outwash, recent repeated inundations have deposited alluvial clay, silt and fine sand on the lowest floodplains.

The general stratigraphy resulting from these geological events indicates an alluvial deposit which becomes coarser with depth, usually from clay and silt floodplain deposits near the ground surface to sand and gravel near the bedrock. It is marked by sharp horizontal and vertical changes in material type.

The stratigraphic column is summarized in the following table:

System	Formation	Lithology
Quanternary	Alluvium	River and glacial outwash deposits; brown, gray, and yellow clay, silt, sand and gravel.
Pennsylvanian	Monogahela	Nonmarine cyclic sequences of gray and brown sandstone, red and varicolored sandy shale, and minor beds of limestone, coal and fire clay.

3.2 Subsurface Conditions at the Fly Ash Facility

3.2.1 Field Work

10 borings were drilled within the existing dikes as part of this report. The purpose of the borings was to obtain information on the soils forming the existing dikes, and the natural soils immediately underlying the existing facility.

During the period of May 28 through June 11, 1996, the borings were drilled to depths in the range of 48.5 to 73.5 feet below the ground surface. Boring locations and elevations were obtained by surveyors from AEP Civil Engineering Laboratory and referenced to a plant benchmark. Boring locations with respect to the existing facilitates are presented on Drawing No. 15-30014. Logs of borings are included in Appendix 3 of this report. Also included are borings SI-3 and 9301 drilled in 1988 and 1993, respectively, to investigate subsurface conditions on the section of the eastern dike that was repaired in 1995.

The current borings were advanced using a 6.5 inch diameter hollow stem auger from ground surface to termination. At regular intervals, disturbed but representative soil samples were obtained by driving a 2-inch O.D. split-barrel sampler into the soil with blows from a 140 pound hammer falling 30 inches (standard penetration test). Split-barrel samples were examined in the field, and representative portions were preserved in airtight jars. At selected locations, undisturbed samples of cohesive deposits were obtained by hydraulically pushing a thin-wall tube (Shelby tube) at a constant rate of penetration. Undisturbed samples were preserved in the tube by sealing the ends with wax.

Next to the locations of borings B-106, B-107, and B-109, three static cone penetration tests (CPT) were performed within the layer of consolidated fly ash encountered at the borings. The Dutch Cone penetrometer was advanced from depths of 24.4 to 30.70 feet to depths of 62.55 to 63.0 feet to evaluate the insitu strength of the consolidated fly ash. Records of the Dutch Cone penetrometer are also included in Appendix 3.

Experienced personnel from AEP Civil Engineering Laboratory provided overall supervision of drilling and sampling procedures and performed the following specific duties: examined all samples recovered from the borings; cleaned and preserved specimens; prepared a log of each boring; made seepage and groundwater observations; and provides a close job liaison with the project engineer, so that the exploratory program could be modified in the event that unusual subsurface conditions were encountered.

3.2.2 Typical Subsurface Conditions

Appendix 3 contains Drawing Nos. 15-30015; 15-30016; and 15-30018 which depict schematic subsurface sections taken through the borings drilled for this project. The stratigraph of the dikes was complemented with historic subsurface and operating information associated with the dike's design, construction and monitoring. In order to simplify these exhibits, the soil descriptions have been presented in an abbreviated form. If more detailed descriptions of the conditions are desired the logs of the individual borings should be examined in conjunction with the schematic sections.

The general subsurface conditions at the dikes may be described in descending order as follows:

3.2.2.1 Northern Dike

Borings B-101 and B-102, depicted on sections E-E and F-F on Drawing No. 15-30015, are representative of this dike and, in general, they revealed the following stratigraphy:

- 3 feet of road stone base and subbase.
- 15 to 25 feet of granular fill consisting of layers of brown silty gravely sand.

- At the location of Boring B-102, approximately 10 feet of dark brown silty sandy gravel; and, 4 feet of brown sandy silt were encountered within the dike's fill.
- Underlying the man-made fill, there were 12 feet of brown silty clay.
- Immediately below the brown silty clay, Boring-101 revealed 2.5 feet of gray silty sand and 2.5 feet of gray clay in descending order.
- The two borings were terminated after advancing in a brown gravely sand layer.

During drilling, the two borings were "dry" - that is to say - no water was encountered or accumulated in the boring.

3.2.2.2 Western Dike

Boring Nos. B-103, B-104, and B-105, depicted on Sections G-G, H-H, I-I on drawing 15-30015, are representative of this dike and in general they revealed the following stratigraphy:

- 2 to 3 feet of road stone base and subbase.
- 14 to 31 feet of silty gravely sand.
- At the location of Boring No. B-104 and B-105, 4 to 16.5 feet of gray silty sand was encountered immediately below the gravely sand layer.
- Below the dike materials, the borings revealed 5 to 17 feet of brown silty clay.
- Borings No. B-103 and B-105, were terminated in a layer of brown silty sand, whereas Boring No. B-104 completely penetrated this layer (10 feet thick) and was terminated after advancing into a brown sandy silt stratum.

During drilling, the three borings were "dry" - that is to say - no water was encountered or accumulated in the boring.

3.2.2.3 Southern Dike

Boring No. B-106 depicted on Section J-J on Drawing 15-30016 is representative of the dike and in general it revealed the following stratigraphy:

- 2 feet of road stone base and subbase.
- 20.5 feet of brown gravely silty sand.
- 5 feet of brown sandy clay.
- 31 feet of fly ash.

- Boring No. B-106 was terminated after advancing in a gray silty clay stratum.

During drilling, water was encountered at a depth of 60.2 feet below the ground surface.

3.2.2.4 Eastern Dike

Boring Nos. B-107, B-108, B-109 and B-110 depicted in sections K-K and L-L on Drawing Nos. 15-30016 and 15-30018 are representative of this dike. Boring Nos. B-107 and B-109 were drilled through the 1972 dike extension and they revealed the following stratigraphy:

- 2 to 2.5 feet of road base and subbase.
- 14 to 15 feet of various mixtures of brown gravel and sand classified as sand "and" gravel in Boring B-107, and as gravely silty sand in Boring B-109.
- 5 to 11 feet of brown silty clay. At the location of Boring B-107, there was 3 feet of sandy silt underlying the silty clay material.
- Immediately underlying the dike structure, there were 32.5 to 37.5 feet of fly ash.
- A 10 foot thick layer of brown and gray clay was encountered beneath the fly ash. Boring B-107 was terminated in this clay layer, whereas Boring B-109 completely penetrated it, and was terminated after advancing into gray silty clay.

During drilling water was encountered at depths of 39.1 and 20.5 feet below the ground surface in Borings B-107 and B-109 respectively.

Boring Nos. B-108 and B-110 were drilled on the existing haul road through the embankments constructed prior to the 1972 raising. These borings revealed the following stratigraphy.

- 2 to 3 feet of road base and subbase. Consisting of 6 inches of asphalt 14 inches of soil/cement and 4 to 16 inches of crushed stone.
- 5 to 7 feet of bottom ash.
- 10 to 13.5 feet of granular fill described as gravely silty sand in Boring B-108 and, as silty sand "and" gravel in Boring B-110.

- 8.5 to 20 feet of cohesive fill described as brown silty clay in Boring B-107 and, as silty sandy clay in Boring B-110.
- At the location of Boring B-107 the cohesive fill was underlying by 2 feet of bottom ash on top of 9 feet of fly ash, before encountering the natural deposits. Whereas at the location of Boring B-110, the cohesive fill was in direct contact with the natural deposits.
- The underlying natural deposits consisted of 8 to 18 feet of gray clay immediately underneath the dike structure. The borings were terminated after completely penetrating this layer and advancing into a gray silty clay stratum.

During drilling, the borings were "dry" - that is to say - no water was encountered.

4.0 TESTING

All of the soil samples were visually identified in the laboratory, and natural moisture content, liquid and plastic limit determinations as well as sieve analysis were performed on selected, representative specimens. In addition, a number of triaxial compression tests were performed on selected undisturbed samples to determine the strength and compress stability characteristics of the natural soils encountered at the dikes. The types and number of tests performed are listed as follows:

Visual Identification	136
Natural Moisture Content	79
Liquid and Plastic Limits	79
Sieve Analysis	79
Triaxial compression	17
Specific Density	6
Relative Density	1

All test results are submitted in Appendix 4.

4.1 Strength Test

Triaxial compression tests under consolidated undrained conditions with back pressure saturation and pore-pressure measurements, Cu' were performed on samples from the borings drilled at the dikes of the facility. A summary of the results obtained is presented on Table II "Tabulation of Undisturbed Test Data" included in Appendix 4. Total and effective stress circles as well s the associated strength envelopes are presented for each soil tested are also included in Appendix 4.

5.0 ENGINEERING PROPERTIES OF LOCAL SOILS

The borings drilled in the dikes revealed a man-made structure composed of both granular soils and cohesive soils. Because of the difficulties associated with obtaining undisturbed samples for strength testing in some of these soils, strength parameters have been selected using well-known correlations between the SPT (N) and either the angle of internal friction (ϕ)[1] for granular soils or the unconfined compression strength (Uc)[1] for cohesive soils. In the case of the consolidated fly ash supporting the 1972 extension of the eastern dike, strength correlation's associated with the CPT [1&2] were also used to confirm parameter selection.

At locations where it was possible to obtain undisturbed samples in the cohesive soils, strength parameters were selected by performing triaxial compression tests on selected representative samples. Results of these tests were also used to ascertain the applicability to the local soils the relationship established by Terzaghi and Peck (1967) between (ϕ') and PI as presented by Hunt [3]. This correlation was then used to select adequate strength parameters to cohesive soils where no-undisturbed samples were procured.

Density determinations of the various deposits were obtained by correlating SPT (N) values and dry density, except in the bottom ash layers where N was correlated to the relative density, D_r. The obtained value of Dr was then used in conjunction with the results of the maximum and minimum density test to determine the unit dry weight of the in-situ bottom ash layers. The density of cohesive soils was obtained using correlations between N and the saturated unit weight (γ_S).

Summaries of the strength and density values obtained based on the borings drilled in the dikes of this facility are presented in Appendix 5. Also included are copies of relevant data from the referenced literature.

6.0 HYDROLOGY

6.1 Basin Characteristics

The fly ash pond is an upground reservoir having a drainage area equal to its maximum surface area at the top of the dikes, nominal elevation 620 feet. The facility receives pumped ash slurry and wastewater as well as precipitation falling within the projected horizontal area of the diking system. The drainage area for the fly ash pond is 75.7 acres.

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[1] "Geotechnical Engineering Techniques and Practice" Roy E. Hunt, McGraw-Hill, Inc. 1986, USA.
[2] Fig. ll, "Approximate Relation Between Static Cone Resistance and Angle of Internal Friction of Sand", Meyerhoff, 1974.
[3] Fig. 3.30, " Approximate Relationship Between ϕ' and PI for Clays of Moderate to Low Sensitivity Under Drained Conditions" as presented by Hunt.

The normal operating level of the pond is elevation 604, which relates to a discharge of 17.5 cfs. At this elevation, the surface area is 42.8 acres. The remaining area consists of an ash delta having an area of 24.1 acres and the slopes of the dikes that are grassed. For purposes of this hydrologic investigation, a SCS curve number of 100 was selected. The table below provides a summary of the areas and volumes for the fly ash pond based on aerial photography dated 1994.

Fly Ash Pond	Area (acres)	Volume (ac-ft)
Normal oper. pool el 604	42.8	0
Elevation 606.3	66.9	125
Elevation 610	70.3	379
Top of dikes, el 620	75.7	1,109

6.2 Design Requirements

The fly ash pond dikes are classified s Class I dams. According to section 47-34-7 of the West Virginia Dam Safety Rule the hydrologic design storm is the full probable maximum precipitation within a six hour duration. For the Sporn Plant area, the 6-hour probable maximum precipitation is 27.5 inches as per the National Weather Service, Hydrometeorological Report No. 51 (HMR 51).

The fly ash pond also falls within the subset of waste disposal dams. The storage and discharge requirements applicable to this facility is paragraph 7.1.2.c.A (b) of the Dam Safety Rule. The facility only has a principal spillway and, therefore, must be capable of storing the equivalent volume of one design storm and discharge 90 percent of the stored volume within 10 days after the storm event.

6.3 Outlet Structure

The outlet structure for the fly ash pond consists of a sloping concrete shaft connected to a 36-inch diameter outfall pipe (corrugated metal). The concrete shaft has an opening of 30 inches and stoplogs were used to regulate the pool level. In 1995, modifications were made to the outlet structure. These modifications consisted of installing a 3-foot H-flume on the concrete shaft to regulate the pool level and measure the discharge. In addition, the 36-inch diameter outfall pipe was sleeved with a 28-inch diameter (O.D.), SDR 32.5 high density polyethylene pipe. The effective interior diameter is 26 inches.

The discharge rating of the H-flume is based on standard dimensions and equations. A copy of the rating table is provided in Appendix 6. The maximum flow through the H-flume before it is overtopped is 30.7 cfs. The hydraulic capacity of the outlet structure was analyzed for various flow conditions. A copy of the analysis and final rating curve is also provided in Appendix 6.

6.4 Hydrologic Evaluation

The Soil Conservation Service's (SCS), now known as the National Resources Conservation Service (NRSC), type II rainfall distribution was used in the hydrologic analysis. A curve number of 100 (conservative) was selected to represent the exposed ash and pool area. The rainfall hydrograph over the fly ash pond was converted into a runoff hydrograph and routed through the pond. The flood routings assumed that the facility was at its normal operating conditions.

6.5 Results

During the design storm, the fly ash pond elevation will rise from the normal operating pool of 604 to elevation 606.75, a 2.75 foot rise. The peak overflow from the pond is 77 cfs. The flood storage waters will be completely drained from the pond within 5 days after the peak storage condition is obtained. The computer output of the flood routing is provided in Appendix 6.

6.6 Conclusion

The fly ash pond has adequate storage and hydraulic capacity to safely pass the design storm requirement of 100% of the probable maximum precipitation. The flood waters will be released within the allowable time constraints.

7.0 GEOTECHNICAL ANALYSIS

Seepage and stability analyses for all four dikes of the bottom ash facility were conducted. These analyses and the selection of design parameters are discussed in this section of the project.

7.1 Seepage

The upper boundary or upper most flow in the seepage through an earth dam is not known, but must be found. Among the available solutions for seepage with a free surface, it was decided to follow the procedures presented by J. E. Bowles in his book "Physical and Geotechnical Properties of Soils", second edition, 1984, pages 296-297.

The seepage flow through the existing dikes was calculated by considering steady state flow with the pool elevation at the maximum design operating level - elevation 605. Using a direct computation of the seepage quantity, the calculated flow is given by the equation:

$$Q = k(a)\tan\beta\sin\beta;$$

and the flow velocity is given by v = ki, where k is the permeability for the dike's materials. Because of the heterogenity of the materials forming the dikes of this facility, and the range of permeability values that a material of similar characteristics may have, it was decided to calculate a single permeability value to represent the permeability of a given dike as a homogeneous mass.

7.1.1 Northern Dike

Seepage analysis was performed using section E-E as the representative cross-section of this dike. Single permeability values were used to represent the permeability of both the existing cohesive soils of the shells and, the existing granular soils of the chimney drains of this dike.

Design permeability values were obtained by using correlation's between permeability and grain size distribution both developed by AEP and reported in the literature. Appendix 7 contains the referenced correlation. On this basis the design permeabilities are as follows:

Cohesive soils "Silty Clay with Sand": $k = 2.8 \times 10^{-7}$ cm/s. Granular soils "poorly grades sand with silt and gravel": $k = 9 \times 10^{-3}$ cm/s.

The freatic line and seepage calculations associated with this dike are presented in Appendix 7. It is estimated that the average seepage flow through the section of the dike, associated with the maximum design operating water level of 605 is:

$$Q_{605} = 2.8x10^{-9} \frac{ft^3}{s}$$

Based on historic design information, it is believed that the granular soils revealed by the borings drilled from the crest of the dike belong to the chimney drain installed to control the seepage of the dike. Based upon the results of visual inspections of this dike, it is believed that the seepage flows freely within the chimney drain as intended. However, a verification of filter and drain requirements on the basis of the soils revealed in the borings and water levels measured in the open pipe piezometers was performed.

ICOLD Bulletin 95, 1994, "Embankment Dams granular Filters and Drains" outlines several criteria for the proper design and functioning of filters and drains. Applicable requirements to the existing northern dike of this facility are listed below:

Retention Criterion:	estimated ratio		
$D_{15} / d_{85} < 4$:	1.4 to 3.3		
Permeability Criterion:	estimated ratio		
$D_{15} / d_{15} > 4$ or 5	86.6 to 200		
Discharge Capacity:	estimated value		
$Q_{sl} < Q_{sf}$:	$9.6x10^{-9} \frac{ft^3}{s} / ft$	$<$	$1.2x10^{-3} \frac{ft^3}{s} / ft$

Calculations associated with the above criteria are presented in Appendix 7.

On the basis of the analyses performed, the results of visual inspections and current performance, it is concluded that in general the existing seepage control measures in the northern dike are adequate for the operating conditions.

7.1.2 Western Dike

Seepage analysis was performed using section H-H as the representative cross-section of this dike.

Single permeability values were used to represent the permeability of both the existing cohesive soils of the clay core and the existing granular soils of the shells of the western dike.

As in the northern dike, design permeability values were obtained by using correlation's between permeability and grain size distribution both developed by AEP and reported in the literature. On this basis, the design permeability values are as follows:

Cohesive Core: "Lean clay with sand": $k = 4.3 \times 10^{-7}$ cm/s
Granular Soils: "Silty sand with gravel": $k = 2.5 \times 10^{-4}$ cm/s

The freatic line and seepage calculations associated with this dike are presented in Appendix 7. It is estimated that the average seepage flow through a section of the dike resulting from the maximum design operating water level of 605 is:

$$Q_{605} = 1.35x10^{-7} \frac{ft^3}{s}$$

Based on historic design information, it is believed the the granular soils revealed by the borings are representative of the downstream shell and they also must provide seepage control within the dike's structure. Based upon the results of visual inspection it is believed that in general the seepage that flows through the clay core, flows freely within the granular downstream shell as intended, without inducing piping or internal erosion. At a few isolated location "points" seeps have been observed over the years but the flow is small and clear. As part of this analysis, a verification of filter and drain requirements was performed on the basis of the soils revealed in the borings and water levels measured in the open pipe piezometers. Applicable requirements to the existing western dike of this facility are listed below:

Retention Criterion:	estimated ratio		
$D_{15} / d_{85} < 4$	0.6 to 0.8		
Premeability Criterion:	estimated ratio		
$D_{15} / d_{15} > 4$ or 5	33.3 to 46.6		
Discharge Capacity:	estimated ratio		
$Q_r/_i < Q_a/_i$:	$8x10^{-8} \frac{ft^3}{s}/ft$	<	$3.5x10^{-5} \frac{ft^3}{s}/ft$

Calculations associated with the above criteria are presented in Appendix .

On the basis of the analyses performed, it is concluded that in general the existing dike structure provides adequate seepage control measures. At the few isolated locations where visual inspection of the dike have detected the presence of "point" seepage, installation of localized inverted filter may be considered following the completion of the reconfiguration of the dike's slopes proposed as a result of the stability analysis performed (see section 7.2.2).

7.1.3 Southern Dike

Seepage analysis was performed using Section J-J as the representative cross-section of this dike. Single permeability values were used to represent the permeability of both existing cohesive soils of the clay core and the existing granular soils of the shells of the southern dike. As in the other two dikes, design permeability values were obtained by using correlation's between permeability and grain size distribution both developed by AEP and reported in the literature. On this basis, the design permeabilities are as follows:

Cohesive core: "Sandy lean clay": $k = 1.5 \times 10^{-6}$ cm/s
Granular soils: "Silty sand with gravel": $k = 1.8 \times 10^{-4}$ cm/s

The Freatic line and seepage calculations associated with this dike are presented in Appendix 7. It is estimated that the average seepage flow through a section of the dike as resulting from the maximum design operating water level of 605 is:

$Q_{605} = 6.7x10^{-7} \frac{ft^3}{s}$

Based on historic design information, it is believed that the granular soils revealed by the borings are representative of the downstream shell and they also must provide seepage control within the dike structure. Based upon the results of visual inspections, it is believed that in general he seepage that flows through the clay core, flows freely within the granular downstream shell as intended, without inducing piping or internal erosion. As part of this analyses, a verification of filter and drain requirements was performed on the basis of the soils revealed in the borings and water levels measured in the open pipe piezometers. Applicable requirements (1) to the existing southern dike of this facility are listed below:

Retention criterion:	estimated ratio		
$D_{15} / d_{85} < 4$	0.1		
Permeability Criterion:	estimated ratio		
$D_{15} / d_{15} > 4$ or 5	13.6		
Discharge capacity:	estimated value		
$Q_{r/ft} < Q_{a/ft}$	$3.6x10^{-7} \frac{ft^3}{s} / ft$	<	$1.8x10^{-5} \frac{ft^3}{s} / ft$

Calculations associated with the above criteria are presented in Appendix 7.

On the basis of the analysis performed, it is concluded that in general, the existing dike structure provides adequate seepage control measures.

7.1.4 Eastern Dike

Seepage analyses were performed using sections K-K and L-L as representative cross-sections of the dike.

The single permeability value used to represent the materials in the dike at the selected cross-sections, was calculated as a weighted average on the basis of a layer's permeability and length of the freatic line through that particular layer. Design permeabilities are as follows:

Section K-K
$k = 2.5 \times 10^{-4}$ cm/s

Section L-L
$k = 1.8 \times 10^{-3}$ cm/s

The freatic lines and seepage calculations associated with these sections of the eastern dike are presented in Appendix 7. It is estimated that the average seepage flow through the selected sections of the dike resulting from the maximum design operating water level of 605 is:

Section K-K
$Q_{605} = 2.95x10^{-5} \frac{ft^3}{S}$

Section L-L
$Q_{605} = 2.2x10^{-4} \frac{ft^3}{S}$

Based upon historic design information and the results of visual inspections it is believed that in general the seepage that flows through the eastern dike various extensions flows freely within the granular soils used in the construction of the downstream shell of the 1968 dike's extension. Observations made during safety inspections over the years have revealed a consistent line of seepage emerging from the downstream face of the dike at approximate elevation 566. The line of seepage flow was interrupted and collected in the northern 400 foot section of the dike, using an underdrain, during the repair of the haul road performed in the fall of 1995. This repair was approved by the West Virginia Dam Safety office as a separate document on October 6, 1995.

It is difficult to access if the flows and velocities of the seepage calculated for the remaining length of this dike could lead to piping and internal erosion of the soils in the downstream shell of the 1968 extension. Such a condition, would be unlikely detected by a limited amount of instrumentation. To preclude the development of piping and internal erosion in this dike, it is proposed to incorporate an aggregate filter on the downstream face of the dike. The proposed filter will extend from the toe to approximate elevation 570 and will drain into a 4 inch collection pipe. Applicable filter requirements are as follows:

A. Soil Analysis:

Embankment Soil: "silty sand with gravel" or "poorly graded gravel with silt and sand".
Filter Material: West Virginia Spec. Table 703.4 #8.

B. Retention criterion: estimated ratio
$D_{15} / d_{85} < 4$ 0.375 to 1.1

C. Permeability criterion: estimated ratio
$D_{15} / d_{15} > 4$ 10 to 120

D.	Discharge capacity:	estimated value		
	$Q_r/_i < Q_a/_i$	$5.9x10^{-5} \frac{ft^3}{s}/ft$ to $5.7x10^{-4} \frac{ft^3}{s}/ft$	<	$3.3x10^{-1} \frac{ft^3}{s}/ft$
	4 inch collector pipe $\frac{D_{50}}{\phi_P} > 1.0$	estimated ratio 2.1 to 3.4		
E.	Segregation, Cu: $\frac{D_{60}}{D_{10}} < 3$	estimated ratio 2		
F.	Self healing: $D_{15} \geqslant 0.1$ mm	estimated value 3 to 6 mm		

G. Quality: Non-calcareous aggregate is required to prevent reaction with potentially low pH water.

Calculations associated with the above criteria are presented in Appendix 7. The geometry of the filter is illustrated on Drawing Nos. 15-30022 and 15-30025 included in Appendix 9.

7.2 Design Shear Strengths

During the selection of the design shear strength the following items were considered:

- Location of the different layers that form the dike and provide their foundation support;
- Whether or not a given material has allowed the dissipation of the excess pore-pressure, due to the weight of the dike, since the dike's construction; thus being fully consolidated and drained
- Behavior of the soil with respect to the location of the specific seepage surface and seepage forces.

In an effort to represent an accurate profile of the dikes, the presence of different layers, and the probable spatial variability of the thickness of the layers forming the dikes, it was decided to analyze sections of this dike in as many locations as where subsurface information was obtained.

7.2.1 Northern Dike

Design strength parameters used in the stability analysis of this dike are presented in tables 7.2.1E and 7.2.1F.

Table 7.2.1E

Section E-E

Stability Analysis - Design Parameters

Stability Analysis Layer #	Material Description	Design Strength	γ_t pcf	γ_s pcf	Location
1	Sandy Silty Clay	C′=0 $\phi' = 38°$	130	136	Foundation
2	Silty Gravelly Sand	C′=0 $\phi' = 35°$	109	115	Embankment
3	Silty Clay	C′=0 $\phi' = 34°$	125	130	Embankment
4	Silty Gravelly Sand	C′=0 $\phi' = 29°$	102	110	Embankment
5	Silty Sand	C′=0 $\phi' = 32°$	106	112	Foundation
6	Clay	C′=0 $\phi' = 33°$	118	125	Foundation
7	Gravelly Sand	C′=0 $\phi' = 33°$	104	110	Foundation

Table 7.2.1F

Section F-F

Stability Analysis - Design Parameters

Stability Analysis Layer #	Material Description	Design Strength	γ_t pcf	γ_s pcf	Location
1	Sandy Clay	C′=0 $\phi' = 38°$	130	136	Foundation
2	Sandy Silt	C′=0 $\phi' = 31°$	108	115	Foundation
3	Silty Sandy Gravel	C′=0 $\phi' = 35°$	112	115	Embankment
4	Sandy Clay	C′=0 $\phi' = 34°$	115	120	Embankment
5	Silty Gravelly Sand	C′=0 $\phi' = 33°$	110	115	Embankment
6	Gravelly Sand	C′=0 $\phi' = 29°$	104	110	Foundation
7	Silty Gravelly Sand	C′=0 $\phi' = 33°$	110	115	Embankment

7.2.2 Western Dike

Design strength parameters used in stability analysis of this dike are presented in Tables 7.2.2G, 7.2.2H, and 7.2.2I.

Table 7.2.2G
Section G-G
Stability Analysis - Design Parameters

Stability Analysis Layer #	Material Description	Design Strength	γ_t pcf	γ_s pcf	Location
1	Silty Clay	$C'=0 \quad \phi' = 34°$	125	130	Foundation & Core
2	Silty Gravelly Sand	$C'=0 \quad \phi' = 35°$	115	130	Embankment
3	Silty Gravelly Sand	$C'=0 \quad \phi' = 33°$	110	115	Embankment
4	Silty Sand	$C'=0 \quad \phi' = 29°$	110	115	Foundation

Table 7.2.2H
Section H-H
Stability Analysis - Design Parameters

Stability Analysis Layer #	Material Description	Design Strength	γ_t pcf	γ_s pcf	Location
1	Silty Clay	$C'=0 \quad \phi' = 34°$	125	130	Foundation
2	Silty Sand	$C'=0 \quad \phi' = 35°$	107	112	Embankment
3	Gravelly Sand	$C'=0 \quad \phi' = 33°$	105	110	Embankment
4	Silty Clay	$C'=0 \quad \phi' = 32°$	115	120	Embankment Crest & Core
5	Silty Sand	$C'=0 \quad \phi' = 31°$	126	131	Foundation
6	Sandy Silt	$C'=0 \quad \phi' = 27°$	125	130	Foundation

Table 7.2.2I
Section I-I
Stability Analysis - Design Parameters

Stability Analysis Layer #	Material Description	Design Strength	γ_t pcf	γ_s pcf	Location
1	Silty Clay	$C'=0 \quad \phi' = 34°$	125	130	Foundation
2	Silty Sand	$C'=0 \quad \phi' = 32°$	100	110	Embankment
3	Silty Gravelly Sand	$C'=0 \quad \phi' = 35°$	100	110	Embankment
4	Silty Gravelly Sand	$C'=0 \quad \phi' = 31°$	100	110	Embankment
5	Silty Clay	$C'=0 \quad \phi' = 34°$	115	120	Core
6	Silty Sand	$C'=0 \quad \phi' = 29°$	105	112	Foundation

7.2.3 Southern Dike

Design strength parameters used in the stability analysis of this dike are presented on Table 7.2.3J and 7.2.3J1.

Table 7.2.3J
Section J-J
Stability Analysis - Design Parameters

Stability Analysis Layer #	Material Description	Design Strength	γ_t pcf	γ_s pcf	Location
1	Silty Clay	C′=0 $\phi' = 33°$	123	128	Cap Over Filled Up Earlier Pond
2	Fly Ash	C′=0 $\phi' = 27°$	105	110	Foundation of Latest Raising
3	Sandy Clay	C′=0 $\phi' = 34°$	125	130	Core
4	Gravelly Silty Sand	C′=0 $\phi' = 33°$	102	110	Embankment
5	Gravelly Silty Sand	C′=0 $\phi' = 33°$	102	110	Road Embankment
6	Gravelly Silty Sand	C′=0 $\phi' = 32°$	102	110	1965 Embankment
7	Silty Clay	C′=0 $\phi' = 32°$	115	120	Foundation

Table 7.2.3J1
Section J1-J1
Stability Analysis - Design Parameters

Stability Analysis Layer #	Material Description	Design Strength	γ_t pcf	γ_s pcf	Location
1	Silty Clay	C′=0 $\phi' = 33°$	123	128	Foundation
2	Silty Clay	C′=0 $\phi' = 34°$	125	130	Foundation
3	Silty Gravelly Sand	C′=0 $\phi' = 32°$	105	110	1965 Embankment
4	Gravelly Silty Sand	C′=0 $\phi' = 33°$	105	110	Embankment
5	Silty Clay	C′=0 $\phi' = 34°$	125	130	Embankment Core

7.2.4 Eastern Dike

Design strength parameters used in the stability analysis of this dike are presented on Tables 7.2.4K and 7.2.4L. Design strength parameters used in association with the 1995 repair (cross-section M'-M' and M-M) are summarized in the report entitled "Deformation and Stability Evaluations Unit 5 Fly Ash Dam Philip Sporn Plant, New Haven, West Virginia" by Woodward-Clyde, 1997. A copy of this report is enclosed in Appendix 2.

Table 7.2.4K
Section K-K
Stability Analysis - Design Parameters

Stability Analysis Layer #	Material Description	Design Strength	γ_t pcf	γ_s pcf	Location
1	Silty Clay	$C'=0 \quad \phi'=34°$	125	130	1972 Embankment Ext.
2	Gravelly Silty Sand	$C'=0 \quad \phi'=33°$	108	115	1972 Embankment Ext
3	Sand & Gravel	$C'=0 \quad \phi'=36°$	114	120	1972 Embankment Ext
4	Bottom Ash	$C'=0 \quad \phi'=32°$	65	90	1968 Embankment Ext.
5	Gravelly Silty Sand	$C'=0 \quad \phi'=35°$	110	115	1968 Embankment Ext.
6	Silty Clay	$C'=0 \quad \phi'=34°$	120	128	1965 Embankment Ext.
7	Bottom Ash	$C'=0 \quad \phi'=29°$	65	90	1965 Embankment Ext.
8	Fly Ash	$C'=0 \quad \phi'=27°$	80	90	Foundation Support 1965 and 1972 Embankment Ext.
9	Sandy Silt	$C'=0 \quad \phi'=31°$	100	105	1972 Embankment Ext.
10	Silty Clay	$C'=0 \quad \phi'=33°$	120	125	Foundation
11	Clay	$C'=0 \quad \phi'=39°$	125	130	Foundation
12	Clay	$C'=0 \quad \phi'=37°$	120	125	Foundation
13	Silty Clay	$C'=0 \quad \phi'=32°$	125	130	Original Dike

Table 7.2.4L

Section L-L

Stability Analysis - Design Parameters

Stability Analysis Layer #	Material Description	Design Strength	γ_t pcf	γ_s pcf	Location
1	Sandy Silty Clay	C′=0 $\phi' = 34°$	125	130	1972 Embankment Ext.
2	Silty Sand	C′=0 $\phi' = 35°$	110	115	1972 Embankment Ext.
3	Silty Sand	C′=0 $\phi' = 34°$	110	115	1972 Embankment Ext.
4	Silty Sand	C′=0 $\phi' = 32°$	100	105	1972 Embankment Ext.
5	Bottom Ash	C′=0 $\phi' = 35°$	65	90	1968 Embankment Ext.
6	Silty Sand & Gravel	C′=0 $\phi' = 32°$	115	120	1968 Embankment Ext.
7	Clay	C′=0 $\phi' = 33°$	110	115	Foundation
8	Silty Clay	C′=0 $\phi' = 37°$	120	125	Foundation
9	Sandy Silty Clay	C′=0 $\phi' = 34°$	125	130	1965 Embankment Ext.
10	Silty Sandy Clay	C′=0 $\phi' = 33°$	125	130	Original Dike
11	Fly Ash	C′=0 $\phi' = 27°$	102	110	Foundation Support 1972 Embankment Ext.
12	Clay	C′=0 $\phi' = 39°$	120	125	Foundation
13	Silty Clay	C′=0 $\phi' = 32°$	125	130	Foundation

7.3 Stability Analyses

Stability analysis of the dikes are presented in Appendix 8 and 9. The circular arc method was used to evaluate the factor of safety. This method provides a uniform basis for evaluating the stability of the different sections of the dikes, and the sensitivity of the factor of safety to variations on the loading conditions. The stability of the dikes was numerically evaluated for the applicable conditions using the computer program known commercially as "XSTABL", developed by Interactive software Designs, Inc. this program allows for a systematic search for the minimum factor of safety. Stability analysis was performed using the loading conditions outlined in rule 7.4.2.2D(a) of the series 34 "Dam Safety Rule" of the West Virginia Division of Environmental Protection, Water Resources - Waste

Management. Summaries of the factors of safety associated with the applicable design conditions are presented in the following sections.

7.3.1 End of Construction

When an embankment is constructed using soils of low permeability, and those soils are compacted at water contents higher than optimum, the loads imposed by the compaction process and the weight of the fill itself, as well as other normal operating loads, induce a condition of excess pore pressures within the embankment and its foundation. This can be a critical stability condition upon the completion of construction as these excess pore pressures have not yet had time to dissipate through the consolidation process. End of construction condition was not, however, assessed in this study because the dikes of the facility were completed in 1972 and any construction induced excess pore pressures have long since dissipated.

7.3.2 Rapid Drawdown

Embankments may become saturated by seepage during prolonged reservoir stages. If subsequently, the reservoir pool is drawn down faster than pore water can escape, excess pore water pressures and unbalanced seepage forces result. The design and operation of the Sporn fly ash facilities does not allow for this condition to develop since there is no mechanism to lower the reservoir rapidly. As a result rapid drawdown does not apply to any of the dikes that form the fly ash facility.

7.3.3 Steady Seepage with Existing Operating Pool

The current water level of about 604 to 605 has been maintained sufficiently long to produce a condition of steady seepage throughout the embankments. This condition affects the stability of the downstream and upstream slopes. Stability analyses were, therefore, performed on the slope of the dikes of the fly ash facility under the conditions of steady seepage at this pool elevation. Factors of safety are summarized on Table 7.1 and 7.2.

7.3.4 Earthquake

Stability factors of safety for earthquake loading under the above mentioned steady-state seepage conditions were determined assuming that the earthquake imparts an additional horizontal force, Fh, acting in the direction of potential failure. The arc or set of planes found to be critical without earthquake loading is used with this added driving force to determine the factor of safety. The horizontal seismic force is equal to the mass involved times the horizontal acceleration, i.e.

$$Fh = \frac{W}{g} a_h$$

The total weight of the sliding soil mass W is based on saturated unit weights below the saturation line and moist unit weights above the line of saturation. Selection of the seismic coefficient is based on the degree of seismic activity in the region where a facility is located. In accordance with U.S. Army Corps of Engineers seismicity map, the unit 5 fly ash facility is located in Zone 1 (Appendix 9). Based on this classification a horizontal acceleration $a_h = 0.05g$ was selected for the earthquake evaluation of the dikes.

Table 7.1
Summary of Factors of Safety
Existing Dike Configuration
Steady Seepage Condition
Operating Water Level = 605

Dike	Section	Slope	Factor of Safety Static	Factor of Safety EQ	Required Factor of Safety Static	Required Factor of Safety Earthquake	Observation
Northern	E-E	DS	1.66	1.46	1.5	1.2	
		US	1.48	1.05*	1.5	1.2	
	F-F	DS	1.58	1.37	1.5	1.2	
		US	1.09*	0.93*	1.5	1.2	
Western	G-G	DS	1.65	1.46	1.5	1.2	
		US	1.26*	1.02*	1.5	1.2	
	H-H	DS	1.26*	1.13*	1.5	1.2	
		US	1.08	0.90*	1.5	1.2	
	I-I	DS	1.02*	0.93*	1.5	1.2	
		US	1.24*	1.03*	1.5	1.2	
Southern	J-J	DS	1.95	1.46	1.5	1.2	
		US	1.95	1.63	1.5	1.2	
	J1-J1	DS	1.44*	1.29	1.5	1.2	
		US	2.26	1.87	1.5	1.2	

* Do not meet stability requirements.

Table 7.1 (Continued)

Summary of Factors of Safety

Existing Geometry

Steady Seepage Condition

Operating Water Level = 605

Dike	Section	Slope	Factor of Safety Static	Factor of Safety EQ	Required Factor of Safety Static	Required Factor of Safety EQ	Observations
Eastern	K-K	DS	1.64	1.34	1.5	1.2	Global Stability
		DS	1.36*	1.15*	1.5	1.2	Local Stability
		DS	2.73	2.27	1.5	1.2	Local Stability
		US	1.90	1.57	1.5	1.2	Global Stability
	L-L	DS	1.94	1.58	1.5	1.2	Global Stability
		DS	1.36*	1.17*	1.5	1.2	Local Stability
		DS	2.95	2.41	1.5	1.2	Local Stability
		US	2.05	1.64	1.5	1.2	Global Stability
	M1-M1 Section of dike before implementation of the 1995 improvements	DS	1.45*	1.19*	1.5	1.2	Global Stability
		DS	1.01*	0.87*	1.5	1.2	Local Stability
		DS	1.64	1.44	1.5	1.2	Local Stability
		US	1.76	1.50	1.5	1.2	Global Stability

* Do not meet stability requirements.

All computer outputs are included in Appendix 8.

It should be pointed out that the dikes of the existing facility are stable under the current operating conditions, even though some of the calculated factors of safety do not meet current stability requirements.

Because of low factor of safety calculated for some sections of the dikes of the facility, it is proposed to improve the stability of the dikes by modifying their geometry. Proposed changes in the configuration of the dikes are presented in drawings Nos. 15-30021, 15-30022, 15-30023 and 15-30024 Appendix 9. Factors of safety associated with the proposed dike configuration are summarized in Table 7.2

Table 7.2
Summary of Factors of Safety
Proposed Dike Configuration
Steady Seepage Condition
Operating Water Level = 605

Dike	Section	Slope	Factor of Safety Static	Factor of Safety Earthquake	Observations
Northern	E-E	DS	1.66	1.46	No Change Proposed
		US	1.73	1.35	Change of Grade, Encourage Fly Ash Deposition
	F-F	DS	1.58	1.37	No Change Proposed
		US	1.38	1.13	Change of Grade, Encourage Fly Ash Deposition
Western	G-G	DS	1.65	1.46	No Change Proposed
		US	1.43	1.12	Change of Grade, Encourage Fly Ash Deposition
	H-H	DS	2.24	1.91	Change of Grade
		US	1.33	1.06	Change of Grade, Encourage Fly Ash Deposition
	I-I	DS	2.03	1.75	Change of Grade
		US	1.52	1.19	Change of Grade
Southern	J-J	DS	1.95	1.46	No Change Proposed
		US	1.95	1.63	No Change Proposed
	J1-J1	DS	1.81	1.57	Change of Grade
		US	2.26	1.87	No Change Proposed
	K-K	DS	1.71	1.4	Global Stability - Berm
		DS	1.77	1.48	Local Stability - Berm
		DS	2.73	2.27	Local Stability
		US	1.9	1.57	Global Stability
	L-L	DS	2.34	1.86	Global Stability - Berm
		DS	1.65	1.41	Local Stability - Berm
		DS	2.95	2.4	Local Stability
		US	2.05	1.64	Global Stability
Southern	M-M Section of dike after implementation of the 1995 improvements	DS	2.04	1.66	Global Stability - Internal Drainage
		DS	1.71	1.5	Local Stability - Internal Drainage
		DS	1.64	1.44	Local Stability
		US	1.76	1.5	Global Stability

All computer output are submitted in Appendix 9.

Based upon the above calculated factors of safety, it is concluded that the proposed configuration of the dikes, will bring the facility's calculated stability factor of safety into the range of commonly accepted safety criteria.

8.0 PROPOSED IMPROVEMENTS

The current detailed review of the dikes of the unit 5 fly ash facility indicates that there is a need for improving some of the features of the different dikes to bring them into today's commonly accepted operation standards. The proposed improvements are in general as follows:

8.1 <u>Northern Dike</u>

The proposed construction consists of cutting the crest of the dike from its present elevation of 619± to elevation 613'. By maintaining the same crest width that is currently available, the upstream slope will be re-graded to approximately 4H:1V. The face of the slope will be seeded. See drawing No. 15-30021, Appendix 9.

8.2 <u>Western Dike</u>

The proposed construction consists of cutting the crest of the dike from its present elevation of 619± to elevation 610'. The downstream slopes will be regraded to form a uniform slope of approximately 3H:1V, whereas the upstream slopes will be reconfigured to approximately 4H:1V. The face of the slopes will be seeded. See drawing No. 15-30024, Appendix 9.

8.3 <u>Southern Dike</u>

The proposed construction consists of cutting the crest of the western section of the dike from current elevation 620± to elevation 613'. The downstream slope will also be regraded to form a uniform slope of approximately 4H:1V, whereas the upstream slope will remain at the same grade. The face of the slope will be seeded. See drawing No. 15-30023, Appendix 9.

8.4 <u>Eastern Dike</u>

The proposed construction consists of installing a drainage/filtering system at the toe of the existing dike as well as building a berm. The berm and drainage will be constructed from elevation 570' to 555'. An internal drain pipe will also be installed to direct seepage to an inverted drainage blanket for release into the Ohio River. The materials used in the drainage/filter system will be W.Va. DOT #8 washed gravel, and the berm material will be the silty gravelly sand removed from the regrading sections of the other dikes. The new surface will be either seeded or

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CASAGRANDE CONSULTANTS FOUNDATIONS & EARTHWORKS

4/19

April 15, 1977

Mr. John R. Struyk
Asst Vice President and Chief Civil Engineer
American Electric Power Service Corporation
2 Broadway
New York, N.Y. 10004

Subject: Project 1301
Bottom Ash Ponds

Dear John:

In response to Paul Anderson's letter of March 1, we submit below the results of our investigations regarding

(1) the existing subsurface conditions in the proposed pond area;
(2) the suitability of the clay from the coal storage area for lining of the ash ponds;
(3) the proposed cross-section of dikes;
(4) stability and settlement analyses, and seepage and underseepage studies, as required by the Department of Natural Resources, State of West Virginia; and
(5) supports for the pipeline and truck bridges over Route 33.

Subsurface Conditions in Area of Bottom Ash Ponds

The locations of 15 exploratory borings which were made in the area of the proposed bottom ash ponds, are shown in Fig. 1. The borings were made by the AEP Civil Engineering Laboratory during the period October 1976 to March 1977. The logs of these borings are contained in Appendix II. The elevation of the existing ground surface in the area of the proposed bottom ash ponds ranges between about El. 593 and 615.

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Our description of the split-spoon samples and the results of classification tests are contained in Tables 1 to 15 in Appendix I. The results of the liquid and plastic limit tests are also plotted on the plasticity chart in Fig. 2.

At 8 of the 15 borings (401 to 404, 406, 409, 412 and 415), clayey or silty fine sand extends from the ground surface to a depth of 10 to 20 ft. At 5 borings (407, 408, 410, 411 and 413) the top stratum consists of clean fine sand and/or fine to medium sand, which extends to a depth of 30 to 60 ft. At 2 borings (405 and 414) the upper approximately 5 ft consist of silty and sandy clay, underlain by 15 to 20 ft of clean fine sand or fine to medium sand.

Grain size distributions of representative samples from the top 15 ft of overburden are plotted in Fig. 3. At all borings the granular soils become coarser with depth, and at 13 of the 15 borings sand-gravel was found at depths ranging from 18 to 58 ft.

The ground water level during drilling was found to range between 47 ft and 60 ft below ground surface.

Suitability of Clay from 1301 Coal Storage Area for Lining of Ponds

Four split-spoon borings were made in the coal storage area at Project 1301, to investigate the suitability of the clay for lining of the ponds against seepage. The logs of these borings, 505, 506, 513 and 514, are included in Appendix II. We did not receive a boring location plan.

Three of the borings disclose clay to depths ranging from about 5 ft to 20 ft, but there was apparently no clay at Boring 506. As shown in Tables 16 to 19 of Appendix I, and in the plasticity chart in Fig. 2, the clay ranges from very sandy, with a liquid limit of 30, to relatively plastic clay with a liquid limit of 51.

We performed one permeability test to establish whether the most pervious of the clay samples, i.e. the very sandy clay from a depth of about 4 ft in Boring 505, would be acceptable for lining the ponds. For the test, the clay was compacted at the natural water content into a 4 cm long cylindrical specimen with a diameter of 3.6 cm. During compaction it was noticed that the natural water content is considerably above standard optimum. The specimen was saturated, consolidated and tested for permeability in a triaxial chamber under an effective confining pressure of $0.5\ kg/cm^2$. During consolidation, the water content decreased from 21.4% to 17.3% The computed coefficient of permeability was $k = 2.2x10^{-8}$ cm/sec. Because the more plastic clays are less pervious than the very sandy clay, it can be concluded that all clays from the coal storage area are suitable for lining ash ponds, provided (1) that they are compacted within ± 2% of standard optimum water content and (2) that the thickness of the clay lining is not less than 3 ft.

Proposed Cross-Section of Dikes

AEP proposes to construct the dikes using the soils excavated from within the pond area. The required depth of excavation to reach grade elevation within the ponds increases from about 7 ft within the area of the north ponds, to about 16 ft in the area of the south ponds. The two borings which were made within the areas of the north ponds, and the borings along the alignment of the dikes indicate that most of the soils to be used for the dikes range from silty and clayey fine sand to fine to medium sand. In compacted state, such soils have satisfactory strength properties, but are very susceptible to erosion by runoff during rain and due to leakage from the pipes along the crest. Therefore, the crest and downstream slope of the dike must be adequately protected against erosion.

The height of the dikes above original ground surface decreases from about 27 ft at the northeast corner of the area, to zero at the southeast corner. A typical cross-section is shown in Fig. 4, which includes a layer of mine waste (1) on the outside slope for protection against erosion, (2) on the inside slope for protection of the clay lining against damage and (3) on the crest for erosion protection and as a road base. Mine waste is available at the nearby Philip Sporn coal mine. The grain size curve of a sample of this material, shipped to us by the AEP Civil Engineering Laboratory, is plotted in Fig. 5. This well-graded material would be suitable for the proposed uses.

The mine waste on the crest of the dikes should be covered with a layer of compacted crushed stone. Where heavy equipment and trucks will be operating on the crest of the dikes, the thickness of crushed stone should be at least 18 in. A plastic filter fabric on the crest, as recommended in our letter of January 31, will not be required if the mine waste is used.

For surface drainage, the crest must be sloped not less than 3% in downstream direction, and the interface between mine waste and underlying fine sand should have a parallel slope.

Stability, Settlement and Seepage Analyses

1. Stability - To obtain an indication of the strength of the materials to be used for the main portion of the dikes, we performed one triaxial S (consolidated-drained) test on a compacted specimen of silty fine sand. Because the individual split-spoon samples did not contain sufficient material to form a test specimen, Sample 1 from Boring 406 was mixed with Sample 1 from Boring 415. These samples have similar grain size curves, as shown in Fig. 3. The results of this test, plotted in Fig. 6, show that the angle of internal friction of this compacted specimen is $\phi = 40.4$ degrees. Therefore, the stability of these dikes

with the proposed 1 on 2.5 slopes (Fig. 4) is not controlled by the angle of internal friction of the compacted dike material, but rather by the strength of the foundation strata.

The weakest soil encountered in the borings was a silty clay from a depth of 3.5 to 5.0 ft in Boring 405. As received, the split-spoon sample was very soft. However, the N-value of 7 blows/ft indicates that the in situ consistency is firm to stiff. The log of Boring 405, in Appendix II, does not give the thickness of this layer. Its in situ consistency, thickness and lateral extent should be investigated before the dikes are constructed.

The areas under the dikes should be proofrolled, after stripping, with a loaded scraper or dump truck. Areas where weaving is noticed should be investigated and any soft to firm clay should be excavated.

For the stability analysis, we have assumed that locally some firm clay is overlooked, and is not excavated from the foundation of the dikes. In addition, the following assumptions were made:

1. The maximum height of dike (27 ft) is directly underlain by firm clay with a shear strength of 0.5 ton/sq ft.
2. The upstream and downstream slopes of the dikes are 1 on 2.5.
3. The minimum crest width of the dike is 30 ft.
4. The end-of-construction condition, with no water or ash in the ponds.
5. The unit weight of the dike materials is 130 pcf.
6. At-rest coefficient of earth pressure in the dikes, $K_o = 0.5$.
7. The seismic coefficient during an earthquake is 0.1.

For these assumptions, the factor of safety during an earthquake, computed as shown in Fig. 7, is FS = 3.2. This factor of safety corresponds to a mobilized friction angle of 25°, which is reasonable for a silty clay. Where the dikes are underlain only by granular soils, the factor of safety would be greater because even loose sand would have an angle of friction larger than 25°. The condition where the pond is filled with water and ash does not govern the stability because the at-rest earth pressure acting in upstream direction at the center of the dike is greater than the pressure of the ash and water acting in downstream direction.

2. Settlement - With some local exceptions, the dikes will be underlain only by granular soils. The majority of the standard penetration resistances within 20 ft of the ground surface exceed 10 blows/ft which, for sand, indicates a relative density of at least 50%. However, some of the penetration resistances were less than 10 blows/ft, with the lowest value of 6 blows/ft in fine sand at a depth of 9 ft in Boring 407, 19 ft in Boring 408 and 29 ft in Boring 412, and such relatively loose sands will contribute to settlements.

The settlements of the higher portions of the dikes due to compression of the top 20 ft of fine sand may range between 2 and 4 in., and will develop during construction. Any differential settlements will be very gradual and will also be completed by the time the dikes are finished. Settlements due to compression of a well compacted fill in the dike and due to the lower foundation strata will be less than 1 in., and will be completed as soon as the dikes reach crest elevation.

Because all soft to firm clay will have to be excavated from the foundation of the dikes, such clay will not contribute to settlements. Any stiff clay has been preconsolidated to loads in excess of the load applied by the highest portion of the dikes and would, therefore, not contribute significantly to settlements.

3. Seepage and Underseepage Analyses - If the ponds are lined with a layer of well compacted clay at least 3 ft thick, seepage from the pond will be very small. For the conservative assumptions of the sandy clay lining with a coefficient of permeability $k = 2.2\text{x}10^{-8}$ cm/sec and of the maximum 22 ft depth of water in the pond, the rate of leakage through the lining in the bottom of the pond will be

$$q = k.i.A.t = 0.003 \text{ gallon/sq ft/day}$$

where

i = hydraulic gradient = 22/3

A = area

t = time

Therefore, for one of the larger ponds, the total seepage through the lining will be at the rate of about one gal/min.

The water seeping through the bottom lining will percolate vertically through the underlying relatively pervious strata to the ground water table at a depth of 47 to 60 ft below existing ground surface.

Because the granular soils in the dikes will be much more pervious than the clay lining on the inside slopes of the dikes, all water which seeps through the lining will also flow vertically to the base of the dike. Where the dikes are underlain only by granular soils, this water will then continue vertically through the in situ soil toward the ground water table. However, where clay directly underlies the dikes, the water will in part flow horizontally toward the downstream toe of the dike. With full pond, the rate of seepage through the clay blanket on the inside slope of the dikes will vary from about 0.003 gal/sq ft/day at the bottom of the slope to zero at pond level.

