HISTORY OF CONSTRUCTION

CFR 257.73(c)(1)

Boiler Slag Pond

Kyger Creek Station
Cheshire, Ohio

October, 2016

Prepared for: Ohio Valley Electric Corporation

Prepared by: American Electric Power Service Corporation

1 Riverside Plaza

Columbus, OH 43215

GERS-16-137

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Attachments

1.0 OBJECTIVE

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

2.0 DESCRIPTION OF CCR THE IMPOUNDMENT

The Kyger Creek Station is located along the Ohio River in Gallia County, Ohio, south of the town of Cheshire, Ohio. The plant currently has two CCR impoundments for the purpose of disposal and storage of CCR known as the Boiler Slag Pond and the South Fly Ash Pond. The Boiler Slag Pond, which is part of a larger complex, is the focus of this report.

The Bottom Ash Complex is located just south of the Kyger Creek Plant and sits adjacent to the Ohio River. The complex consists of approximately 40 acres, and was constructed in 1955, with a an outer dike that is approximately 5,800 feet long, and a 875 feet splitter dike that separates the complex into two separate ponds, the Boiler Slag Pond and the Clearwater Pond, which are 30.1 acres and 9.39 acres respectively. Boiler slag sluice water enters the north end of the Boiler Slag Pond, where the boiler slag is settled and overflow is conveyed through an outlet structure at the south end of the CCR unit to the Clearwater Pond. Water is then discharged to Ohio River via the Clearwater Pond outlet structure.

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 Kyger Creek Station is located at 5758 State Route 7, Cheshire, Ohio 45620 in Gallia County Ohio. It is owned and operated by the Ohio Valley Electric Corporation (OVEC). The plant operates a surface impoundment for temporary storage of CCR called the Boiler Slag Pond. The dam is registered with the Ohio Department of Natural Resources (ODNR) under ID number 8712-014.

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 Boiler Slag Pond is a surface impoundment for the purpose of settling and storing CCR.

6.0 NAME AND SIZE OF WATERSHED THE CCR UNIT IS LOCATED

257.73 (c)(1)(iv)

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

The Boiler Slag Pond is located with the Upper Ohio-Shade watershed (HUC: 05030202), which has a listed acreage of approximately 897,312 acres. The Boiler Slag Pond is a diked impoundment where the only inflows are from plant process water. There is no stormwater run-on from an offsite watershed.

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.]

In 2010, a subsurface investigation was performed at the Boiler Slag Pond by DLZ Ohio, Inc. A total of ten borings were drilled within the outer dike of the complex and subsequent laboratory testing was performed on the recovered materials. The foundation materials beneath the dam down to approximately Elevation 530 ft. were found to primarily consist of lean clay. However, below Elevation 530 lean clay was occasionally interbedded with silt, sand and gravel underlain by layers of granular soils through the depth of the boring.

The lean clay in the foundation soils was generally soft to medium stiff, with lenses of silt and varying amounts of fine to medium sand. Hand penetrometer values of the lean clay ranged from <0.25 to 4.5+ tsf with an average of about 1.5 tsf, while the standard Penetration N_{60} values ranged from 0 to 21 with an average of 8. Below the lean clay, medium dense to dense granular soils were encountered. The Standard Penetration N_{60} values in the granular soils ranged from 1 to 50+ blows per foot with an average of about 24. The percent passing the 200 sieve ranged from 0 to 19 percent, with an average of about 7 percent. The bedrock below the overlaying soils was observed to be soft to medium hard gray siltstone interbedded with shale. Excerpts from the 2010 subsurface investigation are included in Attachment B.

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 Bottom Ash Complex was originally constructed in 1955 as one pond. The original design drawings show the embankment is constructed of earthen fill. The top of the embankment is approximately at elevation 582'. The tallest section of the embankment is approximately 27 feet. The cross section detail shows the inboard and outboard slopes were constructed with a 2.5H to 1V slope and a top width of 10-feet. Excerpts from the 2010 subsurface investigation are included in Attachment B and design drawings are included in Attachment C.

Original construction records are unavailable, but a post-construction subsurface investigation was completed by DLZ, Inc., in 2010. Results of those investigations, including engineering properties are included in Attachment B. In general, the borings indicate that the embankment soils were primarily stiff to very stiff fine-grained soils mostly consisting of lean clay with varying amounts of silt and find sand.

Around 1980, a splitter dike was constructed separating the complex into the current Boiler Slag Pond and the Clearwater Pond. The dike was constructed primarily of boiler slag with a central clay core 10 feet wide. The clay core was keyed into the bottom of the pond. Flow is conveyed from Boiler Slag Pond to the Clearwater Pond by a concrete intake structure and 30" CMP pipe. Since the original construction this 30" CMP pipe has been slip lined with HDPE pipe. The Clearwater Pond is used only for additional polishing of the plant's process waters after boiler slag has been settled out in the Boiler Slag Pond.

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…]

Detailed dimensional drawings, including a plan view and cross sections drawings are included in Attachment C. The outlet structure for the Boiler Slag Pond is located at the southern end of the pond adjacent to the west end of the splitter dike between Boiler Slag Pond and the Clearwater Pond. The Boiler Slag outlet structure is a 42-inch by 39-inch concrete riser structure with a weir as the principal spillway at elevation 557 ft. Water entering the outlet structure is discharged to the Clearwater Pond through a 30-inch CMP which passes through the splitter dike. The outlet structure for the Clearwater Pond is located at the southeast corner of the pond and is discharged to the Ohio River through a concrete riser structure and 30-inch CMP under NPDES permit OIB00005*PD.

Primarily, the inboard slopes of the Boiler Slag Pond are protected by a layer of boiler slag. The inboard slopes of the Clearwater Pond are protected by vegetation. The outboard slopes primarily consist of grass vegetation.

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 Boiler Slag Pond has been determined to be a Significant Hazard potential CCR impoundment. Based on this hazard classification, the design flood as determined by section 257.82(a)(3) was determined to be the 1000-year storm, which corresponds to 7.28 inches in 24 hours for this site. As a requirement of the State of Ohio, an analysis was performed for the 50% PMF (Probable Maximum Flood), which utilizes 50% of the runoff from the Probable Maximum Precipitation (PMP) storm, which is equivalent to 19 inches in 6 hours. This produces significantly more runoff than the 1000-year storm and therefore exceeds the requirements of section 257.82(a)(3). The complete analysis is included in Attachment E.

	Boiler Slag Pond	Clearwater Pond
Normal Pool Elevation	558.0	552.0
Maximum Pool Elevation following peak discharge from inflow design flood (1/2 PMF)	559.3	557.3
Expected Maximum depth of CCR within impoundment	41 ft	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 pond's operations could be adversely affected. These structures include the sluicing system, the auxiliary spillway 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.]

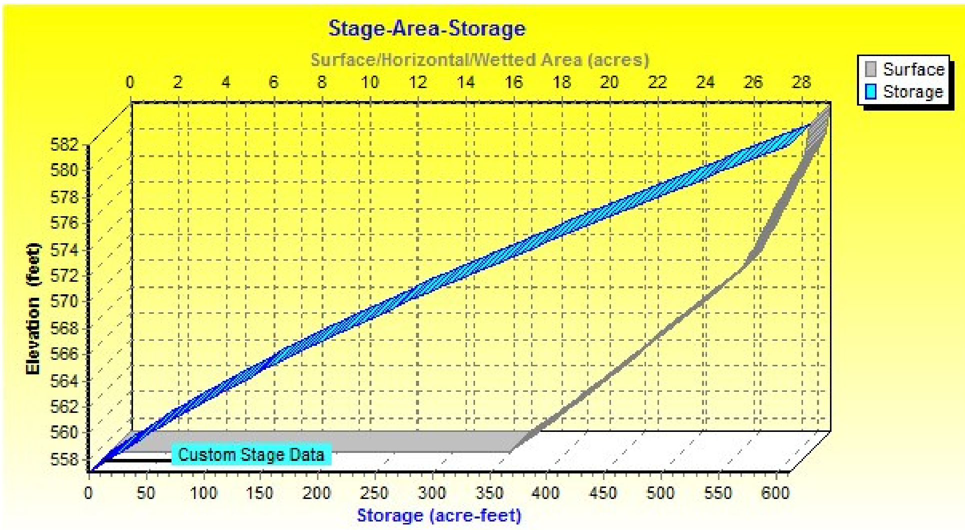
The complex has 6 piezometers located within the crest and toe of the dam. These piezometers are read a minimum of every 30 days for the purpose of determining the phreatic water level within the dike. A location map is provided in Attachment D.

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

[Area-capacity curves for the CCR unit.]

The area capacity curve for the Boiler Slag Pond is described within the Hydrology and Hydraulic Analysis Report by DLZ, September 2015 located in Attachment E.

Boiler Slag Pond



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.]