If the bottom lining is seriously damaged during reclaiming operations, the seepage through the "windows" in the lining will flow down to the ground water table and there will be no underseepage beneath the dikes.

Supports for Pipeline Bridge and Truck Bridge

Together with the logs of the borings made in the coal storage area, we received the logs of Borings 701 and 703 which were made for the proposed pipeline bridge, and Borings 801, 802 and 803 for the truck crossing bridge. However, we did not receive a location plan for these borings, nor any samples. The logs of these borings are included in Appendix II.

According to the boring logs the top 5 to 8 ft at Boring 701 consist of stiff to v. stiff clay, which is underlain by granular soils down to bedrock at a depth of 80.5 ft. At Boring 703, the clay stratum appears to be 15 to 18 ft thick, of which the top 10 ft are probably stiff to very stiff and the lower 5 to 8 ft may be only of firm consistency. The clay stratum at Boring 703 overlies granular soils which extend to bedrock at a depth of 83 ft.

In Boring 801, at the proposed truck bridge, approximately 8 ft of compact ash and gravel fill are underlain by about 10 ft clayey and sandy silt which gradually becomes coarser with depth. At Borings 802 and 803, the fill is absent; and the clayey silt at Boring 802 is approximately 13 ft thick, and about 7 ft thick at Boring 803.

Without detailed information on the design of the bridges and loads involved, we can only offer the following tentative opinion:

1. If the bridge structures are designed so as to permit differential settlements of a least one inch between neighboring piers, spread foundations are feasible.
2. The allowable bearing capacity of the upper stiff to very stiff clay and clayey silt may be of the order of 1 to 2 tsf. The ash and gravel fill would probably permit greater unit loads.
3. If spread footings are contemplated, determination of the allowable design load and resulting settlements would require testing of undisturbed samples of clay and clayey silt.

Conclusions and Recommendations

1. All topsoil and soft to firm clay should be removed from the area of all dikes.
2. The local silty or clayey fine sands may be used for construction of dikes with sideslopes of 1 on 2.5, provided these materials are compacted in lifts not exceeding 6 in., measured after spreading, and provided the slopes and crest are protected against erosion.
3. Judging from experience, we believe that topsoil and vegetation would not offer adequate protection against erosion of slopes constructed of such fine sand. The outside slopes should be covered, as shown in Fig. 4, with well-graded crushed stone or mine waste of the type available at the Sporn mine. The slope surface could then be covered with topsoil and seeded, except for the bottom 2 ft to permit free drainage at the downstream toe.
4. The clay from the coal storage area is well suited for lining the ponds. The bottom of the ponds and the inside dike slopes should be lined with 3 ft of this clay, compacted in thin lifts at water contents within $\pm$ 2% of standard optimum.

The total loss of water by seepage from one of the larger ponds, with maximum pond level, would be about one gallon per minute. There will be no underseepage beneath the dikes.

5. In order to reduce the danger of severe damage to the lining on the inside slope of the dikes during dragline excavation of bottom ash, a protective cover of mine waste or crushed stone, as shown in Fig. 4, is recommended. During reclaiming, a protective layer of bottom ash should be left at the bottom of the ponds, to prevent damage to the bottom lining.

6. Dikes subjected to heavy traffic loads will require an 18 in. layer of crushed stone, on top of a 3 ft layer of mine waste.

7. The crest of the dikes should be sloped transversely toward the outside edge of the crest, not less than 3%.

8. The total settlements of the highest portions of the dikes may range between 2 and 4 in. These settlements will develop almost entirely during construction.

9. The factor of safety against failure of the highest portion of the dikes is 3.2 if underlain by clay, and greater where underlain by granular soils.

10. If the pipeline bridge and truck bridge are to be supported on spread footings, the allowable bearing capacity of the clay and the magnitude of settlements should be investigated by means of undisturbed samples.

Sincerely yours,

L. Casagrande

L. Casagrande

LC:wc

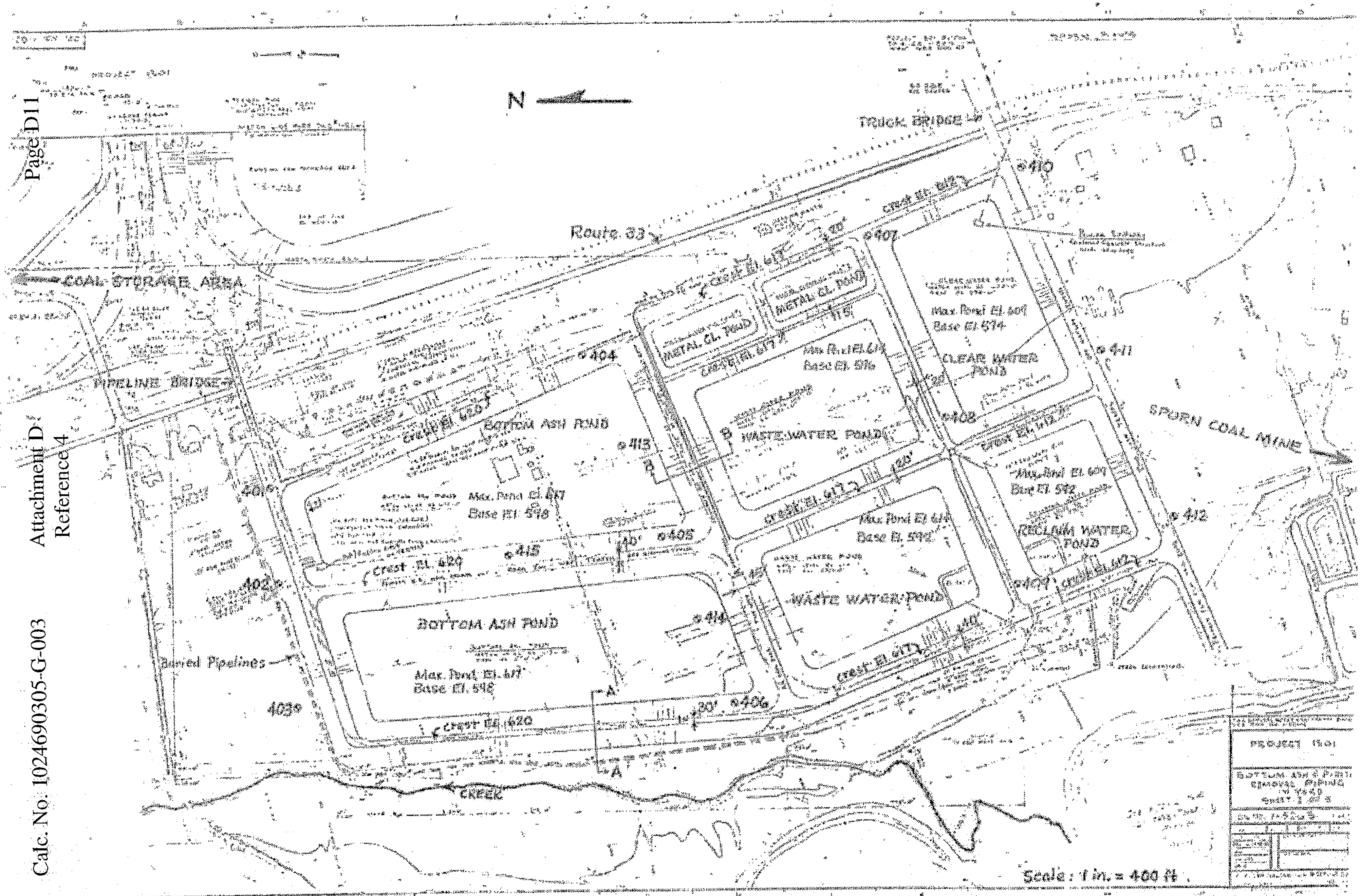


FIG. 1 - LOCATIONS OF BORINGS IN AREA OF BOTTOM ASH PONDS

Page D11
Attachment D
Reference 4
Calc. No. 1024690305-G-003

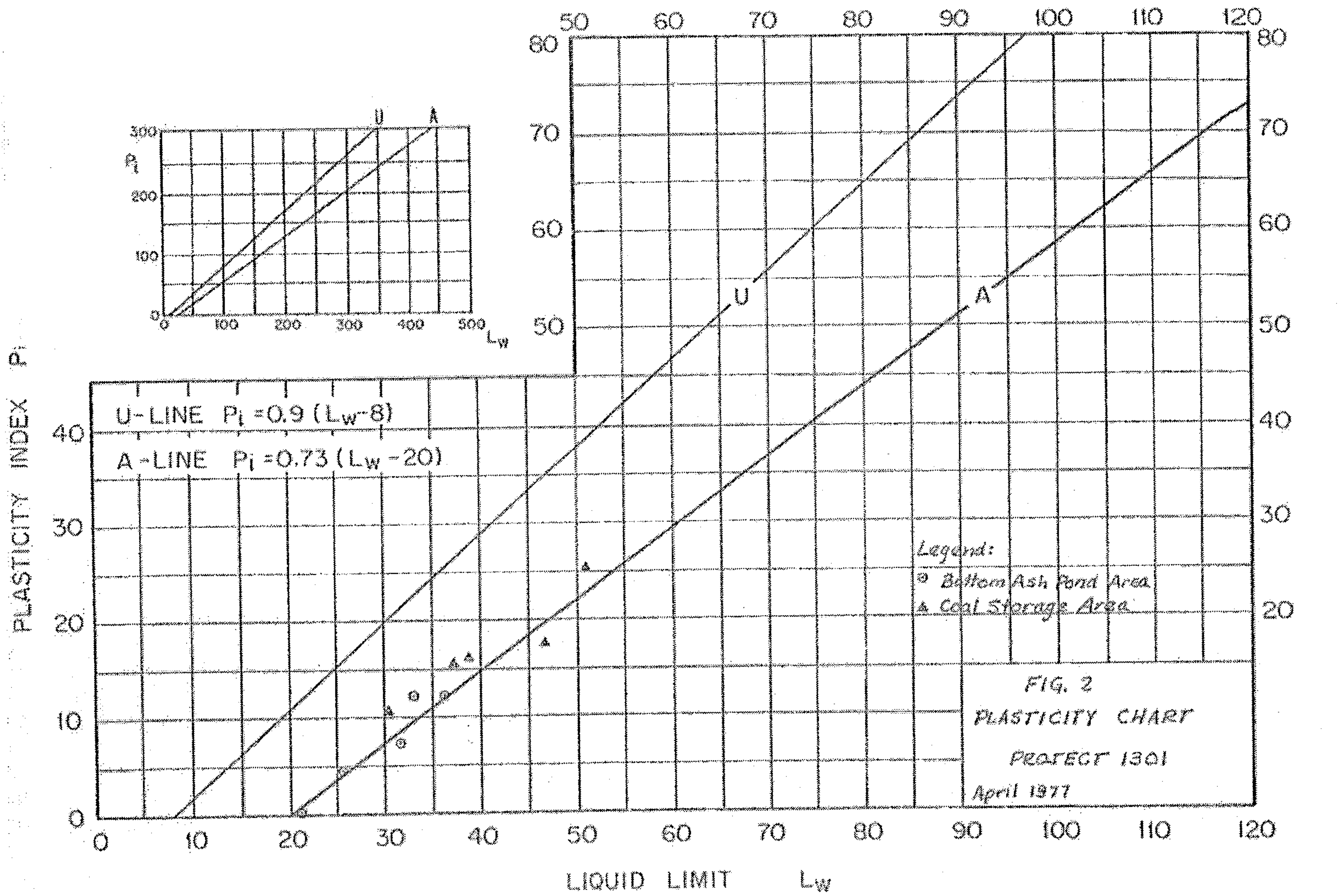
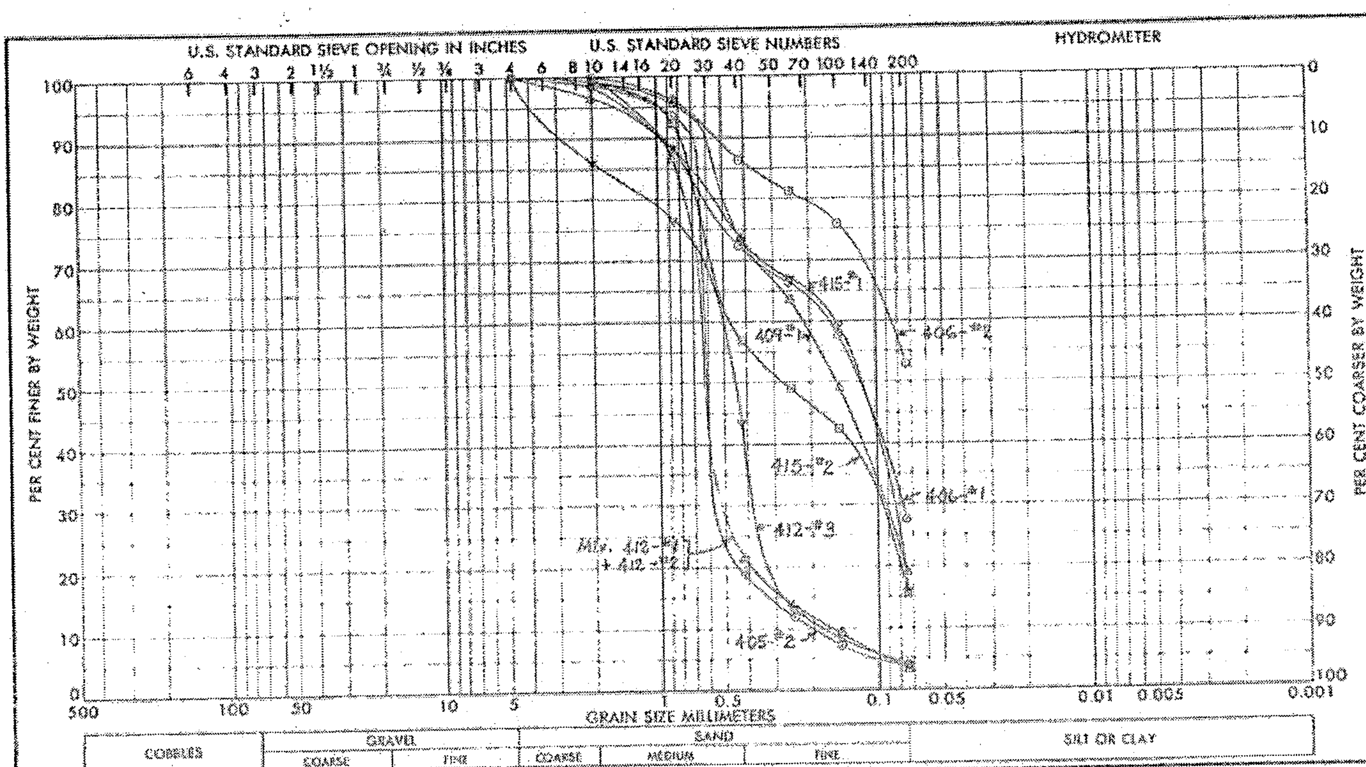


FIG. 2
PLASTICITY CHART
PROJECT 1301
April 1977



BOR. + SAMP. No.	DEPTH, ft	CLASSIFICATION	NAT W%	LL	PL	PI
405-#2	8.5 - 10.0	Brown silty fine to medium sand				
406-#1	3.5 - 5.0	Brown, very silty fine to medium sand				
406-#2	8.5 - 10.0	Brown fine sandy silt				
409-#1	3.5 - 6.0	Brown silty fine sand				
412-#1 + #2	3.5 - 10.0	Brown clayey fine to medium sand				
412-#3	13.5 - 15.0	Brown clayey fine to coarse sand				
415-#1	3.0 - 4.5	Brown clayey fine to medium sand				
415-#2	8.0 - 9.5	Brown clayey fine to medium sand				

PROJECT PROJECT 1301

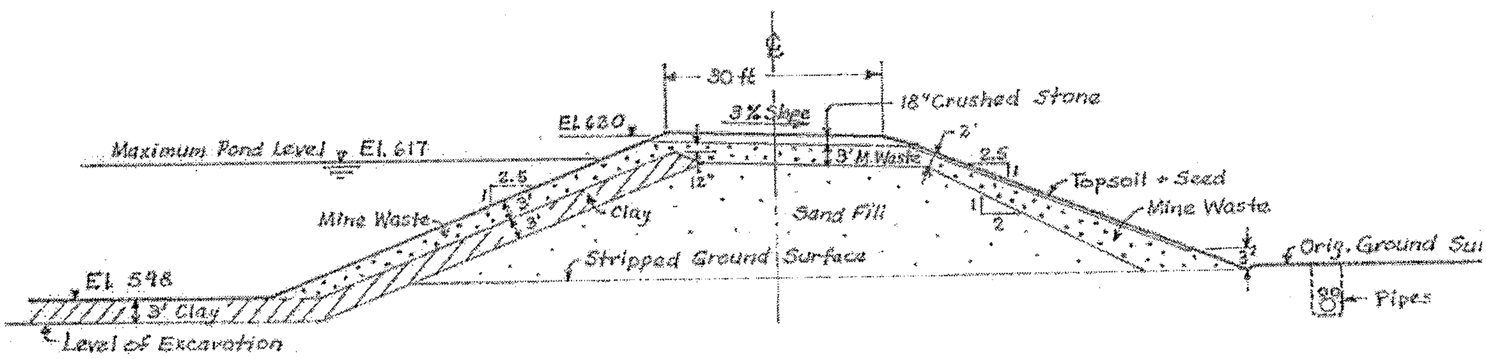
BOTTOM ASH PONDS

AREA

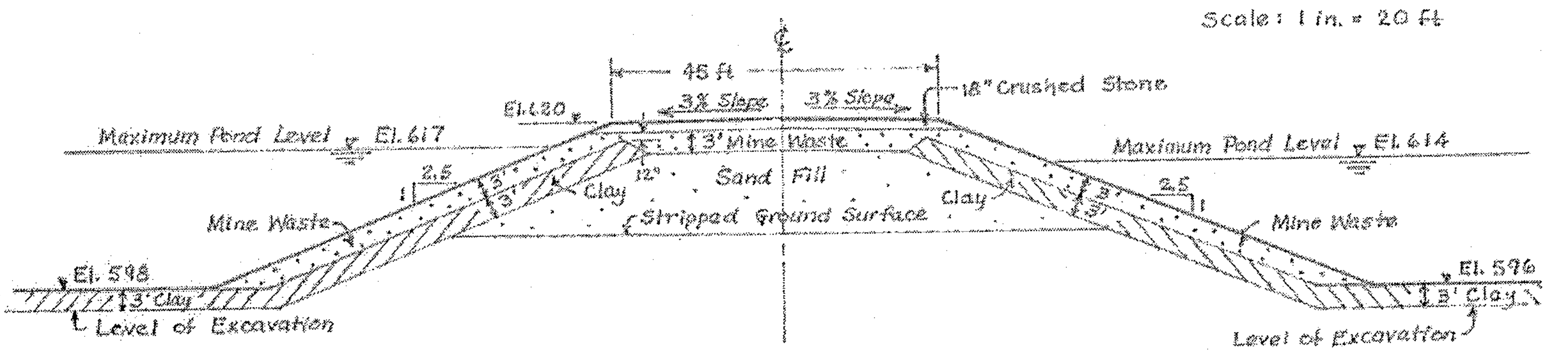
BORING NO

DATE April 1977

FIG. 3 - GRAIN SIZE CURVES OF SAND FROM ASH POND AREA



SECTION A-A THROUGH PERIMETER DIKE



SECTION B-B THROUGH INTERIOR DIKE

FIG. 4 - PROPOSED CROSS-SECTIONS THROUGH DIKES

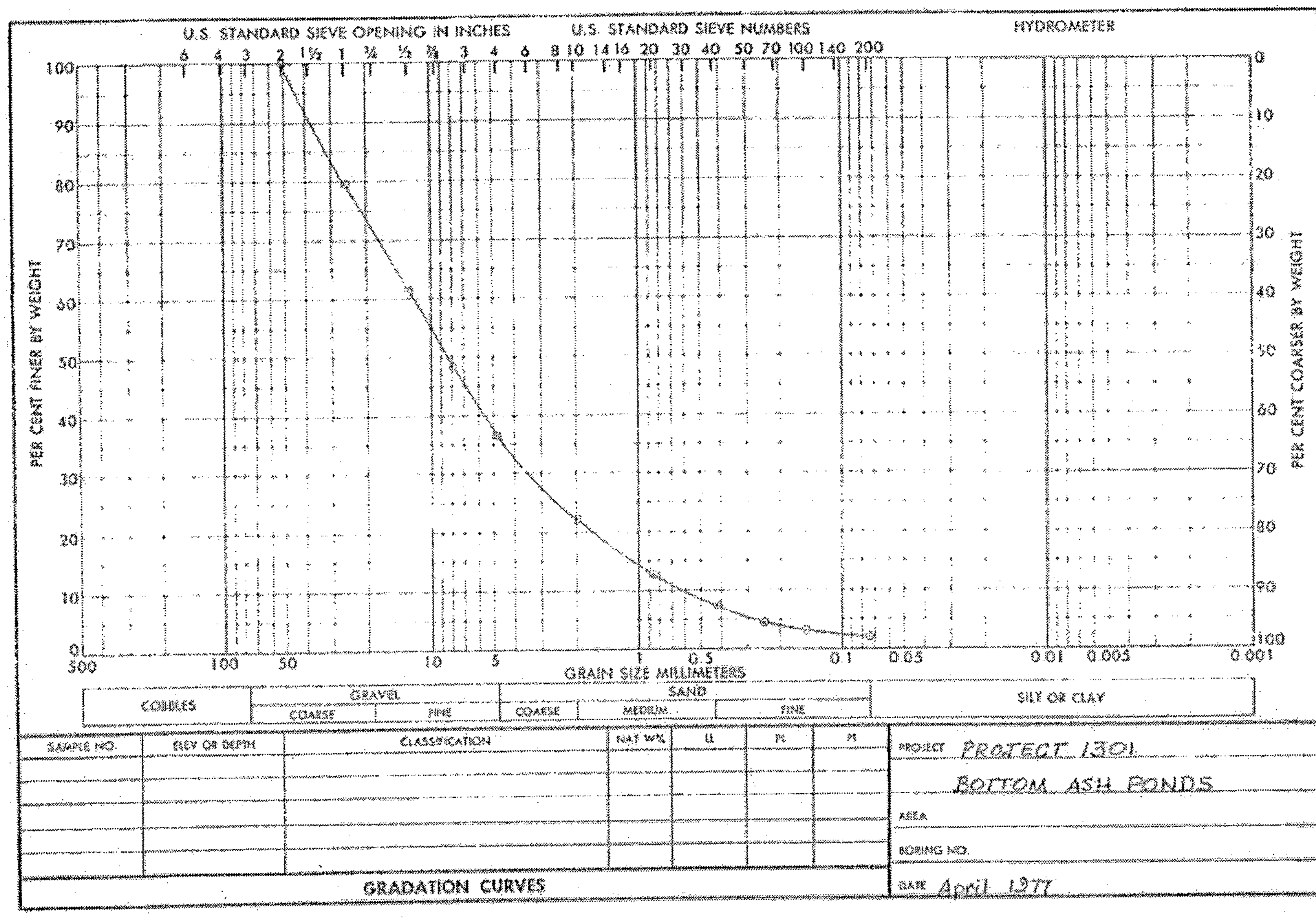
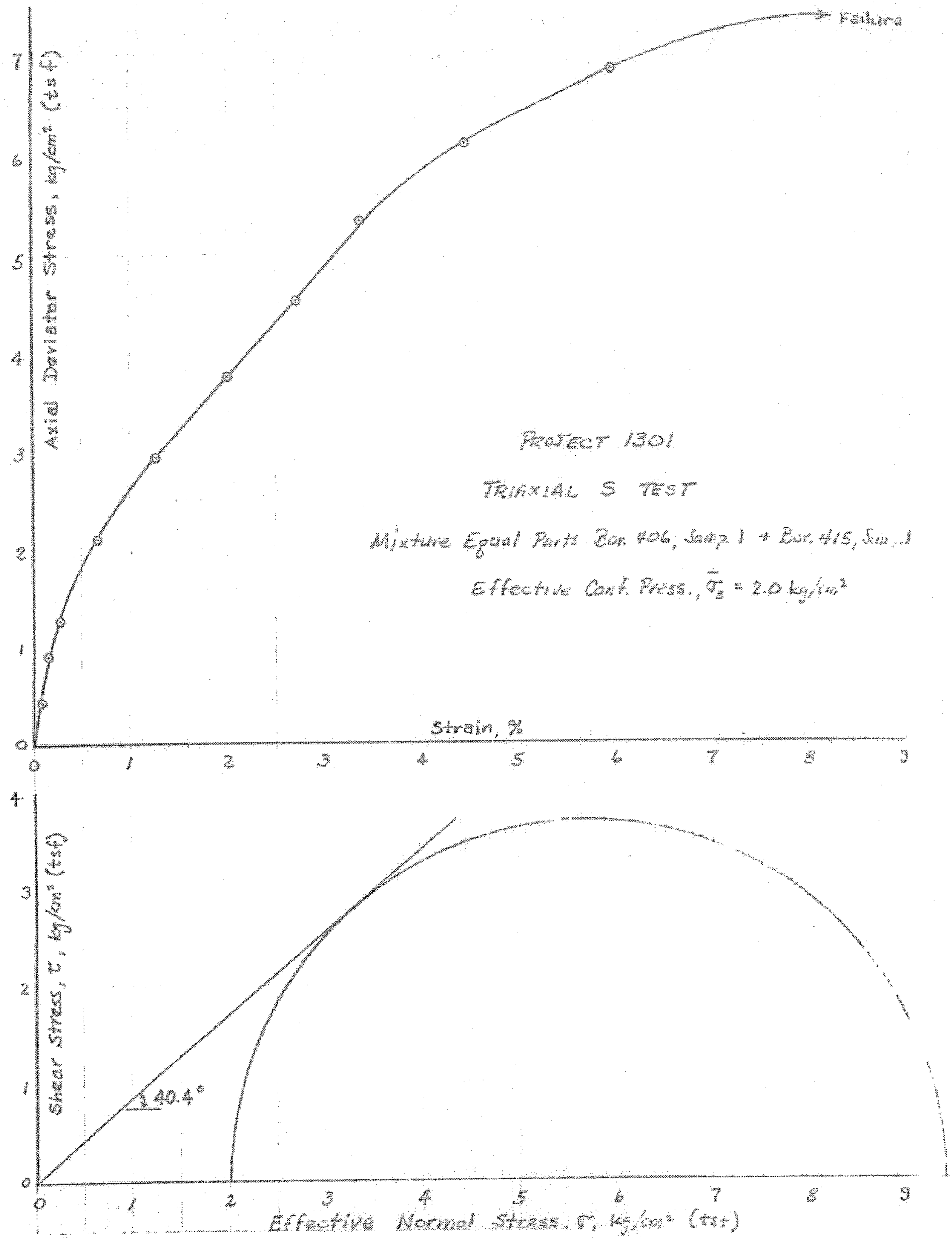


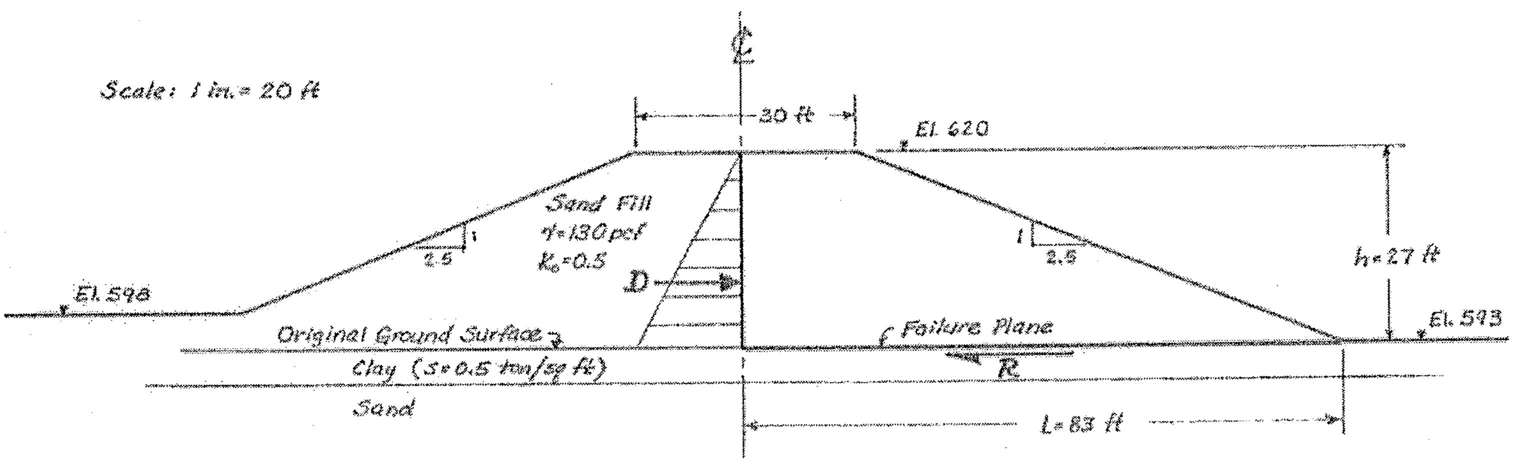
FIG. 5 - GRAIN SIZE CURVE OF MINE WASTE FROM SPORN COAL MINE



Reference 4

FIG. 6 - TRIAXIAL S TEST ON SILTY FINE SAND

Calc. No. 1024690305-G-003 Attachment D Page D16



SIMPLIFIED CROSS-SECTION

DRIVING FORCE

Static Condition: At-Rest Earth Pressure, $D = K_o \frac{\gamma h^2}{2} = 0.5 \frac{(130)(27)^2}{2} = 23,690$ lb/ft

Earthquake Condition: $D_E = D + 0.1D = 23,690 + 2,370 = 26,060$ lb/ft

RESISTING FORCE

Shearing Resistance along Failure Plane, $R = L \cdot s = (83)(0.5 \times 2000) = 83,000$ lb/ft

FACTOR OF SAFETY

Static Condition: $FS = \frac{R}{D} = \frac{83,000}{23,690} = 3.5$

Earthquake Condition: $FS = \frac{R}{D_E} = \frac{83,000}{26,060} = 3.2$

FIG. 7 - STABILITY ANALYSIS FOR HIGHEST PORTION OF DIKES (Northeast Corner)

Specifications

Shaw® Stone & Webster, Inc. PROJECT SPECIFICATION	J.O./W.O. NO.	102469	SPEC. NO.:	PS-J005
	PAGE	Cover	REVISION	4
	CLIENT	American Electric Power		
	PROJECT	Mountaineer Unit 1, FGD Retrofit		
	TITLE	Excavation , Fill and Backfill		

EXCAVATION, FILL AND BACKFILL

JOHN A. LAPERRIERE, REGISTERED, 16179, STATE OF WEST VIRGINIA, PROFESSIONAL ENGINEER

3-16-06

REVISION	0	1	2	3	4	5
REV. DATE	May 21, 2004	July 15, 2004	Sept. 2, 2004	Jan. 26, 2006	3/16/06	
REV. DESC.	IFQ	IFQ	IFRC	IFC	IFC	
PREPARER	PJS	JAH	JAH	JAH	JAH	
LEAD ENG.	PJS	PJS	PJS	DGJ	DGJ	
PROJECT ENG.	RRG	RRG	RRG	RRG	RRG	

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1.0 PART 1 – GENERAL

1.1 Scope

1.1.1 SEE TECHNICAL REQUIREMENTS

1.2 Reference Codes and Standards

1.2.1 The codes and standards referenced below shall be the issues in effect on the date of Invitation to Bid. Metric equivalent shall be used as applicable. If there is, or appears to be, a conflict between this specification and a referenced document, the matter shall be referred to the Engineer.

a. American Society for Testing and Materials (ASTM)

1) *ASTM D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort 56,000 ft-lbf/ft^3.*

2) ASTM D1556, Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.

3) ASTM D2167, Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method

4) ASTM D2487, Classification of Soils for Engineering Purposes (Unified Soil Classification System)

5) ASTM D2448, Standard Practice for Description and Identification of Soils (Visual Manual Procedure)

6) ASTM D2922, Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

7) ASTM D4318, Liquid Limit, Plastic Limit, and Plasticity Index of Soils

1.2.2 General Industry Standards

a. Occupational Safety and Health Administration (OSHA)

b. American Association of State Highway and Transportation Officials (AASHTO)

1.2.3 West Virginia Department of Transportation

a. West Virginia Division of Highways Standard Specifications for Roads and Bridges

1.3 Definition of Terms

The meaning of the following terms, or pronouns used in place of them, whenever used in these specifications, or instruments of construction that these specifications govern, shall be interpreted as follows:

a. Owner: American Electric Power

b. Company: Shaw, Stone and Webster

c. Seller: Any entity providing a service and/or furnishing goods to the Company or Owner.

d. Engineer: Authorized Engineer of the Company.

1.4 Benchmarks and Reference Base Lines

The owner shall establish the benchmarks and reference base lines. The Seller shall furnish all equipment and tools and shall be responsible for accurately locating and staking out the work. Benchmarks and reference lines shall be carefully maintained and, if disturbed or destroyed, shall be replaced by the Seller at no cost to the Company.

1.5 Boring and Soils Data

The Company will provide the Seller with a copy of the subsurface exploration program report, which includes boring and soils data. This report is for general information only and shall not affect the terms of the contract.

1.6 Explosives

If use of explosive is permitted by Owner, the Seller shall arrange for all permits. Safety procedures shall be submitted to the Company for approval. The Seller shall be responsible for all damages resulting from the use of explosives.

1.7 Existing Utility Lines and Underground Facilities

1.7.1 Existing utility lines, where known, are indicated on the drawings. Extreme care shall be exercised so as not to disrupt service or damage these lines.

1.7.2 The locations of underground lines, foundations and other installations, where known, are indicated on the drawings. The Seller shall notify the Company of any additional obstructions encountered and shall provide support, protection or removal of such obstructions as directed by the Company. Reasonable compensation shall be added for work made necessary by these additional obstructions. The Seller shall be fully responsible to the Company in the event of removal or damage of any existing objects that are intended by the Company to remain in place.

1.8 Barricades

Barricades shall be placed around all open excavations except where active work requires opening of such devices, and then only such portion of the barricade needed for work access shall be removed. If several excavations are in one area, the entire area may be enclosed with one warning barricade or each excavation enclosed separately.

1.9 Sheeting, Shoring and Bracing

1.9.1 The Seller shall provide adequate sheeting, shoring and bracing to support any lateral earth pressure, groundwater pressures, and surcharge loads from adjacent facilities, stockpiles and equipment operating located near the top of the sheeting, shoring and bracing. The Seller is fully responsible to protect personnel and adjacent structures against any damage from cave-ins, heaving or other earth movement. Sheeting and shoring shall conform to requirements as set forth in Subsection P of the latest issue of OSHA requirements for the construction industry (29CFR1926).

1.9.2 Sheeting, shoring and bracing shall be removed in a safe manner as backfilling proceeds. If sheeting, shoring and bracing cannot be removed without injury to the work or to adjoining structures, it may, with the approval of the Company, be left fully or partially in place.

1.9.3 The Seller shall submit the design and calculations of the shoring system for review and approval by the Engineer prior to commencing the work.

1.10 Protection

1.10.1 Protect existing structures and buried services from damage, excavate by hand where required.

1.10.2 Protect backfill material, bottoms of excavations and bedding material from contamination, freezing and standing water.

1.10.3 Stockpile all material in a manner to prevent segregation. Do not stockpile excavated materials to interfere with site operations, plant operation, fire fighting or drainage.

1.10.4 Protect Site and adjacent property from dust. Approved methods shall be used to minimize dusting.

2.0 PART 2 – PRODUCTS

2.1 General Requirements

2.1.1 The Seller shall be responsible for determining the nature and quantity of materials, and for the excavation, hauling, blending and processing of all earth materials, as required to meet the requirements of this specification. Earth materials from required excavations that conform to the requirements of this specification shall be used for fill. The materials shall be excavated and handled to facilitate their best use for the various fill types. Additional earth materials, that may be required, shall be provided by the Seller from off-site sources.

2.1.2 All earth materials used as fill shall be free of topsoil; pieces of roots, grass, weeds, other vegetation; organic materials; snow, ice or frozen materials; debris or other foreign material; or chemical contamination (oil, grease, solvents, dissolved metals, etc). The material shall not be excessively dry or moist (i.e. shall be near the optimum moisture content for compaction).

2.2 Source

The Seller shall be responsible for determining the nature and quantity of available materials and for excavating, blending, and processing, as required, to meet the requirements of this specification.

Borrow materials shall be selected by the Seller, subject to approval of the Company. The Seller shall submit test reports of material at the proposed source of borrow showing conformance to the gradation and moisture-density requirements of this specification for structural fill, road base, road subbase, and pipe bedding prior to use on the project and as specified herein.

2.3 Structural Fill (TYPE 1 fill)

Structural fill shall be where indicated by this specification or on the Engineer's drawings.

Structural fill shall conform to Class 9 of Table 704.6.2A, of Section 704.6 of the West Virginia Division of Highways Standard Specifications or an Engineer approved equivalent.

2.4 Free-draining sand and gravel fill (TYPE 2 fill)

Free-draining sand and gravel fill, where indicated by this specification or on the Engineer's drawings, shall consist of hard durable sand and gravel conforming to the following gradation requirements:

Sieve Size	Percent Finer by Weight
2-inch	100
½ -inch	50-85
No. 4	40-75
No. 100	0-15
No. 200	0-5

2.5 Common Fill (TYPE 3 fill)

Common fill shall consist of on-site or similar soils where indicated by this specification or on the Engineer's drawings.

Common Fill shall consist of *silty alluvial soils,* sands or gravels, classified in accordance with the Unified Soil Classification System (ASTM D 2487, ASTM D 2488), or mixtures thereof, containing no individual particles larger than 3 inches in size. The plasticity index (ASTM D 4318) of the material shall not exceed *20.* In areas approved by the Company, such as deep embankments, rocks up to 12 inches in size may be incorporated into the fill material provided such rocks are widely separated in the fill so that compaction of the fill, as determined by the Company, is not affected.

2.6 Geotextiles

Geotextiles shall be as shown on the Engineers' drawings, consisting of Mirafi 600X which is a woven polypropylene slit film fabric. Needle-punched, nonwoven geotextiles, such as Spun Bound 1135 or approved equal, may also be used as shown on the Engineers' drawings. Equivalent fabrics shall meet the strength and filtration characteristics of the specified products.

Geotextile rolls shall be furnished with suitable wrapping for protection against moisture, and extended ultraviolet exposure prior to placement. Each roll shall be labeled or tagged to provide product identification sufficient for inventory and quality control purposes. Rolls shall be stored in a manner which protects them from the elements. If stored outdoors, they shall be elevated and protected with a waterproof cover.

2.7 RIP RAP

Rip rap materials shall conform to Section 704.2 of the West Virginia Division of Highways Standard Specifications and as detailed on the Engineer's drawings.

2.8 Base Course

Base Course shall consist of durable angular gravels conforming to the base course requirements Class 2 Aggregate Base of Table 704.6.2A, of Section 704.6 of the West Virginia Division of Highways Standard Specifications.

2.9 *Aggregate Base Course*

Aggregate base course shall conform to shall consist of durable angular gravels conforming to the aggregate base course requirements Class 4 Aggregate Base of Table 704.6.2A, of Section 704.6 of the West Virginia Division of Highways Standard Specifications.

2.10 Pipe Bedding

Pipe Bedding shall conform to the requirements of Specification PS-J006.

2.11 *Thermal Backfill Material*

Backfill material shall consist of particles of rock that will pass the No. 4 (4.75mm) sieve and be retained on the No. 200 (.075mm) U.S. Standard Sieve.

The material shall be bonded, subangular sand, preferably silicic sand (the primary constituent of which is quartz).

The material shall contain a kaolin-base clay, in an amount not less than 5% and not more than 8%.

The dry compacted density shall be approximately 2,700 pounds per cubic yard.

The material shall be free of rubble, stones, organic matter, salts, ashes, cinders, other boiler wastes, and any other material (s) which may injure the cable or conduit or increase *the thermal resistivity of the backfill.*

The material shall confirm to the following sieve analysis (sieve sizes are U.S. Standard Series):

Sieve Size	*% Passing By Weight*
3/8"	*100*
#4	*95 - 100*
#8	*85 - 95*
#16	*60 - 75*
#30	*35 - 60*
#100	*10 - 30*
#200	*2 - 8*

3.0 PART 3 - EXECUTION

3.1 Excavation

3.1.1 Definition

a. Excavation includes the removal of all materials required to permit the construction of the foundations, structures, pits and trenches shown on the drawings.

b. Common Excavation

1) Common excavation shall include all materials other than solid rock and detached rock or boulders exceeding 2 cu yd (1.5 m^3) in volume.

2) Rippable rock shall be considered common excavation.

3) Rippable rock is defined as rock which can be excavated using a single tooth hydraulic ripper pulled by a D8H or equivalent dozer.

c. Rock Excavation

1) Rock excavation shall include excavation of solid rock in place, which must be removed by line drilling and wedging and all boulders or detached pieces of solid rock more than 2 cu yd (1.5 m3) in volume.

2) At least one month prior to commencing excavation, the Seller shall submit to the Company for approval a plan outlining his proposed methods and sequences of performing rock excavation.

3) No rock excavation shall be started in any area until the plan has been reviewed by the Company and a signed release to proceed has been issued.

3.1.2 Change of Sizes

Permanents excavations shall be at the locations and to the lines and grades shown on the drawings. If, during the progress of the work, the Company requests excavation to different lines and planes from those shown on the drawings, the lines and planes as directed by the Company will be the new excavation limit. Changes in excavation limits shall be used to revise contract quantities of excavation and backfill subject to verification by field surveys, if required.

3.1.3 Overexcavation

Excavation below the elevations shown on the drawings, if not approved by the Company in writing, shall be filled to the correct elevation with concrete having a 28 day compressive strength of at least 2000 psi (14 MPa), or by approved backfill, compacted to meet project requirements, without cost to the Company.

3.1.4 Drainage

Excavation shall be performed in a manner to assure drainage during the course of the work. Flooded excavations shall be dewatered, and all muck removed, before proceeding with the work. If ground water is encountered, the Seller shall not proceed with the work until his construction method is approved by the Company. Well point systems may be required where excavations extend below the groundwater line.

3.1.5 Stability

The Seller is fully responsible for maintaining the stability of all excavated faces and for compliance with all applicable Federal, State and local safety requirements until final acceptance of the work. See paragraphs under section 1.9.

3.1.6 Adjacent Foundations

To prevent the undermining of existing structures, there shall be no excavation slopes within 5 feet of the base of an existing footing or foundation, unless such footing or foundation is properly protected against settlement and erosion damage. Excavations shall extend a sufficient distance from the structures for placing and removing concrete formwork, installing services, other construction, and for inspections.

3.1.7 Bottom (Subgrade) Conditions

Foundations are intended to be founded on undisturbed soil, and excavation bottoms shall be level and clear of loose material. If loose or unsuitable soils, as determined by the Company, are found in excavation bottoms or slopes, the Company will require the excavations to be deepened to remove the loose or unsuitable material. The removed material shall be replaced with 2000 psi (14 MPa) concrete or approved, compacted fill material.

3.1.8 Trenching

a. Excavation for trenches shall be made carefully to install utilities to the depths and alignments shown on the drawings, so that when in final position the utilities are true to line and grade.

b. Trenches shall be excavated to the minimum width sufficient to allow satisfactory connections of utilities and tamping of backfill. Recommended minimum trench width is external diameter plus 24 inches (600 mm) for pipe and width of encasement plus 24 inches (600 mm) for electrical lines.

c. Unstable soil conditions, such as soil with soft spots, or soil which includes ashes, cinders, refuse, organic matter, or other unsuitable bearing material, shall be brought to the attention of the Company for evaluation before preparation of subgrade.

d. Adequate measure shall be taken to prevent slips, cave-ins and slides. Excavated material shall not be stored within 2 feet (0.6 m) of the edge of the excavation.

e. In trenches requiring side slopes for stability, the slope shall not be carried below a plane level with the top of the utility lines.

f. Excavation in ledge rock, rocky or gravelly soil shall be extended to provide a clearance of at least 5 inches (125 mm) but not more than 12 inches (300 mm) below and on each side of all pipes, valves, fittings or encasements.

g. Where pipe is to be placed in embankments, pipe trenches shall be excavated only after the embankment is completed to a level not less than 6 inches (150 mm) above the top of the pipe to be laid.

h. In wet or unstable ground, and as may be otherwise required, the trenches shall be sheeted and braced. Sheeting below the top level of the pipe may be left in place. If it is desired to pull sheeting extending below the top level of the pipe, this shall be done progressively with compaction of the backfill. Sheeting shall not be pulled after the backfill has been compacted.

i. Tunnelling shall not be allowed unless approved by the Company.

j. If a trench is overexcavated, the overexcavated portion shall be filled with concrete or fill, as discussed in Section 3.1.7 of this specification.

k. Excavate bell holes at each joint to provide full length barrel support of the pipe and to prevent point loading at the bells or couplings.

3.1.9 Stockpiling

Excavated material suitable for use as backfill or fill as approved by the Company shall be stockpiled in location specified by the Company. Material not suitable for backfill or fill, and excess material, shall be spread and graded and/or removed from site as directed by the Company.

3.2 Geotextile placement

Geotextile shall be installed as indicated on the Engineers' drawings and outlined herein. The fabric shall be installed in accordance with the manufacturer's instructions. The geotextile shall be placed on the prepared surface in a regular pattern conforming to the shape of the facility and shall be installed as to minimize cutting and wastage. Fabric shall be overlapped a minimum of 12 inches. The geotextile shall be placed in a loose condition such that it will conform to variations in surface contours. Temporary ballast shall be provided as required to prevent displacement by wind. Care shall be taken not to rip the geotextile. Tears shall be covered with pieces of geotextile fabric with 12 inches overlap. The geotextile shall not remain exposed longer than 24 hours.

3.3 Fill

3.3.1 Supply

The Seller shall provide all fill material in the quantities and quality required to conform to this specification and the lines and elevations shown on the drawings.

3.3.2 Proof-Rolling

Prior to placement of earth fill, subgrade surfaces shall be cleaned of debris, organic matter, mud, loose soil and other unsuitable material. The entire area on which fill is to be placed shall be proof-rolled with a heavy pneumatic-tired roller to detect any soft spots. Additional stripping shall be performed in all soft areas revealed by proof-rolling. Any material stripped shall be replaced and compacted with an approved fill.

3.3.3 Preparation

Before placing fill material, the subgrade soil surface shall be scarified to a minimum depth of 6 inches, wetted or dried to produce the optimum moisture content, and recompacted to the specified percent of maximum dry density in accordance with this specification. These requirements shall apply under roads, parking areas, trafficway paved areas, railroad beds, dikes, firewall, ponds, embankments and other earthen structures.

3.3.4 Sloped Surfaces

Sloped surfaces steeper than *2* horizontal-to-1 vertical shall be stepped or benched, scarified and compacted as described above.

3.3.5 Placement

Fill shall not be placed until the excavation and subgrade preparation (or portions thereof) have been completed, inspected, and approved by the Company. Fill shall be placed in horizontal layers not exceeding 8 inches in loose depth and then compacted to bring the area up to grade elevation. Materials placed by dumping in piles or windrows shall be spread uniformly before being compacted. No material shall be placed on surfaces that are muddy, frozen or contain frost. *At the discretion of the Engineer a test fill can be conducted to refine a optimum lift thickness for compaction equipment proposed.*

3.3.6 Compaction

Compaction shall be performed by rolling with approved tamping rollers, pneumatic-tired rollers, three-wheel power rollers or other approved equipment suitable for the soil and compaction specified. Material shall be moistened or aerated as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Each layer shall be compacted to not less than the percentage of maximum density specified below:

	Precent Maximum Density (ASTM D1557)	
	Cohesive Soil	Cohesionless Soil
Unless noted otherwise on the drawing, Fill used as support for equipment, storage tanks, structural slabs, building foundations, floors, road pavements and parking areas.	95	95
Fill used as backfill around foundations, construction of dikes, embankments and open areas.	90	90

3.4 Backfill

3.4.1 Definition

Backfill may consist of excavated material and shall be free from roots and other organic matter, trash, debris, frozen materials and stones larger than three inches in any direction. Backfill material shall be approved by the Company.

3.4.2 Preparation

Backfill shall not begin until construction below finish grade has been approved by the Company, forms removed and the excavation cleaned of trash and debris.

3.4.3 Limitation

Backfill shall not be placed in wet areas or on frozen ground. Materials softened or disturbed by rainfall or flooding shall be dried, if necessary, and recompacted or removed from the fill.

3.4.4 Placement

Backfill shall be placed in horizontal layers. Where heavy equipment is used, the maximum uncompacted thickness shall not exceed 8 inches (200 mm). Where hand tamping equipment is used, the maximum uncompacted thickness shall not exceed 4 inches (100 mm).

3.4.5 Backfill of Trenches

a. Unless other protection work is directed, backfill trenches immediately after the pipe is laid and testing has been successfully completed. In the case of concrete cradle bedding, delay backfilling until the concrete has set sufficiently to support the backfill load. No backfill shall be placed where the material in the trench is frozen.

b. Backfill material to be placed above bedding material shall be free of organic matter, trash, frozen materials, or debris. Unless specifically authorized, place no rock or rock excavation detritus in the upper 18 inches (460 mm) of the trench. Place no rock or stones having a dimension larger than 6 inches (150 mm) within 3 feet (1 m) of the top of the pipe encasement. Large stones may be placed in the remainder of the trench backfill only if well separated and arranged so that no interference with backfill settlement will result.

c. Use puddling, jetting, or waterflooding for consolidating backfill material only when approved by the Engineer prior to start of work. In general, limit the addition of water during backfill to providing optimum moisture content for tamping procedures.

d. Tamped backfill shall be placed in uniform layers not to exceed 6 inches (150 mm) and shall have a moisture content that will ensure that maximum density will be obtained with the placement method. Compaction shall be done with pneumatic tampers or other approved means.

e. All bedding and backfill up to compacted depth of 6 inches (150 mm) above the top of the pipe or duct shall be of fine compatible material (e.g., river sand) free of rocks and debris. Care shall be used during compaction to avoid line displacement. All bedding and backfill shall be compacted to a maximum density as specified in paragraph 3.4.

f. No construction machinery or vehicles shall be allowed to pass over the trench until the trench is backfilled and compacted sufficiently to prevent damage to the pipe.

3.4.6 Compaction

a. Compaction shall begin only after the fill or backfill has been properly placed and the material to be compacted is at the proper moisture content. Compaction shall be performed with equipment compatible with the soil type. If the material to be compacted contains excessive moisture, the material shall be processed to reduce the moisture content to the specified limits. If the soil has less than the specified moisture content, or is likely to lose enough moisture to bring the moisture content below requirements before the completion of compaction, water shall be added and the soil lift thoroughly mixed before compaction. Backfill shall be compacted as specified in paragraph 3.4.

b. Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of the footing. Backfill around foundations shall be brought up evenly on all sides. Heavy vibratory compactors shall not be operated within 5 feet (1.5m) of any structure. The area remaining shall be compacted by power-driven hand tampers suitable for the material being compacted. Backfill shall be placed carefully around pipes (or tanks) to avoid damage to coatings (or to tanks).

c. When applicable specifications do not specify a minimum strength requirement for newly placed concrete structures prior to backfilling, compaction of fill adjacent to structures shall not be started until the following intervals have elapsed:

Footings and slabs	24 hours
Walls, columns and piers backfilled on all sides simultaneously	7 days
Retaining walls where ratio of depth of fill to wall thickness is less than three	7 days
Retaining walls where ratio of depth of fill to wall thickness is greater than three	14 days

Temporary bracing of a wall, pier or column to withstand unbalanced lateral earth pressures will be permitted only upon the written approval of the Engineer subsequent to the review of the proposed bracing scheme.

3.4.7 Finish Grading

Final surfaces of compacted fills and backfills shall be finish graded to the cross sections, lines, grades and elevations indicated on the Engineer's drawings.

3.5 Tests

3.5.1 Performance

a. If a material source, such as a borrow pit, previously approved by the Company changes appreciably in characteristics such as type of soil, gradation, etc., additional testing may be required. Such tests shall be performed by the Company, at no cost to the Seller.

1) Field tests for density and moisture content will be performed in sufficient number to assure that the specified density is being obtained. The field tests will be performed by the Company in accordance with the ASTM D1556, ASTM D2167, or ASTM D2922 at no cost to the Seller.

b. As a minimum, at least one field density test shall be performed by the Company each 20,000 square feet (1,860 m2) of each lift in unrestricted areas. In restricted areas, at least one field density test shall be performed for each 400 cubic yards (300 m3), *or at a minimum one field density test shall be performed each day that fill is placed.*

3.5.2 Rework

Fill placed at densities lower than the specified minimum density or otherwise not conforming to the requirements of this specification shall be reworked or removed and replaced by acceptable fill. Replacement fill shall conform to all requirements of this specification. Rework shall be accomplished at no cost to the Company.