Overflow from the Boiler Slag Pond is conveyed into a reinforced concrete intake structure located at the southern end of the pond near the western end of the splitter dike. The intake structure consists of a 42-inch by 39-inch concrete riser. The elevation of the spillway is at 557 and it can be raised or lowered by the placement of concrete stop logs within the structure. Water entering the intake structure is discharged into the Clearwater Pond through a 30-diameter CMP, which passes through the splitter dike. Since the original construction this 30" CMP pipe has been slip lined with HDPE pipe. Flow entering the Clearwater Pond enters another concrete intake structure located at the southeast corner of the pond and is discharged into the Ohio River through a 30-inch CMP under NPDES permit OIB00005*PD. The intake structure has stop logs set at elevation 552.0', and can be raised by the addition of stop logs. Calculations were performed by DLZ Ohio, Inc. as a part of the Factor of Safety Assessment Report requirements per CFR §257.73 that demonstrate that each spillway is adequate to handle the design storm. Excerpts from that report are included in Attachment E. Drainage is diverted around the complex by natural drainage channels and grass lined ditches.

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.]

The complex was designed by Sargent & Lundy Engineers of Chicago and was constructed by George B. Herring & Sons, Inc. of Mansfield, OH in 1955. Construction specifications and records are unavailable.

As required by the CCR rules the Boiler Slag Pond is inspected at least every 7 days by a qualified person. Also as a requirement of the CCR rule, the impoundment is also inspected annually by a professional engineer. Maintenance items are addressed as they are discovered as part of those inspections.

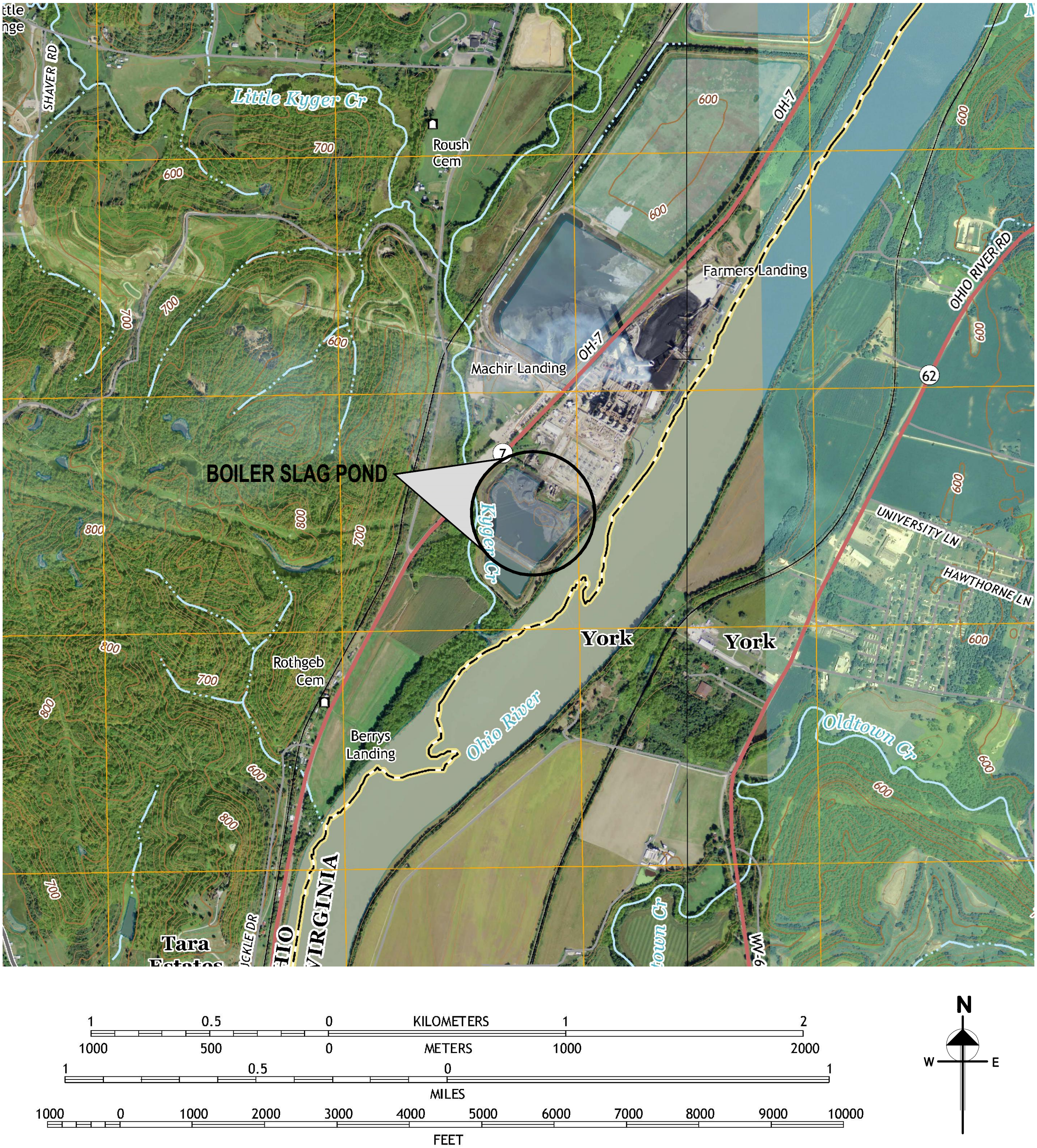
16.0 RECORD OR KNOWLEDGE OF STRUCTURAL INSTABILITY 257.73 (c)(1)(xii)

[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:

AEP PUBLIC

REFERENCE AEP's CORPORATE INFORMATION SECURITY POLICY

OHIO VALLEY ELECTRIC COMPANY

KYGER CREEK PLANT

CHESHIRE OHIO

UNIT: 15

DRAWING NUMBER: LOCATION MAP

REV: 1

SCALE: 1"=2000'

CIVIL ENGINEERING

DR:

CH:

SUP:

ENG:

DATE: 10/4/16

BOILER SLAG POND

USGS TOPO MAP

7.5-MINUTE SERIES

AEP AMERICAN ELECTRIC POWER

AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

ATTACHMENT B

SUBSURFACE INVESTIGATION

Final Report for:

Kyger Creek Power Plant – Subsurface Investigation and Analysis of Ash Pond Embankments

Gallipolis, Ohio

Prepared for:

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January 12, 2011

Prepared by:

DLZ

FINAL REPORT

OF

SUBSURFACE INVESTIGATION AND ANALYSIS

OF THE

ASH POND EMBANKMENTS

AT THE

OHIO VALLEY ELECTRIC CORPORATION (OVEC)

KYGER CREEK STATION

GALLOPOLIS, OHIO

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January 12, 2011

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AGMU Memo 10.1 – Liquefaction Analysis, dated January 2010, from the Illinois DOT
USACE Slope Stability. Engineering Manual 1110-2-1902. October, 2003, page 1-6
Chapter 5 "Liquefaction Potential Evaluation and Analysis" of EPA/600/R-95/051

1.0 INTRODUCTION

DLZ Ohio, Inc. (DLZ) has completed the subsurface investigation and analysis of the ash pond embankments at the Ohio Valley Electric Corporation/American Electric Power's (OVEC/AEP) Kyger Creek Station in Gallipolis, Ohio. The subsurface investigation and the engineering analyses were performed at the request of OVEC/AEP in consideration of the recommendations made in the US EPA Assessment of Dam Safety of Coal Combustion Surface Impoundments (Task 3) Final Report prepared by Clough Harbor and Associates (CHA), dated February 24, 2010.

2.0 SCOPE OF WORK

The scope of the work was developed by OVEC/AEP in consideration of the recommendations included in Section 4.5 "Stability Analysis" of the US EPA Assessment of Dam Safety Final Report. Section 4.5 has been printed as follows.

> ***4.5 Stability Analysis***
>
> *It is recommended that detailed stability analyses be performed for the Bottom Ash Pond and South Fly Ash Pond. CHA was not provided with information regarding stability analyses performed prior to or following construction of the ponds nor was information regarding properties of the embankment and foundation soils provided.*
>
> *The stability analyses for each pond should include a subsurface investigation to determine existing soil parameters in the embankments and foundation soils and the installation of piezometers to determine the current phreatic surface. Loading conditions that should be modeled should include those listed in Table 3, Section 3.3.*

Table 3 in Section 3.3 of the CHA report has been printed below.

Table 3 – Minimum Safety Factors Required

Load Case	Required Minimum Factor of Safety
Steady State Conditions at Present Pool or Maximum Storage Pool Elevation	1.5
Rapid Drawdown Conditions from Present Pool Elevation	1.3
Maximum Surcharge Pool (Flood) Condition	1.4
Seismic Conditions from Present Pool Elevation	1.0
Liquefaction	1.3

At the request of OVEC/AEP, DLZ performed the following scope of work to address the above-mentioned recommendations made by CHA.