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	PROJECT	Mountaineer Unit 1, FGD Retrofit		
	TITLE	Placing Concrete and Reinforcing Steel		

PLACING CONCRETE AND REINFORCING STEEL

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1.0 PART 1 – GENERAL

1.1 SCOPE

1.1.1 This specification covers the requirements for placing concrete and reinforcing steel for foundations and any other reinforced concrete structures.

1.1.2 Concrete structures shall be constructed at the locations and in conformance with the lines, grades, and dimensions shown on the drawings.

1.1.3 The scope of the work includes providing formwork and reinforcement and placing concrete, reinforcement and grout where shown on the Engineer's drawings, as specified herein, and as needed for a complete and proper installation including but not necessarily limited to the following:

A. Ordering, forming, placing, consolidating, finishing, and curing all concrete and starter grout including required patching.

B. Unloading, handling, storing, furnishing and installing all reinforcement including welding and field fabricating of reinforcing steel, as necessary.

C. Unloading, handling, storing, furnishing and installing all accessories for positioning and supporting reinforcement against displacement.

D. Unloading, handling, storing, and installing anchor bolt assemblies and embedments in concrete.

E. Furnishing and installing other required products, such as waterstops, waterproofing, and other products as required and defined by this specification.

1.1.4 This specification shall govern when there is conflict with referenced specifications, except that OSHA requirements and local codes or those of any regulatory agency or body shall be strictly adhered to. Any conflicts shall be immediately brought to the attention of the Engineer.

1.2 REFERENCED CODES AND STANDARDS

The codes and standards referenced below shall be the issues in effect on the date of Invitation to Bid. If there is, or appears to be, a conflict between this specification and a referenced document, the matter shall be referred to the Engineer.

a. American Concrete Institute (ACI)

1) 117, Standard Specification for Tolerances for Concrete Construction and Materials

2) 301, Specifications for Structural Concrete for Buildings
3) 302.1R, Guide for Concrete Floor and Slab Construction.
4) 304R, Guide for Measuring, Mixing, Transporting, and Placing Concrete
5) 305R, Hot Weather Concreting
6) 306R, Cold Weather Concreting
7) 308R, Guide to Curing Concrete
8) 309R, Guide for Consolidation of Concrete
9) 315, Details and Detailing of Concrete Reinforcement
10) 318/318R, Building Code Requirements for Structural Concrete and Commentary
11) 347R, Guide to Formwork for Concrete
12) 350/350R, Code requirements for Environmental Engineering Concrete Structures and Commentary

b. American Society for Testing and Materials (ASTM)

1) A185, Steel Welded Wire Reinforcement, Plain for Concrete
2) A615, Deformed and Plain Billet Steel-Bars for Concrete Reinforcement
3) C31, Standard Practice for Making and Curing Concrete Test Specimens in the Field
4) C33, Concrete Aggregates
5) C94, Ready-Mixed Concrete
6) C143, Standard Test Method for Slump of Hydraulic Cement Concrete
7) C150, Portland Cement
8) C171, Sheet Materials for Curing Concrete
9) C309, Liquid Membrane-Forming Compounds for Curing Concrete
10) C684, Standard Test Method for Making, Accelerated Curing, and Testing Concrete Compression Test Specimens
11) C290, Elastomeric Joint Sealants
12) C1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
13) D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension
14) D994, Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)

15) D1500, Standard Test Method for ASTM Color of Petroleum Products (ASTM Color Scale)
16) D1751, Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
17) D1752, Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
18) D2628, Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
19) D2835, Standard Specification for Lubricant for Installation of Preformed Compression Seals in Concrete Pavements

c. American Welding Society (AWS)

1) D1.4, Structural Welding Code - Reinforcing Steel

d. Concrete Reinforcing Steel Institute (CRSI)

1) Manual of Standard Practice

e. Code of Federal Regulations (CFR)

1) 26CFR 1910, Occupational Safety and Health Standards

f. Shaw Stone & Webster (SS&W) Specifications

1) PS-J021, Detailing and Fabrication of Concrete Reinforcement
2) PS-J022, Concrete Mix Design
3) PS-J023, Mixing and Delivering Concrete
4) PS-J026, Anchor Bolt Fabrication
5) PS-J027, Soils and Concrete Testing Services

1.3 DEFINITION OF TERMS

The meaning of the following terms, or pronouns used in place of them, whenever used in these specifications, or instruments of construction which these specifications govern, shall be interpreted as follows:

a. Owner: American Electric Power

b. Purchaser: Shaw Stone & Webster, Inc.

c. Seller: Any entity providing a service and/or furnishing goods to the purchaser or Owner

d. Engineer: Authorized Engineer of Record providing the engineering services for the Project.

1.4 STORAGE

1.4.1 Provisions for Storage

1.4.2 Material covered by this specification will be stored at the jobsite as follows:

A. Heated Building:

1) Form release agents
2) Surface retarders
3) Weld filler metals
4) Curing compounds
5) Damp proofing material
6) Epoxy and latex materials
7) Floor hardeners
8) Premixed grout
9) Joint fillers and sealants
10) Mechanical reinforcing bar splice materials

B. Unheated Building:

1) Waterstops
2) Curing paper and blankets
3) Form liner

C. Outdoors, with Cribbing:

1) Formwork and accessories
2) Expanded metal
3) Metal lath
4) Handrail sleeves
5) Reinforcing steel
6) Anchor bolt assemblies
7) Steel embedments

2.0 PART 2 - PRODUCTS

2.1 MATERIALS

2.1.1 Reinforcement

A. Deformed reinforcement shall conform to ASTM A615. Bar sizes and grades shall be as shown on the Engineer's drawings. All reinforcing shall be detailed and fabricated in accordance with SS&W Specification PS-J021.

B. Welded wire fabric shall conform to ASTM A185 and shall be spliced by lapping the ends in conformance with ACI 318.

C. All weld filler metals shall conform to AWS D1.4, Section 5.

2.1.2 Formwork

A. Formwork shall generally be steel or smooth-sanded plywood, unless otherwise required herein or on the drawings. Form surfaces shall be capable of producing the finishes specified herein.

B. Formwork materials, sizes and thicknesses of members, accessories, hardware, supports, and attachments shall satisfy the requirements of ACI 347 and of the manufacturer's recommendations.

C. Forms for exposed finish concrete shall be plywood, metal, metal framed plywood faced, or other acceptable panel type materials. Furnish in largest practicable sizes to minimize number of joints.

D. Forms for unexposed finish concrete shall be plywood, lumber, metal, or another acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.

E. Form ties shall be factory fabricated, adjustable length, removable or snap-off metal form ties designed to prevent form deflection and to prevent spilling of concrete upon removal. Provide units that will leave no metal closer than 1-1/2 inches to the plane of the exposed concrete surface. Provide ties that, when removed, will leave holes not larger than 1 inch in diameter in the concrete surface.

F. General purpose form release agents for concrete that is exposed to view shall be nonstaining products such as Formshield by Tamms Industries; Duogard by W. R. Meadows, Inc.; Nox-crete by The Nox-crete Products Group; Magic Kote by Symons Corporation; or approved equal. Form release agents for concrete receiving a special architectural treatment shall be approved by the Engineer. Provide a form release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces. Form release agents shall be capable of commercial formulation and shall have a maximum of 350 g/L volatile organic compounds (VOCs). Form release agents shall be a nonstaining oil not darker than Color No. 3 and shall conform to ASTM D1500.

G. Lacquer base form release coatings shall be nonstaining, plastic type materials such as Formlak by ChemMasters of Madison, Ohio; or approved equal.

H. Forms may be lined with DuPont Zemdrain form liner. This liner may be used to improve the surface finish of exposed formed areas. The liner shall be installed in accordance with the manufacturer's recommendations.

2.1.3 Water

Water for all concrete work, including grout, saturating the concrete, and curing, shall be clean and clear. Water quality at all times shall conform to requirements specified in ASTM C94.

2.1.4 Curing Compound

A. Paper or plastic film for curing concrete shall conform to ASTM C171 and shall be one of the following: Sisalkraft, Orange Label, or Sisalkraft SK-30, manufactured by St. Regis Paper Company or Griffolyn Type 55, manufactured by Reef Industries, Inc., Griffolyn Division, Houston, TX; or approved equal.

B. Curing compounds shall consist of commercially available preparations that satisfy requirements of ASTM C309, Type I, Class A or be one of the following or consist of commercially available preparations that satisfy requirements of ASTM C309, Type I: Horncure WB30 by Tamms Industries or Kure-N-Seal by Degussa, or approved equal. If curing compounds are used where a coating will be applied, they shall be compatible with and approved by the manufacturer of the coating material and approved by the Engineer. The manufacturer's written application instructions shall be followed.

2.1.5 Waterstops

A. Waterstops, unless noted shall be polyvinyl chloride.

B. Waterstops at moving type joints, unless noted, shall be centerbulb type, 6 inches by 3/8 inch or 9 inches by 3/8 inch, as shown on the drawings. Material shall be polyvinyl chloride and shall conform to CRD-C572. Split-type waterstops shall not be used. Waterstops and fittings shall have the capability to withstand the gap dimension in each of the three principal axes simultaneously.

C. Waterstops at non-moving type joints may consist of Synko-Flex preformed adhesive.

D. All splices in waterstops shall incorporate factory fittings and adhesives and be made using tools or equipment recommended by the manufacturer.

2.1.6 Bond Breaker

A. Bond breakers, where required, shall be polyethylene tape, or as recommended in writing or furnished by the sealant manufacturer and approved by the Engineer. Backup materials and preformed joint fillers shall be nonstaining, compatible with sealant and primer, and composed of a closed cell foam rod of polyethylene, urethane, neoprene, as recommended in writing by the sealant manufacturer, or other material approved by Engineer.

B. Compressible material used for formwork shall be polystyrene foam boards as furnished by the Dow Chemical Company, Midland, MI, or Engineer approved equal and shall have properties similar to the following:

1) Density: 0.9 to 2.0 pound per cubic foot

2) Absorption: Less than 3 percent by volume

2.1.7 Bonding Agent

Bonding agent shall be polyvinyl acetate or acrylic base.

2.1.8 Joint Sealant

Joint sealant for sidewalks, slab isolation joints and similar uses shall be nonstaining and shall establish and maintain a watertight and airtight continuous joint seal. Joint sealants and associated materials shall be in conformance with ASTM D1190, D2628, and D2835. The sealant shall be resistant to solvents, fuels and other hydrocarbons and chemicals. The sealant shall be able to withstand cyclic movements of at least 25 percent of the joint width. Joint fillers shall be a material compatible with the joint sealant. Joint sealant installation shall be in accordance with the manufacturer's recommendations.

2.1.9 Evaporation Control

A. Evaporation Control shall consist of monomolecular film-forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss.

B. Provide vapor retarder over prepared base material where indicated below slabs on grade. Use only materials that are resistant to deterioration when tested according to ASTM E154, as follows:

1) Polyethylene sheet not less than 8 mils thick.

2) Water-resistant barrier consisting of heavy kraft papers laminated together with glass-fiber reinforcement and overcoated with black polyethylene on each side.

3.0 PART 3 - EXECUTION

3.1 FORMWORK

3.1.1 Formwork Installation

A. Formwork shall conform to the requirements of ACI 301, Section 2 and 5.3.3, and ACI 347 except as herein specified. All formwork shall be removed except where shown on the drawings. Provide Class A tolerances for concrete surfaces exposed above grade. Provide Class C tolerances for other concrete surfaces.

B. Forms shall conform to the lines and dimensions shown on the Engineer's drawings and shall be substantial and sufficiently tight to prevent mortar leakage. The formwork shall have sufficient strength to withstand the pressure resulting from the placement and vibration of the concrete.

C. Forms shall be designed and secured to allow removal in sections without marring or damaging the concrete surface. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, recesses, and the like for easy removal.

D. Formwork shall be provided with adequate cleanout openings to permit inspection and easy cleaning after reinforcement has been placed. Provide for openings, offsets, keyways, recesses, moldings, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in the work. Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.

E. Exposed edges and corners shall be chamfered 1 inch using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

F. Form materials shall be free of surface defects that would affect the concrete finish. Forms for exposed surfaces shall provide a smooth form finish as specified in Section 5.3.3 of ACI 301. For enclosed areas used for piping or conduit runs, the exposed surfaces shall produce a rough form finish as specified in Section 5.3.3 of ACI 301. For unexposed surfaces and rough work, undressed lumber may be used.

G. Coat contact surfaces of forms with an approved, nonresidual, low-VOC, form-coating compound before placing reinforcement. Do not allow excess form-coating material to accumulate in forms or come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply according to manufacturer's instructions. Coat steel forms with a nonstaining, rust preventative material. Rust stained steel formwork is not acceptable.

3.1.2 Vapor Retarder Sheeting

When specified on the drawings, place vapor retarder sheeting in position with longest dimension parallel with direction of pour. Lap joints 6 inches and seal with manufacturer's recommended mastic or pressure sensitive tape not less than 2 inches wide.

3.1.3 Form Ties

A. Form accessories such as ties and hangers to be partially or wholly embedded in the concrete shall be of a commercially manufactured type.

B. Form ties shall be constructed so that the ends or end fasteners can be removed without causing appreciable spalling at the faces of the concrete.

C. After the ends or end fasteners of form ties have been removed, the embedded portion of the ties shall terminate not less than 2 diameters or twice the minimum dimension of the tie from the formed faces of concrete to be permanently exposed to view, except that in no case shall this distance be less than 1-1/2 inch. (See also Section 3.9)

D. Through ties in water retaining structures shall be filled with an approved waterstop.

3.1.4 Formwork Removal

A. The contact face of removable forms shall be coated with a nonstaining form-release agent. The form-release agent for use on formwork for concrete surfaces that are to be plastered, tiled, or coated shall be a lacquer base coating. The manufacturer's instructions shall be followed. Excess oil shall be removed before placing concrete. Reused forms shall have the contact surfaces cleaned thoroughly. Oil shall be cleaned off reinforcing steel with petroleum naphtha or other suitable solvent.

B. Removal of forms shall conform to Sections 2.3.2, 2.3.3, and 2.3.4 of ACI 301, except as otherwise provided herein. The following table shows the minimum strength of concrete required for columns and walls prior to form removal.

Member	Minimum Strength psi
Nonbearing walls, sides of slabs, beams, girders, fill concrete and massive foundations	500
Columns and bearing walls, provided framing girders are shored to prevent appreciable load from reaching column or wall	1,000

C. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations are maintained.

D. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed in less than 14 days or until concrete has attained at least 75 percent of design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members. Edge forms for slabs on grade may be removed the following day.

E. No superimposed load will be allowed on any concrete structure, or backfill allowed behind a wall until it has attained its 28-day strength, as shown by field cured cylinders or nondestructive testing in accordance with ACI 301, Section 2.3.4.2, unless otherwise approved by the Engineer.

F. Field cured cylinders shall be cast toward the completion of a placement and cured identical to the structure being evaluated.

3.2 REINFORCEMENT

3.2.1 Reinforcement Placement

A. Clean reinforcement of loose rust and mill scale, earth, ice and other materials that reduce or destroys bond with concrete.

B. Reinforcement shall be placed as per Engineer approved Reinforcement Detail and Placement Drawings.

C. Reinforcing steel shall be placed in conformance with ACI 301, Section 3.2, 3.3, ACI 318, Section 7.5, and with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," unless otherwise noted herein. All accessories for positioning and securing reinforcement in its required location and maintaining it there during other phases of construction shall be furnished and installed. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

D. Any cutting or puncturing of the vapor retarder sheet shall be repaired prior to placement of concrete.

E. Locations and lengths of laps splices, and embedments shall be as indicated on approved engineering and rebar detail drawings. Additional field splices in rebars shall require the Engineer's approval.

F. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.2.2 Bar Bending

A. Reinforcing steel shall not be bent or straightened in the field unless approved by the Engineer. Bending or straightening of rebars partially embedded in set concrete shall be in accordance with ACI 318, only if approved by the Engineer.

B. The bent or straightened surfaces of the rebar shall be visually examined for indications of cracks. All sections of rebar containing any breaks, cracks, or splitting shall be removed. Portions of rebars removed shall be replaced by welding in the same size rebars in accordance with the requirements specified elsewhere herein. Welded splices shall develop at least 125 percent of the yield strength of the rebar.

C. Bars of all sizes bent less than 10 degrees embedded in hardened concrete may be straightened at ambient temperatures.

3.2.3 Weld Splicing

A. Splicing of reinforcing steel, where required, shall be approved by the Engineer and may be done by arc or Cadweld welding. Welded splices shall conform to the requirements of AWS D1.4. Other methods of splicing shall be submitted to the Engineer for approval.

B. Procedures for arc and Cadweld welding of reinforcing steel butt splicing shall be qualified in accordance with AWS D1.4 and shall be available at the work site prior to performance of any production welding. Welders shall be qualified for this project in accordance with AWS D1.4.

C. Tack welding on reinforcing bars shall not be permitted. Tack welding or temporary welding on any permanent steel embedments shall not be permitted except where shown on the Engineer's drawings. When tack welding or temporary welding is permitted, it shall be done only under an approved welding procedure.

D. All filler metals for welding shall be in accordance with AWS D1.4.

E. All ends of rebars which are to be Cadwelded shall be marked before splicing with a small diameter, low stress, bullet nose punch. The marks shall be located a fixed dimension from each bar end to permit verification of proper centering of the two pieces of reinforcing longitudinally within the Cadweld sleeve and the amount of embedment of each of the ends of the rebar within the sleeve. The allowable gap between the ends, alignment and location of the rebar within the sleeve shall be as required by Erico Products, Inc. Final acceptance criteria for Cadweld splices shall be based on satisfying the criteria herein for visual inspection.

F. Bar ends shall be prepared and Cadwelding performed in accordance with the manufacturer's instructions.

G. All completed Cadweld joints shall be visually inspected after cooling for proper filling, such that filler metal shall be visible at each accessible end of the sleeve and at the tap hole. In addition, the completed splice shall be examined for longitudinal centering of the sleeve on the spliced bar ends, permissible gap between bar ends based on punch marks, extent of leaking of filler metals, gas blowout, amount of slag at the tap hole, and allowable voids in filler metal in accordance with the manufacturer's instructions.

H. Cadweld materials shall be stored in their shipping containers. Cadweld materials shall be handled and used as specified by the manufacturer.

3.2.4 Unless otherwise shown on the drawings, the minimum clear coverage of the concrete over the steel shall be no less than that specified in Section 3.3 of ACI 301 and the following:

	Cover in Inches
Concrete that will be exposed to sea water, fresh water, or to alkali soil.	3

3.3 JOINTS

3.3.1 Construction Joints

A. Construction joints for all structures shall be located where shown on the Engineer's drawings, or as directed and approved by the Engineer prior to placing concrete. No additional joints shall be made without prior written approval of the Engineer. Construction joints shall be keyed as indicated on the drawings.

B. The surfaces of horizontal and vertical construction joints having no keyway and areas of mats on which concrete walls, columns, or piers are to be placed, shall be treated to remove laitance and to expose clean, sharp aggregate in accordance with ACI 301, Section 5.3. Surfaces shall be roughened by green cutting, sandblasting, or by application of a surface retarder, and then thoroughly cleaned. The cleaned, prepared surface shall provide a rough surface having a full amplitude of at least 1/4 inch from surface to base with aggregate exposed but not undercut.

C. If specified on the Engineer's drawing, use a bonding agent on existing concrete surfaces that will be joined with fresh concrete. Prepare the joint in accordance with ACI 301 and ACI 350 and apply the bonding agent within the time frame for concrete placement in accordance with the manufacturer's specifications and procedures. Follow recommendations of the bonding agent manufacturer for protection of rebar and waterstop material.

D. Reinforcement shall be continued across joints unless the drawings show otherwise. The surface of joints shall be cleaned of scale and laitance and thoroughly wetted before placing adjoining concrete. Horizontal joint surfaces shall be covered with a maximum 1/2 inch thick coat of a cement grout (starter grout) in conformance with Section 5.3 of ACI 301.

3.3.2 Control and Expansion Joints

A. Control and expansion joints shall be constructed at such locations shown and in accordance with the details indicated on the Engineer's drawings.

B. Where a construction joint is to be used as a control joint, the first formed joint surface of the hardened concrete shall be coated with two heavy coats of approved curing compound. The curing compound shall have been placed within 48 hours before the adjacent concrete is cast.

C. Control joints in slabs shall be formed by either a tooled groove joint or saw cut to a minimum width of 1/8 inch and depth of one-fourth the thickness of the slab. The location of the control joints shall be as per Engineer's drawings. If joint pattern is not shown, provide joints not exceeding 15 feet in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays). Isolation joints in slabs-on-grade shall be located at points of contact between slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated by Engineer's drawings.

D. Surface primers for joint sealants shall be as recommended in writing by the sealant manufacturer. Non sagging sealants shall be used for floor, wall, and ceiling applications. A traffic supporting sealant shall be used where pedestrian or wheel traffic occurs. A sealant that will be immersed or in contact with water for long periods of time shall be a formulation expressly designed for that duty. Color of sealants shall be selected to blend with the surrounding exposed construction. Sealant shall conform to ASTM C920.

E. Exposed edges of expansion joints in walls or abutments shall be beveled or rounded.

F. The seat of sliding joints shall be finished to a smooth plane surface and allowed to harden for at least 48 hours before additional concrete is placed. Two thicknesses of building paper shall be placed on the seat before depositing superimposed concrete.

G. Where indicated on the drawings, exposed expansion joints between two distinct concrete members shall be filled with an elastic joint filler of approved quality and the thickness specified, or shown on the drawings. Joints in the filler material shall be made tight so that mortar from the concrete will not seep through to the opposite concrete surface. Filler shall conform to ASTM D1751 or D1752.

3.4 EMBEDDED ITEMS

All items to be embedded in concrete for structural steel, anchor bolts and sleeves, waterstops, pipe supports, and equipment foundations and stubs for machinery bases shall be accurately located and secured and maintained so as not to be displaced during the placing of concrete. Tack welding to rebar is not permitted.

3.4.1 Waterstops

A. Where required, waterstops shall be as specified herein and placed in construction, control, and expansion joints in accordance with the Engineer's drawings and ACI 301, Section 2.2. Field splices, where required, shall be made in accordance with the manufacturer's recommendations. Splices shall incorporate recommended applicable fittings, adhesives, and welding tools. Waterstops shall be free of grease, oil, dirt, or any other foreign material which might prevent bond.

B. Supports shall be provided, and suitable precautions shall be taken to protect the waterstops during the progress of the work. Nailing of waterstops will not be permitted.

Edges of waterstops shall not be cut to surround reinforcement. Field fabricate joints in waterstops according to manufacturer's printed instructions.

C. The width embedded in concrete at each side of any joint shall be at least 2-1/2 inches, except that, for expansion and control joints, the amount of embedment shall at least meet the manufacturer's recommendation for any design head of water specified.

3.4.2 Anchor Bolts and Bolt Sleeves

A. Anchor bolts and sleeves shall be accurately located, and secured from displacement, per Engineer's drawing. Usage of template for bolt group location is recommended.

B. Water shall be excluded from anchor bolt sleeves to prevent freezing and cracking of the concrete. Preformed plastic anchor bolt sleeves may be placed around the bolt. Antifreeze such as ethylene glycol may be placed in the sleeves, or bolts may be wrapped with two or more full turns of expanded polyethylene foam wired in place to provide space for expansion of any freezing water.

C. After concrete is placed, all uncoated or unprotected anchor bolt threads shall be coated with NO-OX-ID.A-Special as manufactured by Sanchem Inc. or Tectyl 506 as manufactured by Ashland or equal, approved by the Engineer.

3.4.3 Miscellaneous Embeds

A. All inserts, pipe sleeves, drainage piping, electrical conduit and similar materials shall be set and maintained as shown on the Engineer's drawings.

B. Pipe sleeves, thimbles, and similar openings shall be installed as shown on the drawings. Sleeves, pipes, or conduits of aluminum shall not be embedded in concrete unless effectively coated or covered to prevent aluminum-concrete reaction or electrolytic action between aluminum and steel. Effective coatings include two coats of bitumastic paint or two coats of clear lacquer or similar inert isolation material.

C. Electrical conduit or embedded pipes in groups or in layers shall be spaced not closer than three times the diameter of the conduit/pipe on centers, in no case less than 2 inches and, where more than one layer is installed; the vertical layers shall be separated by a clear space of an least the dimension of the largest size of conduit/pipe used and, in no case less than 2 inches. Care shall be taken to ensure that the reinforcing steel, as detailed on the drawings, is not displaced by the conduit or other piping installed.

3.5 CONCRETE PLACING

3.5.1 General Preparation

A. Concrete placing shall conform to the requirements of ACI 301, 304, and 318, unless otherwise specified herein. All concrete placing equipment and methods must be acceptable to the Engineer.

B. Hardened concrete and foreign materials shall be removed from the inner surfaces of the forms and conveying equipment.

C. Prior to concrete placement, formwork shall have been completed; snow, ice, debris and water shall have been removed; reinforcement shall have been secured in place; expansion joint material, anchors, and other embedded items shall have been positioned; and the entire preparation shall have been completed.

D. Underground pipe, conduits, and ducts in the pour area shall be completely installed before placing concrete.

E. Where required, subgrades shall be sprinkled with water sufficiently to prevent absorption of water from freshly placed concrete.

F. When called for on the drawings, slabs on grade shall be poured over a vapor retarder sheeting.

3.5.2 Placing Conditions

A. Concrete shall not be placed on frozen subgrade or subgrade that is excessively wet. Concrete shall not be placed in rain, sleet, or snow unless adequate protection is provided.

B. When the concrete arrives at the jobsite too stiff for proper placing, slump adjustment may be made with the agreement of the Engineer by the addition of a suitable additive or by one or several additions of water just prior to discharging concrete from the truck mixer. Once the discharge of concrete has started for final placement, no further adjustment of water content shall be permitted. Concrete slumps shall be as follows, unless otherwise approved by the Engineer:

Concrete Use	Maximum	Minimum
Foundations	5 Inches	3 Inches
Drilled Piers and Cast-in-Place Piles	6 Inches	4 Inches
Beams and Columns	5 Inches	3 Inches
Pavements and Slabs	4 Inches	2 Inches

C. Water shall be removed from excavations before concrete is deposited. Any flow of water into the excavation shall be diverted. No attempt to seal the flow of water by means of the freshly deposited concrete will be permitted. Unless otherwise specified herein, all concrete shall be placed upon clean, damp surfaces, and never upon mud, dried porous earth, or fills that have not obtained required compaction.

3.5.3 Concrete Conveyance

A. Concrete shall be handled from the truck chute to the place of final deposits as rapidly as practicable by methods which will prevent segregation or loss of ingredients and in a manner which will ensure that the required quality of the concrete is maintained.

B. Conveying equipment shall be an approved type and shall be of a size and design such that detectable setting of concrete does not occur before adjacent concrete is placed. Conveying equipment shall be cleaned at the end of each operation or workday. Conveying equipment and operations shall conform to the following additional requirements:

1) Belt conveyors shall be horizontal or at a slope that will not cause excessive segregation or loss of ingredients. Concrete shall be protected against undue drying or rise in temperature. An approved arrangement shall be used at the discharge end to prevent apparent segregation. Mortar shall not be allowed to adhere to the return length of the belt. Long runs shall be discharged into a hopper or through a baffle.

2) Chutes shall be metal or metal-lined and shall have a slope not exceeding one vertical to two horizontal and not less than one vertical to three horizontal. Chutes more than 20 feet long and chutes not meeting the slope requirements may be used provided they discharge into a hopper before distribution. Chutes made of aluminum or aluminum alloys shall not be used.

3) Pumping or pneumatic conveying equipment shall be of suitable type with adequate pumping capacity. Pneumatic placement shall be controlled so that segregation is not apparent in the discharged concrete.

C. Water shall not be added at the hopper to facilitate pumping. If the concrete is too stiff to pump, water may be added in accordance with this specification. Concrete shall not be conveyed through pipe made of aluminum or aluminum alloy.

D. Concrete shall be placed and consolidated before initial set has occurred and before it has contained its water content for more than 90 minutes, except as otherwise provided by ASTM C94.

E. Mixing and agitation of the concrete mix in the truck mixer shall not exceed 300 revolutions.

3.5.4 Concrete Placement

A. Concrete placing shall conform to the requirements of ACI 301, 304, and 318, unless otherwise specified herein. All concrete placing equipment and methods must be acceptable to the Engineer.

B. In general, all concrete shall be deposited in approximately horizontal layers, not to exceed 18 inch thickness when compacted. Slabs up to and including 24 inches thick, shall generally be placed in one course. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

C. Lateral movement of concrete by means of vibrators shall not be permitted except for local consolidation of the mass or melting down of small mounds where deposited.

D. The placement shall be carried on at such a rate that all concrete not yet placed to its final elevation shall not have reached its initial set before additional concrete is placed on it. If a section cannot be placed continuously, provide construction joints as specified.

E. Placing of concrete shall be done in a manner that will prevent the segregation or loss of materials. There shall be no vertical drop (free fall) greater than 6 feet for any concrete except where chutes, elephant trunks, or pipes are provided, and the drop shall be reduced if segregation occurs. Water retention structures shall be limited to a vertical drop of 4 feet.

F. Concrete shall not be dumped against waterstops, but shall be placed adjacent to, and thoroughly consolidated under horizontal waterstops or uniformly on both sides of vertical waterstops before they are submerged. The practice of working waterstop down into placed concrete will not be permited.

3.5.5 Concrete Consolidation

A. Use equipment and procedures for consolidation of concrete complying with ACI 309.

B. Concrete shall be consolidated by vibration, spading, rodding, or forking so that the concrete is thoroughly worked around the reinforcement, around embedded items, and into the corners of forms, eliminating air or stone pockets which may cause honeycombing, pitting, or planes of weakness.

C. Internal vibrators shall have a minimum frequency of 8000 vibrations per minute and sufficient amplitude to consolidate the concrete effectively. Competent workmen shall operate them. The use of vibrators to transport concrete within forms shall not be allowed. Vibrators shall be inserted and withdrawn in points approximately 18 inches apart. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, the duration shall be sufficient to consolidate the concrete, but not sufficient to cause segregation, generally from 5 to 15 seconds. Spare vibrators shall be kept at the site of the work during concrete placing operations. Use one vibrator per 10 cu yards/hr walls and two per 20 cu yards/hr for slabs.

D. Bring slab surfaces to correct level with a straightedge and strike off. Use bull floats or darbies to smooth surface free of humps or hollows.

E. Where the concrete is to have an as-cast finish, a full surface of mortar shall be brought against the form by the vibration process, supplemented if necessary by spading to work the coarse aggregate back from the formed surface.

3.5.6 Cold Weather Requirements

A. Cold weather is defined as a period when for more than three successive days the average daily air temperature is less than 40°F and the air temperature is not greater than 50°F for more than one-half day of any 24-hour period. Cold weather concreting shall comply with the requirements of ACI 306.

B. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures. Place no concrete during rain or snow. When air temperature has fallen to or is expected to fall below 40°F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50°F and not more than 80°F at point of placement.

C. Chill factor shall be taken into consideration in determining proper protection of the concreting operations.

D. When heavy frost or freezing is forecast at the jobsite, all concrete surfaces shall be protected from freezing for the first 24 hours after placement.

E. All concrete materials and all reinforcement, forms, fillers, and ground with which the concrete is to come in contact shall be free from frost, snow, and ice. Contact surfaces shall not be more than 10°F cooler than the minimum concrete placing temperature nor less than 40°F. Concrete shall have a temperature conforming to Table 3.2.1 of ACI 306.1, when placed in the forms and shall be maintained at a temperature conforming to Column 2 of Table 3.2.1 of ACI 306.1 for not less than 72 hours after placing.

F. No dependence shall be placed on salt or other chemicals for the prevention of freezing.

3.5.7 Hot Weather Requirements

Hot weather is defined as any combination of high air temperature, low relative humidity, and wind velocity tending to impair the quality of fresh or hardened concrete or otherwise affecting concrete properties.

Hot weather requirements for concreting shall conform to ACI 301, Sections 4.2, 5.3 and ACI 305. All concrete shall be delivered to the forms at all times at the coolest temperature which is practicable under current conditions but consistent with the temperature requirements specified. Concrete will not be acceptable if it has a temperature in excess of 90°F for placements less than 4 feet thick, and 70° for placements equal to and exceeding 4 feet thick at the time of placement. Concrete shall not be placed when hot weather conditions would prevent proper placement and consolidation.

Cover reinforcing steel with water soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.

Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without puddles or dry areas.

Use water reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, when acceptable to Engineer.

Initiate approved curing practices as soon as possible to prevent premature surface drying of concrete.

3.6 FINISHES

3.6.1 Care shall be exercised to avoid excessive floating and troweling of finish while there is moisture on the surface of the slab. Under no circumstances, shall dry cement and sand or other material be sprinkled on the surface of the wet concrete or finish for the purpose of drying up pools of bleed water or condensation. As an alternate to this, the surplus moisture may be blotted up with dry burlap or removed by spreading cement and sand over a sheet of burlap laid over the freshly screeded surface of the finish. The dampened sand and cement shall be discarded.

3.6.2 Float Finish

After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units. Finish surfaces to tolerances of F(F) 28 (floor flatness) and F(L) 23 (floor levelness) measured according to ASTM E1155. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

3.6.3 Trowel Finish

After floating, begin first trowel-finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and finish surfaces to tolerances of F(F) 30 (floor flatness) and F(L) 25 (floor levelness) measured according to ASTM E1155, unless otherwise specified. Grind smooth any surface defects that would telegraph through applied floor covering system.

3.6.4 Broom Finish

Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. After floating is complete, the top edges at the contraction joints shall be slightly rounded by means of a steel edging tool.

3.6.5 Non Slip Aggregate Finish

After completing float finishing and before starting trowel finish, uniformly spread 25 lb of dampened nonslip aggregate per 100 sq ft of surface. Tamp aggregate flush with surface using a steel trowel, but do not force below surface. After broadcasting and tamping, apply trowel finishing as specified. After curing, lightly work surface with a steel wire brush or an abrasive stone, and water to expose nonslip aggregate.

3.6.6 Dry Shake Metallic Hardener Floor Finish

Note that if a dry shake metallic floor hardener is used, the manufacturer shall be consulted to ensure acceptability of the per cent of air entrainment in the concrete mix. Typically, the manufacturers of dry shake finish limit concrete mix air entrainment to less than 3%. An adjustment of the mix design will be required. Apply dry shake materials for the hardened finish at a rate of 250 lb per 100 sq ft, unless a smaller maximum amount is recommended by material manufacturer. Immediately following the first floating operation, uniformly distribute with mechanical spreader approximately two-thirds of the required weight of the dry shake material over the concrete surface, and embed by power floating. Follow floating operation with second shake application, uniformly distributing remainder of dry shake material with overlapping applications to ensure uniform color, and embed by power floating. After broadcasting and floating, apply a trowel finish as specified. Cure slab surface with a curing compound recommended by the dry shake material manufacturer. Apply the curing compound immediately after the final finishing.

3.6.7 After the finishing is completed, the curing and protection procedures required under Section 3.7, herein, shall be started. When hot, dry winds, direct sunshine, or a combination of these indicate the likelihood of plastic cracking, the surface of the slabs shall be protected before and after finishing to minimize surface cracking. Foot traffic and construction loads shall be restricted as much as possible to minimize surface damage during the construction period.

3.6.8 Surface finishes

Surface finishes shall be applied as per Engineer's drawings. For surface finishes not called out on Engineer's drawing finishes shall be applied as following:

Surface Finish	Concrete Surfaces
Float	Roof slab to be covered with insulation and built-up roofing.
Trowel	Interior: Walkways, platforms, ramps, slabs and floors. Floor to be covered with resilient flooring, carpet, ceramic to quarry tiles, epoxy coat, thin film coat or paint. Roof slab to be covered with vapor barrier, built-up roofing without insulation or membrane waterproofing
Broom	Exterior: Walkways, platforms, ramps, slabs and floors. Steps, stair treads, stair landing pads, sidewalks and pavements

3.7 CURING AND PROTECTION

3.7.1 General Requirements

A. Curing and protection of freshly deposited concrete or grout shall conform to the requirements described herein and in accordance with ACI 308. For other conditions not covered herein, requirements shall conform to ACI 301, Section 5.3.6 unless otherwise noted. These requirements include the control of moisture loss from concrete, control of concrete temperature, and the use of combustion heaters.

B. Concrete shall be cured by moist curing, by moisture-retaining cover curing, by curing compound, or by combining these methods, as specified.

3.7.2 Water Curing

A. Where water curing is specified, it shall require the presence of a visibly wet concrete surface together with the presence of some free water continually throughout the required curing period.

B. Unformed surfaces shall be covered with burlap, cotton, or other approved fabric mats kept in intimate contact with the concrete, or with clean sand, and shall be kept continuously wet for the duration of the curing period. Surfaces cured with sand shall be covered with a minimum uniform thickness of 2 inches of sand. Where formed surfaces are cured while still in the forms, the forms shall be kept wet continually. If the forms are removed before the end of the curing period, curing shall continue as on unformed surfaces. Burlap shall be used only on surfaces to be unexposed in the finished work. Concrete shall be protected from the direct rays of the sun during the first 3 days of the curing period.

3.7.3 Curing by Compounds

A. The storage, handling, and application of curing materials shall conform to the manufacturer's recommendations.

B. Concrete may be cured with a curing compound of the surface membrane type instead of moist curing with water. The curing compound shall be applied to unformed surfaces immediately after finishing. The surfaces shall be thoroughly covered with the curing compound applied in accordance with the manufacturer's recommendations.

C. On formed surfaces, the curing compound shall be applied immediately after removal of forms unless surface cleanup and repair of surface defects are to be done at once. In this case, the surface shall be kept moist to prevent drying out during this work, and the curing compound shall be applied upon its completion. If there is any appreciable drying or loss of moisture from the concrete surface that is to be coated with curing compound, the surface shall be sprayed with water and brought to a uniformly damp appearance just prior to applying the curing compound.

D. Concrete surfaces subjected to heavy rainfall within 3 hours after the curing compound has applied shall be retreated. Compounds shall not be used on surfaces to which additional concrete will be bonded, where the surface has been prepared by exposing aggregate, or during the period concrete is required to be water cured, or to which resilient flooring or epoxy coatings will be applied.

3.7.4 Curing Conditions

A. Large foundation mats having a thickness of 7 feet or greater, shall be water cured for a minimum period of 14 days. Curing period may consist of 14 days of water curing or 7 days of water curing followed by 7 days of curing with a curing compound. When the mean daily outside air temperature is less than 40°F, the concrete shall be protected by a heated enclosure, or insulation, or blankets to keep the surface of the concrete at all points above 50°F, but no more than 70°F for the initial 7-day curing period.

B. Temperature control during and following the water curing period shall be provided to ensure that the maximum air temperature change immediately adjacent to the concrete does not exceed 5°F in any 1 hour, or 50°F in any 24 hours. Where blankets or other insulating covers are used to provide temperature control without an enclosure structure, the above cooling rate shall apply to the concrete surface.

C. Walls, slabs, or other concrete that are between 30 inches and 7 feet thick in their least dimension shall be water cured for 48 hours. For an additional 5 days, the concrete shall be cured by any of the methods listed herein and the above requirements on temperature control and rate of temperature change shall not be exceeded.

D. When the mean daily outdoor temperature is less than 40°F, the temperature of the concrete shall be maintained between 50°F and 70°F for the required curing period. When necessary, arrangements for heating, covering, insulating, or housing the concrete work shall be made in advance of placement and shall be adequate to maintain the required temperature without injury to concrete due to heat concentration.

Combustion heaters shall not be used during the first 24 hours unless precautions are taken to prevent exposure of the concrete to exhaust gases which contain carbon dioxide. Additional curing measures shall be taken in accordance with the recommendations of ACI 306. The records shall be kept of the air temperature, the temperature within any heated or protective enclosure, and of the concrete temperature during the required curing period. The records shall satisfy the intent of Section 2.4 of ACI 306R.

E. For hot weather conditions, provision for windbreaks, shading, fog spraying, sprinkling, ponding, or wet covering with a light colored material shall be made in advance of placement, and such protective measures shall be taken as quickly as concrete hardening and finishing operations will allow. Additional curing measures shall be taken in accordance with the applicable recommendations of ACI 305.

3.8 ROUTINE TESTS OF CONCRETE

3.8.1 Concrete test responsibilities of field personnel are defined in SS&W Specification PS-J023.

3.8.2 No less than two sets of compressive strength test specimens for each mix design of concrete placed will be made during the first two days of placing concrete, and at least one set of test specimens will be made per 8-hour shift or for each 100 cubic yard placed. Slump, air content, temperature, and density tests will be made at the time of casting cylinders for compressive strength tests or as necessary to maintain these parameters within their limits.

Concrete material for preparing test specimens will be taken from the truck's discharge or at the end of discharge line.

3.8.3 A quality control program shall be in place to address inspection of concrete reinforcing, formwork, and concrete placement. These inspections shall be documented and available for owner's review.

3.9 REPAIR OF SURFACE DEFECTS

3.9.1 Patching Defective Areas

Repair and patch defective areas with cement mortar immediately after removing forms in accordance with the requirements of ACI 301, with Engineer's approval. The patching material shall consist of the same materials and proportions as the concrete mix except the course aggregate shall be omitted. Pre-package materials may be used when acceptable to the Engineer.

A. Cut out honeycombs, rock pockets, voids which cannot be completely covered by a quarter, and holes left by tie rods and bolts down to solid concrete. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with bonding agent. Place approved patching mortar before bonding agent has dried.

B. For surfaces exposed to view, blend white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Provide test areas at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3.9.2 Repairing Formed Surfaces

Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Engineer. Surface defects include texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes and fill with dry-pack mortar.

A. Repair concealed formed surfaces, where possible, that contain defects that affect the concrete's durability or, where applicable, water tightness. If defects cannot be repaired, remove and replace the concrete.

3.9.3 Repairing Unformed Surfaces

Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface tolerances specified for each surface and finish. Correct low and high areas as specified. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having the required slope.

A. Repair finished unformed surfaces containing defects that affect the concrete's durability. Surface defects include crazing and cracks in excess of 0.01 inch wide or that penetrate to the reinforcement or completely through nonreinforced sections regardless of width, spalling, popouts, honeycombs, rock pockets and other objectionable conditions.

B. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days.

C. Correct low areas in unformed surfaces during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.

D. Repair defective areas, except random cracks and single holes not exceeding 1 inch in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose reinforcing steel with at least ¾-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

3.9.4 Repair single holes 1 inch or less in diameter by dry-pack method. Cut out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Place dry-pack before bonding agent has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

3.9.5 Perform structural repairs according to approved procedures and obtain prior approval of the Engineer for materials, method and procedure.

3.9.6 Repair methods not specified above may be used, subject to acceptance of the Engineer.

3.9.7 Any repaired area measuring 6 inches or more across in any direction shall be cured by being kept thoroughly damp for 7 days.

Shaw® Stone & Webster, Inc. **PROJECT SPECIFICATION**	J.O./W.O. NO.	1024690300	SPEC. NO.:	PS-J009-US
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	PROJECT	Mountaineer Unit 1, FGD Retrofit		
	TITLE	Auger Cast-In-Place Piles		

AUGER CAST-IN-PLACE PILES

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10/20/04

REVISION	0	1	2	3	4	5
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REV. DESC.	IFP	IFC				
PREPARER	JKM	JKM				
LEAD ENG.	PJS	PJS				
PROJECT ENG.	RRG	RRG				

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1.0 PART 1 - GENERAL

1.1 SCOPE

1.1.1 The work covered by this specification consists of design and furnishing all equipment, materials, labor and supervision and performing all work necessary for pile load tests and installing auger cast-in-place piles to support concrete foundations.

1.1.2 The extent of work is as shown on Engineer's drawings including piling location plans.

1.1.3 The Seller shall provide pile schedules, pile load test program, piling details and such other drawings as may be required.

1.1.4 Bench marks and reference base lines will be established by the Purchaser. The Seller shall furnish all equipment and tools and shall be responsible for accurately locating and staking out the work. Bench marks and reference lines shall be carefully maintained and, if disturbed or destroyed, shall be replaced by the Seller at no cost to the Purchaser.

1.2 REFERENCED CODES AND STANDARDS

1.2.1 The codes and standards referenced below shall be the issues in effect on the date of Invitation to Bid. Metric equivalent shall be used as applicable. If there is, or appears to be, a conflict between this specification and a referenced document, the matter shall be referred to the Engineer.

a. International Building Code 2000 Edition

1) Section 1809.3, Drilled or Augered Uncased Piles

b. American Society for Testing and Materials (ASTM)

1) A36, Standard Specification for Structural Steel

2) A615, Standard Specification for Deformed and Plain Billet Steel-Bars for Concrete Reinforcement

3) C109, Standard Test for Compressive Strength of Hydraulic Cement Mortars

4) C942, Standard Test Method for Compressive Strength of Grouts

5) D1143, Standard Test Method for Piles under Static Axial Compressive Load

6) D3689, Standard Test Method for Individual Piles Under Static Axial Tensile Load

c. American Welding Society (AWS)

1) AWS D1.1, Structural Welding Code - Steel

2) AWS D1.4, Structural Welding Code – Reinforcing Steel

d. American Concrete Institute (ACI)

1) ACI 543R

e. Stone & Webster (S&W) Specifications

1) PS-J021, Detailing and Fabrication of Concrete Reinforcement

2) PS-J024, Placing Concrete and Reinforcing Steel

1.3 DEFINITION OF TERMS

The meaning of the following terms, or pronouns used in place of them, whenever used in these specifications, or instruments of construction which these specifications govern, shall be interpreted as follows:

a. Owner: American Electric Power.

b. Purchaser: American Electric Power.

c. Seller: Any entity providing a service and/or furnishing goods to the Purchaser or Owner.

d. Engineer: Authorized Engineer of Record providing the engineering services for the Project.

1.4 SITE CONDITIONS

1.4.1 The Purchaser will provide the Seller with a copy of the boring locations, log of borings and soils laboratory test results.

1.4.2 The Seller shall carefully examine the data and take whatever steps may be necessary to satisfy himself as to the subsurface conditions to be encountered when installing piles. Lack of knowledge of existing conditions or facilities will not be considered as a basis for additional compensation.

1.4.3 Existing utility lines and lines to be demolished and removed by others, where known, are indicated on the drawings. Extreme care shall be exercised so as not to disrupt service or damage other utilities adjacent to the Work area.

1.4.4 The location of underground lines, foundations and other installations, where known and to be demolished and removed by others, are indicated on the drawings. The Seller shall notify the Purchaser of any additional obstructions encountered and shall provide support, protection or removal of such obstructions as directed by the Purchaser.

1.5 SCHEDULES

The Seller shall submit a preliminary schedule of work, identifying time lapsed from award of delivery of piling, mobilization and the sequence of completion and completion of work, including initial pile load tests and time to perform a working load and proof load test.

1.6 SUBMITTALS

1.6.1 Details and analysis for design and installation of auger cast-in-place piles including type, size, installed depth and reinforcement for uplift and shear transfer to foundation.

1.6.2 Description of pile installation equipment to be utilized for the project, in particular the drilling equipment, auger size, rated torque, grout pumping equipment, grout placement and auger retrieval monitoring procedure.

1.6.3 Grout mix design requirements for 4,500 psi 28-day design strength.

1.6.4 Grout quantities and deliver schedule requirements for pile installation.

1.6.5 Pile load test program and test load details for compression test and uplift test, including analysis to be performed in conjunction with the load test.

2.0 PART 2 - PRODUCTS

2.1 MATERIALS

The Seller shall provide the following materials or Engineer's approved equal.

2.1.1 Auger cast-in-place piles which satisfy design load requirements for each foundation.

2.1.2 The number of piles, location and cutoff datum shall be as indicated on the Engineer's drawings.

2.1.3 Reinforcing steel for uplift and shear transfer shall conform to ASTM A615, Grade 60. Detailing and fabrication shall conform to S&W Specification PS-J021. The bars shall be installed in the piles to ensure appropriate placement within the concrete foundation.

2.1.4 A 4,500 psi 28-day grout will be supplied by the Purchaser per the Seller's grout design mix requirements.

2.2 MATERIAL HANDLING

2.2.1 Material shall be protected to prevent damage and corrosion during handling and shipping.

2.2.2 Care shall be taken to prevent materials from becoming contaminated with grease, oil, dirt, or other unsuitable material during handling and shipping. The Seller shall be responsible for removing unsuitable coatings.

2.2.4 All rebar, etc. shall be stored at the jobsite on cribbing. The Seller shall material so that bending or twisting will not occur.

3.0 PART 3 - EXECUTION

3.1 PILE DESIGN

3.1.1 The Seller shall be responsible for designing piles to meet the loads indicated on the Engineer's drawings. Each pile shall be capable of carrying the combination design working loads specified.

3.1.2 All piles shall be designed for the respective compression, tension (uplift) and lateral (shear) loads given on the drawings. Where piles are required to support lateral loads they shall be structurally capable of supporting the lateral load when applied in combination with the design working load in compression and/or in tension as applicable.

3.1.3 The auger cast-in-place piles installed diameter shall be 16 inches or larger.

3.1.3 Compression

Piles shall have an ultimate capacity based on a minimum factor of safety of 2.0 on the design load.

The piles shall have a short-term settlement of 1/2 inch or less at the design load.

3.1.4 Tension

In addition to compression loading, piles designated as 'uplift piles' shall be designed for design load in tension as specified. A factor of safety of at least 2.0 for the design load shall be provided on the ultimate capacity in tension.

3.1.5 Lateral

All piles shall be designed for a lateral (shear) design load as specified. The pile shall be designed such that a pile-head deflection of 3/8 inch or less is obtained in a load test when the specified working load is applied at the top of the pile in free-head condition. A factor of safety of at least 2.0 for combined design load shall be provided on the ultimate lateral capacity.

3.1.6 The Seller shall submit drawings, calculations and details of dimensions and materials etc. along with a detailed method statement for pile construction for approval by the Engineer at least 2 weeks before commencing installation of permanent piles. The Seller shall be prepared to incorporate into his design any modification proposed by the Engineer. The design calculation shall be finalized and resubmitted after completion of the preliminary pile load tests. The Engineers' approval of the Seller's design shall not relieve the Seller from any costs arising in the future from inadequate design.

3.2 PILE INSTALLATION

3.2.1 The piling shall be installed at the location shown on the drawings. Only experienced Piling Contractors will be acceptable on the job.

3.2.2 A continuous flight hollow shaft (minimum inside diameter of 2 1/2 inches) auger shall be rotated into the underlying soil to pre-determined tip elevation or refusal whichever occurs first. Leaving the auger in the hole and maintaining a slow positive rotation, begin injecting the specified mortar through the hollow shaft. Inject a sufficient quantity of grout to completely fill the augered hole, carefully coordinating the rate of injection as the auger is being withdrawn.

3.2.3 Protection of Piles:

Provide a sequence of pile installation with grout placement within 6 diameters of adjacent piles until initial set has occurred. Initial set is that time period when the grout in adjacent piles changes to a solid. A physical check of the adjacent pile is the most accurate way of determining when initial set has occurred.

In the event non-augerable material is encountered above the desired tip elevation, the pile shall be completed to that depth and the length of this short pile shall be included in the total linear foot of pile for payment. An additional pile may be required at the Engineer's direction and shall be paid for in accordance with the unit price for additional piles.

Auger cast-in-place piles shall be poured to top of ground and the mortar may be removed to the cut-off elevation prior to initial set. If hole will not stand open, the pile must be cut off after final set of mortar and the excavation for pile cap has been made.

When the pile cutoff is 12 inches or greater below the ground surface at the time of installation , the grout shall be placed to ground level and the Seller shall cut the pile off at design cutoff elevation after the excavation has been completed.

Auger refusal shall be defined as an auger penetration rate of one (1) foot per minute, or less.

3.3 PLACING OF GROUT

3.3.1 No pile shall be installed and grouted within 6 pile diameters, center to center, of a pile grouted less than 12 hours old unless initial set has been achieved and approval obtained from the Purchaser. The Purchaser, or his designee, shall be present when the piles are filled with grout.

3.3.2 Grout shall be placed in the pile in accordance with ACI 543R and Stone & Webster Specification PS-J024. Placing of grout in each pile shall be continuous.