- Performed two borings at each of eleven cross-section locations; one boring near the downstream toe and one on the dike crest; the borings were advanced to depths of 30 to 70 feet below ground surface
- Installed 12 piezometers at selected cross-section locations
- Performed field survey to determine coordinates and elevations of the soil borings and elevations at the top of riser at the piezometer locations
- Conducted cross-section surveys at the eleven cross-section locations
- Performed laboratory testing consisting of index testing, triaxial shear tests and permeability tests
- Performed slope stability evaluations for the load cases indicated in Table 3 of CHA's report
- Performed liquefaction assessment of foundations soils using the Simplified Procedure reported in Youd, et. al (2001)
- Performed a steady-state seepage evaluation using the phreatic surface measured in the piezometers

3.0 GENERAL PROJECT INFORMATION

The Kyger Creek Station is located along the Ohio River in Gallia County, Ohio, south of the town of Cheshire, Ohio. The Ohio River is located directly east of the facility and Kyger Creek flows along the west and south side of the facility. **Exhibit 1** shows the general location of the plant and is included in **Appendix I**.

The plant currently has two process and disposal areas for the coal combustion waste products generated at the plant, known as the Bottom Ash Pond and the South Fly Ash Pond. Overflow from the Bottom Ash Pond is carried into a reinforced concrete intake structure at the south end of the Bottom Ash Complex. Water entering the intake structure is discharged into a Clearwater Pond located to the southwest end of the Bottom Ash Pond. The Bottom Ash Pond and the Clearwater Pond is separated by a splitter dike. **Exhibits 2 and 3** show a more detailed layout of the ponds and are included in **Appendix I**. The configurations and the hydrologic and hydraulic data for the ponds are summarized in the following tables.

Configurations of the Ponds[1]

Pond	Year Constructed	Height (feet)	Crest Elevation (MSL)	Inboard Slope	Outboard Slope[2]
South Fly Ash	1955	40	590	2H:1V	2.3H:1V to 2.9H:1V
Bottom Ash	1955	41	582	2.25H:1V	2.6H:1V to 3H:1V
Clearwater	1980	30 – 45[1]	582	2.5H:1V to 3H:1V	2.5H:1V to 3H:1V

Note: 1)The pond information is based on the US EPA Assessment of Dam Safety of Coal Combustion Surface Impoundments (Task 3) Final Report prepared by Clough Harbor and Associates (CHA), dated February 24, 2010 and the 2009 Dam and Dike Inspection Report for Kyger Creek Power Station, Gallipolis, Ohio prepared by Stantec, dated April 21, 2009.
2)The outboard slopes are based on the survey performed by DLZ for this investigation.

Summary of Hydrologic and Hydraulic Data for the Ponds[1]

Pond	Drainage Area (acres)	Peak Flow Rate In (cfs)	50% PMF Storage Volume (ac-ft)	50% PMF Storage Peak Elevation (ft)
South Fly Ash	67.3	627.1	72.9	584.0
Bottom Ash	32.3	300.6	34.6	559.3
Clearwater	9.9	92.3	10.8	558.6

Note: 1)The hydrologic and hydraulic data is based on the US EPA Assessment of Dam Safety of Coal Combustion Surface Impoundments (Task 3) Final Report prepared by Clough Harbor and Associates (CHA), dated February 24, 2010.

Summary of Elevation Data for the Ponds

Pond	Top of Pond Elevation (feet)[1]	50% PMF Storage Peak Elevation (ft)[2]	Free-board (feet)	Normal Pool Elevation (feet)[3]
South Fly Ash	588 to 589	584.0	4 to 5	585
Bottom Ash	580 to 581	559.3	20.7 to 21.7	558
Clearwater	580	558.6	21.4	552

Note: 1) Elevation data is based on the elevations of the borings on the dike crest surveyed by DLZ.
2) Elevations are from the CHA's report.
3) Elevation data is from Gary Zych of AEP.

4.0 SUBSURFACE EXPLORATION

The subsurface exploration consisted of drilling two borings, one near the downstream toe and one on the dike crest, at each of the selected eleven locations at the Bottom Ash Complex and the South Fly Ash Complex. Borings KC-1001 through KC-1012 were drilled at the South Fly Ash Pond, and Borings KC-1013 through KC-1016, KC-1021 and KC-1022 were drilled at the Bottom Ash Pond. Borings KC-1017 through KC-1020 were drilled at the Clearwater Pond. The depths of borings varied from 30 to 70 feet below the existing ground surface. The borings were drilled between August 16, 2010 and September 9, 2010 using a track-mounted drill rig. Information concerning the drilling procedures is presented in **Appendix II**.

The locations and elevations of the borings were determined in the field by representatives of DLZ. **Exhibits 4 and 5** show the approximate boring locations at pond dikes and are included in **Appendix II**. Ground surface elevations at the borings are presented on the boring logs, which are also in **Appendix II**. The ground surface elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29).

Water level measurements were taken in each boring upon completion of drilling or prior to washing out sand blockages with drilling water. The borings were backfilled with bentonite grout after the water level measurements except for the borings where piezometers were installed to allow extended monitoring of the water levels. Piezometers were installed in Borings KC-1003, KC-1004, KC-1007, KC-1008, KC-1011 and KC-10012 at the South Fly Ash Pond. Piezometers were also installed in Borings KC-1015, KC-1016, KC-1021 and KC-1022 at the Bottom Ash Pond and in Borings KC-1017 and KC-1018 at the Clearwater Pond. The well completion diagrams for the piezometers are included in **Appendix II** of this report.

A field log was prepared for each boring. These logs contain visual classifications of the materials encountered during drilling as well as an interpolation of the subsurface conditions between samples. Final logs, included in **Appendix II**, include information from the field logs along with modifications based on laboratory observations and tests of the field samples. The final logs describe the materials encountered, their thicknesses, and the locations where samples were obtained.

5.0 FINDINGS OF SUBSURFACE EXPLORATION

The following section presents the generalized subsurface conditions encountered by the borings. For more detailed information, please refer to the Boring Logs presented in Appendix II of this report. Please note that the strata contact lines shown on the boring logs represent approximate boundaries between soil types. In the field, the actual soil transition might be different both vertically and laterally. Laboratory test results are presented on the boring logs and/or on a summary sheet, which is included in **Appendix III**.

Based on the results of field survey, the cross-section views of the boring locations were prepared. The surveyed cross-sections with the subsurface conditions at the boring locations in each cross section are included in **Appendix IV**.

5.1 Soil Conditions

The borings generally penetrated the embankment fill and the underlying cohesive foundation soils, and were terminated approximately 2 to 35 feet into the lower foundation sand and gravel layers. However, Borings KC-1006, KC-1008 of the South Fly Ash Complex and KC-1017 of the Clearwater Pond did not encountered granular soils within the depth of borings, between 40 feet (Elevation 540.9) and 60 feet (Elevation 520.1), and were terminated in cohesive soils. In order to determine the depths to bedrock at the site, Borings KC-1002 and K-1018 penetrated the full depth of the overburden and extended to refusal on underlying bedrock approximately at Elevation 499. Based on the visual observations of the recovered samples of the bedrock, the bedrock encountered in these borings was soft to medium hard gray siltstone interbedded with shale.

Results of the subsurface investigation indicate that the subsurface conditions at the South Fly Ash Pond, the Bottom Ash Pond and the Clearwater Pond were similar. Generally, the embankment fill was primarily stiff to very stiff fine-grained soils mostly consisting of lean clay with varying amounts of silt and fine sand. Hand penetrometer values of the embankment fill ranged from 1.0 to 4.5+ tons per square foot (tsf) with an average of about 2.5 tsf, while the Standard Penetration N_{60}-values ranged from 5 to 30 with an average of 13. The N_{60}-values are N-values adjusted for hammer efficiency as well as field procedure and apparatus.

The foundation soils beneath the dikes, down to approximately Elevation 530, primarily consisted of lean clay. However, below Elevation 530, lean clay occasionally interbedded with silt, sand and gravel underlain by layers of granular soils were encountered to the depths of borings. The top of the granular soil generally ranged from Elevations 531.2 to 513.8. However, granular soils were encountered at shallower depths in Borings KC-1001 and KC-1002 compared to the majority of the borings. Boring KC-1001 encountered granular soils at a depth of 49.4 feet (Elevation 539.9) and Boring KC-1002 at a depth of 23.5 feet (Elevation 534.8).

The lean clay in the foundation soils was generally soft to medium stiff with lenses of silt and varying amounts of fine to medium sand. Hand penetrometer values of the lean clay ranged from <0.25 to 4.5+ tsf with an average of about 1.5 tsf while the Standard Penetration N_{60}-values ranged from 0 to 21 with an average of 8. Below the lean clay, medium dense to dense granular soils were encountered. The Standard Penetration N_{60}-values in the granular soils ranged from 1 to 50+ blows per foot with an average of about 24. The percent passing the 200 sieve ranged from 0 to 19 with an average of about 7. Find sands were encountered in the granular layers at various depths in the borings.