3.4 STRENGTH TESTING

During the progress of the job, standard 2-inch compression test cubes shall be tested in accordance with ASTM C-109 and by a qualified commercial testing laboratory, approved by the Purchaser. A minimum of one (1) set of six (6) cubes shall be made for each days work. From each set of six (6) cubes, two (2) shall be tested at 3 days, two (2) at 7 days, and two (2) at 28 days unless specified strength has already been obtained. If a special pozzolan is used, make and break two (2) additional cubes at 90 days, if necessary.

3.5 FABRICATION

3.5.1 Reinforcing bars shall be deformed bars conforming to the requirements of ASTM A615, grade 60.

3.5.2 Reinforcing steel materials shall be new. Certified copies of mill test reports or certificates of conformance identifying the material used and its origin shall be submitted to the Purchaser for review.

3.5.3 Fabrication shall include the cutting and bending of reinforcing steel materials to conform to the dimensions and shapes defined by the Seller's reinforcement details.

3.5.4 All rebar fabrication shall be in accordance with Stone & Webster Specification PS-J021.

3.5.4 Welding of rebar is not permitted unless approved by the Engineer. All welding shall be in accordance with AWS D1.1 and D1.4.

3.6 TOLERANCE AND ACCEPTANCE CRITERIA

3.6.1 Piles shall be located in accordance with the lines and grades shown on the Engineer's drawings.

3.6.2 The maximum deviation of a driven pile from the plan center location specified on the Engineer's drawings, as measured at the pile cutoff elevation, shall be 3 inches. The maximum deviation of a vertical installed pile from a true plumb position shall be 1 %. Cutoff elevation tolerance shall be ± one inch.

3.6.4 If the Seller notes that a pile does not meet the tolerances given herein, he should immediately inform the Purchaser. Such notice may permit the Engineer to immediately redesign the pile cluster and prevent rejection of the mislocated or misaligned pile.

3.7 PILING INSPECTION

3.7.1 Prior to driving of any pile, the Purchaser shall be notified.

3.7.2 Accurate records of each pile will be kept, including as a minimum the following information:

a. Pile number and location

b. Date and time of installation

c. Sketch and/or description of pile drilling equipment utilized

d. Complete description of method of installation including monitoring of grout take vs. retrieval of auger

e. Mortar design mix used

f. Volume of grout placed in auger hole, to nearest cubic foot.

g. Comparison of theoretical and actual volumes of grout installed in auger hole.

h. Any deviation of pump pressure during grouting from the specified pump pressure and the depth at which it occurs. Grouting times shall be recorded

i. Any deviation from the specified withdrawal rate and the depth at which it occurs.

j. Any redrilling required due to deviation from the installation procedure, the depth to whit it extends, and the cause for redrilling.

k. Type of pile design, including butt and tip diameters.

l. Reinforcement placed in pile.

m. Elevation of tip when installation is completed

n. Elevation of cutoff

These records will be kept on the standard form "Pile Inspectors Summary Report" included in this document.

The Seller shall cooperate with the Purchaser in taking of these measurements to ensure complete and accurate records.

The Seller shall submit copies of the pile installation records, within two working days of the installation, to the Engineer for review.

At the completion of work the Seller shall submit "as-built" drawings that accurately locate all piles in place, abandoned, out of tolerance and extra piles added, if any.

3.8 PILE LOAD TEST

3.8.1 General

The Seller shall be responsible for performing the load test on the piles as per this specification

a. The Seller shall install preliminary piles and carry out a load tests in advance of the piling works as indicated on the drawings or as described in the scope of work. The tests specified shall be regarded as the minimum required. The Seller, may at his option, propose additional tests if deemed necessary to optimize the pile design.

b. Preliminary piles and test piles shall be designed and tested with pile tips in the same bearing stratum as the working piles. The Seller shall identify the bearing stratum for the piles in his method statement.

c. The Seller shall include with his proposals a method statement and detailed schedule indicating times of mobilization, execution and reporting for the load tests on preliminary piles and working piles. The reporting shall include testing equipment and set up, a description of testing procedure, supportive calculations, and a record of results and interpretative conclusions.

3.8.2 Installing Test Piles

An initial test pile shall be installed for a compression pile test and a tension pile test. The test piles shall be installed at a representative location at the Chimney as agreed with the Engineer. The test pile locations shall wherever possible be adjacent to Chimney and borings to facilitate correlation with encountered soil strata, particularly the founding layer.

3.8.3 Static Load Tests

Compression and tension pile tests shall be in accordance with ASTM D1143 and ASTM D3689 respectively.

Lateral load pile tests shall be in accordance with ASTM D3966, if requested.

The Seller shall include in his method statement, details of the load tests including loading sequence and holding periods, instrumentation and other test details. Reaction piles or anchors, if used shall be monitored for "pull out" during the compression load tests.

3.8.4 Removal of Temporary Works

Following acceptance of the tests the Seller shall remove all temporary works erected for the preliminary works, including any temporary pile cap. Any piles located in the area of permanent pile caps shall be cut off 20 inches (500mm) below bearing elevation of the pile cap. Piles located outside of the footprint of pile caps shall be cut off 20 inches (500mm) below final grade elevation.

3.8.5 Test Report

After completion of the load tests, the Seller shall submit the test results which shall include a description of methods used, pile installation data, test results and interpretation, conclusions, and proposed modifications to the pile design.

3.9 TESTING OF WORKING PILES

3.9.1 The Seller shall be responsible for performing various tests as described below. The Seller shall however, confirm or otherwise his agreement to these tests having regard to his guarantee of load bearing capacity, and provide a detailed method statement for performing, recording and reporting the required tests. Testing shall consist of proof compression testing.

3.9.2 Proof compression load tests shall be performed on at least one working pile in the Chimney foundation, one working pile in an Absorber foundation, and at least two more piles at other FGD structure or tank foundations, as selected by the Engineer. The pile shall be tested to a maximum loading of 1.5 times design load. The pile shall have a settlement of 1/2 inch (12mm) or less at the design load. It should be noted that each test would require a significant time (say up to one week) for set up, test and removal. Residual settlement 12 hours after the final removal of the test load shall not exceed 1/8 inch.

3.9.3 Proof compression load tests shall be performed on suspect pile, as directed by the Engineer. The pile shall be tested to a maximum loading of 1.0 times design load. The pile shall have a settlement of 1/2 inch (12mm) or less at the design load. It should be noted that each test would require a significant time (say up to one week) for set up, test and removal.

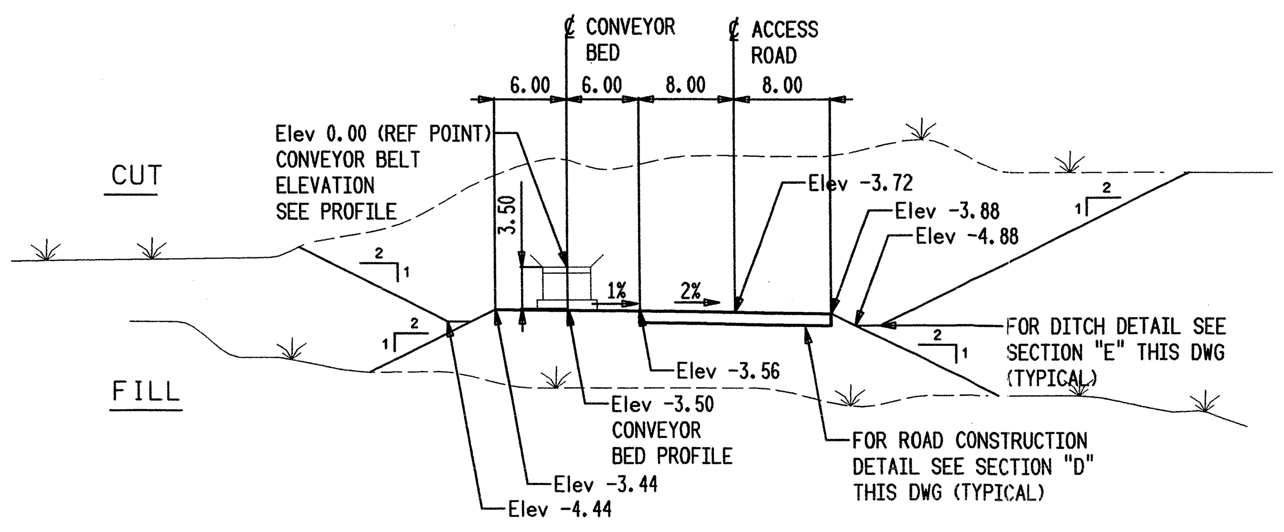
3.9.4 If a working pile is indicated by proof testing or dynamic testing to have inadequate capacity, or to be damaged, the Seller shall install at his own costs, additional piles as directed by the Engineer. It is probable that more than one additional pile may be required as replacement for each damaged pile.

3.9.5 All pile tests shall be directed and continuously supervised by a qualified and experienced engineer provided by the Seller.

DRAWINGS

Drawings

DWG. NO. 1-30222-3



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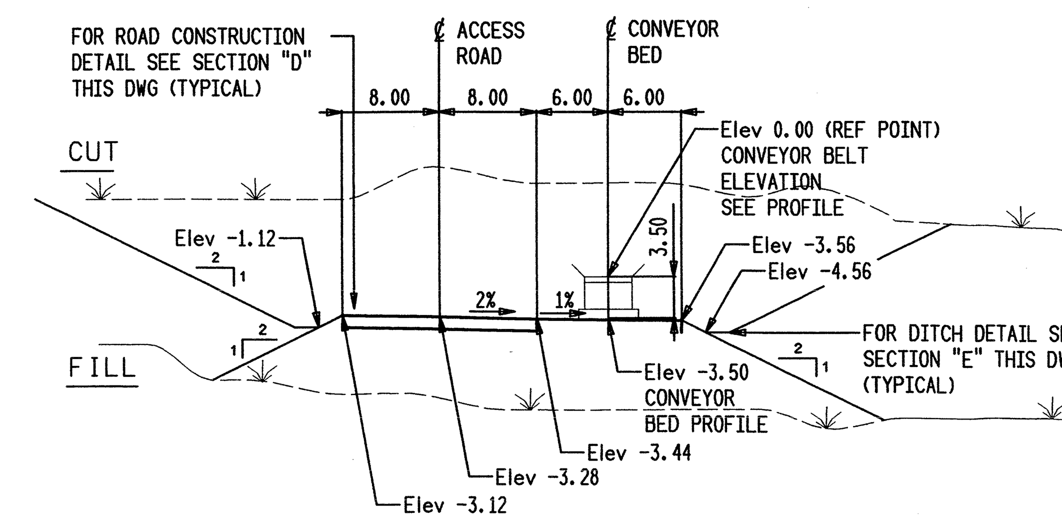

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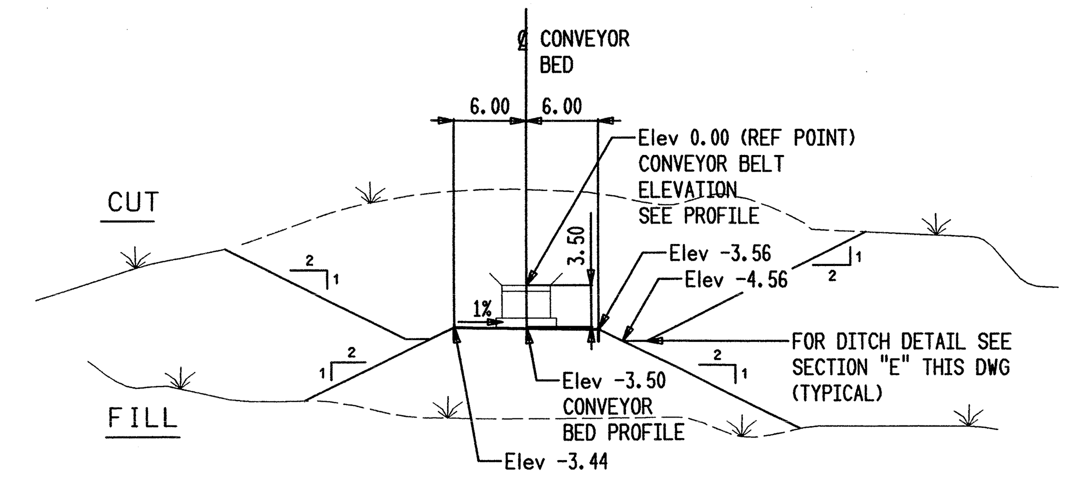

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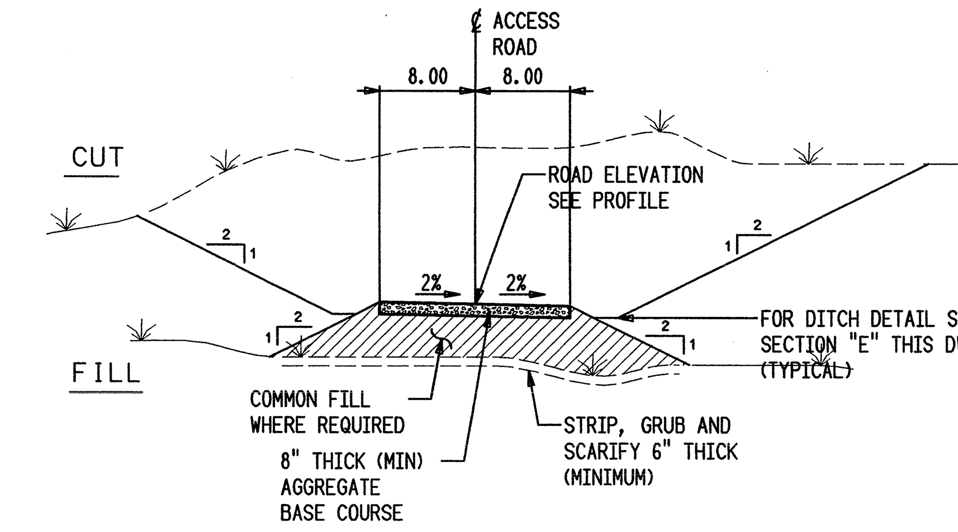

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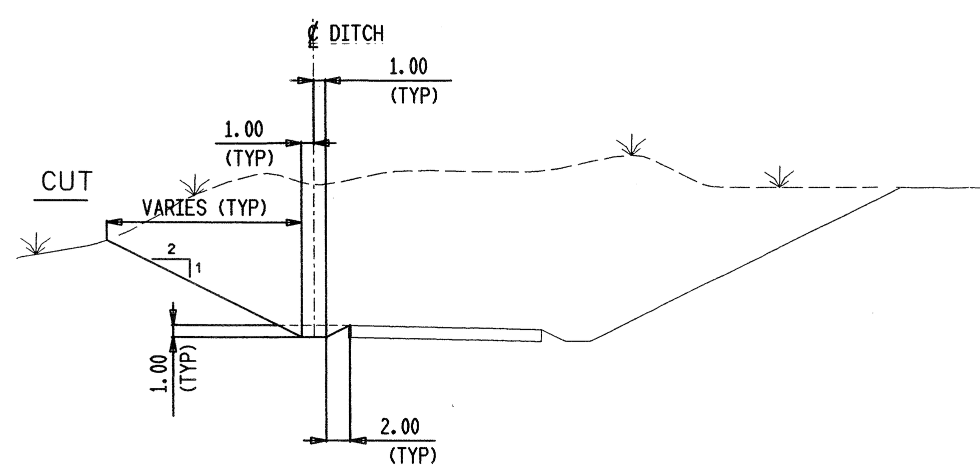

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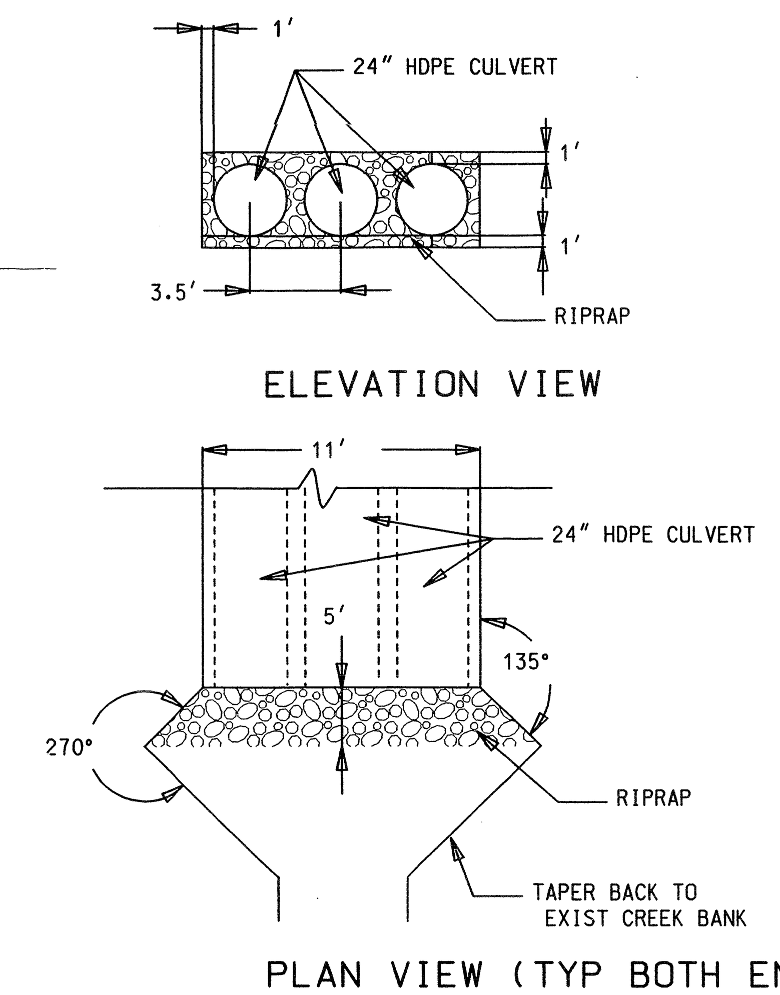

DETAIL 2 1-30217
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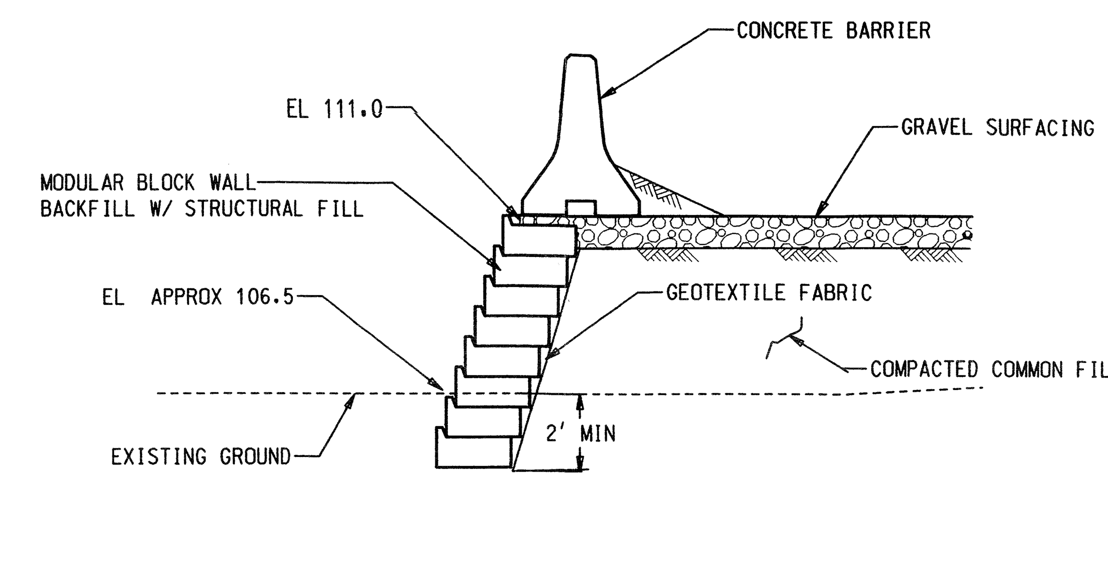

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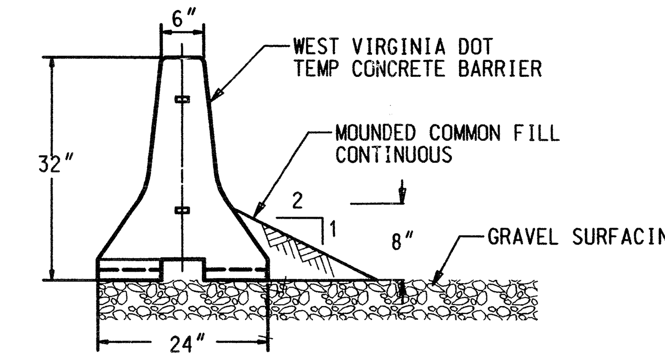

CONCRETE BARRIER DETAIL
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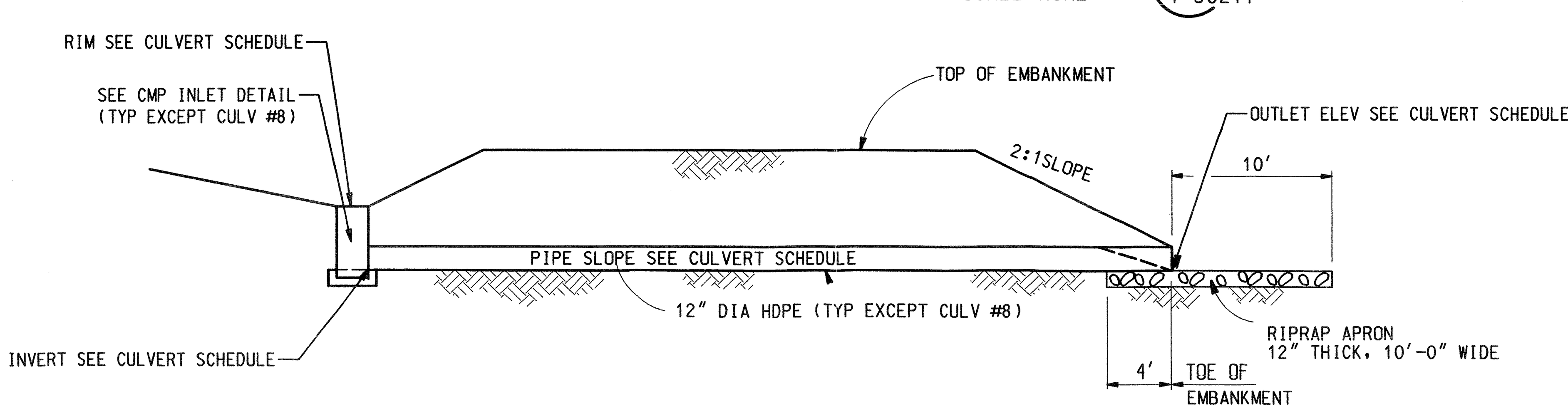

TYPICAL CORRUGATED METAL PIPE INLET
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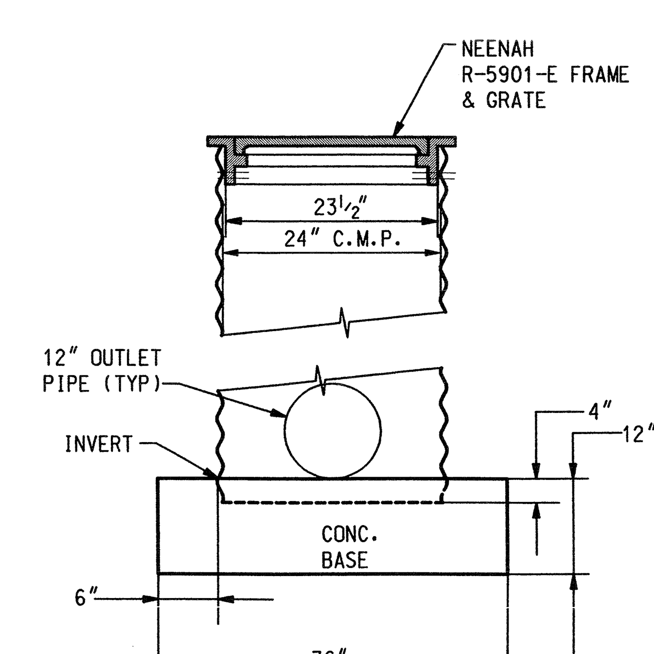
CULVERT SCHEDULE

CULV #	DWG #	ALIGNMENT	INLET STA	OFFSET	INV EL	RIM EL	OUT STA	OFFSET	INV EL	L (FT)	SIZE	SLOPE
1	1-30215	CONV RD 1	2+94	L 14.8	109.3	111.8	2+93	R 16.9	109.0	30	12" HDPE	0.0083
2	1-30215	CONVEYOR	26+40	L 8.5	125.0	128.0	26+39	R 49.7	115.8	56	12" HDPE	0.1652
3	1-30215	CONVEYOR	29+87	L 8.4	120.4	123.4	29+87	R 40.1	115.8	46	12" HDPE	0.1011
4	1-30215	CONVEYOR	32+00	R 48.5	107.5	110.0	32+02	R 76.6	107.2	26	12" HDPE	0.0115
5	1-30215	CONVEYOR	32+68	L 10.0	108.0	110.5	32+73	R 30.0	107.6	37	12" HDPE	0.0108
6	1-30216	CONVEYOR	40+46	L 10.7	113.0	115.5	40+47	R 40.1	112.0	49	12" HDPE	0.0204
7	1-30216	CONVEYOR	48+99	L 16.5	113.5	116.0	48+98	R 32.2	113.0	46	12" HDPE	0.0109
8	1-30217	CONVEYOR	52+02	R 13.4	114.3	–	53+01	L 32.3	114.0	110	3 X 24"	0.0025
9	1-30217	CONVEYOR	62+12	L 49.9	155.0	158.0	62+60	L 43.6	154.0	50	12" HDPE	0.0200
10	1-30218	CONVEYOR	84+48	L 30.9	199.0	201.5	84+50	R 16.5	196.0	45	12" HDPE	0.0667
11	1-30219	CONVEYOR	87+00	L 28.0	182.0	185.0	87+00	R 17.3	177.0	43	12" HDPE	0.1163
12	1-30219	CONVEYOR	87+79	L 29.3	181.0	184.0	87+79	R 25.0	176.0	49	12" HDPE	0.1020
13	1-30219	CONVEYOR	89+67	L 13.3	188.3	191.3	89+49	R 29.7	182.5	44	12" HDPE	0.1307
14	1-30219	CONVEYOR	93+48	L 10.6	231.0	236.0	92+92	R 50.6	208.0	80	12" HDPE	0.2875
15	1-30219	CONVEYOR	95+07	L 60.4	258.0	263.0	95+17	R 33.9	237.0	92	12" HDPE	0.2283
16	1-30219	CONVEYOR	96+30	L 27.0	253.5	256.5	96+35	R 20.0	252.0	45	12" HDPE	0.0333
17	1-30219	CONVEYOR	101+55	L 10.0	295.0	298.0	101+93	R 83.9	294.0	101	12" HDPE	0.0099
18	1-20221	CONVEYOR	120+34	L 22.2	324.5	329.5	120+09	R 73.2	302.0	98	12" HDPE	0.2296
19	1-20221	CONVEYOR	122+09	L 73.0	339.0	342.0	122+33	R 17.2	328.0	93	12" HDPE	0.1183
20	1-20221	CONVEYOR	124+63	L 73.8	330.0	333.0	124+60	R 20.9	318.0	95	12" HDPE	0.1263



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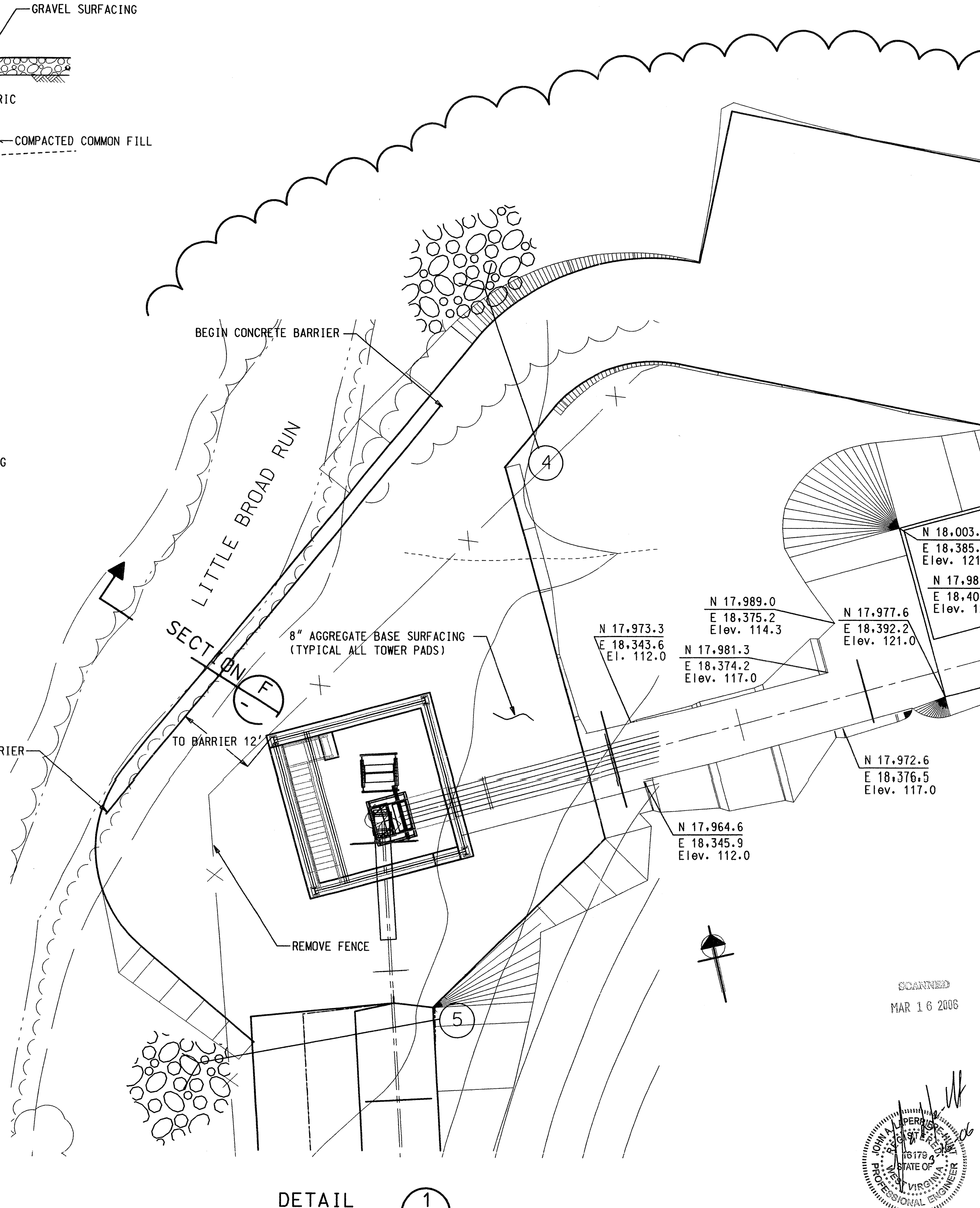

DETAIL 1 1-30215
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SCANNED MAR 1 6 2006

DATE	NO.	DESCRIPTION	APPD.
03/15/06	3	REVISED DETAIL 1 — BY JAH CHK DJ ENG DJ	RRG
01/16/05	2	REVISED CULVERT SCHEDULE — BY JAH CHK DJ ENG DJ	RRG
12/12/05	1	GENERAL REVISION — BY JAH CHK DJ ENG DJ	RRG
11/10/05	0	ISSUED FOR CONSTRUCTION — BY GPH CHK JAH ENG DJ	RRG

REVISIONS

Igs ::S:/MT/I/GEO HYRO SITE/30222.DGN
Igs ::

APPALACHIAN POWER COMPANY

MOUNTAINEER PLANT

NEW HAVEN WEST VIRGINIA

OVERLAND CONVEYOR GRADING SECTIONS SHEET 8 OF 8

DWG. NO. 1-30222-3

SCALE: 1:50
DR:
CH:
DATE:
APPROVED BY
CIVIL ENGINEERING DIVISION
THIS DRAWING WAS CREATED BY STONE & WEBSTER INC. A LOUISIANA CORP. CENTENNIAL, COLORADO
S&W PROJECT NO: 1024690300

Shaw Stone & Webster, Inc.

AEP AMERICAN ELECTRIC POWER
AEP SERVICE CORP. 1 RIVERSIDE PLAZA COLUMBUS, OH 43215

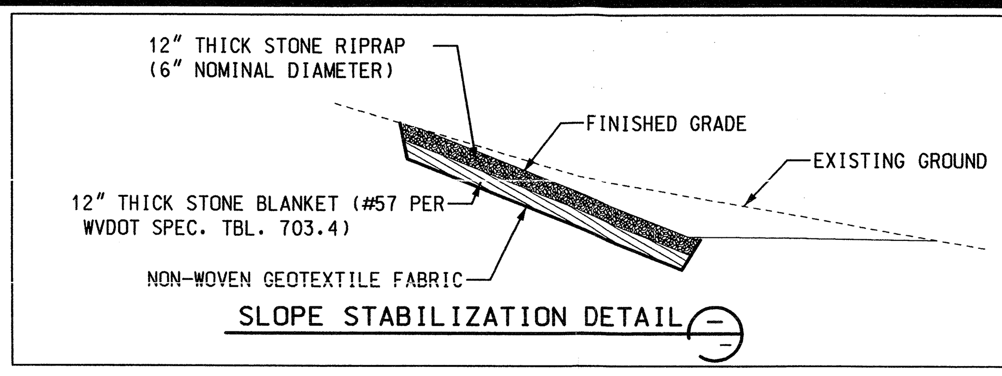
SYSTEM DATE-DD-MMM-YYYY
SYSTEM TIME-HOUR:MINUTE

IGS0694

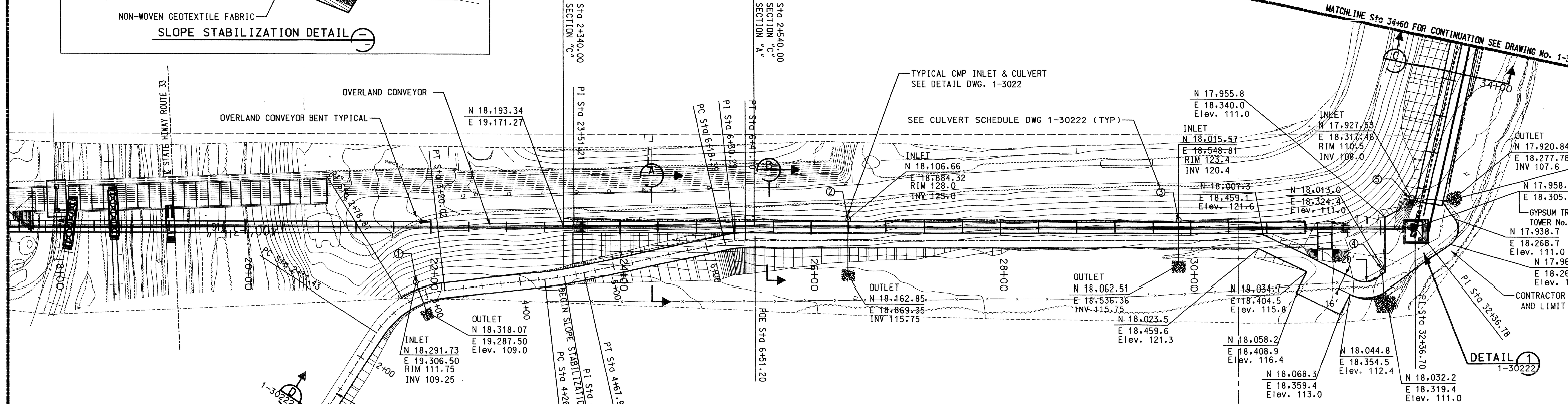
DWG. NO. 1-30215-2

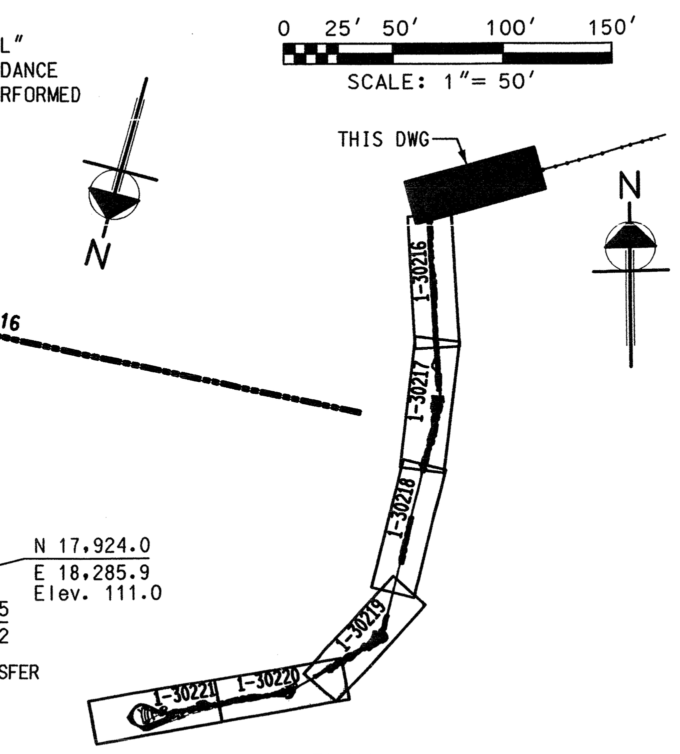
NOTE:

1. COMMON FILL MEETING THE REQUIREMENTS OF SECTION 2.5 OF SPECIFICATION PS-J005, "EXCAVATION, FILL AND BACKFILL" SHALL BE PLACED AND COMPACTED AS DIKE MATERIAL IN ACCORDANCE WITH SECTION 3.3 OF PS-J005. FILED TESTING SHALL BE PERFORMED IN ACCORDANCE WITH SECTION 3.5 OF PS-J005.



SLOPE STABILIZATION DETAIL

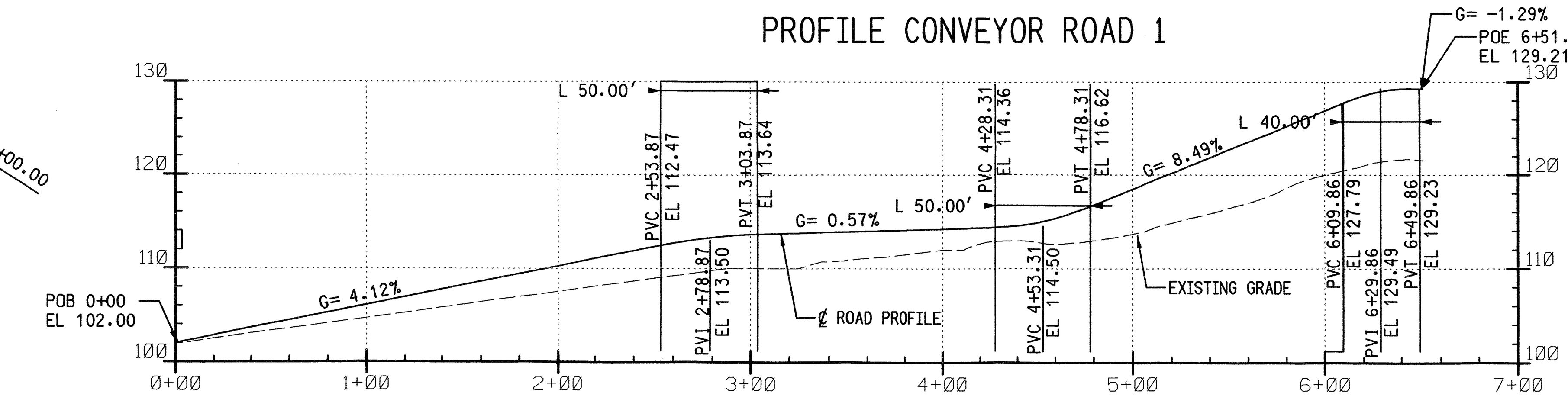


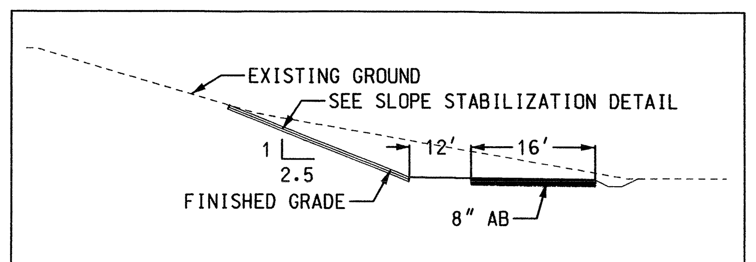


KEY PLAN
Scale 1:1000

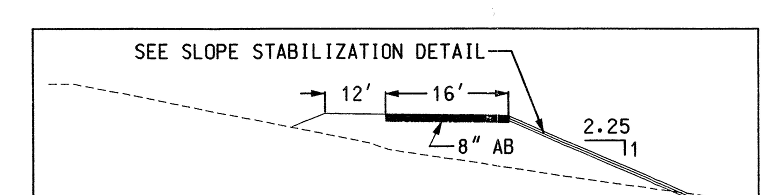
CONVEYOR ROAD 1			Coordinates		Stationing	Curve Data				
Point	Bearing	Distance	Northing	Easting	PC	PT	Delta	Radius	Length	Tangent
POB			18574.75	19402.88	0+00.00					
	S 17°37'26" W	278.87								
PI			18308.97	19318.45						
					2+31.43	3+20.02	50°45'19"	100.00	88.58	47.44
	S 68°22'45" W	174.44								
PI			18244.70	19156.29						
					4+26.01	4+67.99	6°00'47"	-400.00	41.98	21.01
	S 62°21'58" W	183.30								
PI			18159.68	18993.89						
					6+19.39	6+41.10	12°26'30"	100.00	21.71	10.90
	S 74°48'29" W	21.00								
POE			18154.17	18973.62	6+51.20					

PROFILE CONVEYOR ROAD 1





SECTION C



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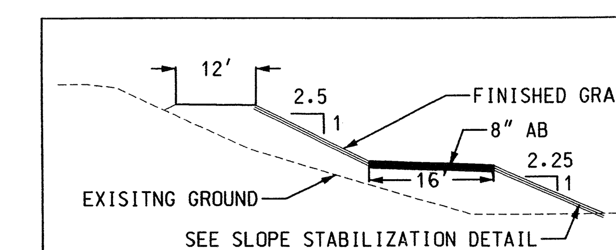
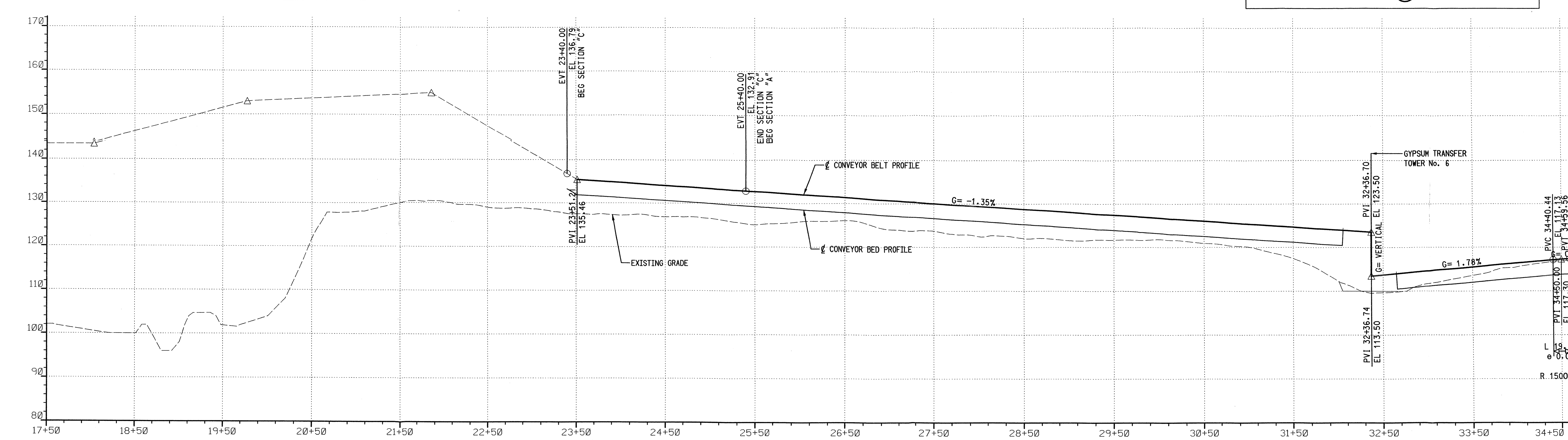


SECTION A



PROFILE Sta 17+50 TO Sta 34+60

Scale: Horiz 1:50
Vert 1:10

DATE	NO.	DESCRIPTION	APPD.
03/15/06	2	REVISED SECTIONS	RRG
12/12/05	1	REVISED DETAIL CALLOUTS	RRG
11/18/05	0	ISSUED FOR CONSTRUCTION	RRG

REVISIONS

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SCANNED
MAR 1 6 2006

APPALACHIAN POWER COMPANY
MOUNTAINEER PLANT
NEW HAVEN WEST VIRGINIA

OVERLAND CONVEYOR
GRADING PLAN & PROFILE
SHEET 1 OF 8

DWG. NO. 1-30215-2

SCALE: 1:50
CIVIL ENGINEERING DIVISION
THIS DRAWING WAS CREATED BY STONE & WEBSTER INC. A LOUISIANA CORP. CENTENNIAL, COLORADO
S&W PROJECT NO: 18248930

Shaw Stone & Webster, Inc.

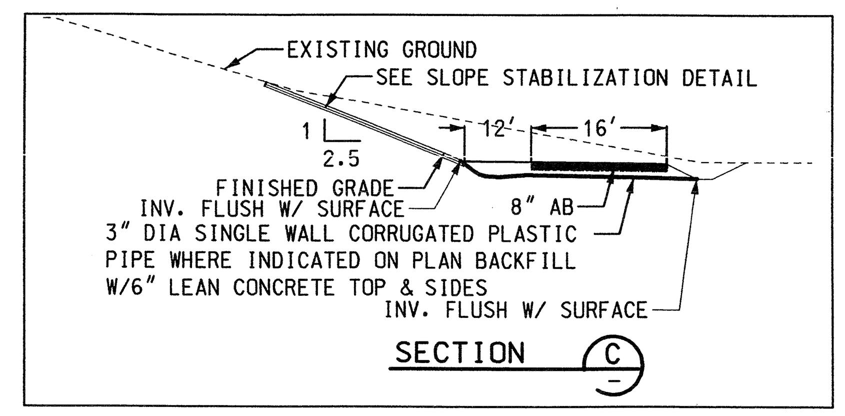
AEP AMERICAN ELECTRIC POWER
AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

AEPMTP-000660

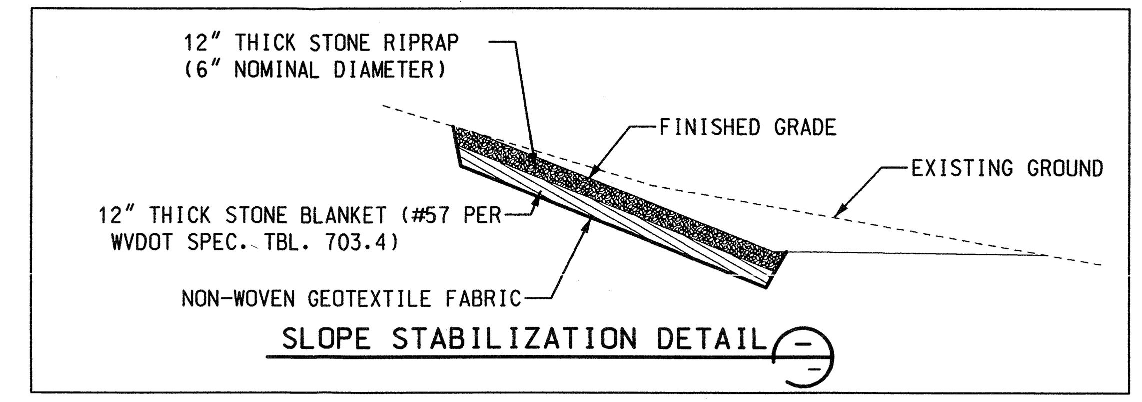
DWG. NO. 1-30216-2

NOTE:

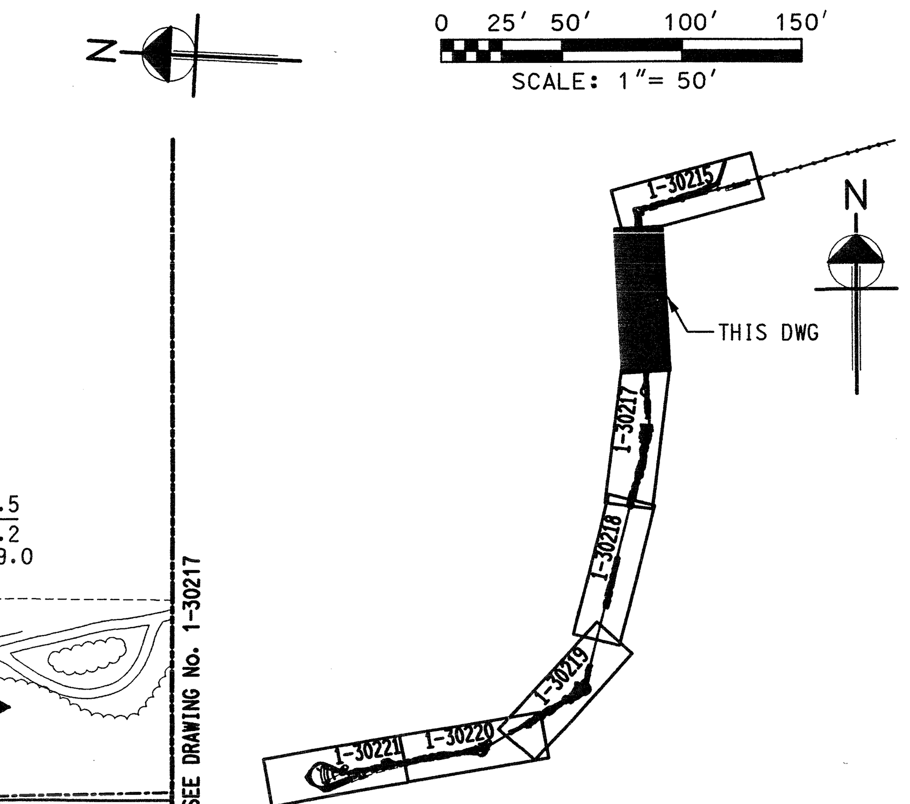
1. COMMON FILL MEETING THE REQUIREMENTS OF SECTION 2.5 OF SPECIFICATION PS-J005, "EXCAVATION, FILL AND BACKFILL" SHALL BE PLACED AND COMPACTED AS DIKE MATERIAL IN ACCORDANCE WITH SECTION 3.3 OF PS-J005. FILED TESTING SHALL BE PERFORMED IN ACCORDANCE WITH SECTION 3.5 OF PS-J005.