5.2 Groundwater Conditions

At the time the borings were drilled, perched groundwater was first encountered between Elevations 552.3 and 518.8. Prior to adding water to the borings during the drilling operations, water levels varied from Elevations 542.2 to 527.4. It should be noted that during this field investigation a small amount of perched groundwater was encountered at depths between 35.5 feet (Elevation 545.4) and 40.0 feet (Elevation 540.9) in Boring KC-1008; however, no measurable groundwater was encountered in the boring at the end of the drilling operation. Note that no groundwater was encountered in KC-1017 throughout the drilling operation. It is our understanding that the normal pool elevation is at approximately 538 MSL in the Ohio River adjacent to the plant and at approximately 540 MSL in Kyger Creek.

Piezometer readings were taken during the field investigation between August 20 and September 15, 2010. A summary of the piezometer readings is included in **Appendix IV**. Based on the September 15, 2010 readings, groundwater levels in the piezometers installed on the crest of the South Fly Ash Pond varied from Elevations 562.3 to 560.8 while the groundwater levels in the piezometers on the crest of the Bottom Ash Pond and Clearwater Pond varied from Elevations 546.0 to 537.6. These groundwater levels were between 12 and 24 feet below the pool levels behind the dams, indicating rapid hydraulic head dissipation in the clay soil.

Piezometers were installed in Borings KC-1004, KC-1008 and KC-1012 at the downstream toes of the South Fly Ash Pond. Groundwater levels in KC-1004 and KC-1012 were at Elevations 549.4 and 561.8, respectively. These elevations are generally at or slightly below the ground surface at the piezometer locations. Note that the piezometer in Boring KC-1008 (Cross-section 4) was dry throughout the monitoring period; the bottom elevation of this piezometer is 548.6.

Piezometers were also installed in Borings KC-1016, KC-1018 and KC-1022 at the downstream toes of the Bottom Ash Pond and the Clearwater Pond. Groundwater levels in these piezometers were between Elevations 539.2 and 536.7. These groundwater levels were generally 5 to 22 feet below the ground level at the piezometer locations.

The groundwater levels may fluctuate other times of the year due to change in pool levels and rainfall conditions.

6.0 LABORATORY TEST RESULTS

Besides index testing on selected Standard Penetration split spoon samples, laboratory tests were performed on twelve (12) undisturbed samples of the overburden soils. These tests included:

- Consolidated Undrained Shear Tests (ASTM D-4767)
- Liquid and plastic limit (ASTM D-4318)
- Particle-size analysis (ASTM D-422)
- Falling Head Permeability (ASTM D-5084 Method C)

Results of the laboratory permeability tests and the consolidated undrained shear tests are summarized in the following tables. For additional information, please refer to the test reports included in **Appendix III**.

Laboratory Permeability Testing

Sample Location	Soil Type	Permeability, cm/sec
KC-1003 @ 31'-33'	Lean Clay (CL)	1.8x10^{-7}
KC-1005 @18.5'-20.5'	Lean Clay (CL)	4.5x10-^{8}
KC-1009 @16'-18'	Lean Clay with sand (CL)	1.9x10^{-8}
KC-1010 @31'-33'	Sandy Lean Clay (CL)	1.8x10^{-7}
KC-1014 @11'-13'	Lean Clay (CL)	2.2x10^{-8}
KC-1018 @8.5'-10.5'	Lean Clay (CL)	9.3x10^{-6}
KC-1019 @26'-28'	Sandy Silt (ML)	3.2x10^{-4}
KC-1021 @18.5'-20.5'	Sandy Lean Clay (CL)	8.0x10^{-8}

Consolidated Undrained Shear Tests

Sample Location		Soil Type	Total		Effective	
			c, psf	Φ, degree	c', psf	Φ', degree
Embankment	KC-1001, 28.5'-30'	Very Stiff Lean Clay (CL)	160	25.9	110	36.5
	KC-1017, 18.5'-20.5'	Stiff Sandy Lean Clay (CL)	356	20.3	216	37.2
Foundation	KC-1012, 21'-23'	Very Soft to Soft Sandy Lean Clay (CL)	546	15.7	208	32.8
	KC-1016, 8.5'-10.5'	Soft to Medium Stiff Lean Clay with Sand (CL)	356	16.2	276	32.2