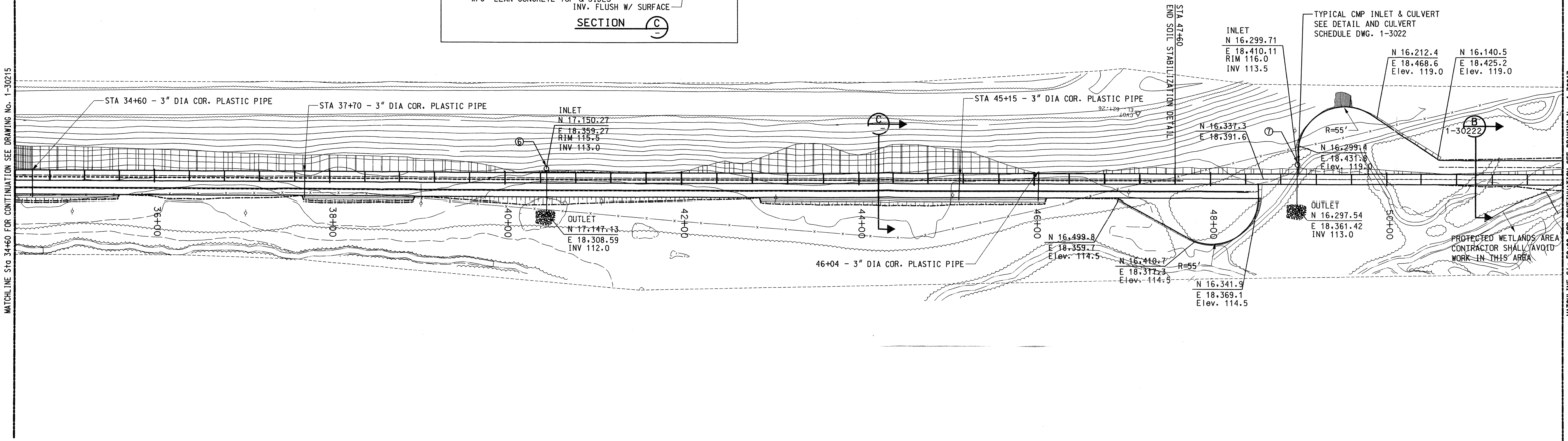
SECTION C

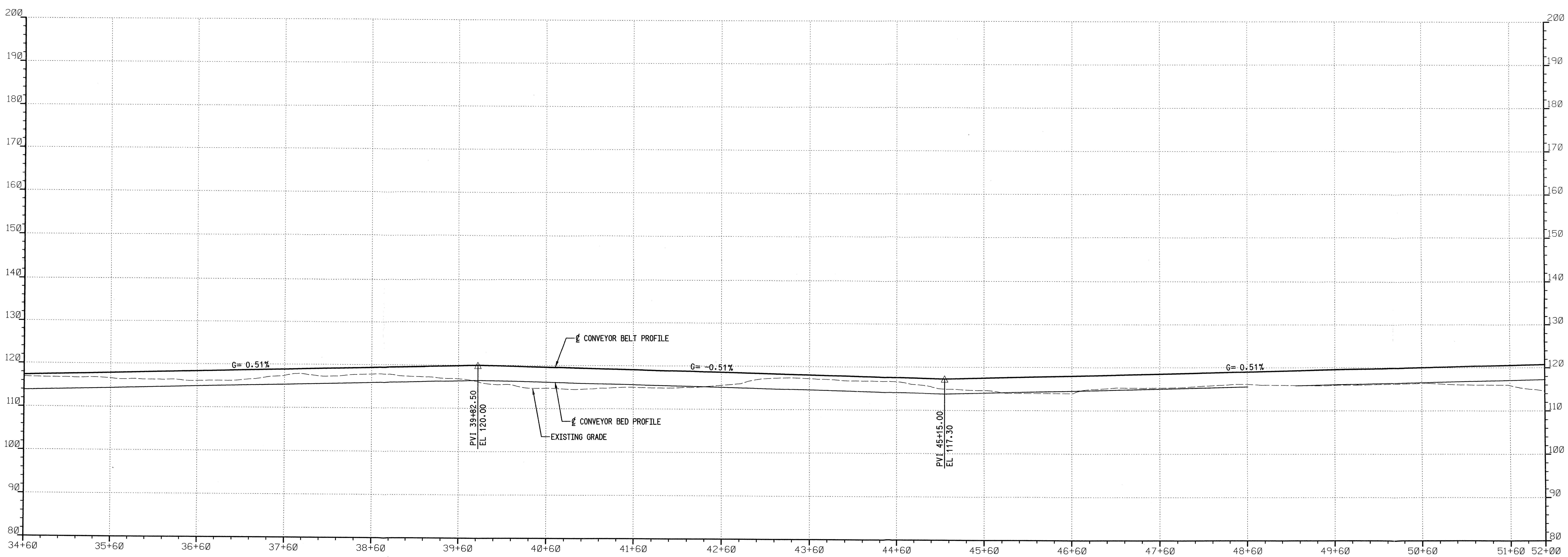


SLOPE STABILIZATION DETAIL



KEY PLAN
Scale 1:1000





PROFILE Sta 34+60 TO Sta 52+00

Scale: Horiz 1:50
Vert 1:10

DATE	NO.	DESCRIPTION	APPD.
03/15/06	2	REVISED SECTIONS BY JAH CK DJ ENG DJ	RRG
12/12/05	1	REVISED WETLANDS AREA SCOPE OF WORK BY JAH CK DJ ENG DJ	RRG
11/18/05	0	ISSUED FOR CONSTRUCTION BY GPH CK JAH ENG DJ	RRG

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MAR 16 2006

APPALACHIAN POWER COMPANY

MOUNTAINEER PLANT

NEW HAVEN WEST VIRGINIA

OVERLAND CONVEYOR
GRADING PLAN & PROFILE
SHEET 2 OF 8

DWG. NO. 1-30216-2

SCALE: 1:50 — CIVIL ENGINEERING DIVISION

THIS DRAWING WAS CREATED BY STONE & WEBSTER INC. A LOUISIANA CORP. CENTENNIAL, COLORADO

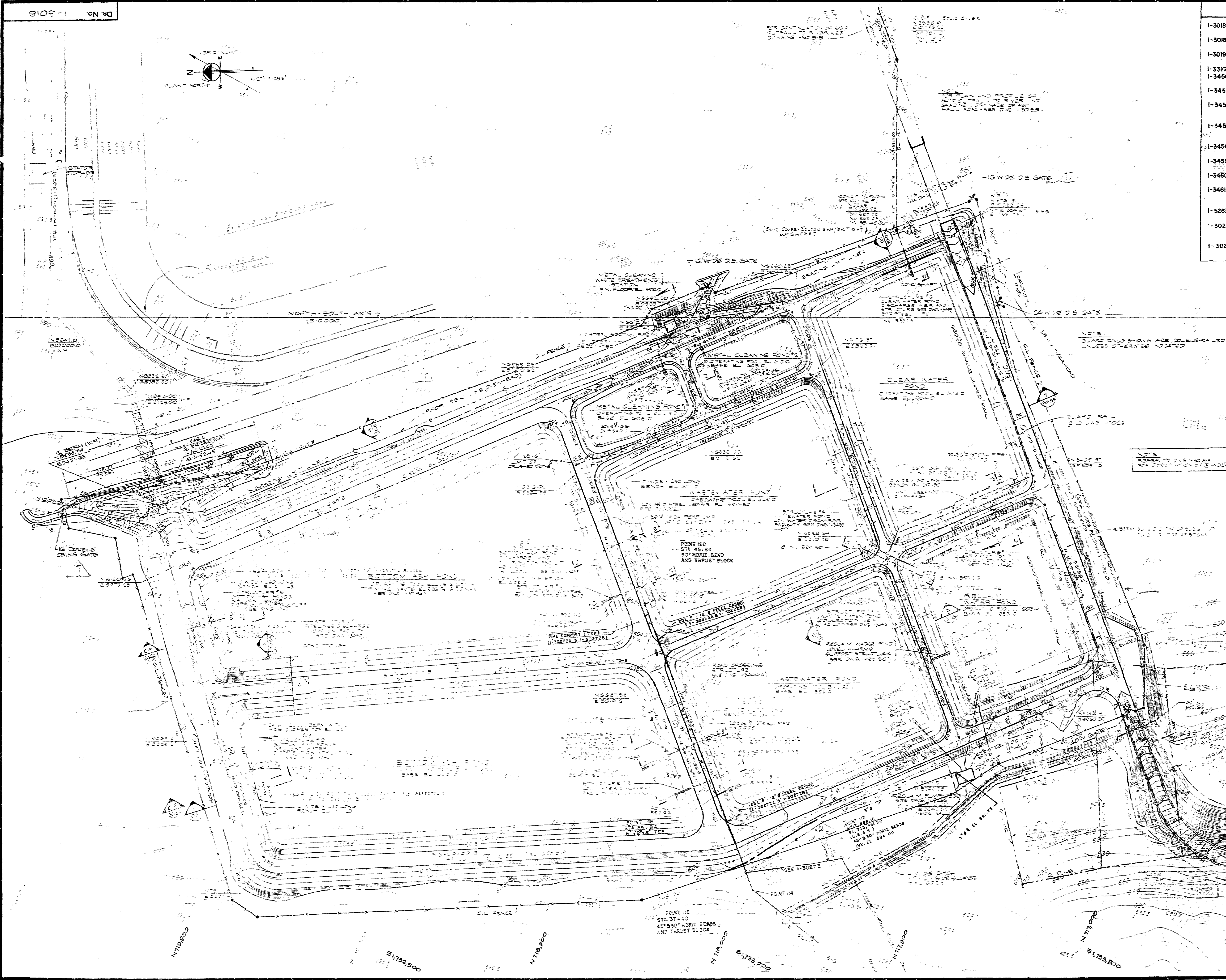
S&W PROJECT NO: 1024690300

Shaw Stone & Webster, Inc.

AEP AMERICAN ELECTRIC POWER — AEP SERVICE CORP. 1 RIVERSIDE PLAZA COLUMBUS, OH 43215

ATTACHMENT C

DESIGN DRAWINGS



REFERENCE DRAWINGS

- 1-3018A,C- WASTEWATER & BOTTOM ASH POND AREA - SECTIONS & DETAILS.
- 1-3018B- CLEARWATER POND OUTFALL - PLAN AND PROFILE & ASH HAUL ROAD.
- 1-3019A- ASH HAUL ROAD - GRADING & DRAINAGE PLAN AND PROFILE.
- 1-3317- PIPELINE BRIDGE OVER RTE. 33 & B&O.
- 1-3450- PIPELINES DISCHARGE DIVERSION FACILITY - STRUCTURE No. 1
- 1-3452- LOW WATER DISCHARGE FACILITY STRUCTURE No. 2
- 1-3453- BOTTOM ASH POND DISCHARGE & DISTRIBUTION FACILITY STRUCTURE No. 3
- 1-3455- WASTEWATER POND LOW WATER DISCHARGE FACILITY STRUCTURE No. 4
- 1-3456- WASTEWATER POND COLLECTION WEIR FACILITY - STRUCTURE No. 5
- 1-3459- CLEARWATER POND DISCHARGE WEIR & STRUCTURE - STRUCTURE No. 6
- 1-3460- CLEARWATER POND DISTRIBUTION FACILITY - STRUCTURE No. 7
- 1-3461- BOTTOM ASH PONDS INFLUENT WATER DISTRIBUTION STRUCTURE STRUCTURE No. 8
- 1-5263- BOTTOM ASH & PYRITES REMOVAL PIPING IN YARD - DETAILS
- 1-3027ZA- FLY ASH STRUCTURAL LANDFILL COLLECTION POND FORCE MAIN PROFILE
- 1-3027ZB- FLY ASH STRUCTURAL LANDFILL LOCATION DATA AND DETAILS

DATE	NO.	DESCRIPTION	APP'D

REVISIONS

PROJECT 1301

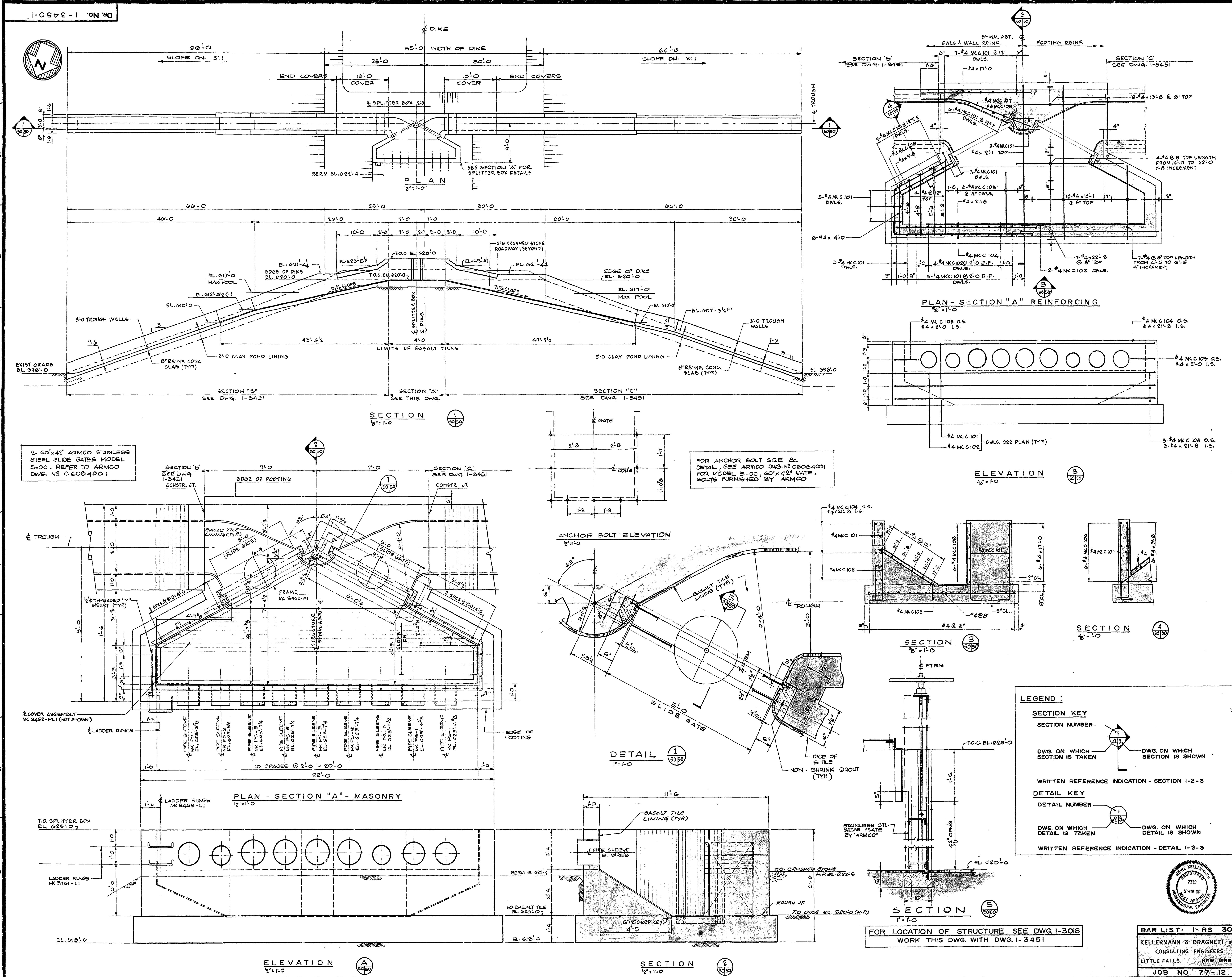
WASTEWATER & BOTTOM ASH POND AREA GRADING & DRAINAGE

DR. NO. 1-3018-17

ARCH.		ELEC.		MECH.		STR.	

SCALE: 1"=100'
DR. RS
CK. —
SQ. LDR. S.F.
DATE: 3-23-79
APPROVED BY: ENGINEERING DIV. / DESIGN DIV.

AMERICAN ELECTRIC POWER SERVICE CORP.



GENERAL NOTES

CONCRETE NOTES

ALL CONCRETE MATERIALS AND WORKMANSHIP SHALL CONFORM TO THE A.E.P.S. CORP. SPECIFICATIONS 41000A.

DIMENSIONS GIVEN FOR REINFORCING STEEL ARE TO CENTER LINE OF BARS.

CONSTRUCTION JOINTS ARE NOT TO BE ADDED, OMITTED OR RELOCATED, EXCEPT WITH THE WRITTEN APPROVAL OF THE N.Y. OFFICE, AND FURTHER, PROVIDED THAT THE CONTRACTOR'S MIXING AND PLACING EQUIPMENT IS PROPERLY SIZED SO THAT NO COLD JOINTS WILL RESULT IN THE CONCRETE.

EXPANSION JOINTS MUST BE LOCATED AS SHOWN.

ALL EXPOSED EDGES SHALL HAVE A 3/4 INCH BEVEL.

FLOOR FINISH SHALL CONFORM TO THE A.E.P.S. CORP'S SPEC. AND TYPE OF SAME WILL BE DECIDED UPON BY CONCRETE LABORATORY.

ALL EXPOSED VERTICAL EXTERIOR CONCRETE SURFACES TO HAVE RUBBED FINISH.

CONCRETE SHALL BE CAPABLE OF DEVELOPING A MINIMUM COMPRESSIVE STRENGTH OF 3.000 PSI AT 28 DAYS.

REINFORCING BARS SHALL BE ASTM A615. GRADE 60 DEFORMED TYPE - UNLESS OTHERWISE NOTED.

FOR STRUCTURAL STEEL NOTES SEE DWG. 1-3462.

MATERIAL

CONCRETE	108.0 CU. YDS
REINFORCING	4.0 TONS

FOR LISTING OF FABRICATORS, SEE DWG. 1-3451

REFERENCE DRAWING

1-3018	WASTEWATER & BOTTOM ASH POND AREA-GRADING & DRAINAGE
1-3018A	WASTEWATER & BOTTOM ASH POND AREA-SECTIONS & DETAILS
1-3018B	CLEAR WATER POND OUTFALL-PLAN & PROFILE
1-3450 & 1-3451	PIPELINES DISCHARGE DIVERSION FACILITY STRUCTURE NO. 1
1-3452	BOTTOM ASH POND - LOW WATER DISCHARGE FACILITY-STRUCTURE NO. 2
1-3453 & 1-3454	BOTTOM ASH POND - DISCHARGE AND DISTRIBUTION FACILITY-STRUCTURE NO. 3
1-3455	WASTEWATER POND - LOW WATER DISCHARGE FACILITY-STRUCTURE NO. 4
1-3456, 1-3457 & 1-3458	WASTEWATER POND - COLLECTION WEIR FACILITY - STRUCTURE NO. 5
1-3459	CLEAR WATER POND-DISCHARGE WEIR & STRUCTURE - STRUCTURE NO. 6
1-3460	CLEAR WATER POND-DISTRIBUTION FACILITY - STRUCTURE NO. 7
1-3461	BOTTOM ASH PONDS - INFLUENT WATER DISTRIBUTION STRUCTURE STRUCTURE NO. 8
1-3462	MISCELLANEOUS STEEL DETAILS - SHEET NO. 1
1-3463	MISCELLANEOUS STEEL DETAILS - SHEET NO. 2
1-3464	CONCRETE DISSIPATOR STRUCTURES NO. 1 2 & 3 - MASONRY, REINFORCING & MISCELLANEOUS DETAILS.

REVISIONS

DATE	NO.	DESCRIPTION	APPD.
3-17-78	1	REVISED QUANTITIES INCREASED TROUGH WALL HEIGHT, CHANGED LENGTH CONC. COVERS SECT. 1 REVISED GATE OPN'G ADDED DET 1 & SECT 5 & ANCHOR BOLT LAYOUT	HTS

PROJECT 1301

BOTTOM ASH & WASTEWATER PONDS

PIPELINES DISCHARGE DIVERSION FACILITY STRUCTURE NO. 1

DR. NO. 1-3450-1

ARCH. WH | ELEC | MECH. | STR. WB

SCALE: AS NOTED
DR. S.A.N.
CH. J.B.
SQ. LDR. A.S
DATE: 1/12/78

APPROVED BY: ENGINEERING DIV / DESIGN DIV

HEINZ KELLERMANN REGISTERED 7132 STATE OF WEST VIRGINIA PROFESSIONAL ENGINEER

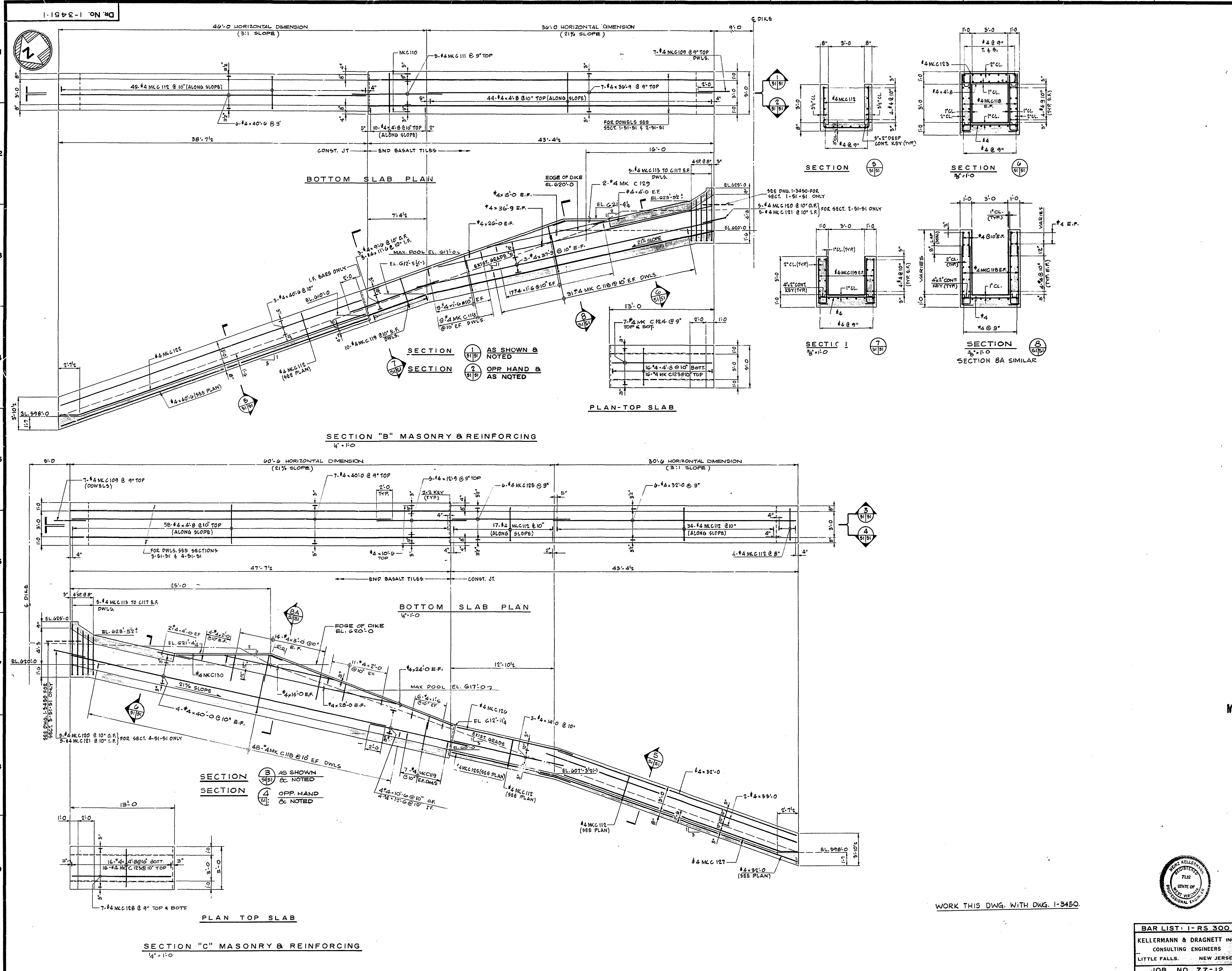
BAR LIST: 1-RS 300

KELLERMANN & DRAGNETT INC.
CONSULTING ENGINEERS
LITTLE FALLS, NEW JERSEY

JOB NO. 77-12

AMERICAN ELECTRIC POWER SERVICE CORP.

AEP3046XY



GENERAL NOTES

FOR CONCRETE NOTES SEE DWG. NO. 1-3450.
FOR STRUCTURAL STEEL NOTES SEE DWG. NO. 1-3462

MATERIAL

FOR MATERIAL QUANTITIES SEE DWG. No. 1-3450

STEEL (INCLUDING RINGS & GASKETS-OMIT SLEEVES)
BY: GREMP STEEL CO.
ORDER # 3461927

GRATING
BY: BORDEN METAL PRODUCTS CO.
ORDER # 3445917

HANDRAIL
BY: J.P. MULL STEEL SUPPLY INC
ORDER # 3463917

BOLTS
BY: ESCO IRON WORKS INC.
ORDER # 7422914

TIMBER
BY: KOPPERS CO, INC.
ORDER # 01682-851-8

MANHOLE FRAMES & COVERS
BY: FLOCKHART FOUNDRY CO.
ORDER # 02247-851-8

BASALT TILE
BY: CBP Eng Co., [illegible]
ORDER # 05520-851-8

SLIDE GATES
BY: ARMCO STEEL CO.
ORDER # 10102-851-7

PIPE SLEEVES
BY: FIELD

REFERENCE DRAWINGS

FOR LIST OF REFERENCE DRAWINGS SEE DWG. NO. 1-3453.

REVISIONS

DATE	NO.	DESCRIPTION	APPD.
3-17-78	1	INCREASED TROUGH WALL HTS REDUCED LEN. CONC. COVERS REVISED REINF.	HTS

PROJECT 1301

BOTTOM ASH & WASTEWATER PONDS

PIPELINES DISCHARGE DIVERSION FACILITY STRUCTURE NO. 1

DR. NO. 1-3451-1

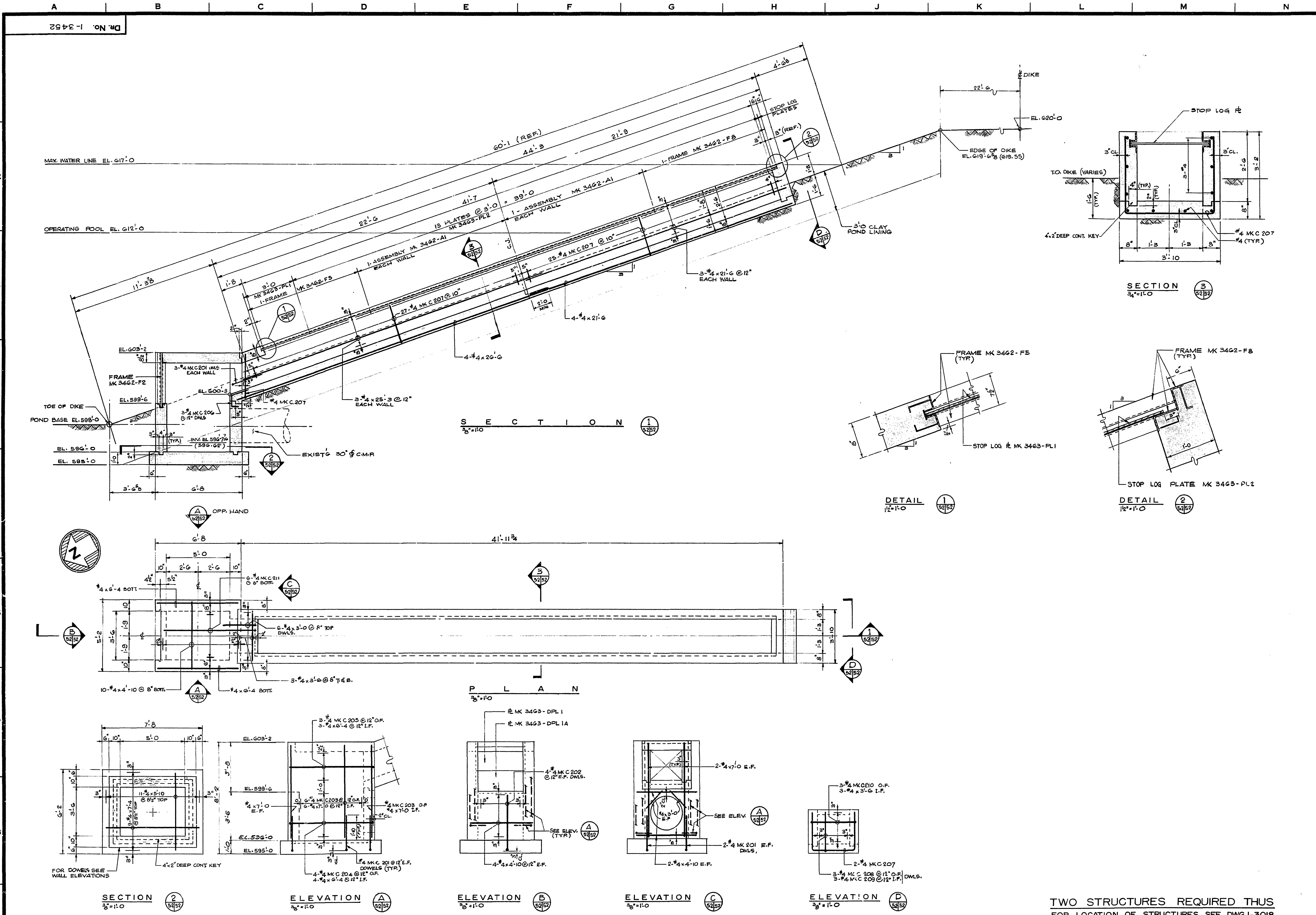
ARCH. WH | ELEC | MECH. | STR.
SCALE: AS NOTED
DR. S.A.M.
CH. JB
SQ. LDR.
DATE: 1/12/78
APPROVED BY — ENGINEERING DIV — DESIGN DIV

HEINZ KELLERMANN REGISTERED 7132 STATE OF WEST VIRGINIA PROFESSIONAL ENGINEER

BAR LIST: 1-RS 300

KELLERMANN & DRAGNETT INC.
CONSULTING ENGINEERS
LITTLE FALLS. NEW JERSEY
JOB NO. 77-12

AMERICAN ELECTRIC POWER SERVICE CORP.



TWO STRUCTURES REQUIRED THUS
FOR LOCATION OF STRUCTURES SEE DWG. 1-3018

GENERAL NOTES

FOR CONCRETE NOTES SEE DWG. 1-3450
FOR STRUCTURAL STEEL NOTES SEE DWG. 1-3462.

MATERIAL

TOTAL FOR TWO STRUCTURES

CONCRETE	34.0 CU. YDS.
REINFORCING	1.4 TONS

FOR LISTING OF FABRICATORS, SEE DWG. 1-3451

REFERENCE DRAWING

FOR LIST OF REFERENCE DRAWINGS SEE DWG. 1-3450.

DATE	NO.	DESCRIPTION	APPD.

REVISIONS

PROJECT 1301

BOTTOM ASH & WASTEWATER PONDS

BOTTOM ASH POND - LOW WATER DISCHARGE FACILITY STRUCTURE NO. 2

DR. NO. 1-3452

ARCH. W4 ELEC MECH. STR. WB.

SCALE: NOTED
DR. EEM
CH. J.B.
SQ. LDR. A&B
DATE: 12/14/77

APPROVED BY: ENGINEERING DIV / DESIGN DIV

AMERICAN ELECTRIC POWER SERVICE CORP.

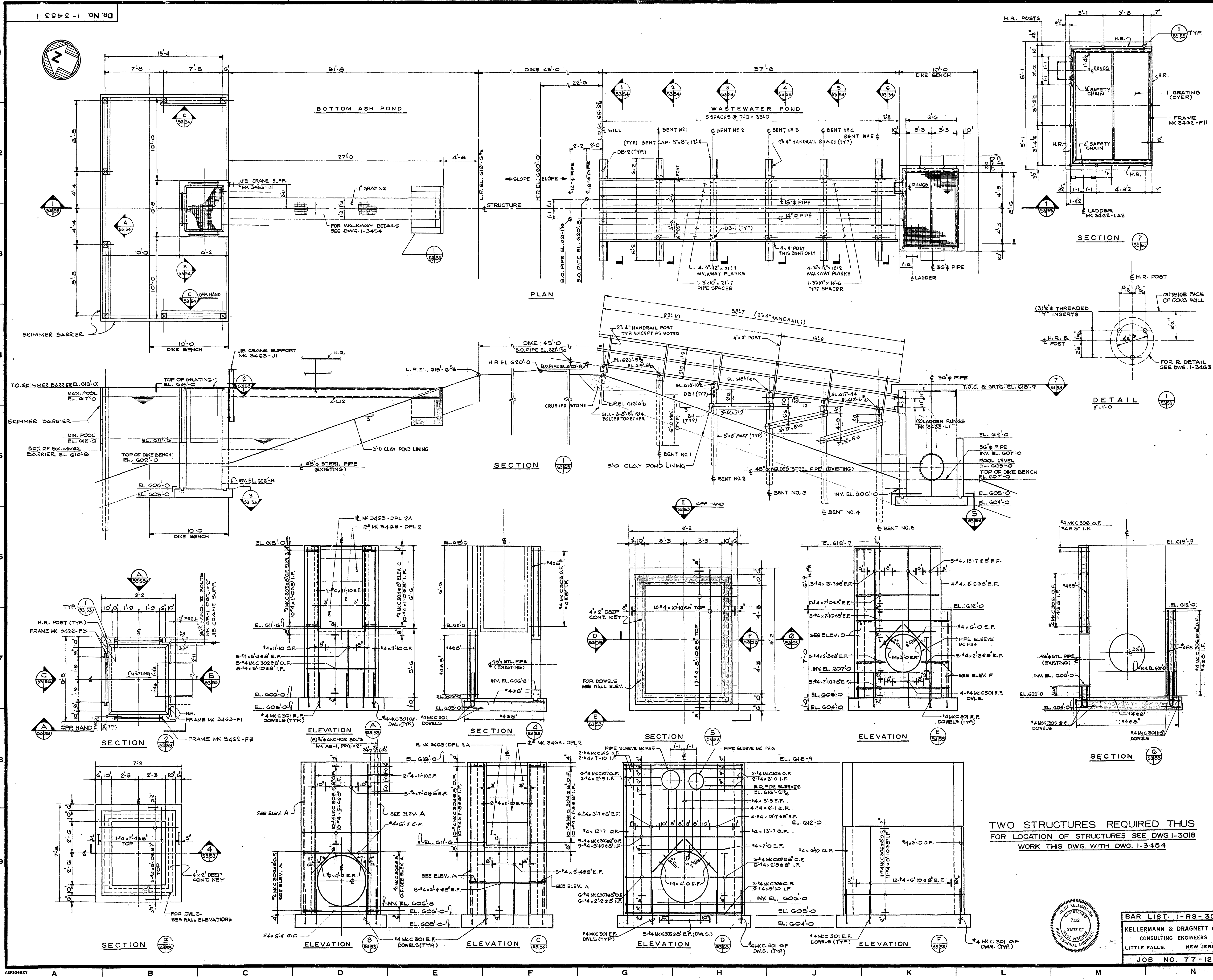
BAR LIST: 1-RS-300

KELLERMANN & DRAGNETT INC.
CONSULTING ENGINEERS
LITTLE FALLS, NEW JERSEY

JOB NO. 77-12

HEINZ KELLERMANN REGISTERED 7132 STATE OF WEST VIRGINIA PROFESSIONAL ENGINEER

AEP5046XY



GENERAL NOTES

FOR CONCRETE NOTES SEE DWG. I-3450
FOR STRUCTURAL STEEL NOTES SEE DWG. I-3462

TIMBER NOTES:

ALL TIMBER TO BE DOUGLAS FIR OR SOUTHERN YELLOW PINE, SELECT STRUCTURAL, SIZES IN ACCORDANCE WITH AMERICAN LUMBER STANDARDS

ALL TIMBER TO BE CREOSOTED. CREOSOTING TO CONFORM TO SPEC. AWPA C-2. LATEST REVISION

ALL BOLTS AND WASHERS TO BE A36 STEEL, AND ALL TO RECEIVE ONE FIELD COAT OF BITUMASTIC PAINT.

GRATING NOTES:

GRATING SHALL BE RECTANGULAR TYPE WITH 3/16" X 1" BEARING BARS AT 1-3/16" CENTERS AND CROSS BARS AT 4" CENTERS. GRATING SHALL BE GALVANIZED.

STEEL GRATING SHALL BE SECURED BY FIELD WELDING TO SUPPORTING MEMBERS AT EVERY TENTH BEARING BAR TO PROVIDE LATERAL STABILITY. (⟵⟶) INDICATES DIRECTION OF GRATING SPAN.

MATERIAL

TOTAL FOR TWO STRUCTURES	
CONCRETE	52.0 CU YDS
REINFORCING	3.1 TONS

FOR TIMBER & BOLT SCHEDULES SEE DWG. I-3454.

FOR LISTING OF FABRICATORS, SEE DWG. I-3451.

REFERENCE DRAWINGS

FOR LIST OF REFERENCE DRAWINGS SEE DWG. I-3450

DATE	NO.	DESCRIPTION	APPD.
3-17-78	1	CHANGED H.R. DIMENSION SECT. 7-53-53	HTS

REVISIONS

PROJECT 1301

BOTTOM ASH & WASTEWATER PONDS

BOTTOM ASH POND-DISCHARGE AND DISTRIBUTION FACILITY STRUCTURE NO. 3

DR. NO. I-3453-I

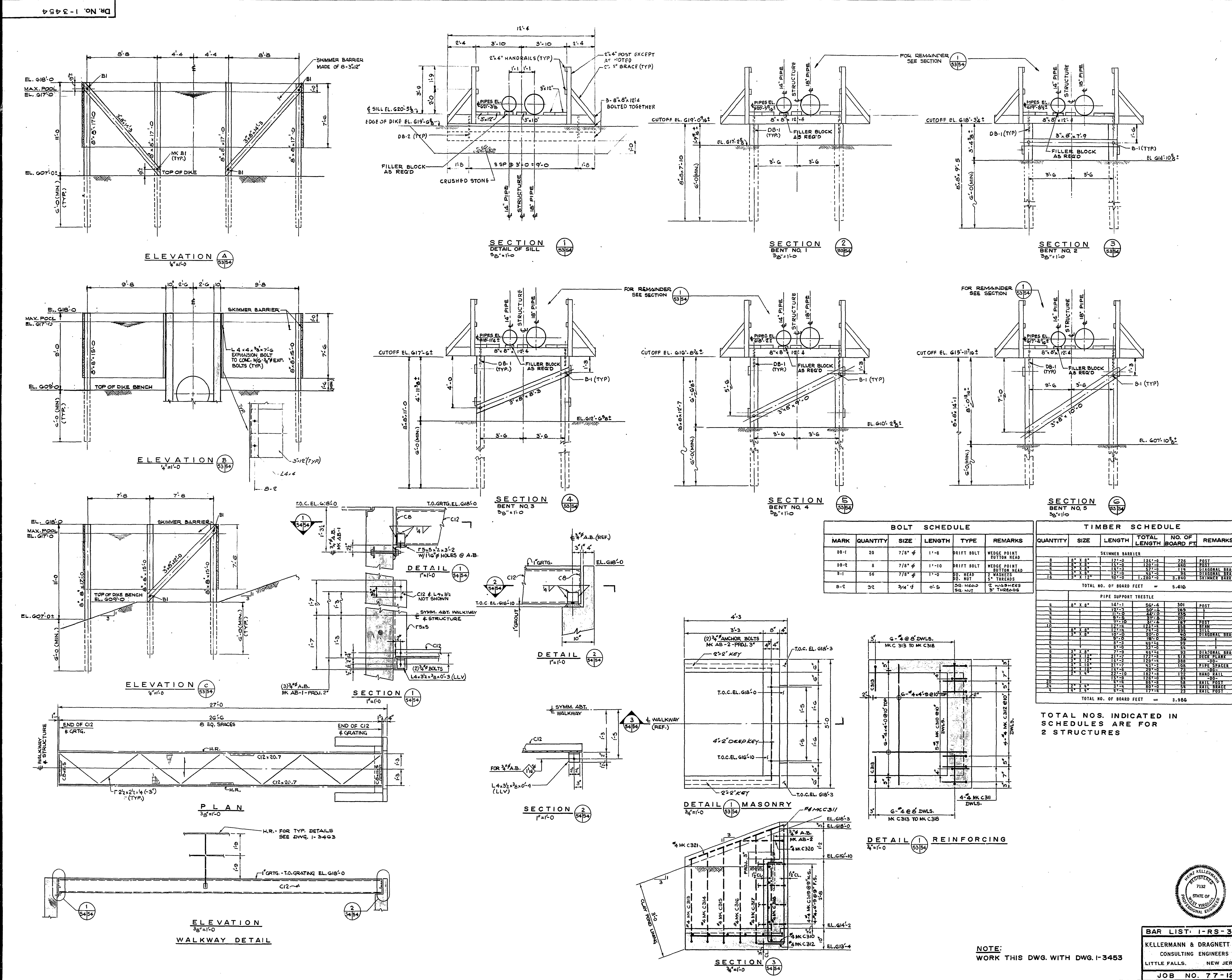
ARCH. | ELEC | MECH. | STR.

SCALE: 1/4"=1'-0, 3/8"=1'-0
DR. A.I.P.
CH. J.B.
SQ. LDR.
DATE: 12/14/77

APPROVED BY — ENGINEERING DIV — DESIGN DIV

AMERICAN ELECTRIC POWER SERVICE CORP.

DR. No. 1-3454



BOLT SCHEDULE					
MARK	QUANTITY	SIZE	LENGTH	TYPE	REMARKS
DB-1	20	7/8" ⌀	1'-8	DRIFT BOLT	WEDGE POINT BUTTON HEAD
DB-2	8	7/8" ⌀	1'-10	DRIFT BOLT	WEDGE POINT BUTTON HEAD
B-1	56	7/8" ⌀	1'-0	SQ. HEAD SQ. NUT	2 WASHERS 5" THREADS
B-2	32	3/4" ⌀	0'-5	SQ. HEAD SQ. NUT	2 WASHERS 3" THREADS

TIMBER SCHEDULE					
QUANTITY	SIZE	LENGTH	TOTAL LENGTH	NO. OF BOARD FT.	REMARKS
	SKIMMER BARRIER				
8	8" X 8"	17'-0	136'-0	726	POST
8	8" X 8"	15'-0	120'-0	640	POST
4	3" X 8"	14'-3	57'-0	114	DIAGONAL BRACING
4	3" X 8"	12'-0	48'-0	96	DIAGONAL BRACING
16	3" X 12"	80'-0	1,280'-0	3,840	SKIMMER BARRIER
TOTAL NO. OF BOARD FEET = 5,416					
	PIPE SUPPORT TRESTLE				
4	8" X 8"	14'-1	56'-4	301	POST
4		12'-7	50'-4	269	
4		11'-0	44'-0	235	
4		9'-5	37'-8	201	
4		7'-10	31'-4	167	POST
10		12'-4	123'-4	658	BEAM
6	8" X 8"	12'-4	74'-0	395	SILL
2	3" X 8"	10'-0	20'-0	40	DIAGONAL BRACING
2		9'-0	18'-0	36	
6		8'-3	49'-6	99	
4		8'-0	32'-0	64	
6	3" X 8"	7'-9	46'-6	93	DIAGONAL BRACING
8	3" X 12"	21'-7	172'-8	518	DECK PLANK
8	3" X 12"	16'-2	129'-4	388	-DO-
2	3" X 10"	21'-7	43'-2	108	PIPE SPACER
2	3" X 10"	14'-6	29'-0	73	-DO-
8	2" X 4"	22'-10	182'-8	122	HAND RAIL
8		15'-9	126'-0	84	-DO-
20		4'-4	86'-8	58	RAIL POST
24	2" X 4"	3'-4	80'-0	54	RAIL BRACE
4	4" X 4"	4'-4	17'-4	23	RAIL POST
TOTAL NO. OF BOARD FEET = 3,986					

TOTAL NOS. INDICATED IN SCHEDULES ARE FOR 2 STRUCTURES

NOTE:
WORK THIS DWG. WITH DWG. 1-3453

GENERAL NOTES

FOR CONCRETE NOTES SEE DWG. 1-3450.
FOR STRUCTURAL STEEL NOTES SEE DWG. 1-3462.
FOR TIMBER NOTES SEE DWG. 1-3453.

MATERIAL

FOR MATERIAL QUANTITIES SEE DWG. 1-3453

FOR LISTING OF FABRICATORS, SEE DWG. 1-3451.

REFERENCE DRAWINGS

FOR LIST OF REFERENCE DRAWINGS SEE DWG. 1-3450.

DATE	NO.	DESCRIPTION	APPD.

REVISIONS

PROJECT 1301

BOTTOM ASH & WASTEWATER PONDS

BOTTOM ASH POND-DISCHARGE AND DISTRIBUTION FACILITY STRUCTURE NO. 3

DR. NO. 1-3454

ARCH. WH ELEC MECH. STR. H.B.
SCALE AS NOTED
DR. FW/RW
CH.
SQ. LDR.
DATE 12/14/77
APPROVED BY
ENGINEERING DIV
DESIGN DIV

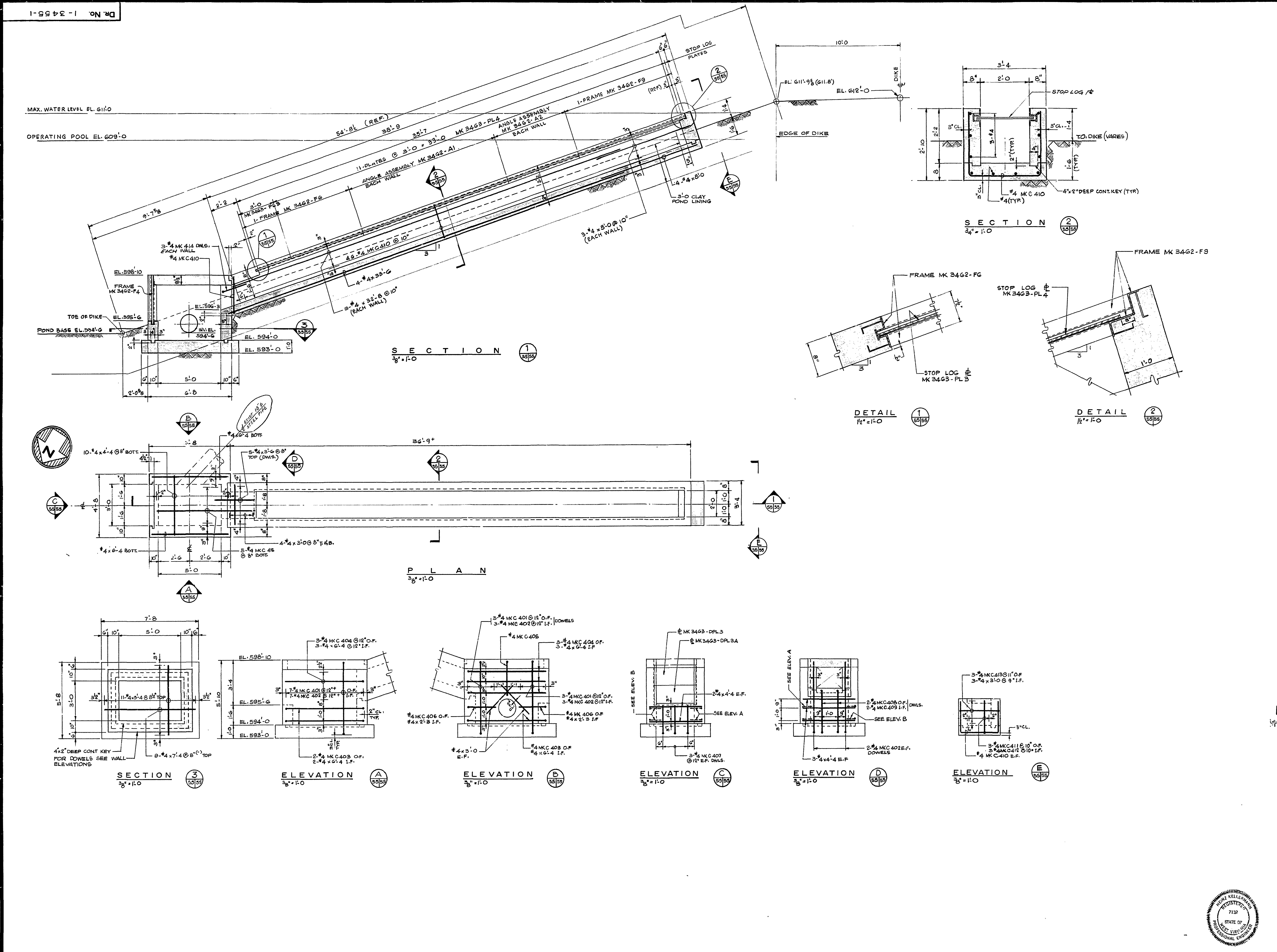
AMERICAN ELECTRIC POWER SERVICE CORP.

BAR LIST: 1-RS-300

KELLERMANN & DRAGNETT INC.
CONSULTING ENGINEERS
LITTLE FALLS, NEW JERSEY

JOB NO. 77-12

AEP3046XY



FOR LOCATION OF STRUCTURE SEE DWG. 1-3018

GENERAL NOTES

FOR CONCRETE NOTES SEE DWG. 1-3450
FOR STRUCTURAL STEEL NOTES SEE DWG. 1-3462

MATERIAL

CONCRETE	15 CU. YDS.
REINFORCING	0.5 TONS

FOR LISTING OF FABRICATORS, SEE DWG. 1-3451.

REFERENCE DRAWING

FOR LIST OF REFERENCE DRAWINGS SEE DWG. 1-3450.

REVISIONS

DATE	NO.	DESCRIPTION	APPD.
5/1/78	2	DISCHARGE PIPE TO BE STEEL IN LIEU OF C.M.P. IN PLAN.	HTS
4/11/78	1	REVISED MATERIAL QUANTITIES REVISED SECT. 1 & PLAN. ADDED ANGLE ASSEMBLIES A2 & 2-STOP-LOG PL PL4	HTS

PROJECT 1301

BOTTOM ASH & WASTEWATER PONDS

WASTEWATER POND - LOW WATER DISCHARGE FACILITY STRUCTURE NO. 4

DR. NO. 1 - 3455-2

ARCH. WH | ELEC | MECH. JCC | STR. W.B.

SCALE: AS NOTED
DR. EEM
CH. J.B.
SQ. LDR. A.N.S.
DATE: 12/19/77

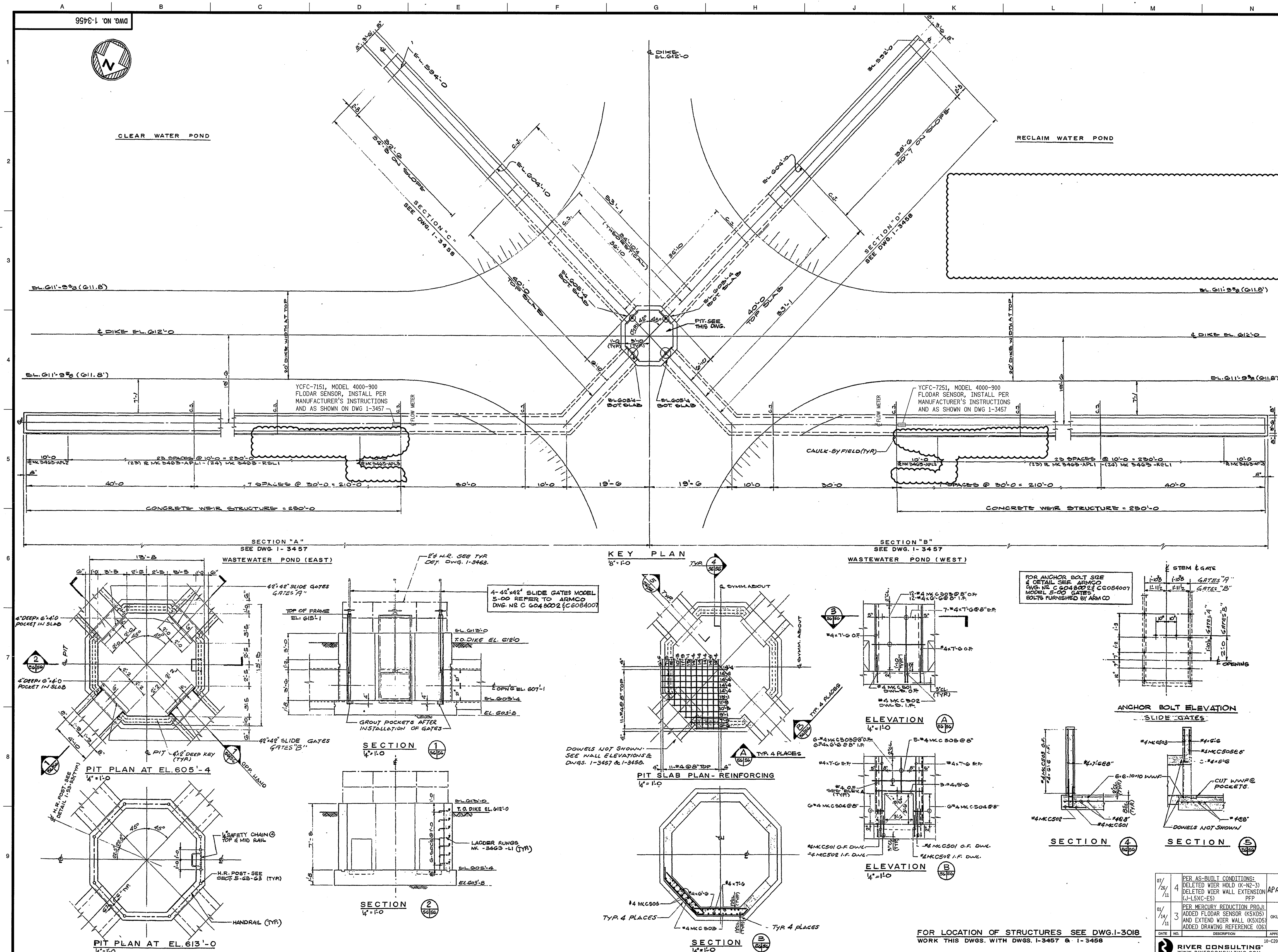
APPROVED BY — ENGINEERING DIV / DESIGN DIV

BAR LIST: 1-RS-300

KELLERMANN & DRAGNETT INC.
CONSULTING ENGINEERS
LITTLE FALLS, NEW JERSEY

JOB NO. 77-12

AMERICAN ELECTRIC POWER SERVICE CORP.



GENERAL NOTES

FOR CONCRETE NOTES SEE DWG. 1-3450
FOR STRUCTURAL STEEL NOTES SEE DWG. 1-3362

MATERIAL

CONCRETE	520 CU. YDS.
REINFORCING	12.5 TONS

FOR LISTING OF FABRICATORS, SEE DWG. 1-3451.

REFERENCE DRAWING

FOR LIST OF REFERENCE DRAWINGS SEE DWG. 1-3450.

1-5178026 INSTRUMENTATION AND CONTROL P&ID IN-POND COAGULANT FEED SYSTEM

THIS DRAWING HAS BEEN ELECTRONICALLY RE-CREATED. SEE DOCUMENT MANAGEMENT RECORDS FOR DRAWING REVISION HISTORY AND SIGNATURES.

REVISIONS

DATE	NO.	DESCRIPTION	APPD.
07/26/11	4	PER AS-BUILT CONDITIONS: DELETED WIER HOLD (K-N2-3) DELETED WIER WALL EXTENSION (J-L5XC-E5) PFP	APR
01/14/11	3	PER MERCURY REDUCTION PROJ: ADDED FLODAR SENSOR (K5XD5) AND EXTEND WIER WALL (K5XD5) ADDED DRAWING REFERENCE (O6)	GKL

APPALACHIAN POWER COMPANY

MOUNTAINEER PLANT

NEW HAVEN WEST VIRGINIA

WASTEWATER POND COLLECTION WEIR FACILITY STRUCTURE NO. 5

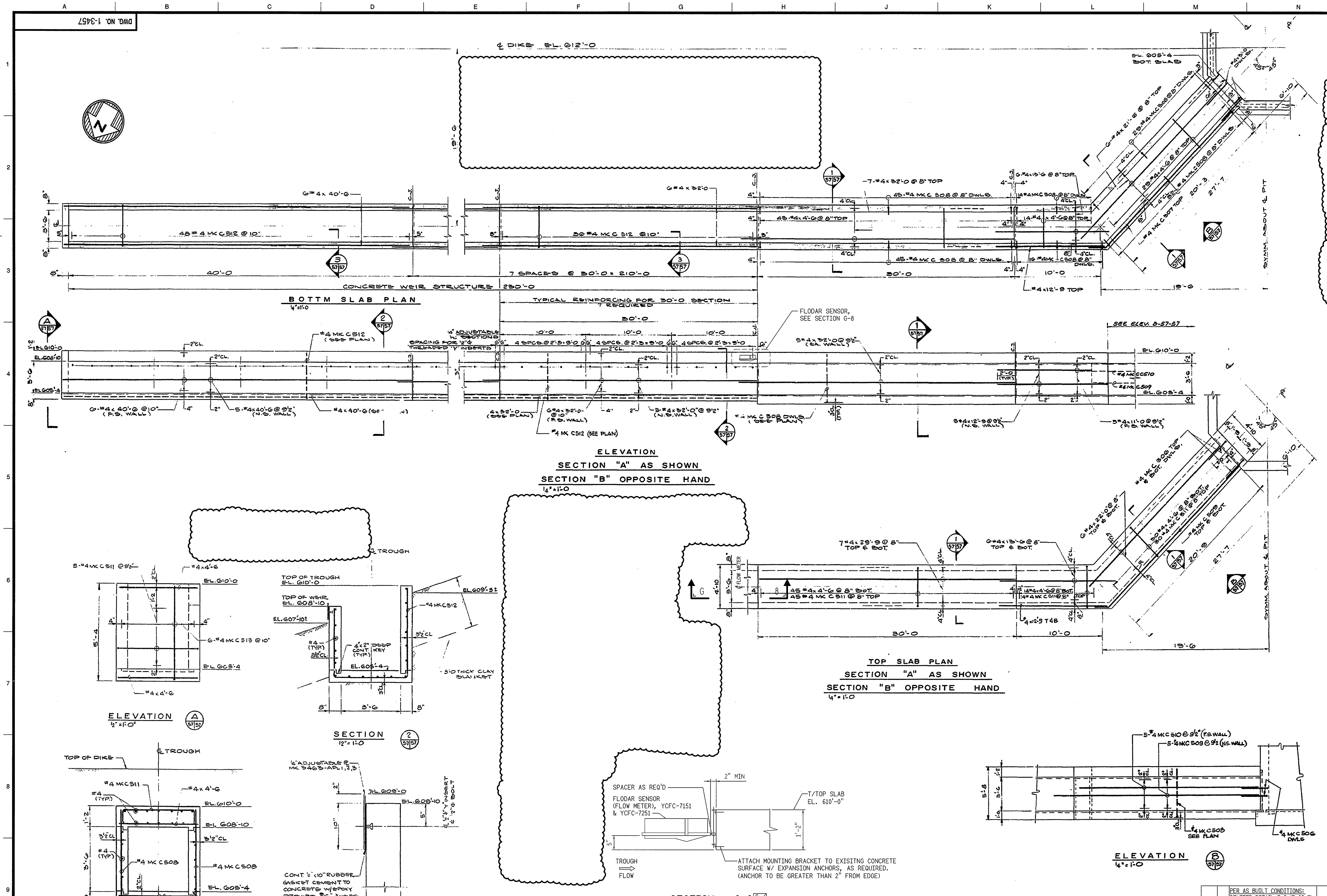
DWG. NO. 1-3456-4

SCALE: NOTED — CIVIL ENGINEERING
DR: GJS
CH: JB
DES SUPV: ANS
DATE: 1/12/78

RIVER CONSULTING® WWW.RIVERCONSULTING.COM 10-C202

AEP AMERICAN ELECTRIC POWER — AEP SERVICE CORP. 1 RIVERSIDE PLAZA COLUMBUS, OH 43215

IGS0700



DATE	NO.	DESCRIPTION	APPD.
07/26/11	4	PER AS BUILT CONDITIONS: DELETED DETAIL F-7 (E-G5-7) CHANGED NOTE (F8) DELETED NOTES 2-6 (O1-3) DELETED WIER HOLD (E-H1-2) PFP	APR
01/14/11	3	PER MERCURY REDUCTION PROJ: ADDED DETAIL F-7 AND SECTION G-8, ADDED FLODAR SENSOR (H3), NOTES (O2), REFERENCE (O6)	GKL

RIVER CONSULTING™
WWW.RIVERCONSULTING.COM
10-C202

GENERAL NOTES

FOR CONCRETE NOTES SEE DWG. 1-3450

1. ALL DRILLED CONCRETE ANCHORS ARE TO CONFORM TO AEP SPECIFICATION SES-3007 "DRILLED IN CONCRETE ANCHORS".

MATERIAL

FOR MATERIAL QUANTITIES SEE DWG. 1-3456

FOR LISTING OF FABRICATORS, SEE DWG 1-3451.

REFERENCE DRAWINGS

FOR LIST OF REFERENCE DRAWINGS SEE DWG. 1-3450

1-5178026 INSTRUMENTATION AND CONTROL P&ID IN-POND COAGULANT FEED SYSTEM

THIS DRAWING HAS BEEN ELECTRONICALLY RE-CREATED. SEE DOCUMENT MANAGEMENT RECORDS FOR DRAWING REVISION HISTORY AND SIGNATURES.

DATE	NO.	DESCRIPTION	APPD.

REVISIONS

APPALACHIAN POWER COMPANY

MOUNTAINEER PLANT

NEW HAVEN WEST VIRGINIA

WASTEWATER POND COLLECTION WIER FACILITY STRUCTURE NO. 5

DWG. NO. 1-3457-4

SCALE: NOTED | CIVIL ENGINEERING

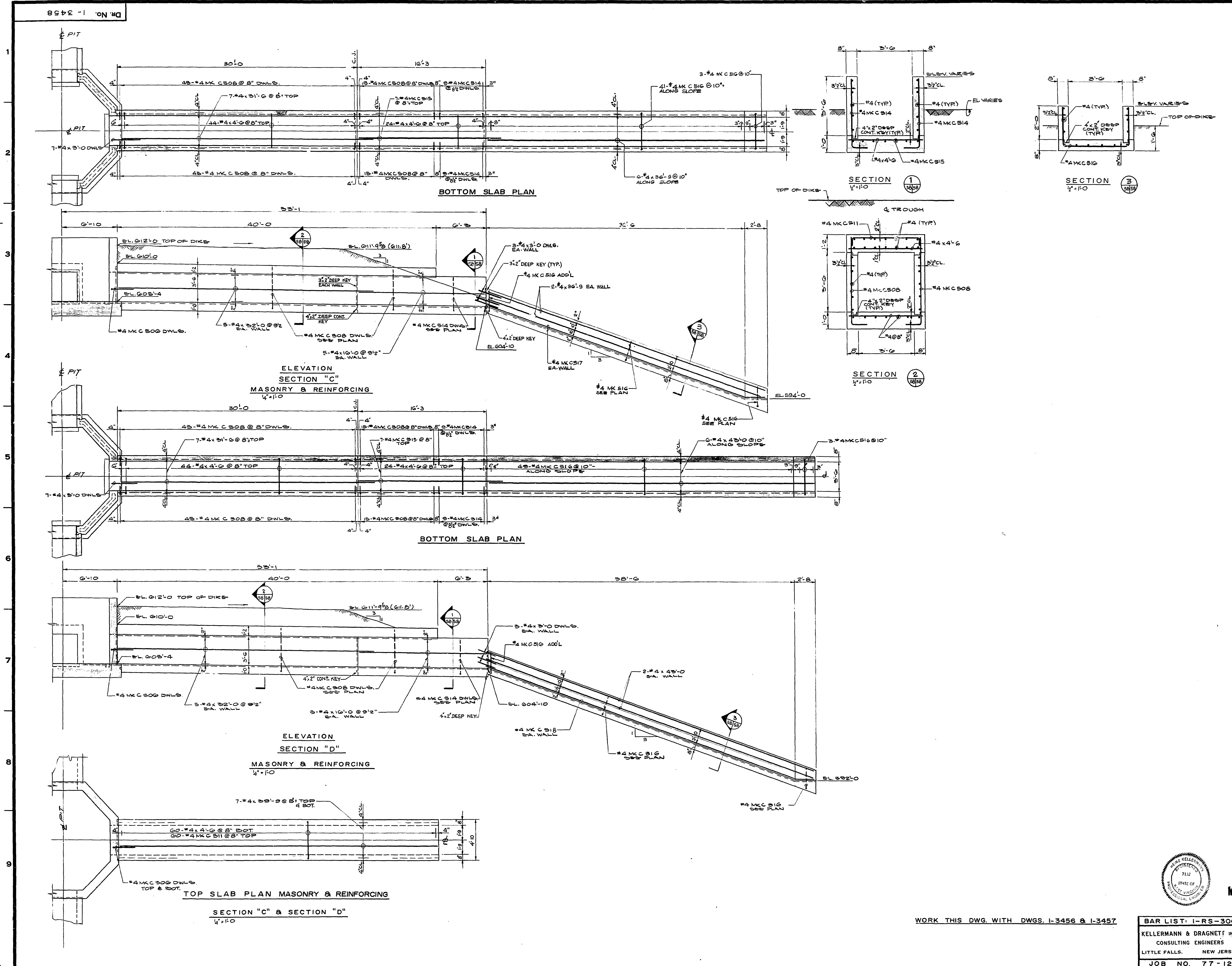
DR: GJS
CH: JB
DES SUPV: ANS
PROJ ENGR:
DATE: 1/12/78
APPROVED BY

AEP AMERICAN ELECTRIC POWER

AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

Rev. No:
Plot Date:
Plotted by:

IGS0700



GENERAL NOTES

FOR CONCRETE NOTES SEE DWG. I-3450

MATERIAL

FOR MATERIAL QUANTITIES SEE DWG. I-3456.

FOR LISTING OF FABRICATORS, SEE DWG. I-3451

REFERENCE DRAWINGS

FOR LIST OF REFERENCE DRAWINGS SEE DWG. I-3450.

DATE	NO.	DESCRIPTION	APPD.

REVISIONS

PROJECT 1301

BOTTOM ASH & WASTEWATER PONDS

WASTEWATER POND COLLECTION WIER FACILITY STRUCTURE NO. 5

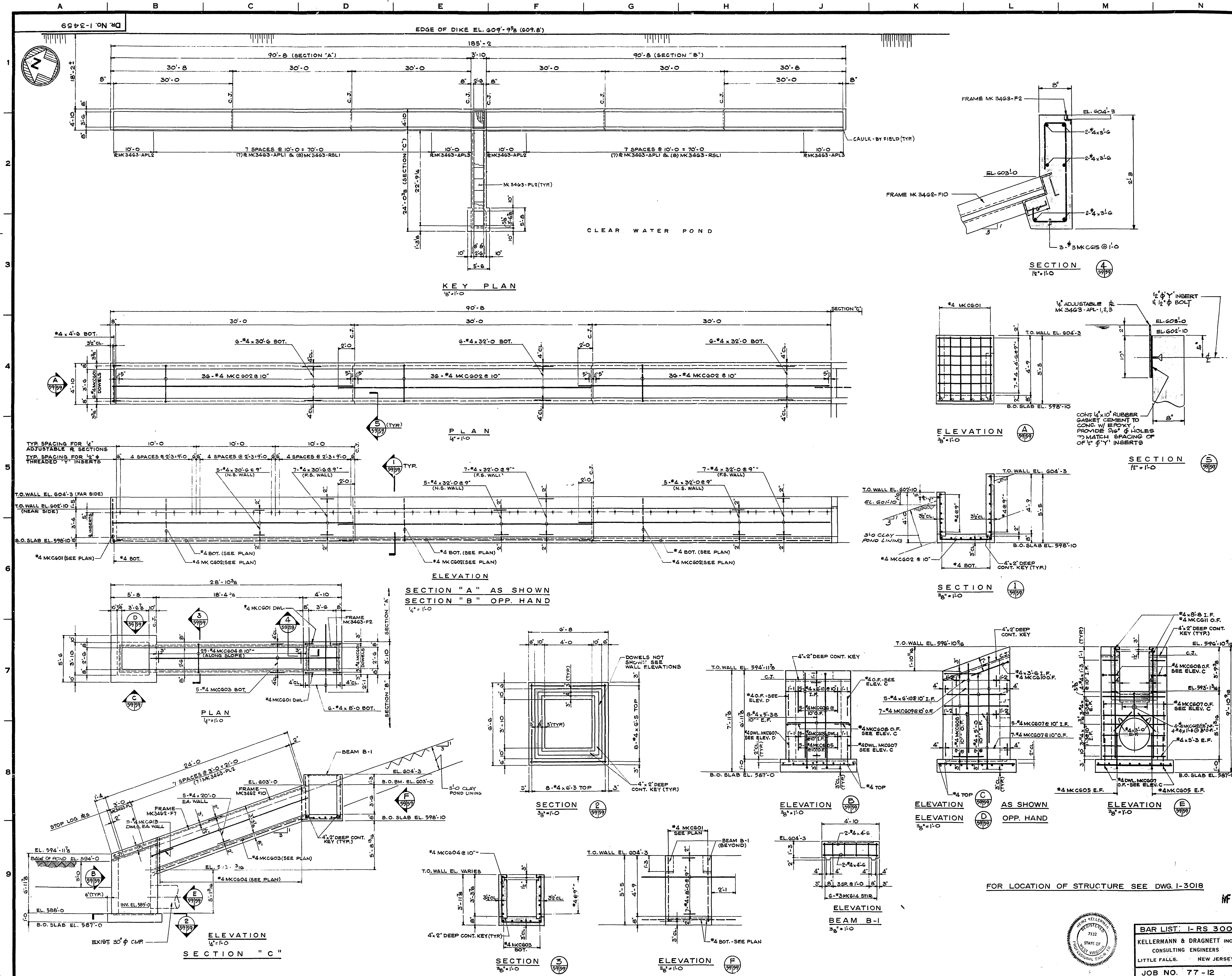
DR. NO. I-3458

BAR LIST: I-RS-300

KELLERMANN & DRAGNETT INC.
CONSULTING ENGINEERS
LITTLE FALLS, NEW JERSEY

JOB NO. 77-12

AMERICAN ELECTRIC POWER SERVICE CORP.



GENERAL NOTES

FOR CONCRETE NOTES SEE DWG. 1-3450
FOR STRUCTURAL STEEL NOTES SEE DWG. 1-3462

MATERIAL

CONCRETE	72.0 CU. YDS.
REINFORCING	2.73 TONS

FOR LISTING OF FABRICATORS, SEE DWG. 1-3451

REFERENCE DRAWINGS

FOR LIST OF REFERENCE DRAWINGS SEE DWG. 1-3450.

DATE	NO.	DESCRIPTION	APPD.

REVISIONS

PROJECT 1301

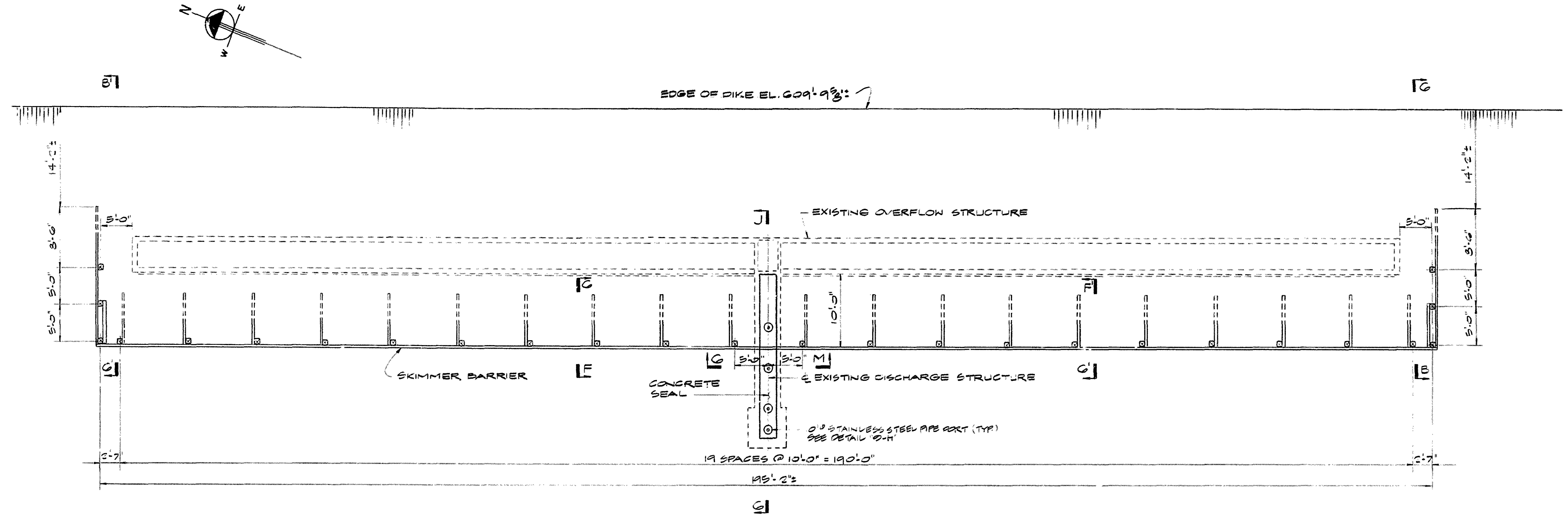
BOTTOM ASH & WASTEWATER PONDS

CLEAR WATER POND
DISCHARGE WEIR & STRUCTURE
STRUCTURE NO. 6

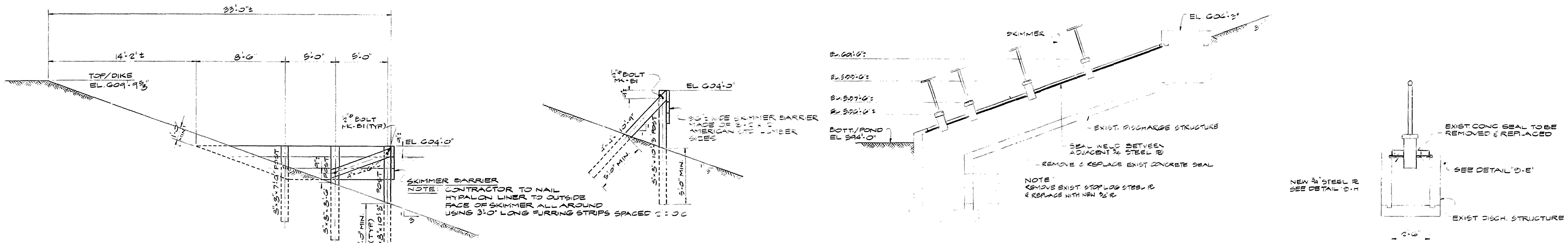
DR. NO. 1-3459

AMERICAN ELECTRIC POWER SERVICE CORP.

DR. NO. 1-3459A



KEY PLAN
SCALE: ⅛"=1'-0"

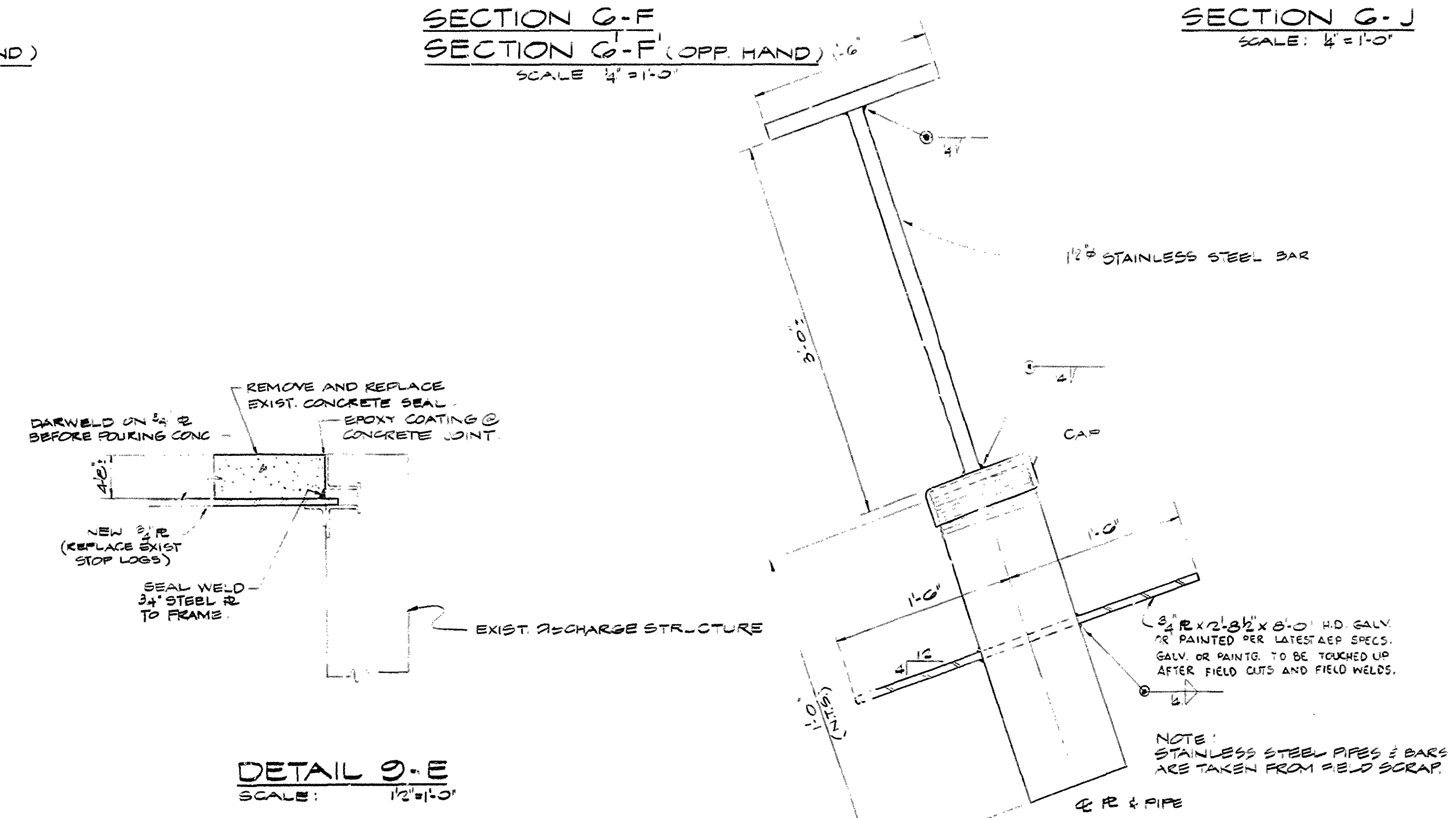


SECTION 6-B
SECTION 6'-B' (OPP. HAND)
SCALE: ¼"=1'-0"

SECTION 6-F
SECTION 6'-F' (OPP. HAND)
SCALE: ¼"=1'-0"

SECTION 6-J
SCALE: ¼"=1'-0"

SECTION 6-M
SCALE: ⅜"=1'-0"



DETAIL 9-E
SCALE: 1½"=1'-0"

DETAIL 9-H (4-REQUIRED)
SCALE: 1½"=1'-0"

TIMBER SCHEDULE				
NO.	SIZE	LENGTH	TOTAL LENGTH	REMARKS
22	8"×8	10'-3	225'-6"	POST
2	8"×8"	3'-6	7'-0"	POST
2	8"×8"	7'-0"	14'-0"	POST
20	4"×4	10'-9	215'-0"	KNEE BRACE
2	4"×4	6'-2"	[illegible]	VERT. BRACE
[illegible]	[illegible]	195'-10"	587'-6"	SKIMMER BARRIER
6	2"×12"	3'-10"	113'-0"	SKIMMER BARRIER
113	1"×2"	3'-0"	[illegible]	FURRING STRIPS
TOTAL NO. OF BOARD FEET = 3130 BD. FT.				

BOLT SCHEDULE					
MARK	QTY	SIZE	LENGTH	TYPE	REMARKS
B1	24	½"Ø	-1"	SQUARE HEAD SQUARE NUT	2 WASHERS 5" THREAD

RDR SP-06-661

GENERAL NOTES

DO NOT SCALE THIS DWG.

1.- POND TO BE DEWATERED BEFORE ALL MODIFICATION WORKS BEGIN.
2.- EXISTING STOP LOG PLATES TO BE REMOVED & CLEANED. A COAT OF BITUMASTIC PAINT IS TO BE APPLIED BEFORE REPLACING
3.- CAULK VERTICAL SLOT OF STEEL PLATES BEFORE APPLYING CONCRETE SEAL.
4.- ALL TIMBER TO BE DOUGLAS FIR OR SOUTHERN YELLOW PINE SELECT STRUCTURAL & ALL TO BE CREOSOTED
5.- CREOSOTING TO CONFORM TO SPEC. AWPA C-2 LATEST REVISION
6.- BACKFILL AROUND POSTS SHALL BE WELL COMPACTED
7.- ALLOWABLE SOIL BEARING PRESSURE = 1500 PSF.
8.- ALL BOLTS NUTS & WASHERS SHALL BE GALVANIZED & TO RECEIVED ONE FIELD COAT OF BITUMASTIC PAINT

CONCRETE f'c = 3500 PSI

MATERIALS

CONCRETE ... [illegible]
TIMBER ... 3130 BD. FT.
BY BURKE PARSONS + BOWLBY ORDER NO. 02712
SKIMMERS
HYPALON LINER (36 MILS THK.) - 3'-0" × 225'-3" [illegible]
BY:
½"Ø × 1'-1" LG. BOLT ... 24 REQ'D
BY:
ALL MATERIALS ON REVISION NO. 2 BY FIELD

REFERENCE DRAWINGS

1-3459 - CLEAR WATER POND DISCHARGE WEIR STRUCT. - STRUCT'L

DATE	NO.	DESCRIPTION	APPD.
8/[illegible]/84	2	INDICATED 10"Ø S.S. PIPE POSTS ON DISCHARGE STRUCTURE. REVISED SECTIONS "6-J" & "6-M". ADDED DETAILS "9-E", "9-H" & NOTE [illegible]	[illegible]
8/13/81	1	ADDED FURRING STRIPS ON TIMBER SCHEDULE & REVISED NO. BD FT.	S.F

REVISIONS

PROJECT 1301

(CLEAN-UP ITEMS NO. 155 & 156)
CLEAR WATER POND
OVERFLOW & DISCHARGE
STRUCTURE MODIFICATION

DR. NO. 1-3459A-2

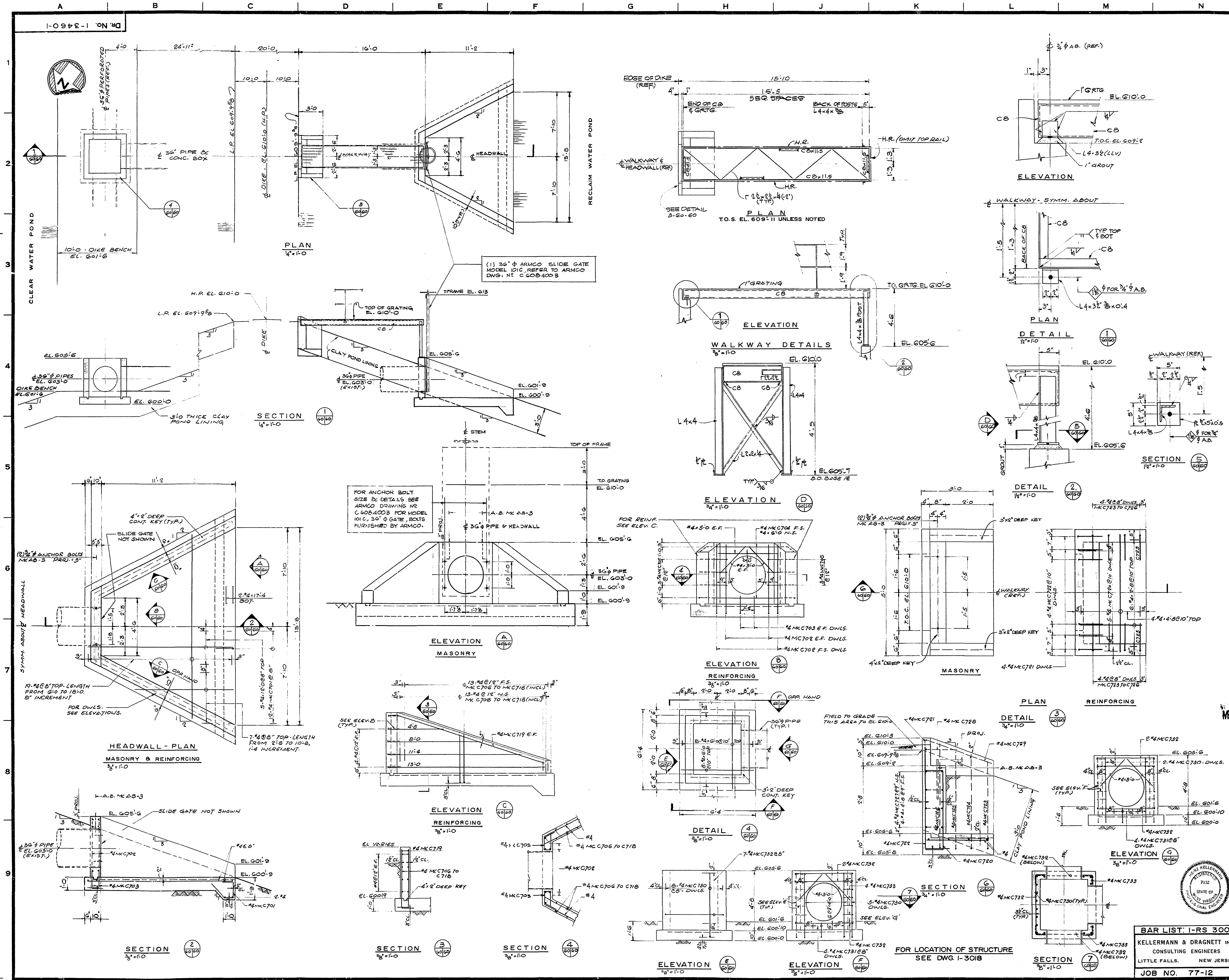
ARCH. – ELEC – MECH. – STR.

SCALE: AS NOTED
DR. R.G. DURO
CH. R. MACK
S.J. LOR T.S.
DATE: 7-10-81

APPROVED BY: ENGINEERING DIV; DESIGN DIV

AMERICAN ELECTRIC POWER SERVICE CORP.

AEP5046XY



GENERAL NOTES

FOR CONCRETE NOTES SEE DWG. 1-3450
FOR STRUCTURAL STEEL NOTES SEE DWG. 1-3462
FOR GRATING NOTES SEE DWG. 1-3453.

MATERIAL

CONCRETE	15.0 CU. YDS.
REINFORCING	0.6 TON

FOR LISTING OF FABRICATORS, SEE DWG. 1-3451.

REFERENCE DRAWINGS

FOR LIST OF REFERENCE DRAWINGS SEE DWG. 1-3450

REVISIONS

DATE	NO.	DESCRIPTION	APPD.
3-17-78	1	ADDED ANCHOR BOLTS FOR ARMCO GATE EL. "A"	HHS

PROJECT 1301

BOTTOM ASH & WASTEWATER PONDS

CLEAR WATER POND DISTRIBUTION FACILITY STRUCTURE NO. 7

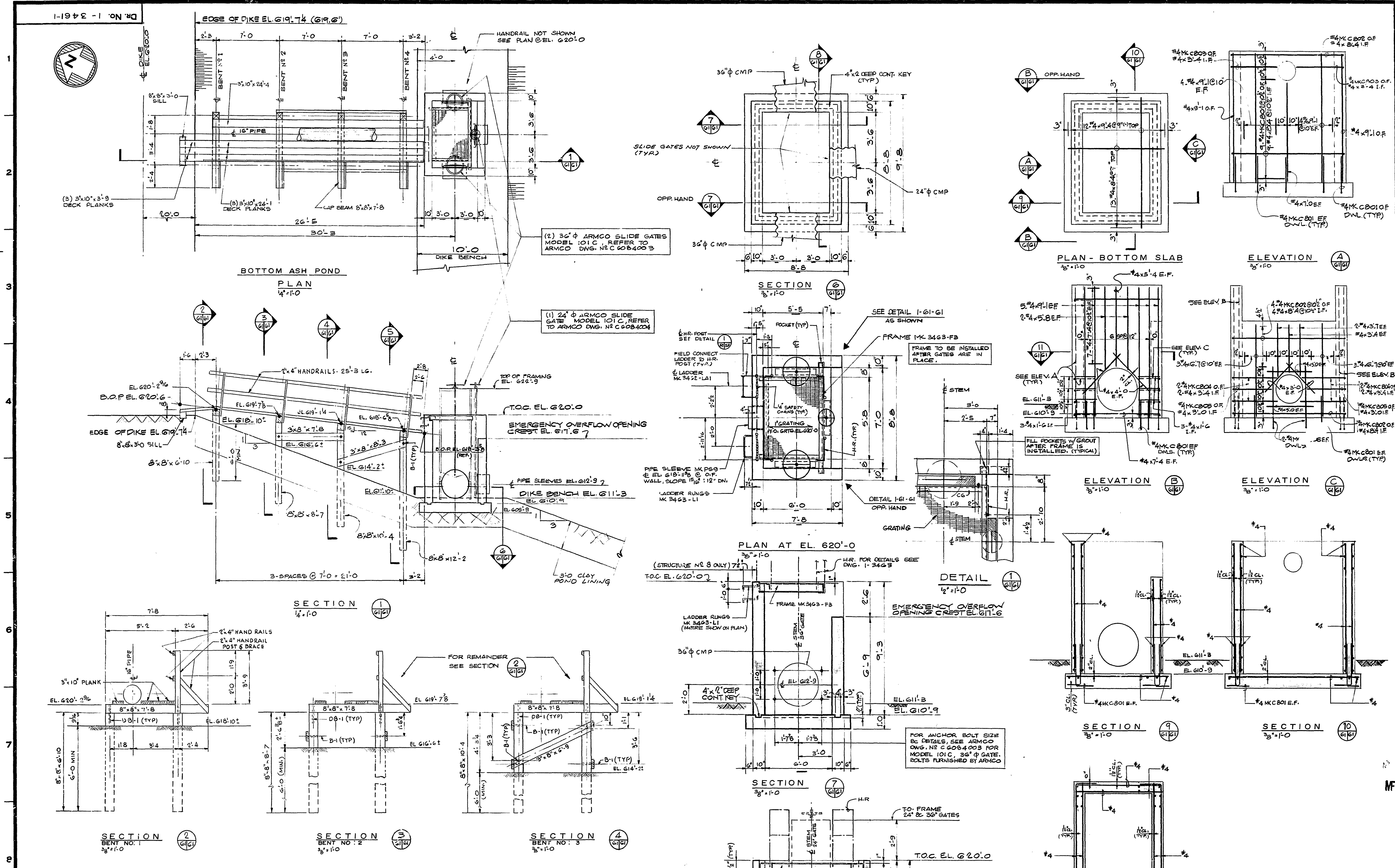
DR. NO. 1-3460-1

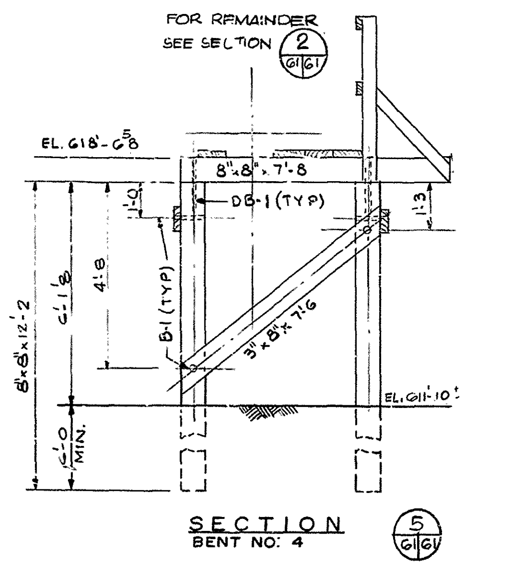
ARCH. WH ELEC MECH. JAL STR. LWB.

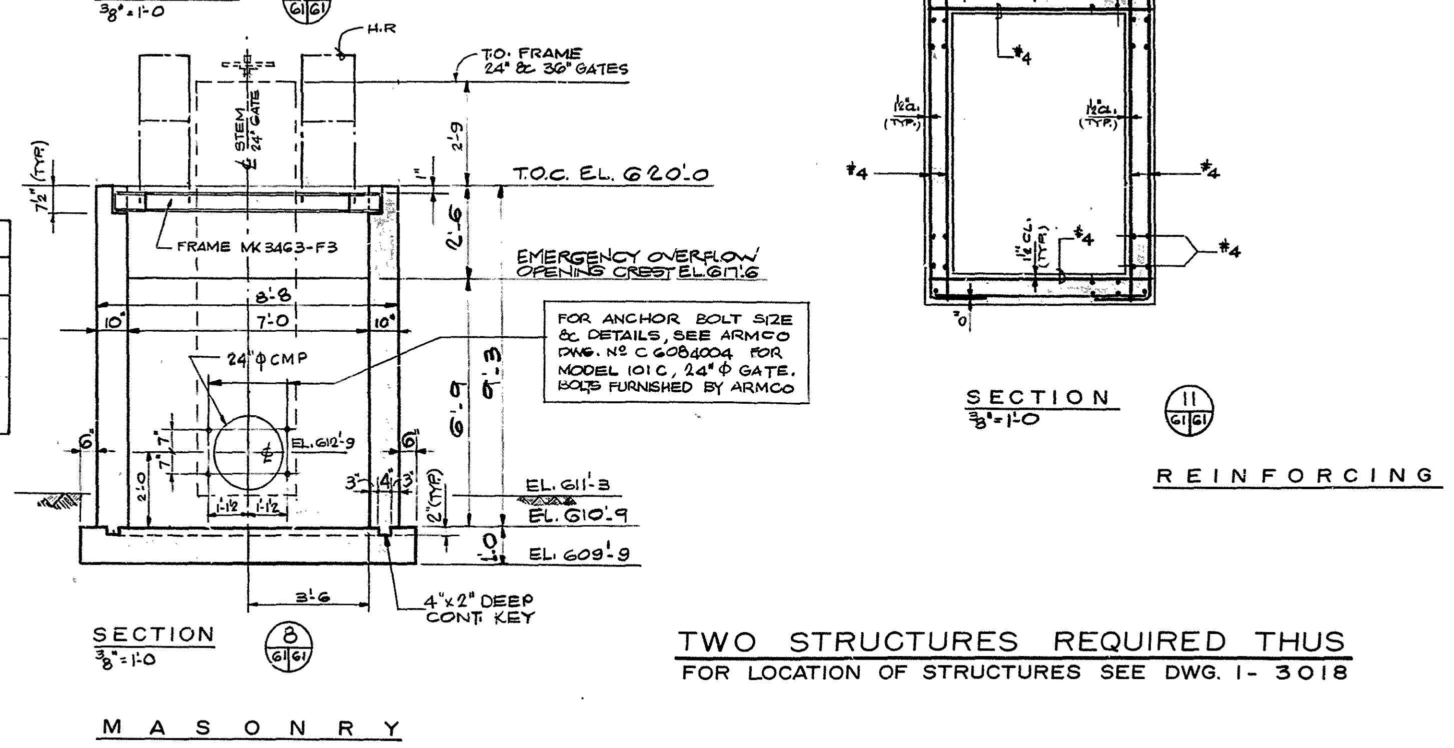
SCALE: AS NOTED
DR. T.M./ANS
CH. J.B.
SQ. LDR ANS
DATE: 12/14/77

APPROVED BY: ENGINEERING DIV / DESIGN DIV

AMERICAN ELECTRIC POWER SERVICE CORP.







TIMBER SCHEDULE					
QUANTITY	SIZE	LENGTH	TOTAL LENGTH	NO. OF BOARD FT.	REMARKS
4	8" X 8"	12'-2	48'-8	260	POST
4		10'-4	41'-4	221	
4		8'-7	34'-4	183	
4		6'-10	27'-4	146	POST
8		7'-8	61'-4	327	BEAM
2	8" X 8"	3'-0	6'-0	32	SILL
4	3" X 8"	8'-3	33'-0	66	DIAGONAL BRACING
4		7'-8	30'-8	62	
2		7'-6	15'-0	30	
2	3" X 8"	6'-9	13'-6	27	DIAGONAL BRACING
2	3" X 10"	24'-4	48'-8	122	DECK PLANKS
6	3" X 10"	24'-1	144'-6	362	-DO-
6	3" X 10"	3'-9	22'-6	57	-DO-
4	2" X 4"	25'-3	101'-0	68	HAND RAIL
8	2" X 4"	4'-4	34'-8	23	RAIL POSTS
8	2" X 4"	3'-4	26'-8	18	RAIL BRACE

TOTAL NO. OF BOARD FT. = 2,004

BOLT SCHEDULE					
MARK	QUANTITY	SIZE	LENGTH	TYPE	REMARKS
DB-1	16	7/8"φ	1'-8	DRIFT BOLT	WEDGE POINT BUTTON HEAD
B-1	24	7/8"φ	1'-0	SQ. HEAD SQ. NUT	2 WASHERS 5" THREADS

TOTAL NOS. INDICATED ARE FOR TWO STRUCTURES

TWO STRUCTURES REQUIRED THUS

FOR LOCATION OF STRUCTURES SEE DWG. 1-3018

GENERAL NOTES

FOR CONCRETE NOTES SEE DWG. 1-3450
FOR STRUCTURAL STEEL NOTES SEE DWG. 1-3462
FOR TIMBER NOTES SEE DWG. 1-3453
FOR GRATING NOTES SEE DWG. 1-3453

MATERIAL

TOTAL FOR TWO STRUCTURES

CONCRETE 22.0 CU. YDS
REINFORCING 1.10 TONS

FOR LISTING OF FABRICATORS, SEE DWG. 1-3451

REFERENCE DRAWINGS

FOR LIST OF REFERENCE DRAWINGS SEE DWG. 1-3450

DATE	NO.	DESCRIPTION	APPD.
2-17-78	1	DELETED SLEEVES PS10 & PS11 ADDED 24" & 36"φ CMP. — ADDED ANCHOR BOLTS FOR ARMCO GATES, REV. FRAME MK3463-F3 & H.R. TO CONFORM ARMCO REQUIREMENT	HTS

REVISIONS

PR… ECT 1301

BOTTOM ASH & WASTEWATER PONDS

BOTTOM ASH PONDS INFLUENT WATER DISTRIBUTION STRUCTURE STRUCTURE NO. 8

DR. NO. 1-3461-1

ARCH. W/L ELEC MECH. VL STR. WB

SCALE: AS NOTED
DR. TM/R.J.
CH. J.B.
SQ. LDR A.J.S.
DATE: 1/12/78

APPROVED BY: ENGINEERING DIV / DESIGN DIV

BAR LIST: 1-RS-300

KELLERMANN & DRAGNETT INC.
CONSULTING ENGINEERS
LITTLE FALLS, NEW JERSEY
JOB NO. 77-12

HEINZ KELLERMANN REGISTERED 7132 STATE OF WEST VIRGINIA PROFESSIONAL ENGINEER

AMERICAN ELECTRIC POWER SERVICE CORP.

DR. No. 1 - 3462-2

PIPE SLEEVE SCHEDULE

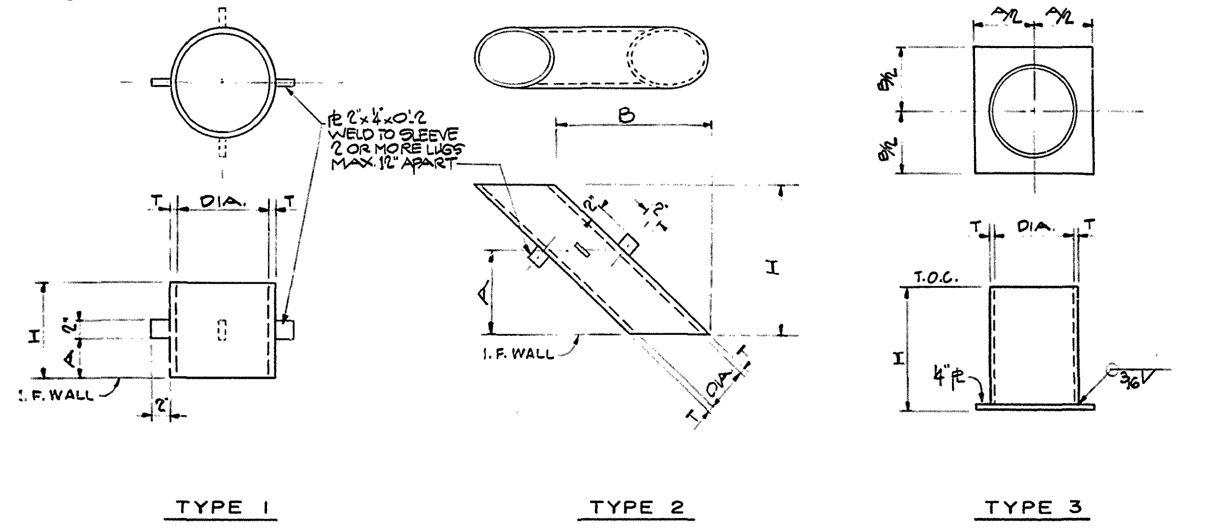
MARK	TYPE	NO. REQ'D	SIZE DIA.	SIZE H	OTHER DIMENSIONS T	A	B	C	D	LOCATION	DWG. NO.	FURNISHED BY	DATE ORDERED	LISTED BY	CHECKED BY	REMARKS
PS1	1	3	16"	1'-4	STD.	5"	-	-	-	STR.#1	1-3450			T.M.	ans	
PS2	1	2	14"	1'-4	STD.	5"	-	-	-	STR.#1	1-3450			T.M	ans	
PS3	1	4	18"	1'-4	STD.	5"	-	-	-	STR#1	1-3450			T.M	ans	
PS4	4	4	36	2'-0	16GA	5"	-	-	-	STR.#3	1-3453			E.M.	ans	
PS5	2	2	20"	1'-2	STD	5"	2"	-	-	STR.#3	1-3453			E.M	ans	
PS6	2	2	16"	1'-2	STD.	5"	2"	-	-	STR.#3	1-3453			E.M.	ans	
PS9	2	2	20"	1'-2	STD.	5"	1⅛"	-	-	STR.#8	1-3461			E.M.	ans	

PIPE SLEEVE PACKING SHALL BE LINK SEAL OR OAKUM FOR ALL TYPES, EXCEPT TYPES 3 & 4

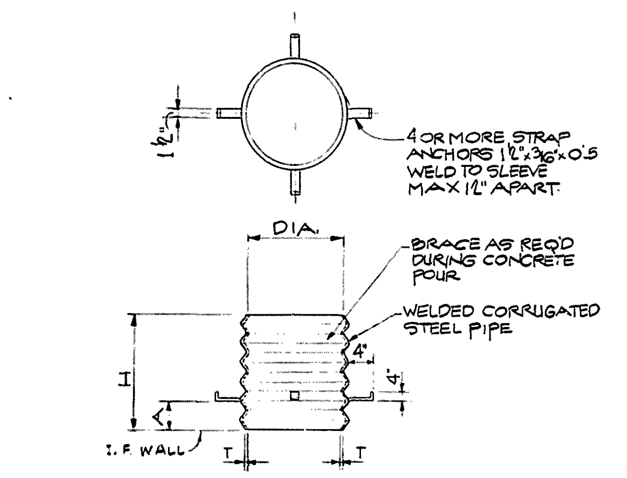
ANCHOR BOLT SCHEDULE

MARK	TYPE	NO. REQ'D	SIZE	LENGTH	THREAD	DIMENSIONS X	Y	Z		WASHER SIZE	LOCATION	DWG. NO.	FURN. BY	DATE ORDERED	LISTED BY	CHECKED BY	REMARKS
AB-1	2	22	¾"φ	0'-9	2"	0'-9	-	4"		STD.	JIB CRANE & WALKWAY	1-3453 1-3454			J.B.	A.N.S.	STR.#8 - FOR TWO STRUCTURES
AB-2	1	4	¾"φ	2'-6	2½"	2'-3	3"	-		STD.	WALKWAY	1-3454			J.B.	A.N.S.	
AB-3	1	4	¾"φ	2'-6	2½"	2'-3	3"	-		STD.	WALKWAY	1-3460			J.B.	A.N.S.	STR.#7
AB-4	1	16	¾"φ	2'-0	2½"	1'-9	3"	-		STD.	MANHOLE FRAME	1-3464			J.B.	A.N.S.	DISSIPATOR STRUCT. NO. 1 & 2

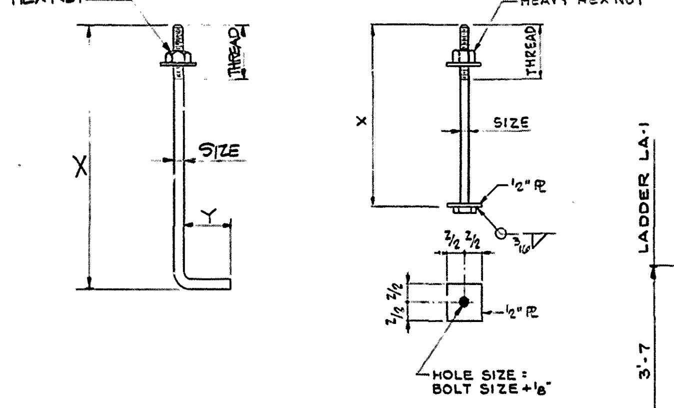
ALL ANCHOR BOLTS - MAT'L A-36



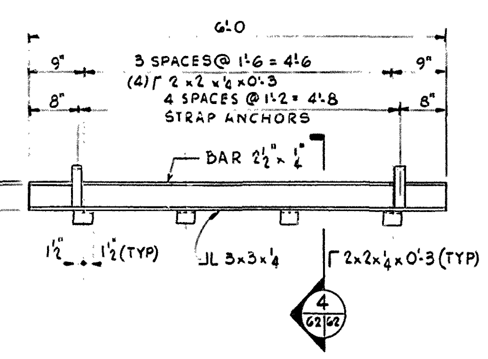
TYPE 1 TYPE 2 TYPE 3



TYPE 4

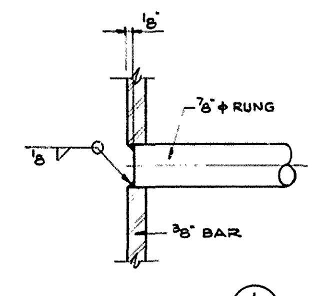


TYPE 1 TYPE 2

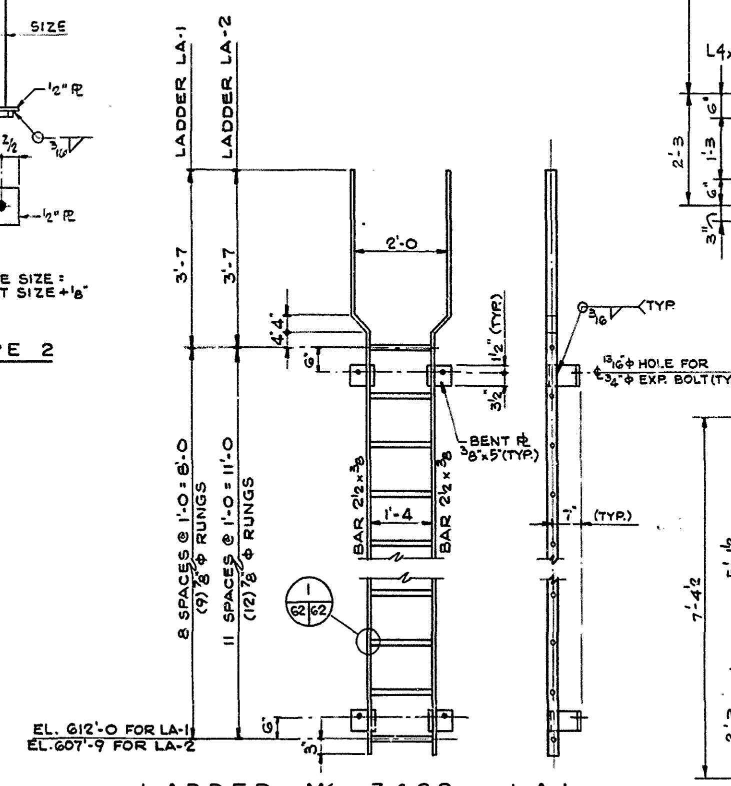


PLAN

ANGLE ASSEMBLY MK 3462-A2
2-REQD. (STR. Nº 4)
¾"=1'-0

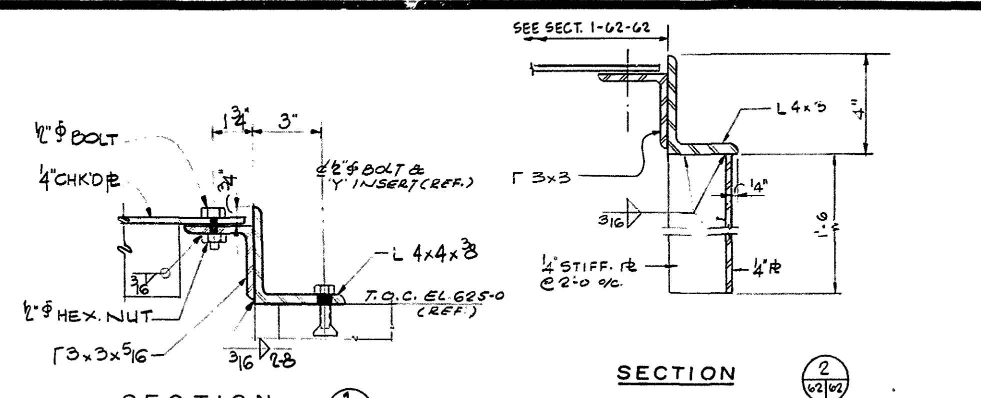


DETAIL 1



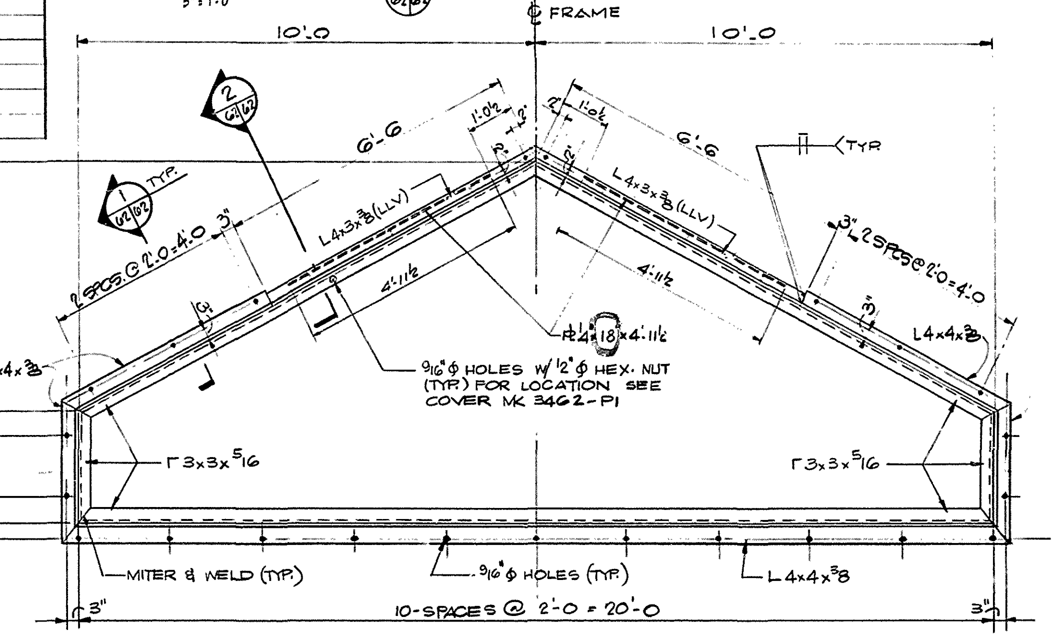
LADDER MK 3462 - LA1
(2 REQ'D - STR. NO. 8)

LADDER MK 3462 - LA2
(2 REQ'D - STR. NO. 3)



SECTION 1
3"=1'-0

SECTION 2



FRAME MK 3462-F1 (1) REQ'D (STR. NO. 1)
½"=1'-0

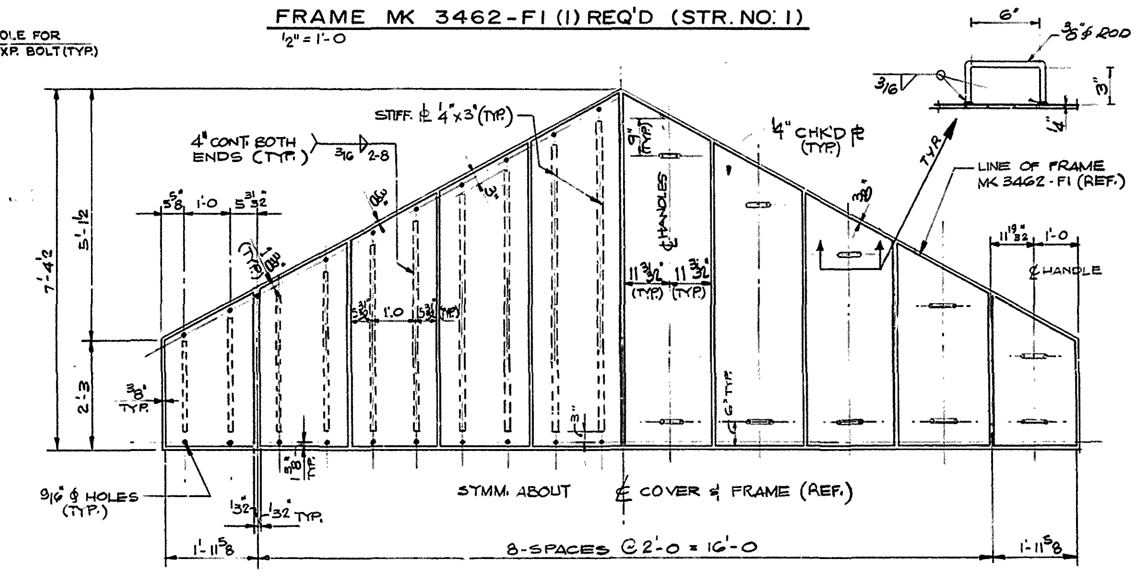
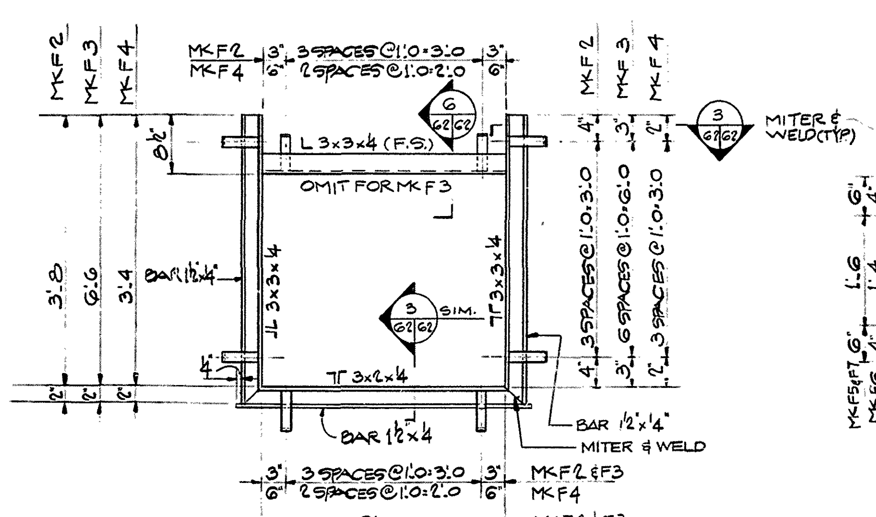
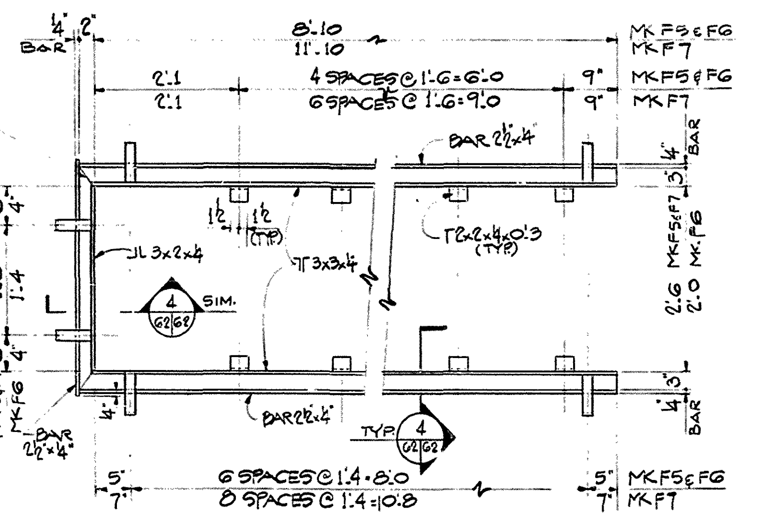


PLATE COVER ASSEMBLY - MK 3462-P1 (1) REQ'D (STR. NO. 1)
½"=1'-0



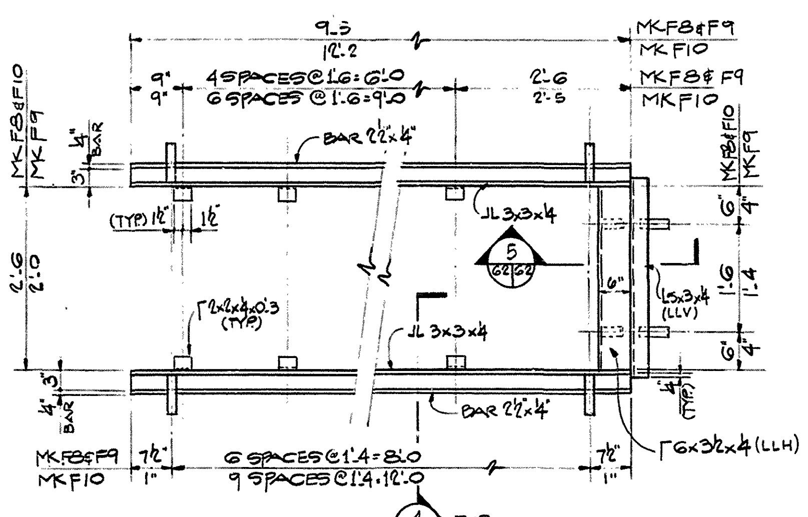
ELEVATION

FRAME: MK 3462-F2-2 REQ'D (STR. NO. 2)
N.T.S. MK 3462-F3-6 REQ'D (STR. NO. 3)
MK 3462-F4-1 REQ'D (STR. NO. 4)



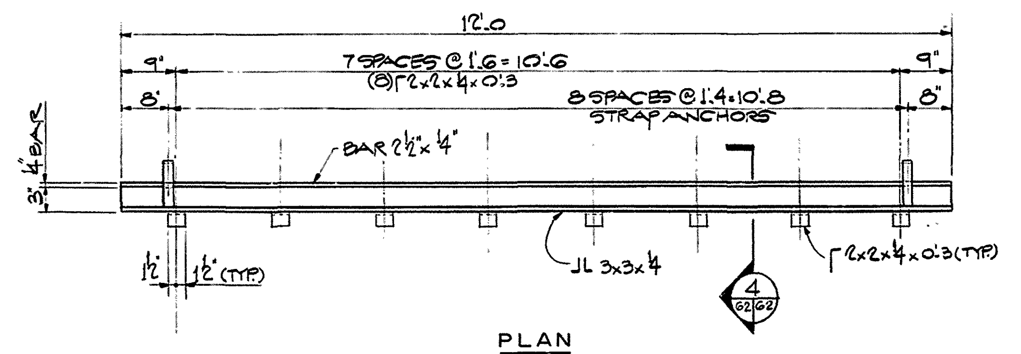
PLAN

FRAME: MK 3462-F5-2 REQ'D (STR. NO. 2)
N.T.S. MK 3462-F6-1 REQ'D (STR. NO. 4)
MK 3462-F7-1 REQ'D (STR. NO. 6)



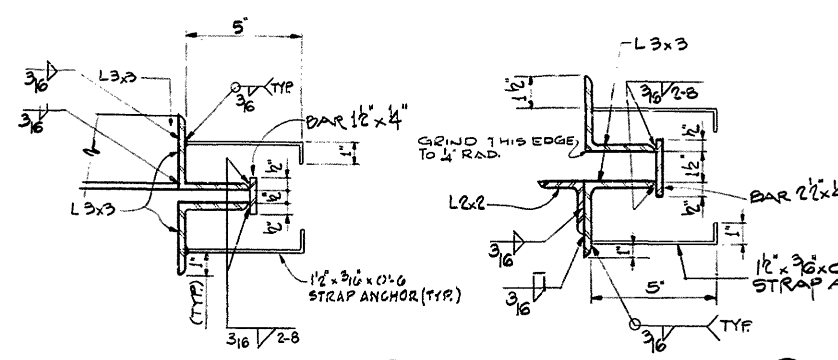
PLAN

FRAME: MK 3462-F8-2 REQ'D (STR. NO. 2)
N.T.S. MK 3462-F9-1 REQ'D (STR. NO. 4)
MK 3462-F10-1 REQ'D (STR. NO. 6)



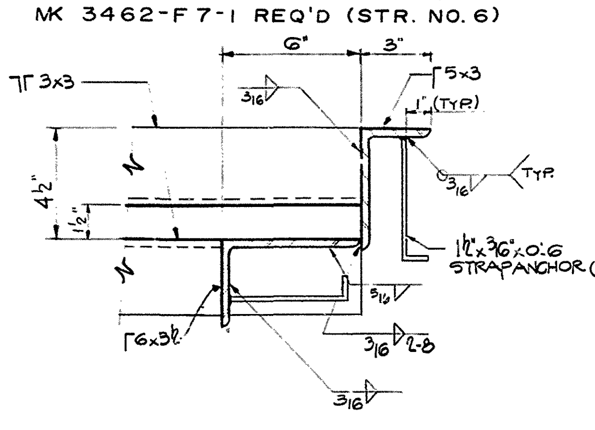
PLAN

ANGLE ASSEMBLY MK 3462-A1 8 REQ'D. (STR. NO. 2)
¾"=1'-0 2 REQ'D. (STR. NO. 4)

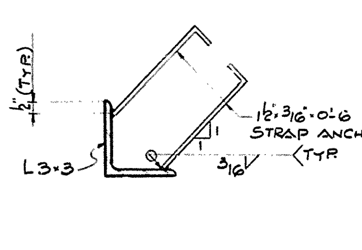


SECTION 3
3"=1'-0

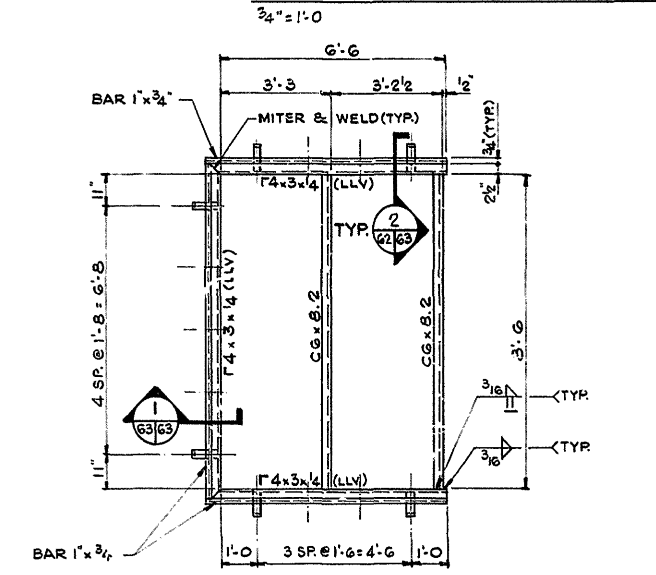
SECTION 4
3"=1'-0



SECTION 5
3"=1'-0



SECTION 6
3"=1'-0



FRAME MK 3462 - F11
2 REQ'D (STR. NO. 3)
N.T.S.

KELLERMANN & DRAGNETT INC.
CONSULTING ENGINEERS
LITTLE FALLS, NEW JERSEY
JOB NO. 77-12

GENERAL NOTES

ALL PIPE SLEEVES SHALL CONFORM TO ASTM SPECIFICATION A53, GRADE B OR A501.

STRUCTURAL STEEL

ALL STRUCTURAL STEEL AND WORKMANSHIP SHALL CONFORM TO THE A.I.S.C. SPECIFICATIONS FOR A 36 STEEL UNLESS NOTED.

ALL SHOP CONNECTIONS SHALL BE RIVETED OR WELDED UNLESS NOTED.

ALL FIELD CONNECTIONS SHALL BE BOLTED USING HIGH TENSILE STRENGTH BOLTS AND WASHERS (EXCEPT WHERE WELDING IS CALLED FOR) AND ARE TO BE SHIPPED WITH THE STRUCTURAL STEEL. USE FRICTION TYPE CONNECTIONS.

ALL RIVETS AND BOLTS SHALL BE 7/8" DIAMETER UNLESS NOTED.

HIGH TENSILE BOLTS AND WASHERS, THEIR USE AND INSTALLATION, SHALL CONFORM TO LATEST SPECIFICATIONS OF THE RESEARCH COUNSEL ON RIVETED AND BOLTED STRUCTURAL JOINTS.

THE FABRICATOR SHALL PREPARE BOLT LIST AND FURNISH FIVE COPIES TO THE PURCHASER.

WHEREVER WELDED CONNECTIONS ARE CALLED FOR THE WORK IS TO BE DONE IN ACCORDANCE WITH THE AMERICAN WELDING SOCIETY'S "CODE FOR WELDING IN BUILDING CONSTRUCTION."

ALL WELDS SHALL BE 5/16" FILLET WELDS UNLESS NOTED.

THE STEEL ERECTOR SHALL FURNISH REQUIRED AMOUNT OF WELDING OF RODS IN PROPER SIZES AND LENGTHS FOR THE FIELD ERECTION. ALSO SUFFICIENT NUMBER OF ERECTION BOLTS.

DO NOT PAINT STEEL IN CONTACT WITH CONCRETE.

PAINTING SPECIFICATIONS
SHOP PROCEDURES

A) SURFACE PREPARATION: STEEL SHALL BE PREPARED FOR PAINTING IN ACCORDANCE WITH STEEL STRUCTURES PAINTING COUNCIL NO. 3 POWER TOOL CLEANING, SPECIFICATION SSPC-SP-3-63 DATED OCTOBER 1, 1963 (OR LATEST REVISION) OR BY BLASTING BY MEANS OF WHEELABRATOR EQUIPMENT.

B) SHOP COAT SPECIFICATIONS: APPLY AT A SPREADING RATE OF 400-450 SQUARE FEET PER GALLON ONE SHOP COAT OF READY MIXED RED LEAD BASE PAINT, CONFORMING TO FEDERAL SPECIFICATION TTP 86 F, TYPE 2 (OR LATEST REVISION). DRY FILM THICKNESS SHALL BE A MINIMUM OF 2.0 MILS. MANUFACTURER SHALL CERTIFY IN WRITING THAT HE CONFORMS TO THE SPECIFICATION.

C) SUPPLIERS: PAINT SHALL BE PURCHASED FROM ANY ONE OF THE FOLLOWING APPROVED SUPPLIERS:
1. CON LUX PAINT PRODUCTS - EDISON, NEW JERSEY
2. DEBEVOISE PAINT COMPANY - BROOKLYN, NEW YORK
3. E. I. DUPONT DE NEMOURS - WYNNEWOOD, PENNSYLVANIA
4. GLIDDEN PAINT COMPANY - CLEVELAND, OHIO
5. HARRISON PAINT & VARNISH - CANTON, OHIO
6. KEELER & LONG COMPANY - WATERBURY, CONNECTICUT
7. O'BRIEN CORPORATION - SOUTH BEND, INDIANA
8. PATTERSON SARGENT COMPANY - NEW BRUNSWICK, NEW JERSEY
9. PPG INDUSTRIES - PITTSBURGH, PENNSYLVANIA
10. SHERWIN WILLIAMS COMPANY - CLEVELAND, OHIO

D) PAINT SHALL BE APPLIED IN ACCORDANCE AND CONFORMING TO THE CURRENT FEDERAL (OSHA), STATE AND LOCAL HEALTH AND SAFETY REGULATIONS.

MATERIAL

FOR LISTING OF FABRICATORS, SEE DWG. 1-3451.

REFERENCE DRAWINGS

FOR LIST OF REFERENCE DRAWINGS SEE DWG. 1-3450

REVISIONS

DATE	NO.	DESCRIPTION	APPD.
7-11-78	3	DIMENSION CHANGED TO AGREE WITH SECTION 2. MC	HTS
4-11-78	2	ADDED DET. OF MK 3462-A2 FOR STRUCTURE Nº4	HTS
3-11-78	1	DELETED SLEEVES PS10 & PS11 CHANGED 2'-0 to 1'-6 Sec. 2-62	HTS

PROJECT 1301

BOTTOM ASH & WASTEWATER PONDS

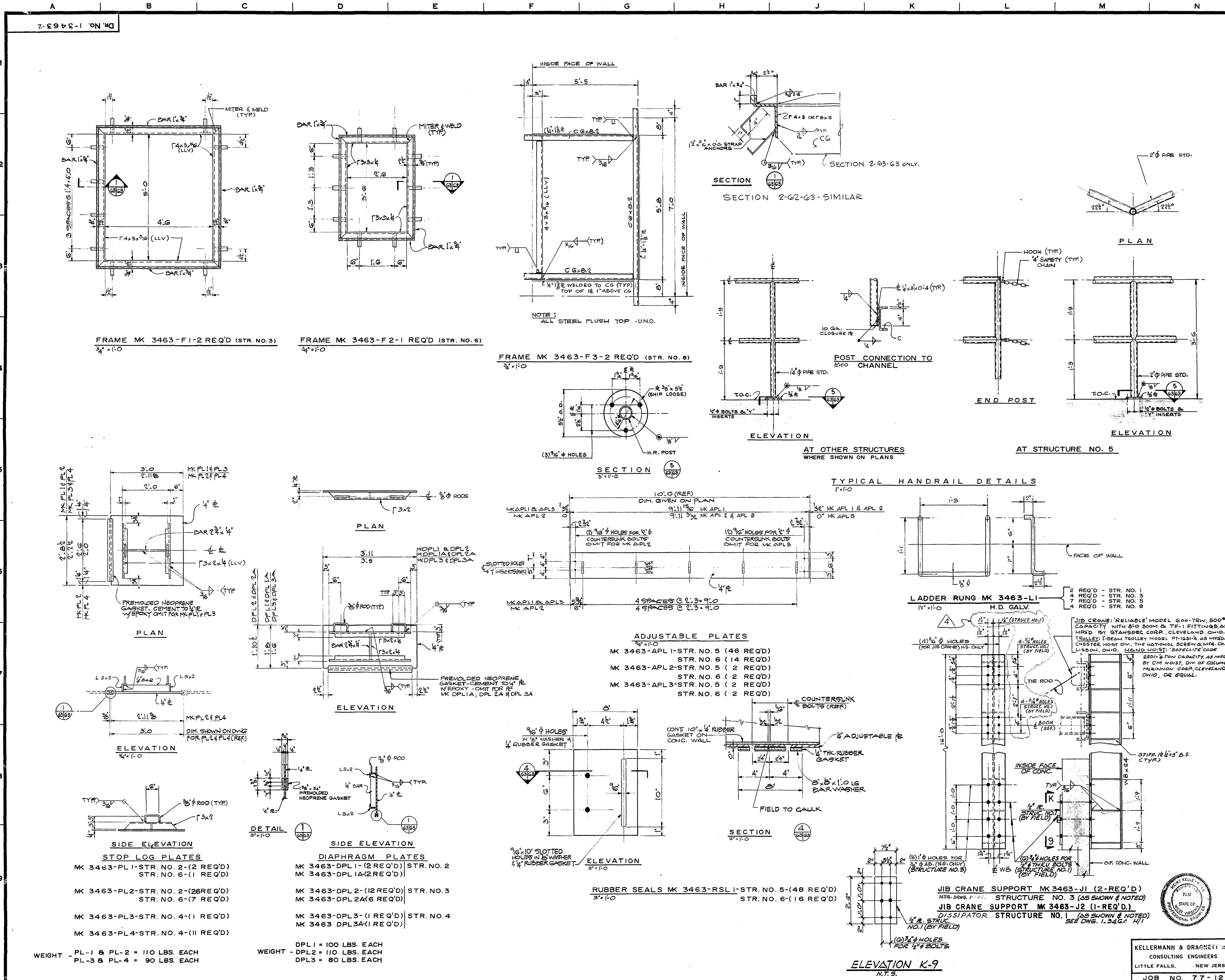
MISCELLANEOUS STEEL DETAILS SHEET NO.1

DR. NO. 1-3462-3

ARCH.	ELEC.	MECH.	STR.
			W.B.

SCALE: AS NOTED
DR. T.M.
CH. J.B.
SQ. LDR ANS
DATE: 1/12/78
APPROVED BY: ENGINEERING DIV / DESIGN DIV

AMERICAN ELECTRIC POWER SERVICE CORP.



GENERAL NOTES

FOR STRUCTURAL STEEL NOTES SEE DWG. 1-3462.

MATERIAL

FOR LISTING OF FABRICATORS, SEE DWG 1-3451

REFERENCE DRAWINGS

FOR LIST OF REFERENCE DRAWINGS SEE DWG. 1-3450.

REVISIONS

DATE	NO.	DESCRIPTION	APPD.
	4	AS PER RDR SP-OG-555, REVISED HOLES FOR JIB CRANE SUPPORT J-2, STRUCTURE NO. 1 (BY FIELD)	SF
	3	AS PER RDR SP-OG-555 ADD: JIB CRANE SUPPORT FOR STRUCTURE NO. 1 MK 3463-J2 (BY FIELD)	SF
	2	STRUCTURE NO. 4 - CHANGED MK 3463-PL4 FROM 9 TO 11 REQ'D	
2-17-78	1	REV. FRAME MK 3463-F3 DELETED SECT. 3-63-63	

PROJECT 1301

BOTTOM ASH & WASTEWATER PONDS

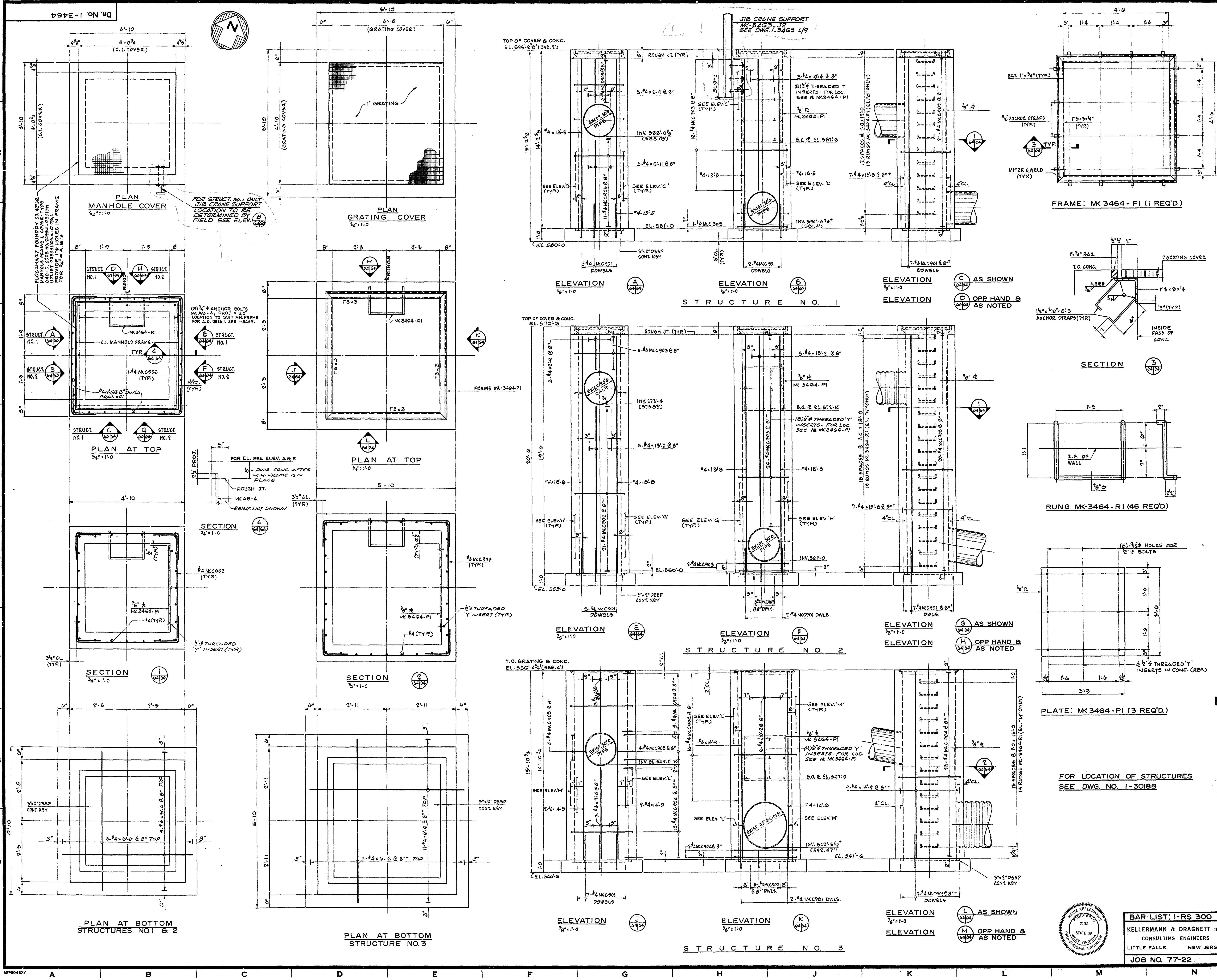
MISCELLANEOUS STEEL DETAILS SHEET NO. 2

DR. NO. 1-3463-4

KELLERMANN & DRAGNETT INC.
CONSULTING ENGINEERS
LITTLE FALLS, NEW JERSEY

JOB NO. 77-12

AMERICAN ELECTRIC POWER SERVICE CORP.



GENERAL NOTES

FOR CONCRETE NOTES SEE DWG. 1-3450.
FOR STRUCTURAL STEEL NOTES SEE DWG. 1-3462.
FOR GRATING NOTES SEE DWG. 1-3453

MATERIAL

CONCRETE	25.0 CU. YDS.
REINFORCING	1.2 TONS

FOR LISTING OF FABRICATORS, SEE DWG 1-3451

REFERENCE DRAWING

FOR LIST OF REFERENCE DRAWINGS SEE DWG. 1-3450.

REVISIONS

DATE	NO.	DESCRIPTION	APPD.
11/26/80	1	AS PER RDR. SP-OG-555 ADD.: JIB CRANE SUPPORT (BY FIELD) B/2 H/1	SF

PROJECT 1301

BOTTOM ASH & WASTEWATER PONDS

CONCRETE DISSIPATOR STRUCTURES NO.1, 2 & 3 MASONRY, REINFORCING & MISCELLANEOUS DETAILS

DR. NO. 1-3464-1

BAR LIST: 1-RS 300

KELLERMANN & DRAGNETT INC.
CONSULTING ENGINEERS
LITTLE FALLS. NEW JERSEY

JOB NO. 77-22

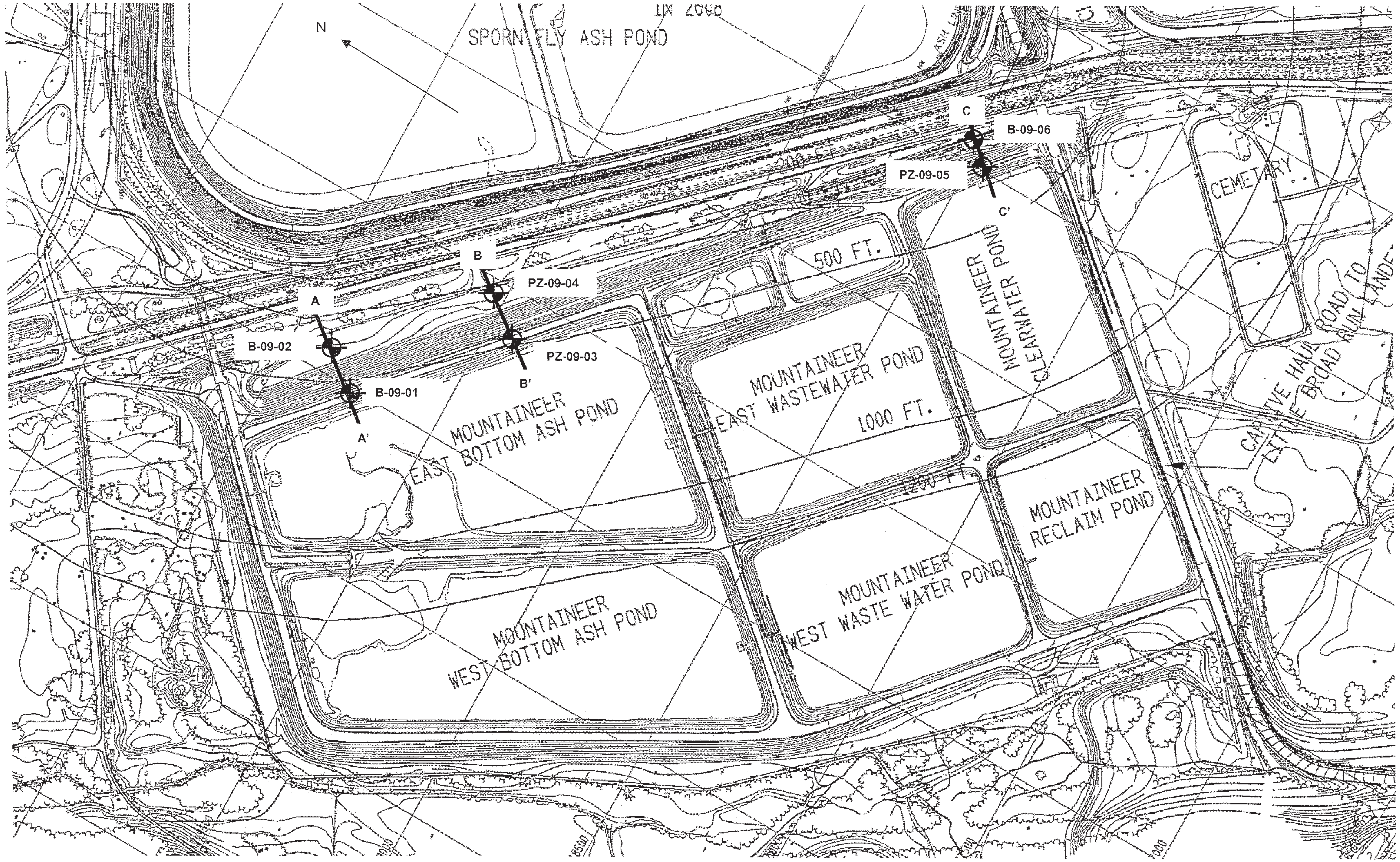
SCALE: AS NOTED
DR. S.A.M.
CH. J.B
SQ. LDR ANS
DATE: 12/14/77

APPROVED BY — ENGINEERING DIV — DESIGN DIV

AMERICAN ELECTRIC POWER SERVICE CORP.

<u>ATTACHMENT D</u>

INSTRUMENTATION LOCATION MAP



Approximate Boring Location		
Slope Stability Cross Section Lines		

Project Mngr:	YSR	Project No.	N2095019
Drawn By:	YSR	Scale:	NTS
Checked By:	YSR	File No.	N2095019
Approved By:		Date:	2/23/2009

Terracon
Consulting Engineers and Scientists
Charleston, West Virginia

Boring Location Diagram

Mountaineer Bottom Ash Pond Complex
New Haven, West Virginia
American Electric Power

FIG. No. 1

AEPMTP-000145

ATTACHMENT E

HYDROLOGY AND HYDROLOGIC REPORT

Hydrologic and Hydraulic Analysis Report

Mountaineer Plant Bottom Ash Pond Complex
New Haven, West Virginia

September 2015

Terracon Project Number: N4155129

Prepared for:

American Electric Power
1 Riverside Plaza
Columbus, Ohio

Prepared by:

Terracon Consultants, Inc.
Columbus, Ohio

September 30, 2015

American Electric Power
1 Riverside Plaza
Columbus, OH 43215

Attn: Mr. Brett Dreger
P: [614] 716 2258
E: badreger@aep.com

Re: Hydrologic and Hydraulic Analysis, and Professional Engineer Certification
Mountaineer Plant Bottom Ash Pond Complex, New Haven, West Virginia
Terracon Project Number: N4155129

Dear Mr. Dreger:

Terracon Consultants, Inc. is submitting the enclosed report for the Hydrologic and Hydraulic analysis and P.E. Certification for AEP Mountaineer Plant Bottom Ash Pond Complex located near New Haven, West Virginia. The report analyzes the impoundment's existing design and outlet structures for conformance with the recently mandated USEPA rule 40 CFR Part 257, Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities (CCR rules) and provides a professional engineer certification.

If you have any questions regarding this submittal, please contact me at (614) 328-5184.

Sincerely,
Terracon Consultants, Inc.

Baba M. Yahaya, P.E.
Project Engineer

Mohammad S. Finy, P.E
Department Manager, Geo-Environmental Services

Enclosure

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1.0 INTRODUCTION

This report provides hydrologic and hydraulic analysis of the existing Bottom Ash Pond Complex (impoundment facility) of the Mountaineer Plant (plant) located near Mason County, West Virginia. The site location is shown on Exhibit 1. The plant uses the impoundment facility to temporarily store Coal Combustion Residuals (CCR). The impoundment facility consists of a series of ponds, and a metal cleaning tank secondary containment basin as shown on Exhibit 2. Six of the ponds including: East Bottom Ash Pond, West Bottom Ash Pond, East Wastewater Pond, West Wastewater Pond, Reclaim Water Pond, and Clearwater Pond are interconnected and receive mainly CCR and stormwater pumped from the plant to the system as its major external influent. The other source of influent is direct precipitation that falls within the perimeter of the impoundment facility during a storm event. The pond complex is isolated from any significant storm water inflow from adjacent catchment areas. The CCR is pumped into the system at the active Bottom Ash Pond and Wastewater Pond, and the effluent from the system eventually discharges through an outlet structure located in the Clearwater Pond.

The intent of this analysis is to determine whether or not the impoundment facility meets the April 17, 2015 USEPA mandated CCR rules requirements.

According to the CCR rules, CCR surface impoundments shall comply with the hydrologic and hydraulic capacity requirements specified under Section 257.82 of the rules and presented below:

Section 257.82

(a) The owner or operator of an existing or new CCR surface impoundment or any lateral expansion of a CCR surface impoundment must design, construct, operate, and maintain an inflow design flood control system as specified in paragraphs (a)(1) and (a)(2) of this section.

   (1) The inflow design flood control system must adequately manage flow into the CCR unit during and following the peak discharge of the inflow design flood specified in paragraph (a)(3) of this section.
   (2) The inflow design flood control system must adequately manage flow from the CCR unit to collect and control the peak discharge resulting from the inflow design flood specified in paragraph (a)(3) of this section.
   (3) The inflow design flood is:
      (i) For a high hazard potential CCR surface impoundment, as determined under section 257.73(a)(2) or section 257.74(a)(2), the probable maximum flood;
      (ii) For a significant hazard potential CCR surface impoundment, as determined under section 257.73(a)(2) or section 257.74(a)(2), the 1,000-year flood;

(iii) For a low hazard potential CCR surface impoundment, as determined under section 257.73(a)(2) or section 257.74(a)(2), the 100-year flood; or

(iv) For an incised CCR surface impoundment, the 25-year flood.

(b) Discharge from the CCR unit must be handled in accordance with the surface water requirements under section 257.3-3.

(c) Inflow design flood control system plan.

(1) Content of the plan. The owner or operator must prepare initial and periodic inflow design flood control system plans for the CCR unit according to the timeframes specified in paragraphs (c)(3) and (c)(4) of this section. These plans must document how the inflow design flood control system has been designed and constructed to meet the requirements of this section. Each plan must be supported by appropriate engineering calculations. The owner or operator of the CCR unit has completed the inflow design flood control system plan when the plan has been placed in the facility's operating record as required by section 257.105(g)(4).

(2) Amendment of the plan. The owner or operator of the CCR unit may amend the written inflow design flood control system plan at any time provided the revised plan is placed in the facility's operating record as required by § 257.105(g)(4). The owner or operator must amend the written inflow design flood control system plan whenever there is a change in conditions that would substantially affect the written plan in effect.

(3) Timeframes for preparing the initial plan.

(i) Existing CCR surface impoundments. The owner or operator of the CCR unit must prepare the initial inflow design flood control system plan no later than October 17, 2016.

(ii) New CCR surface impoundments and any lateral expansion of a CCR surface impoundment. The owner or operator must prepare the initial inflow design flood control system plan no later than the date of initial receipt of CCR in the CCR unit.

(4) Frequency for revising the plan. The owner or operator must prepare periodic inflow design flood control system plans required by paragraph (c)(1) of this section every five years. The date of completing the initial plan is the basis for establishing the deadline to complete the first periodic plan. The owner or operator may complete any required plan prior to the required deadline provided the owner or operator places the completed plan into the facility's operating record within a reasonable amount of time. In all cases, the deadline for completing a subsequent plan is based on the date of completing the previous plan. For purposes of this paragraph, the owner or operator has completed an inflow design flood control system plan when the plan has been placed in the facility's operating record as required by section 257.105(g)(4).

(5) The owner or operator must obtain a certification from a qualified professional engineer stating that the initial and periodic inflow design flood control system plans meet the requirements of this section.

(d) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in section 257.105(g), the notification requirements specified in section 257.106(g), and the internet requirements specified in section 257.107(g).

2.0 INFLOW DESIGN FLOOD CONTROL SYSTEM

As mentioned in section 1.0, inflow into the impoundment facility include CCR and stormwater from various sources pumped into the facility; and direct precipitation that falls within the perimeter of the facility. Water from the Bottom Ash Ponds flow to the Wastewater Pond, which flow into the valve structure and can be discharged into the Reclaim Water Pond or the Clearwater Pond. Discharge water from the Reclaim Water Pond is either pumped back to the plant for recirculation, or flows to the Clearwater Pond and then to the Ohio River via an outfall structure. The CCR and stormwater are pumped into the facility through a series of pipes designed to handle the various required capacities. The pipes discharge into the facility through concrete vaults to handle the inflows. The Water from the Bottom Ash Ponds flows into the Wastewater Ponds through a reinforced concrete vertical drop inlet connected to a 48 inch diameter steel pipe located in the southern dikes of the Bottom Ash Ponds. The Wastewater Ponds drain either to the Reclaim Water Pond or the Clearwater Pond through a gated distribution structure. A 36 inch diameter steel pipe connects the Reclaim Pond to the Clearwater Pond. Effluent from the impoundment facility is discharged through an outlet structure located in the Clearwater Pond. The outlet structure consists of a concrete overflow channel leading to a vault/riser with a 30-inch diameter metal outflow pipe. The outflow pipe leads to a dissipation structure and another 30 inch steel pipe from the dissipation structure to an outfall at the Ohio River.

Water balance information provided by AEP indicates that influent is pumped into the facility at the rate of approximately 15 million gallons per day (MGD) (24 cfs) to the Bottom Ash Pond, 4 MGD (6 cfs) to the Wastewater pond; and 1 MGD (2cfs) to the Clearwater Pond. Information on the influent is presented in Attachment 1. The additional inflow due to direct precipitation is dependent on the hazard potential classification of the facility. For the purpose of this analysis, the facility is classified as a “significant hazard potential” facility. The hazard potential classification approach is presented in Section 2.2 of this report. The additional inflow under this significant hazard potential classification is estimated as the peak discharge during and following the 1000-year flood. The peak discharge from the 1000-year inflow design flood is estimated using Bentley’s PondPack software (see Section 2.3 of this report).

2.1 Hazard Potential Classification

Hazard potential classification means the possible adverse incremental consequences that result from the release of water or stored contents due to failure of the diked CCR surface impoundment or mis-operation of the diked CCR surface impoundment or its appurtenances. The hazardous potential classifications for CCR surface impoundment include high hazard potential, significant hazard potential, and low hazard potential.

- A High hazard potential CCR surface impoundment means a diked surface impoundment where failure or mis-operation will probably cause loss of human life.

- A significant hazard potential CCR surface impoundment means a diked surface impoundment where failure or mis-operation results in no probable loss of human life, but can cause economic loss, environmental damage, disruption of lifeline facilities, or impact other concerns.

- A Low hazard potential CCR surface impoundment means a diked surface impoundment where failure or mis-operation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the surface impoundment owner's property.

The Mountaineer Plant Bottom Ash Pond Complex is bounded to the north by the Mountaineer Plant, to the south by a power substation to the west by a material processing unit and to the east by Highway 62. A breach of the dikes and loss of the impoundment may result in a release of bottom ash and wastewater into Little Broad Run and the Ohio River, which would be a moderate environmental and economic concern. Minor flooding would be expected within plant property, along the haul road and State Route 62, and onto the property of the adjacent decommissioned Sporn Plant. The facility's location, configuration, and operation are such that failure or mis-operation may result in no probable loss of human life, but can cause economic loss, environmental damage, and disruption to lifeline facilities. As a result of this assessment, the facility is classified as a significant hazard potential impoundment.

Pursuant to Section 257.73(a)(2) of the CCR rules, the hazard potential classification assessments of this facility will be performed every five years.

2.2 Computation Methods

The impoundment facility was modeled and analyzed for its adequacy to collect and control the peak discharge resulting from 1000-year design storm using Bentley's PondPack software (PondPack).

PondPack is a versatile software program to model site drainage studies. The program can be used to model rainfall and runoff from watersheds to detention and retention facilities, outlet structures, and channels.

Development of the PondPack model requires catchment area, runoff curve number and time of concentration and input defining the facility's structural components, including pond, inlet, and outlet structures. Operationally, the east and west Bottom Ash/Wastewater Ponds operate in alternate sequences where the active set receives influent and the inactive set is cleaned out. For this analysis, a scenario in which water flow from the East Bottom Ash Pond to the East Wastewater Pond and to the Clearwater Pond is considered and modeled (See Exhibit 3). Each ponds surface area defines it catchment area. A precipitation depth of 7 inches corresponding to the 1000 year storm (see Attachment 1) was used. A curve number of 100 was used since the rainfall will be direct runoff. A minimum time of concentration of 5 minutes was used. The Water from the Bottom Ash Ponds flows into the Wastewater Ponds through a reinforced concrete vertical drop inlet connected to a 48 inch diameter steel pipe located in the southern dikes of the Bottom Ash Ponds. The Wastewater Ponds drain either to the Reclaim Water Pond or the Clearwater Pond through a gated distribution structure. A 36 inch diameter steel pipe connects the Reclaim Pond to the Clearwater Pond. A 30 inch diameter steel pipe leads from the Clearwater Pond to a dissipation structure, and another 30 inch steel pipe from the dissipation structure to an outfall at the Ohio River.

2.3 Results

The PondPack analysis, the maximum water surface elevation and freeboard resulting from the 1000-year flood are summarized in the table below:

Pond	Maximum Water Elevation (ft)	Freeboard (ft)
East Bottom Ash Pond	613.3	6.7
East Wastewater Pond	609.3	2.7
Clearwater Pond	603.6	6.4

It can be concluded from the above results that the Bottom Ash Pond Complex has adequate hydrologic and hydraulic capacity to collect and control the peak discharge resulting from the 1000-year inflow design flood and therefore meets the April 17, 2015 USEPA mandated CCR rules requirements.

3.0 DISCHARGE FROM THE IMPOUNDMENT FACILITY

The discharge from the impoundment facility to the Ohio River is handled in accordance with the Plant's NPDES Permit. This conforms to the requirements Section 257.82 (b) of the CCR rules.

4.0 INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN

The inflow design flood control system plan will be prepared pursuant to Section 257.82 (c) of the CCR rules. The plan will document how the inflow design flood control system has been designed and constructed to meet the rules requirements.

5.0 RECORDKEEPING, NOTIFICATION, AND INTERNET REQUIREMENTS

Pursuant to Sections 257.105(g), 257.106(g) and 257.107(g), the initial and periodic inflow design flood control system plan as required by Section 257.82(c) will be placed in the facility's operating records, as well as published on the facility's CCR rule compliance data information website. AEP will notify the Director of West Virginia Department of Environmental Protection when the information is placed in the operating record and on the website.

6.0 REFERENCES

- AEP Project Number 1301 Drawing Numbers 1-3018A-7, 1-3018B-8, and 1-3018C, containing cross section and details for the Mountaineer Bottom Ash Complex.

- Report on Dam Safety Inspection, Bottom Ash Pond Complex. Prepared by Woodward-Clyde Consultants, Inc. Wayne, New. January 1985.

7.0 P.E. CERTIFICATION

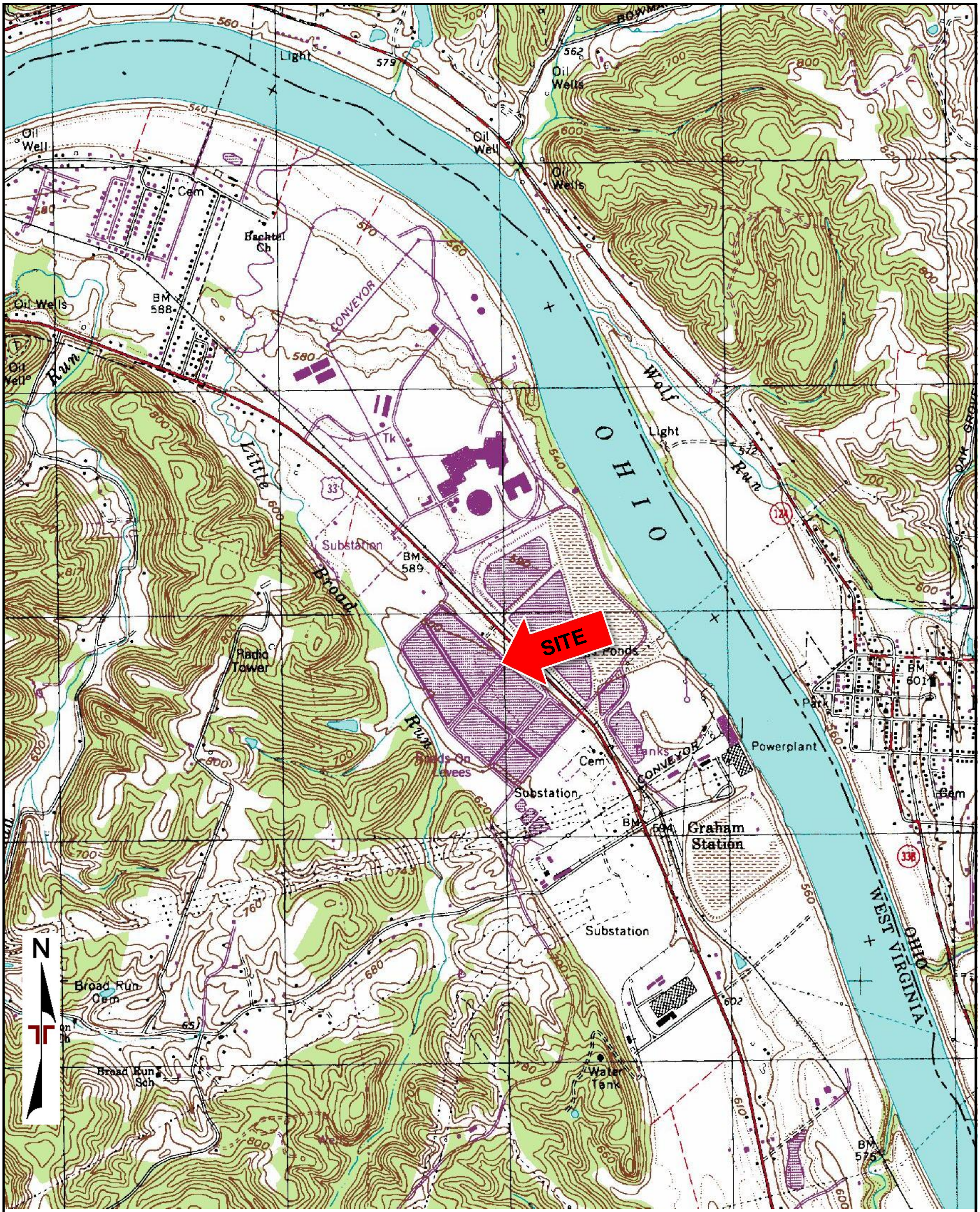
Based on the site reconnaissance visit, hazard potential assessment, and the hydrologic and hydraulic analysis performed by Terracon personnel, I hereby certify that the significant hazard potential classification for the Mountaineer Plant Bottom Ash Pond Complex in this report was conducted in accordance with requirements of Section 257.73 of the CCR Rules and that the facility has adequate hydrologic and hydraulic capacity to collect and control the peak discharge resulting from 1000-year design storm.

STATE OF OHIO
MOHAMMAD S. FINY
69705
REGISTERED PROFESSIONAL ENGINEER

9-30-2015

Mohammad S. Finy, P.E.
Certifying Engineer
E-69705

EXHIBITS



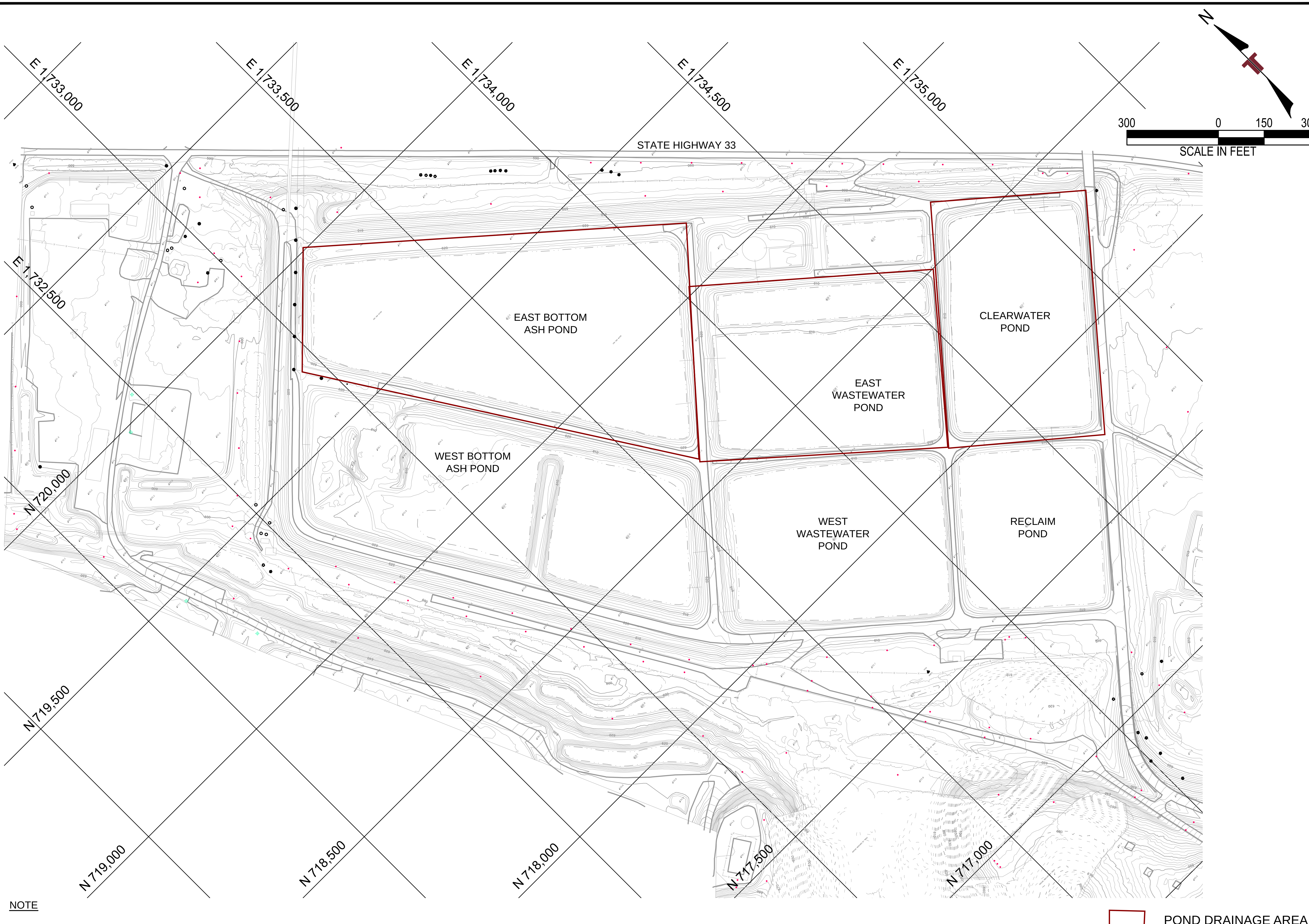
TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY
QUADRANGLES INCLUDE: NEW HAVEN, WV (1/1/1994).

Project Manager: BYM	Project No. N4155129	Terracon	SITE LOCATION MAP	Exhibit
Drawn by: DAB	Scale: 1"=24,000 SF	800 MORRISON ROAD	MOUNTAINEER PLANT IMPOUNDMENT CERTIFICATION	1-A
Checked by: MSF	File Name: Siteloc2	COLUMBUS, OHIO 43230	AMERICAN ELECTRIC POWER	
Approved by: KMF	Date: 9/29/15		MOUNTAINEER PLANT BOTTOM ASH POND COMPLEX	

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

Project Manager: BYM	Project No. N4155129	Terracon 800 MORRISON ROAD COLUMBUS, OHIO 43230	SITE LOCATION MAP	Exhibit
Drawn by: DAB	Scale: AS SHOWN		MOUNTAINEER PLANT IMPOUNDMENT CERTIFICATION AMERICAN ELECTRIC POWER MOUNTAINEER PLANT BOTTOM ASH POND COMPLEX	1-B
Checked by: MSF	File Name: Siteloc2			
Approved by: KME	Date: 9/29/15			



NOTE

THE AERIAL TOPOGRAPHY WAS OBTAINED FROM HENDERSON AERIAL SURVEYS INC., DATED 3/20/2012.

EXHIBIT 2

DESIGNED BY:	BMY
DRAWN BY:	DAB
APP'VD. BY:	MSF
SCALE:	1"=300'
DATE:	9/29/15
JOB NO.	N4155129
ACAD NO.	SET1
SHEET NO.:	2 OF 3

SITE PLAN

MOUNTAINEER PLANT IMPOUNDMENT CERTIFICATION

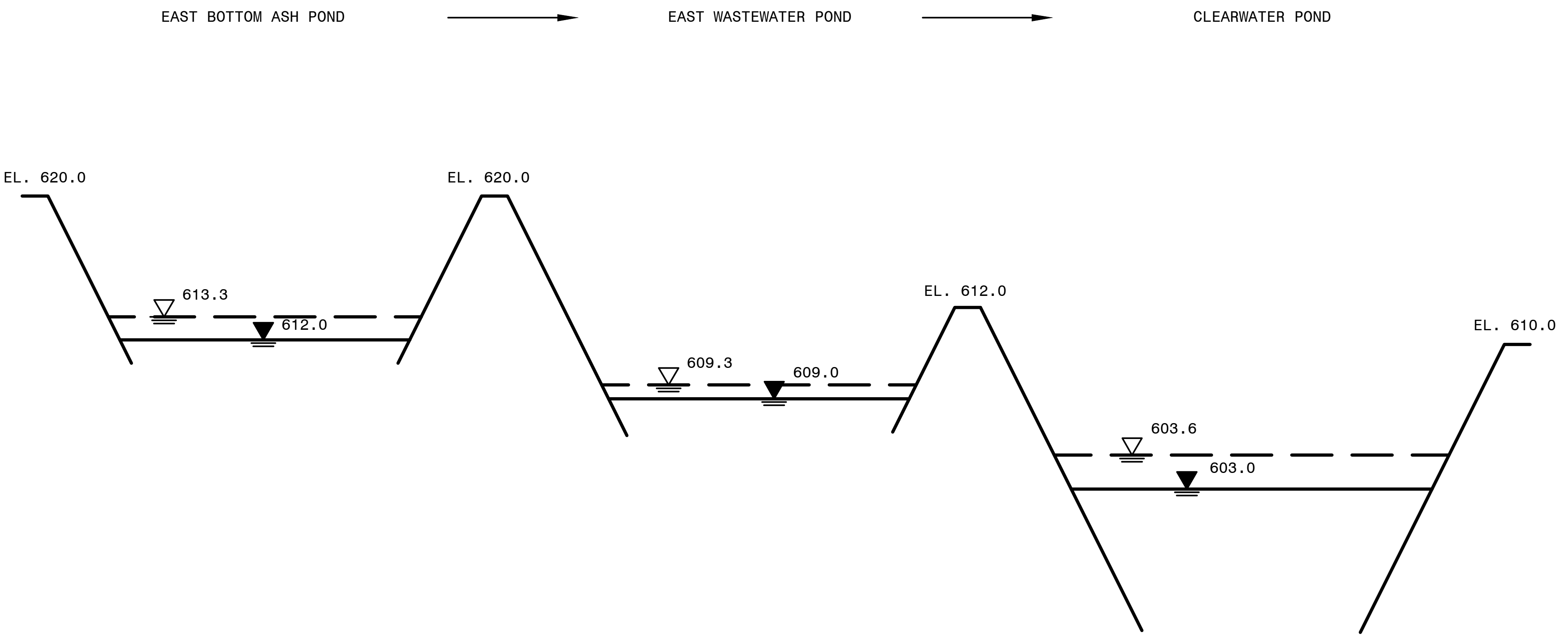
AMERICAN ELECTRIC POWER

MOUNTAINEER PLANT BOTTOM ASH POND COMPLEX

NEW HAVEN, MASON COUNTY WV

Terracon
Consulting Engineers and Scientists
800 MORRISON ROAD COLUMBUS, OHIO 43230
PH. (614) 863-3113 FAX. (614) 863-0475

REV.	DATE	BY	DESCRIPTION



LEGEND

613.3 MAX. RESULTANT POOL LEVELS DURING THE DESIGN STORM

603.0 NORMAL OPERATING POOL LEVELS

NOTE:

EMBANKMENT CREST ELEVATIONS AND NORMAL OPERATING POOL LEVELS SHOWN TAKEN FROM AEP PROVIDED DRAWINGS 1-3018A-7, 1-3018B-8, AND 1-3018C-5, CONTAINING SECTIONS AND DETAILS FOR THE POND COMPLEX.

REV.	DATE	BY	DESCRIPTION

Terracon
Consulting Engineers and Scientists
800 MORRISON ROAD, COLUMBUS, OHIO 43230
PH. (614) 863-3113 FAX. (614) 863-0475

POND SCHEMATIC
MOUNTAINEER PLANT IMPOUNDMENT CERTIFICATION
AMERICAN ELECTRIC POWER
MOUNTAINEER PLANT BOTTOM ASH POND COMPLEX
NEW HAVEN, MASON COUNTY WV

EXHIBIT 3

DESIGNED BY:	BMY
DRAWN BY:	DAB
APPVD. BY:	MSF
SCALE:	NTS
DATE:	9/30/15
JOB NO.	N4155129
ACAD NO.	SET1
SHEET NO.:	3 OF 3

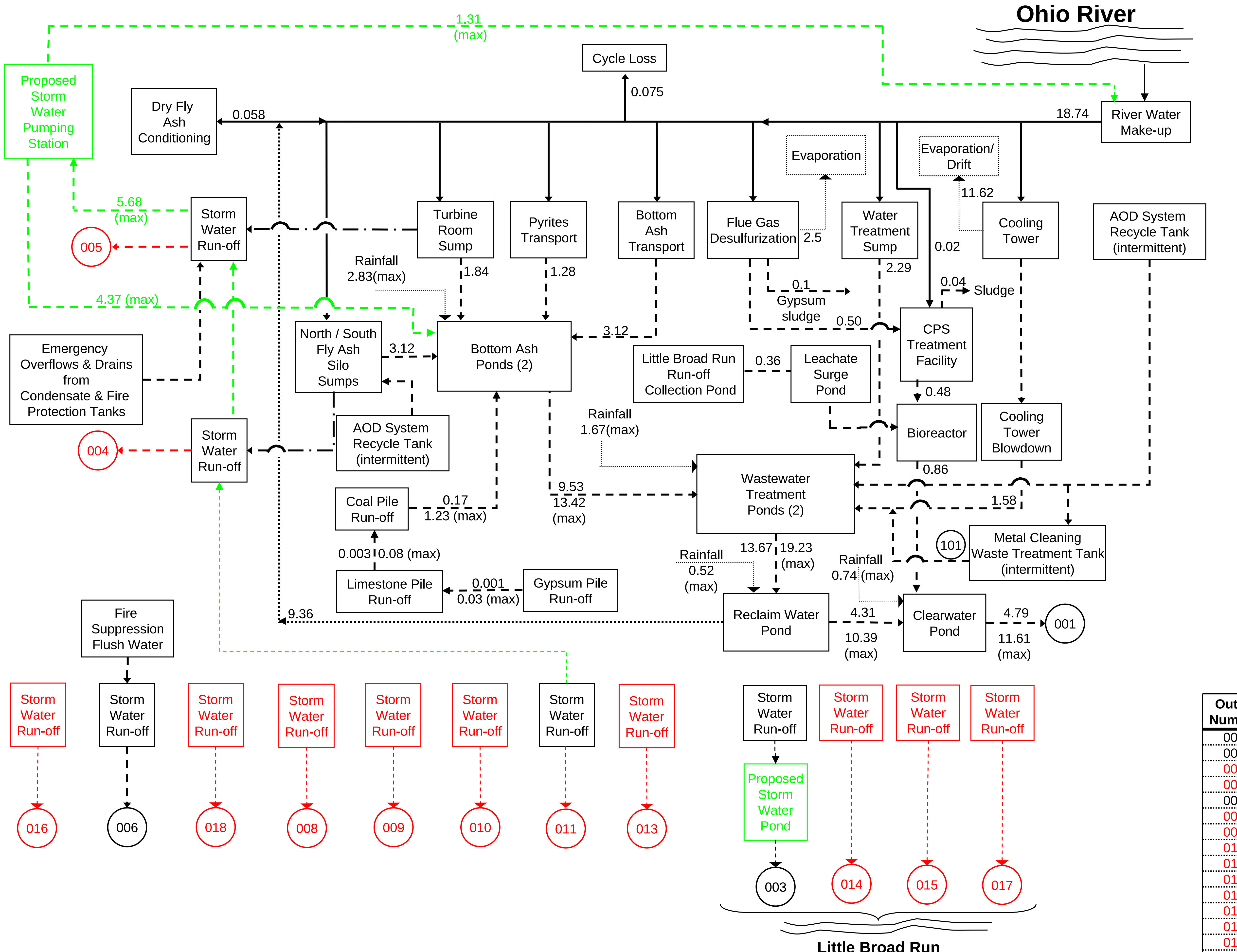
ATTACHMENT 1

Pumped Influent and Water Balance Information

Mountaineer Plant Impoundment System
Pumped Influent

Influent Sources	Rate (mgd)	cfs
To Bottom Ash Pond		
Coal Pile Run-off	1.23	
Fly Ash Silo Sumps	3.12	
Stormwater	4.37	
Turbine Room Sump	1.84	
Pyrites Transport	1.28	
Bottom Ash Transport	3.12	
Total	**14.96**	**24**
To Wastewater Pond		
Water Treatment Sump	2.29	
Cooling Tower Blowdown	1.58	
Total	**3.87**	**6**
To Bottom Ash Pond		
Bioreactor	0.86	**2**

Note:
Influent pumped is compiled from the attached water balance data provided by AEP.



Appalachian Power Co.

Mountaineer Plant

Water Balance Flow Diagram

NOTES

Note 1: All flows represent average water usage with the unit operating at full load.

Note 2: Maximum (max) flows include rainfall for a 10-year/24-hour storm event.

Note 3: Maximum (max) flow entering the Storm Water Pumping Station (SWPS) is the 24 hours of highest intensity in a 10 year/24-hour storm event.

Note 4: The design overflow of the SWPS to the River Water Make-up is anything over a 1" storm in a 24-hour period.

Note 5: Proposed storm water management modifications indicated in **GREEN**, and proposed storm water management terminations indicated in **RED**.

LEGEND

- Supply Water
- Waste Water
- Reclaim Water
- Storm Water
- Evaporation/Rainfall
- No flow associated with normal operating conditions (emergency overflow)
- ### Outlet Number

Outlet Number	Receiving Water	Average Discharge	Maximum Discharge
001	Ohio River	4.79	11.61
003	Little Broad Run	0.169	3.978
004	Ohio River	0.110	2.605
005	Ohio River	0.307	7.238
006	Ohio River	0.019	0.458
008	Ohio River	0.003	0.062
009	Ohio River	0.006	0.134
010	Ohio River	0.001	0.029
011	Ohio River	0.009	0.216
013	Ohio River	0.012	0.273
014	Little Broad Run	0.001	0.026
015	Little Broad Run	0.011	0.252
016	Ohio River	0.004	0.098
017	Little Broad Run	0.002	0.064
018	Ohio River	0.001	0.024

Revision date 12/28/2012 - Drawing is intended to communicate water flow for NPDES Permitting purposes.
Not to be used for any other purposes.

All flows measured in million gallons per day (MGD)

ATTACHMENT 2

Precipitation Data

NOAA Atlas 14, Volume 2, Version 3
Location name: Letart, West Virginia, US*
Latitude: 38.9697°, Longitude: -81.9364°
Elevation: 621 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.337 (0.305-0.371)	0.401 (0.364-0.442)	0.481 (0.436-0.530)	0.542 (0.491-0.597)	0.619 (0.558-0.680)	0.677 (0.610-0.742)	0.732 (0.656-0.801)	0.786 (0.703-0.859)	0.857 (0.761-0.934)	0.907 (0.803-0.988)
10-min	0.523 (0.474-0.576)	0.625 (0.568-0.691)	0.747 (0.678-0.824)	0.837 (0.758-0.921)	0.947 (0.854-1.04)	1.03 (0.924-1.13)	1.10 (0.988-1.21)	1.17 (1.05-1.28)	1.26 (1.12-1.37)	1.32 (1.17-1.44)
15-min	0.641 (0.581-0.706)	0.765 (0.694-0.845)	0.917 (0.832-1.01)	1.03 (0.933-1.13)	1.17 (1.06-1.29)	1.27 (1.14-1.39)	1.37 (1.23-1.50)	1.46 (1.31-1.60)	1.57 (1.40-1.71)	1.65 (1.46-1.80)
30-min	0.848 (0.769-0.934)	1.02 (0.929-1.13)	1.26 (1.14-1.39)	1.43 (1.30-1.57)	1.65 (1.49-1.81)	1.82 (1.64-1.99)	1.98 (1.77-2.16)	2.13 (1.90-2.33)	2.33 (2.07-2.54)	2.48 (2.19-2.70)
60-min	1.04 (0.939-1.14)	1.26 (1.14-1.39)	1.58 (1.43-1.74)	1.82 (1.65-2.00)	2.14 (1.93-2.35)	2.39 (2.15-2.62)	2.64 (2.37-2.89)	2.89 (2.58-3.16)	3.22 (2.86-3.51)	3.48 (3.08-3.79)
2-hr	1.21 (1.10-1.33)	1.46 (1.33-1.61)	1.84 (1.67-2.02)	2.13 (1.92-2.33)	2.52 (2.27-2.76)	2.84 (2.55-3.10)	3.16 (2.82-3.45)	3.50 (3.11-3.80)	3.95 (3.48-4.28)	4.31 (3.78-4.66)
3-hr	1.28 (1.16-1.41)	1.54 (1.40-1.70)	1.93 (1.76-2.13)	2.24 (2.03-2.47)	2.66 (2.41-2.92)	3.00 (2.70-3.29)	3.36 (3.01-3.67)	3.72 (3.31-4.06)	4.23 (3.73-4.60)	4.62 (4.06-5.02)
6-hr	1.52 (1.39-1.67)	1.82 (1.67-2.01)	2.26 (2.07-2.49)	2.62 (2.39-2.87)	3.12 (2.83-3.41)	3.54 (3.19-3.85)	3.96 (3.56-4.31)	4.41 (3.94-4.78)	5.04 (4.45-5.44)	5.54 (4.86-5.97)
12-hr	1.79 (1.65-1.94)	2.13 (1.96-2.32)	2.61 (2.41-2.85)	3.02 (2.78-3.28)	3.59 (3.29-3.88)	4.06 (3.70-4.38)	4.56 (4.13-4.90)	5.08 (4.58-5.45)	5.82 (5.19-6.23)	6.42 (5.68-6.85)
24-hr	2.14 (2.01-2.28)	2.55 (2.40-2.72)	3.09 (2.90-3.29)	3.53 (3.31-3.76)	4.14 (3.88-4.40)	4.64 (4.33-4.92)	5.15 (4.79-5.46)	5.68 (5.27-6.01)	6.41 (5.92-6.77)	6.98 (6.42-7.37)
2-day	2.55 (2.40-2.71)	3.02 (2.85-3.22)	3.63 (3.41-3.86)	4.11 (3.87-4.37)	4.78 (4.48-5.07)	5.31 (4.96-5.63)	5.85 (5.45-6.20)	6.40 (5.95-6.78)	7.16 (6.61-7.58)	7.74 (7.12-8.19)
3-day	2.74 (2.58-2.90)	3.24 (3.06-3.45)	3.87 (3.65-4.11)	4.37 (4.12-4.64)	5.05 (4.75-5.35)	5.59 (5.24-5.92)	6.13 (5.73-6.48)	6.68 (6.23-7.07)	7.42 (6.88-7.84)	7.98 (7.37-8.43)
4-day	2.93 (2.77-3.10)	3.46 (3.27-3.67)	4.12 (3.89-4.37)	4.64 (4.38-4.91)	5.33 (5.02-5.64)	5.87 (5.51-6.21)	6.41 (6.01-6.77)	6.96 (6.50-7.35)	7.67 (7.14-8.10)	8.22 (7.63-8.67)
7-day	3.52 (3.33-3.72)	4.16 (3.94-4.40)	4.90 (4.63-5.17)	5.46 (5.16-5.76)	6.20 (5.85-6.54)	6.76 (6.37-7.13)	7.32 (6.88-7.71)	7.86 (7.37-8.27)	8.56 (8.00-9.01)	9.08 (8.46-9.57)
10-day	4.03 (3.82-4.25)	4.75 (4.50-5.01)	5.53 (5.24-5.83)	6.12 (5.80-6.45)	6.89 (6.51-7.25)	7.47 (7.05-7.85)	8.02 (7.56-8.44)	8.56 (8.05-9.00)	9.24 (8.67-9.72)	9.73 (9.11-10.2)
20-day	5.62 (5.34-5.91)	6.59 (6.26-6.92)	7.56 (7.18-7.94)	8.28 (7.87-8.69)	9.20 (8.73-9.65)	9.87 (9.37-10.4)	10.5 (9.96-11.0)	11.1 (10.5-11.6)	11.8 (11.2-12.4)	12.4 (11.7-13.0)
30-day	6.94 (6.64-7.26)	8.11 (7.76-8.49)	9.20 (8.80-9.63)	10.0 (9.57-10.5)	11.0 (10.5-11.5)	11.8 (11.2-12.3)	12.4 (11.9-13.0)	13.1 (12.4-13.7)	13.8 (13.1-14.5)	14.4 (13.6-15.0)
45-day	8.87 (8.50-9.26)	10.3 (9.89-10.8)	11.6 (11.1-12.1)	12.5 (12.0-13.1)	13.6 (13.1-14.2)	14.4 (13.8-15.1)	15.2 (14.5-15.9)	15.9 (15.1-16.6)	16.6 (15.9-17.4)	17.2 (16.4-18.0)
60-day	10.5 (10.1-11.0)	12.2 (11.7-12.7)	13.6 (13.1-14.2)	14.6 (14.0-15.2)	15.8 (15.2-16.5)	16.7 (16.0-17.4)	17.5 (16.7-18.2)	18.1 (17.4-18.9)	18.9 (18.1-19.7)	19.5 (18.6-20.3)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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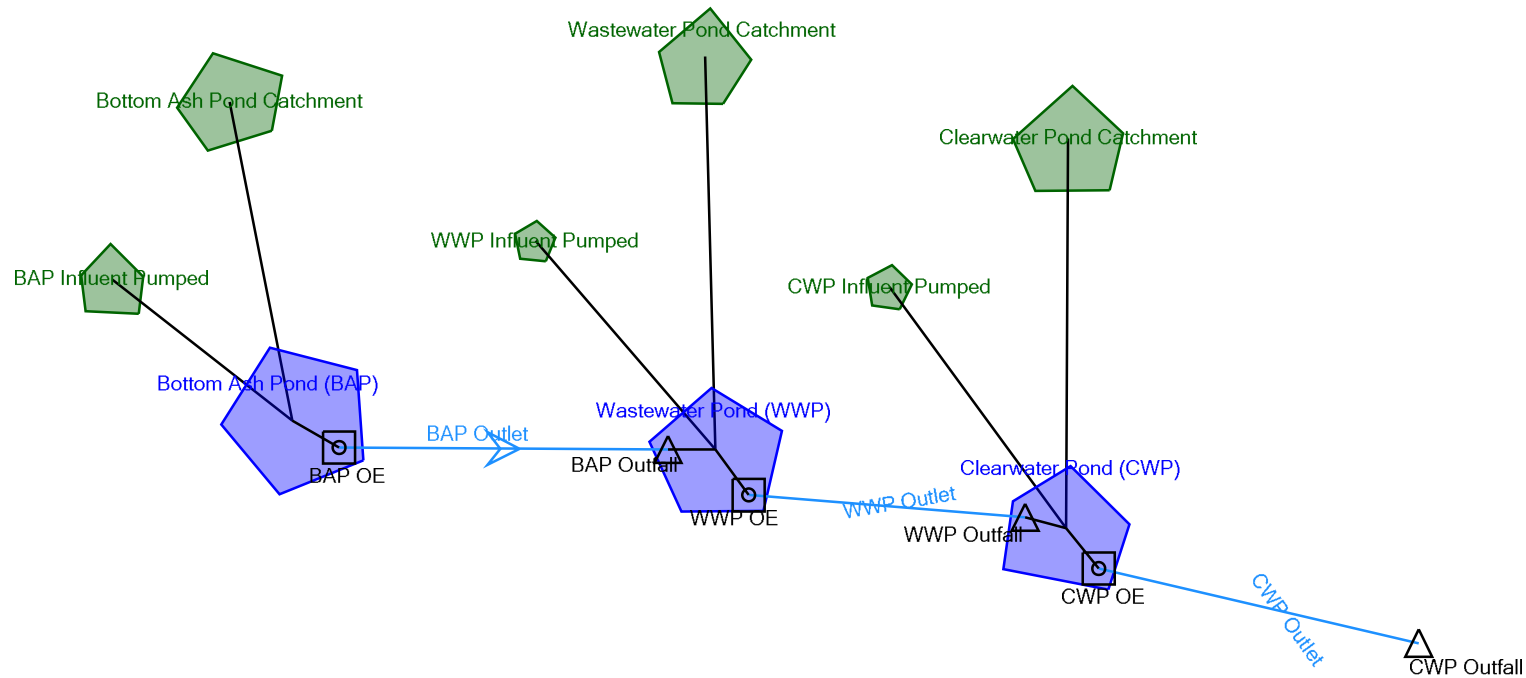
PF graphical

ATTACHMENT 3

PondPack Model Output

Scenario: Post-Development 1000 Year



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Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
BAP Influent Pumped	Post-Development 1000 Year	1,000	47.603	0.000	24.00
Bottom Ash Pond Catchment	Post-Development 1000 Year	1,000	9.300	11.900	143.80
CWP Influent Pumped	Post-Development 1000 Year	1,000	3.967	0.000	2.00
Clearwater Pond Catchment	Post-Development 1000 Year	1,000	5.230	11.950	76.86
WWP Influent Pumped	Post-Development 1000 Year	1,000	11.901	0.000	6.00
Wastewater Pond Catchment	Post-Development 1000 Year	1,000	6.102	11.950	89.67

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
CWP Outfall	Post-Development 1000 Year	1,000	73.655	12.350	77.07

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
Bottom Ash Pond (BAP) (IN)	Post-Development 1000 Year	1,000	56.903	11.900	167.80	(N/A)	(N/A)
Bottom Ash Pond (BAP) (OUT)	Post-Development 1000 Year	1,000	50.508	12.400	37.74	613.25	16.505
Clearwater Pond (CWP) (IN)	Post-Development 1000 Year	1,000	74.860	11.950	168.12	(N/A)	(N/A)
Clearwater Pond (CWP) (OUT)	Post-Development 1000 Year	1,000	73.655	12.350	77.07	603.55	3.877
Wastewater Pond (WWP) (IN)	Post-Development 1000 Year	1,000	68.511	11.950	129.67	(N/A)	(N/A)
Wastewater Pond (WWP) (OUT)	Post-Development 1000 Year	1,000	65.663	12.050	100.24	609.29	3.775

Peak Discharge	24.00 ft³/s
Time to Peak	7.900 hours
Hydrograph Volume	47.603 ac-ft

HYDROGRAPH ORDINATES (ft³/s)
Output Time Increment = 0.100 hours
Time on left represents time for first value in each row.

Time (hours)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)
0.000	24.00	24.00	24.00	24.00	24.00
0.500	24.00	24.00	24.00	24.00	24.00
1.000	24.00	24.00	24.00	24.00	24.00
1.500	24.00	24.00	24.00	24.00	24.00
2.000	24.00	24.00	24.00	24.00	24.00
2.500	24.00	24.00	24.00	24.00	24.00
3.000	24.00	24.00	24.00	24.00	24.00
3.500	24.00	24.00	24.00	24.00	24.00
4.000	24.00	24.00	24.00	24.00	24.00
4.500	24.00	24.00	24.00	24.00	24.00
5.000	24.00	24.00	24.00	24.00	24.00
5.500	24.00	24.00	24.00	24.00	24.00
6.000	24.00	24.00	24.00	24.00	24.00
6.500	24.00	24.00	24.00	24.00	24.00
7.000	24.00	24.00	24.00	24.00	24.00
7.500	24.00	24.00	24.00	24.00	24.00
8.000	24.00	24.00	24.00	24.00	24.00
8.500	24.00	24.00	24.00	24.00	24.00
9.000	24.00	24.00	24.00	24.00	24.00
9.500	24.00	24.00	24.00	24.00	24.00
10.000	24.00	24.00	24.00	24.00	24.00
10.500	24.00	24.00	24.00	24.00	24.00
11.000	24.00	24.00	24.00	24.00	24.00
11.500	24.00	24.00	24.00	24.00	24.00
12.000	24.00	24.00	24.00	24.00	24.00
12.500	24.00	24.00	24.00	24.00	24.00
13.000	24.00	24.00	24.00	24.00	24.00
13.500	24.00	24.00	24.00	24.00	24.00
14.000	24.00	24.00	24.00	24.00	24.00
14.500	24.00	24.00	24.00	24.00	24.00
15.000	24.00	24.00	24.00	24.00	24.00
15.500	24.00	24.00	24.00	24.00	24.00
16.000	24.00	24.00	24.00	24.00	24.00
16.500	24.00	24.00	24.00	24.00	24.00
17.000	24.00	24.00	24.00	24.00	24.00
17.500	24.00	24.00	24.00	24.00	24.00
18.000	24.00	24.00	24.00	24.00	24.00
18.500	24.00	24.00	24.00	24.00	24.00
19.000	24.00	24.00	24.00	24.00	24.00

Subsection: Read Hydrograph
Label: BAP Influent Pumped

Return Event: 1,000 years
Storm Event: 1000 Year

HYDROGRAPH ORDINATES (ft³/s)
Output Time Increment = 0.100 hours
Time on left represents time for first value in each row.

Time (hours)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)
19.500	24.00	24.00	24.00	24.00	24.00
20.000	24.00	24.00	24.00	24.00	24.00
20.500	24.00	24.00	24.00	24.00	24.00
21.000	24.00	24.00	24.00	24.00	24.00
21.500	24.00	24.00	24.00	24.00	24.00
22.000	24.00	24.00	24.00	24.00	24.00
22.500	24.00	24.00	24.00	24.00	24.00
23.000	24.00	24.00	24.00	24.00	24.00
23.500	24.00	24.00	24.00	24.00	24.00
24.000	24.00	(N/A)	(N/A)	(N/A)	(N/A)

Storm Event	1000 Year
Return Event	1,000 years
Duration	24.000 hours
Depth	7.0 in
Time of Concentration (Composite)	0.083 hours
Area (User Defined)	16.000 acres

Computational Time Increment	0.011 hours
Time to Peak (Computed)	11.911 hours
Flow (Peak, Computed)	146.03 ft^3/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	11.900 hours
Flow (Peak Interpolated Output)	143.80 ft^3/s

Drainage Area	
SCS CN (Composite)	100.000
Area (User Defined)	16.000 acres
Maximum Retention (Pervious)	0.0 in
Maximum Retention (Pervious, 20 percent)	0.0 in

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	7.0 in
Runoff Volume (Pervious)	9.307 ac-ft

Hydrograph Volume (Area under Hydrograph curve)	
Volume	9.300 ac-ft

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.083 hours
Computational Time Increment	0.011 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	217.54 ft^3/s
Unit peak time, Tp	0.056 hours

SCS Unit Hydrograph Parameters	
Unit receding limb, Tr	0.222 hours
Total unit time, Tb	0.278 hours

Storm Event	1000 Year
Return Event	1,000 years
Duration	24.000 hours
Depth	7.0 in
Time of Concentration (Composite)	0.100 hours
Area (User Defined)	9.000 acres

Computational Time Increment	0.013 hours
Time to Peak (Computed)	11.920 hours
Flow (Peak, Computed)	79.77 ft³/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	11.950 hours
Flow (Peak Interpolated Output)	76.86 ft³/s

Drainage Area	
SCS CN (Composite)	100.000
Area (User Defined)	9.000 acres
Maximum Retention (Pervious)	0.0 in
Maximum Retention (Pervious, 20 percent)	0.0 in

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	7.0 in
Runoff Volume (Pervious)	5.235 ac-ft

Hydrograph Volume (Area under Hydrograph curve)	
Volume	5.230 ac-ft

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.100 hours
Computational Time Increment	0.013 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	101.97 ft³/s
Unit peak time, Tp	0.067 hours

SCS Unit Hydrograph Parameters	
Unit receding limb, Tr	0.267 hours
Total unit time, Tb	0.333 hours

Peak Discharge	2.00 ft³/s
Time to Peak	7.900 hours
Hydrograph Volume	3.967 ac-ft

HYDROGRAPH ORDINATES (ft³/s)
Output Time Increment = 0.100 hours
Time on left represents time for first value in each row.

Time (hours)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)
0.000	2.00	2.00	2.00	2.00	2.00
0.500	2.00	2.00	2.00	2.00	2.00
1.000	2.00	2.00	2.00	2.00	2.00
1.500	2.00	2.00	2.00	2.00	2.00
2.000	2.00	2.00	2.00	2.00	2.00
2.500	2.00	2.00	2.00	2.00	2.00
3.000	2.00	2.00	2.00	2.00	2.00
3.500	2.00	2.00	2.00	2.00	2.00
4.000	2.00	2.00	2.00	2.00	2.00
4.500	2.00	2.00	2.00	2.00	2.00
5.000	2.00	2.00	2.00	2.00	2.00
5.500	2.00	2.00	2.00	2.00	2.00
6.000	2.00	2.00	2.00	2.00	2.00
6.500	2.00	2.00	2.00	2.00	2.00
7.000	2.00	2.00	2.00	2.00	2.00
7.500	2.00	2.00	2.00	2.00	2.00
8.000	2.00	2.00	2.00	2.00	2.00
8.500	2.00	2.00	2.00	2.00	2.00
9.000	2.00	2.00	2.00	2.00	2.00
9.500	2.00	2.00	2.00	2.00	2.00
10.000	2.00	2.00	2.00	2.00	2.00
10.500	2.00	2.00	2.00	2.00	2.00
11.000	2.00	2.00	2.00	2.00	2.00
11.500	2.00	2.00	2.00	2.00	2.00
12.000	2.00	2.00	2.00	2.00	2.00
12.500	2.00	2.00	2.00	2.00	2.00
13.000	2.00	2.00	2.00	2.00	2.00
13.500	2.00	2.00	2.00	2.00	2.00
14.000	2.00	2.00	2.00	2.00	2.00
14.500	2.00	2.00	2.00	2.00	2.00
15.000	2.00	2.00	2.00	2.00	2.00
15.500	2.00	2.00	2.00	2.00	2.00
16.000	2.00	2.00	2.00	2.00	2.00
16.500	2.00	2.00	2.00	2.00	2.00
17.000	2.00	2.00	2.00	2.00	2.00
17.500	2.00	2.00	2.00	2.00	2.00
18.000	2.00	2.00	2.00	2.00	2.00
18.500	2.00	2.00	2.00	2.00	2.00
19.000	2.00	2.00	2.00	2.00	2.00

HYDROGRAPH ORDINATES (ft^3/s)
Output Time Increment = 0.100 hours
Time on left represents time for first value in each row.

Time (hours)	Flow (ft^3/s)	Flow (ft^3/s)	Flow (ft^3/s)	Flow (ft^3/s)	Flow (ft^3/s)
19.500	2.00	2.00	2.00	2.00	2.00
20.000	2.00	2.00	2.00	2.00	2.00
20.500	2.00	2.00	2.00	2.00	2.00
21.000	2.00	2.00	2.00	2.00	2.00
21.500	2.00	2.00	2.00	2.00	2.00
22.000	2.00	2.00	2.00	2.00	2.00
22.500	2.00	2.00	2.00	2.00	2.00
23.000	2.00	2.00	2.00	2.00	2.00
23.500	2.00	2.00	2.00	2.00	2.00
24.000	2.00	(N/A)	(N/A)	(N/A)	(N/A)

Storm Event	1000 Year
Return Event	1,000 years
Duration	24.000 hours
Depth	7.0 in
Time of Concentration (Composite)	0.100 hours
Area (User Defined)	10.500 acres

Computational Time Increment	0.013 hours
Time to Peak (Computed)	11.920 hours
Flow (Peak, Computed)	93.07 ft³/s
Output Increment	0.050 hours
Time to Flow (Peak Interpolated Output)	11.950 hours
Flow (Peak Interpolated Output)	89.67 ft³/s

Drainage Area	
SCS CN (Composite)	100.000
Area (User Defined)	10.500 acres
Maximum Retention (Pervious)	0.0 in
Maximum Retention (Pervious, 20 percent)	0.0 in

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	7.0 in
Runoff Volume (Pervious)	6.108 ac-ft

Hydrograph Volume (Area under Hydrograph curve)	
Volume	6.102 ac-ft

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.100 hours
Computational Time Increment	0.013 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	118.97 ft³/s
Unit peak time, Tp	0.067 hours

SCS Unit Hydrograph Parameters	
Unit receding limb, Tr	0.267 hours
Total unit time, Tb	0.333 hours

Peak Discharge	6.00 ft³/s
Time to Peak	7.900 hours
Hydrograph Volume	11.901 ac-ft

HYDROGRAPH ORDINATES (ft³/s)
Output Time Increment = 0.100 hours
Time on left represents time for first value in each row.

Time (hours)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)
0.000	6.00	6.00	6.00	6.00	6.00
0.500	6.00	6.00	6.00	6.00	6.00
1.000	6.00	6.00	6.00	6.00	6.00
1.500	6.00	6.00	6.00	6.00	6.00
2.000	6.00	6.00	6.00	6.00	6.00
2.500	6.00	6.00	6.00	6.00	6.00
3.000	6.00	6.00	6.00	6.00	6.00
3.500	6.00	6.00	6.00	6.00	6.00
4.000	6.00	6.00	6.00	6.00	6.00
4.500	6.00	6.00	6.00	6.00	6.00
5.000	6.00	6.00	6.00	6.00	6.00
5.500	6.00	6.00	6.00	6.00	6.00
6.000	6.00	6.00	6.00	6.00	6.00
6.500	6.00	6.00	6.00	6.00	6.00
7.000	6.00	6.00	6.00	6.00	6.00
7.500	6.00	6.00	6.00	6.00	6.00
8.000	6.00	6.00	6.00	6.00	6.00
8.500	6.00	6.00	6.00	6.00	6.00
9.000	6.00	6.00	6.00	6.00	6.00
9.500	6.00	6.00	6.00	6.00	6.00
10.000	6.00	6.00	6.00	6.00	6.00
10.500	6.00	6.00	6.00	6.00	6.00
11.000	6.00	6.00	6.00	6.00	6.00
11.500	6.00	6.00	6.00	6.00	6.00
12.000	6.00	6.00	6.00	6.00	6.00
12.500	6.00	6.00	6.00	6.00	6.00
13.000	6.00	6.00	6.00	6.00	6.00
13.500	6.00	6.00	6.00	6.00	6.00
14.000	6.00	6.00	6.00	6.00	6.00
14.500	6.00	6.00	6.00	6.00	6.00
15.000	6.00	6.00	6.00	6.00	6.00
15.500	6.00	6.00	6.00	6.00	6.00
16.000	6.00	6.00	6.00	6.00	6.00
16.500	6.00	6.00	6.00	6.00	6.00
17.000	6.00	6.00	6.00	6.00	6.00
17.500	6.00	6.00	6.00	6.00	6.00
18.000	6.00	6.00	6.00	6.00	6.00
18.500	6.00	6.00	6.00	6.00	6.00
19.000	6.00	6.00	6.00	6.00	6.00

HYDROGRAPH ORDINATES (ft³/s)
Output Time Increment = 0.100 hours
Time on left represents time for first value in each row.

Time (hours)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)
19.500	6.00	6.00	6.00	6.00	6.00
20.000	6.00	6.00	6.00	6.00	6.00
20.500	6.00	6.00	6.00	6.00	6.00
21.000	6.00	6.00	6.00	6.00	6.00
21.500	6.00	6.00	6.00	6.00	6.00
22.000	6.00	6.00	6.00	6.00	6.00
22.500	6.00	6.00	6.00	6.00	6.00
23.000	6.00	6.00	6.00	6.00	6.00
23.500	6.00	6.00	6.00	6.00	6.00
24.000	6.00	(N/A)	(N/A)	(N/A)	(N/A)

Subsection: Elevation-Area Volume Curve | Return Event: 1,000 years
Label: Bottom Ash Pond (BAP) | Storm Event: 1000 Year

Elevation (ft)	Planimeter (ft²)	Area (acres)	A1+A2+sqr(A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
612.00	0.0	13.000	0.000	0.000	0.000
613.00	0.0	13.290	39.434	13.145	13.145
614.00	0.0	13.606	40.343	13.448	26.592
616.00	0.0	14.191	41.692	27.795	54.387
618.00	0.0	14.725	43.372	28.915	83.302
620.00	0.0	15.326	45.074	30.049	113.351

Subsection: Elevation-Area Volume Curve
Label: Clearwater Pond (CWP)

Return Event: 1,000 years
Storm Event: 1000 Year

Elevation (ft)	Planimeter (ft²)	Area (acres)	A1+A2+sqr(A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
603.00	0.0	6.900	0.000	0.000	0.000
603.70	0.0	7.159	21.087	4.920	4.920
604.00	0.0	7.209	21.551	2.155	7.075
606.00	0.0	7.571	22.167	14.778	21.853
608.00	0.0	7.929	23.248	15.498	37.352
610.00	0.0	8.299	24.340	16.226	53.578

Elevation (ft)	Planimeter (ft²)	Area (acres)	A1+A2+sqr(A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
608.70	0.0	6.240	0.000	0.000	0.000
610.00	0.0	6.492	19.096	8.275	8.275
612.00	0.0	9.265	23.512	15.674	23.949

Requested Pond Water Surface Elevations	
Minimum (Headwater)	612.00 ft
Increment (Headwater)	0.10 ft
Maximum (Headwater)	620.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Inlet Box	BAP Riser	Forward	BAP Culvert	612.00	620.00
Culvert-Circular	BAP Culvert	Forward	TW	606.67	620.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Structure ID: BAP Riser Structure Type: Inlet Box	
Number of Openings	1
Elevation	612.00 ft
Orifice Area	28.3 ft²
Orifice Coefficient	0.600
Weir Length	9.00 ft
Weir Coefficient	3.00 (ft^0.5)/s
K Reverse	1.000
Manning's n	0.000
Kev, Charged Riser	0.000
Weir Submergence	False
Orifice H to crest	False

Structure ID: BAP Culvert Structure Type: Culvert-Circular	
Number of Barrels	1
Diameter	48.0 in
Length	125.00 ft
Length (Computed Barrel)	125.00 ft
Slope (Computed)	0.005 ft/ft

Outlet Control Data	
Manning's n	0.013
Ke	0.900
Kb	0.005
Kr	0.900
Convergence Tolerance	0.00 ft

Inlet Control Data	
Equation Form	Form 1
K	0.0340
M	1.5000
C	0.0553
Y	0.5400
T1 ratio (HW/D)	1.260
T2 ratio (HW/D)	1.422
Slope Correction Factor	-0.500

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

T1 Elevation	611.71 ft	T1 Flow	87.96 ft³/s
T2 Elevation	612.36 ft	T2 Flow	100.53 ft³/s

Requested Pond Water Surface Elevations	
Minimum (Headwater)	603.00 ft
Increment (Headwater)	0.10 ft
Maximum (Headwater)	610.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Inlet Box	CWP Riser	Forward	CWP Culvert	610.00	610.00
Rectangular Weir	CWP Weir	Forward	CWP Culvert	603.00	610.00
Culvert-Circular	CWP Culvert	Forward	TW	588.55	610.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Structure ID: CWP Riser
Structure Type: Inlet Box

Number of Openings	1
Elevation	610.00 ft
Orifice Area	28.3 ft²
Orifice Coefficient	0.600
Weir Length	16.00 ft
Weir Coefficient	3.00 (ft^0.5)/s
K Reverse	1.000
Manning's n	0.000
Kev, Charged Riser	0.000
Weir Submergence	False
Orifice H to crest	False

Structure ID: CWP Culvert
Structure Type: Culvert-Circular

Number of Barrels	1
Diameter	30.0 in
Length	140.00 ft
Length (Computed Barrel)	140.00 ft
Slope (Computed)	0.004 ft/ft

Outlet Control Data

Manning's n	0.013
Ke	0.900
Kb	0.009
Kr	0.900
Convergence Tolerance	0.00 ft

Inlet Control Data

Equation Form	Form 1
K	0.0340
M	1.5000
C	0.0553
Y	0.5400
T1 ratio (HW/D)	1.261
T2 ratio (HW/D)	1.423
Slope Correction Factor	-0.500

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

T1 Elevation	591.70 ft	T1 Flow	27.16 ft³/s
T2 Elevation	592.11 ft	T2 Flow	31.05 ft³/s

Structure ID: CWP Weir Structure Type: Rectangular Weir	
Number of Openings	1
Elevation	603.00 ft
Weir Length	180.00 ft
Weir Coefficient	3.00 (ft^0.5)/s

Structure ID: TW Structure Type: TW Setup, DS Channel	
Tailwater Type	Free Outfall

Convergence Tolerances	
Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft^3/s
Flow Tolerance (Maximum)	10.000 ft^3/s

Requested Pond Water Surface Elevations	
Minimum (Headwater)	608.70 ft
Increment (Headwater)	0.10 ft
Maximum (Headwater)	612.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Rectangular Weir	WWP Weir	Forward + Reverse	WWP Culvert	609.00	612.00
Culvert-Box	WWP Culvert	Forward	TW	603.00	612.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Structure ID: WWP Culvert Structure Type: Culvert-Box	
Number of Barrels	1
Width	3.00 ft
Height	4.00 ft
Length	50.00 ft
Length (Computed Barrel)	50.00 ft
Slope (Computed)	0.000 ft/ft

Outlet Control Data	
Manning's n	0.013
Ke	0.000
Kb	0.006
Kr	0.000
Convergence Tolerance	0.00 ft

Inlet Control Data	
Equation Form	Form 2
K	0.5000
M	0.6670
C	0.0446
Y	0.6500
T1 ratio (HW/D)	1.153
T2 ratio (HW/D)	1.364
Slope Correction Factor	-0.500

Use unsubmerged inlet control 1 equation below T1 elevation.
Use submerged inlet control 1 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

T1 Elevation	607.61 ft	T1 Flow	84.00 ft³/s
T2 Elevation	608.45 ft	T2 Flow	96.00 ft³/s

Structure ID: WWP Weir
Structure Type: Rectangular Weir

Number of Openings	1
Elevation	609.00 ft
Weir Length	210.00 ft
Weir Coefficient	3.00 (ft^0.5)/s

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ATTACHMENT F

MAINTENANCE PLAN

AEP AMERICAN® ELECTRIC POWER

MAINTENANCE PLAN

1301 ASH POND DAM

Located in New Haven, Mason County, West Virginia

American Electric Power
Mountaineer Plant

Issued:	**November 2007**
Revision:	**Initial Issue**
Issued By:	**American Electric Power**
	Civil Engineering Department
	Geotechnical Engineering Section
	Columbus, Ohio

INTRODUCTION

PURPOSE

The purpose of this document is to provide guidance for the routine monitoring and maintenance of the 1301 Ash Pond Dam and related ancillary facilities and appurtenances.

OVERVIEW

The 1301 Ash Pond Dam is an upground reservoir formed by the dam and an internal dike system for the disposal of coal combustion byproducts. The internal dikes form six reservoirs for specific byproduct disposal and water treatment purposes. Those reservoirs include the east and west bottom ash ponds, the east and west wastewater ponds, the reclaim pond and the clear water pond.

MAINTENANCE PLAN

The maintenance plan for the facility is defined by the timeframes shown for those activities listed on the spreadsheet included herein. The maintenance plan is also intended to include those items not specifically listed herein, but identified as deficient during the routine quarterly inspections and during the annual engineering inspections. Those inspections should be considered complementary to the maintenance plan. The form used during the performance of the quarterly inspections is included herein as is the facility plan that accompanies that form.

AMERICAN ELECTRIC POWER

MOUNTAINEER PLANT - 1301 ASH POND - ID #05307
MAINTENANCE PLAN

ACTIVITIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Maintenance Inspections												
Quarterly dike inspection			X			X			X			X
Bi-Annual engineering inspection - Alternating Years										X		
Embankments												
Mow embankment									X			
Repair erosion gullies					X							
Restore dead grass areas and bare spots				X			X			X		
Repair animal burrows	X			X			X			X		
Remove all trees and brush				X						X		
Repair crest roadway as necessary					X							
Overflow Weirs												
Adjust weir plates as necessary				X								
Replace and/or repair damaged/missing components				X								
Clear debris and vegetation				X						X		
Repair stairs, walkways, ramps and platforms as necessary						X						
Skimmers												
Repair/Replace components as necessary				X						X		
Repair stairs, walkways, ramps and platforms as necessary				X						X		
Mechanical												
Maintain valves, gates and operators as necessary						X						
Maintain pipe supports as necessary						X						
Concrete and Steel												
Remove vegetation from joints, cracks and inverts			X							X		
Seal new cracks						X						
Reseal deteriorated or missing sealants						X						
Repair or replace deteriorated steel						X						
Prepare surface and recoat areas exhibiting paint failure						X						

Note: Items detected during quarterly and annual inspections that could impact safety, operations or compliance must be addressed in an appropriate timeframe.