7.0 SHEAR STRENGTH PARAMETERS FOR SLOPE STABILITY ANALYSES

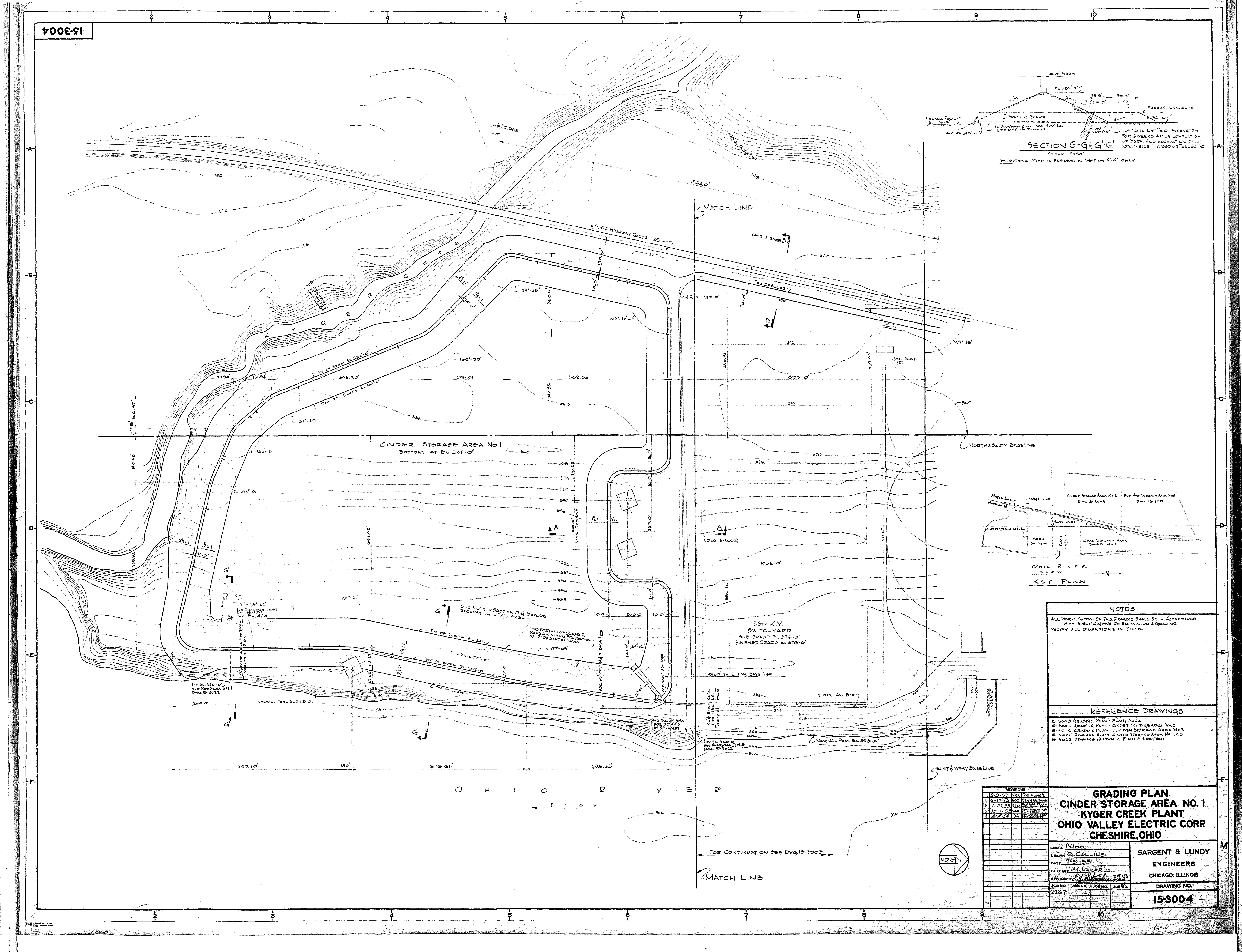
Because of similarities in the types of embankment fill and foundation soils encountered at both of the pond sites, results of the shear strength testing for soil samples from both sites were considered when selecting soil parameters for the stability analyses. The shear strength values were chosen in consideration of the field and laboratory test results, correlations with particle sizes, SPT N_{60}-values, in-situ densities, and engineering judgment.

Shear Strength Parameters for Slope Stability Analyses

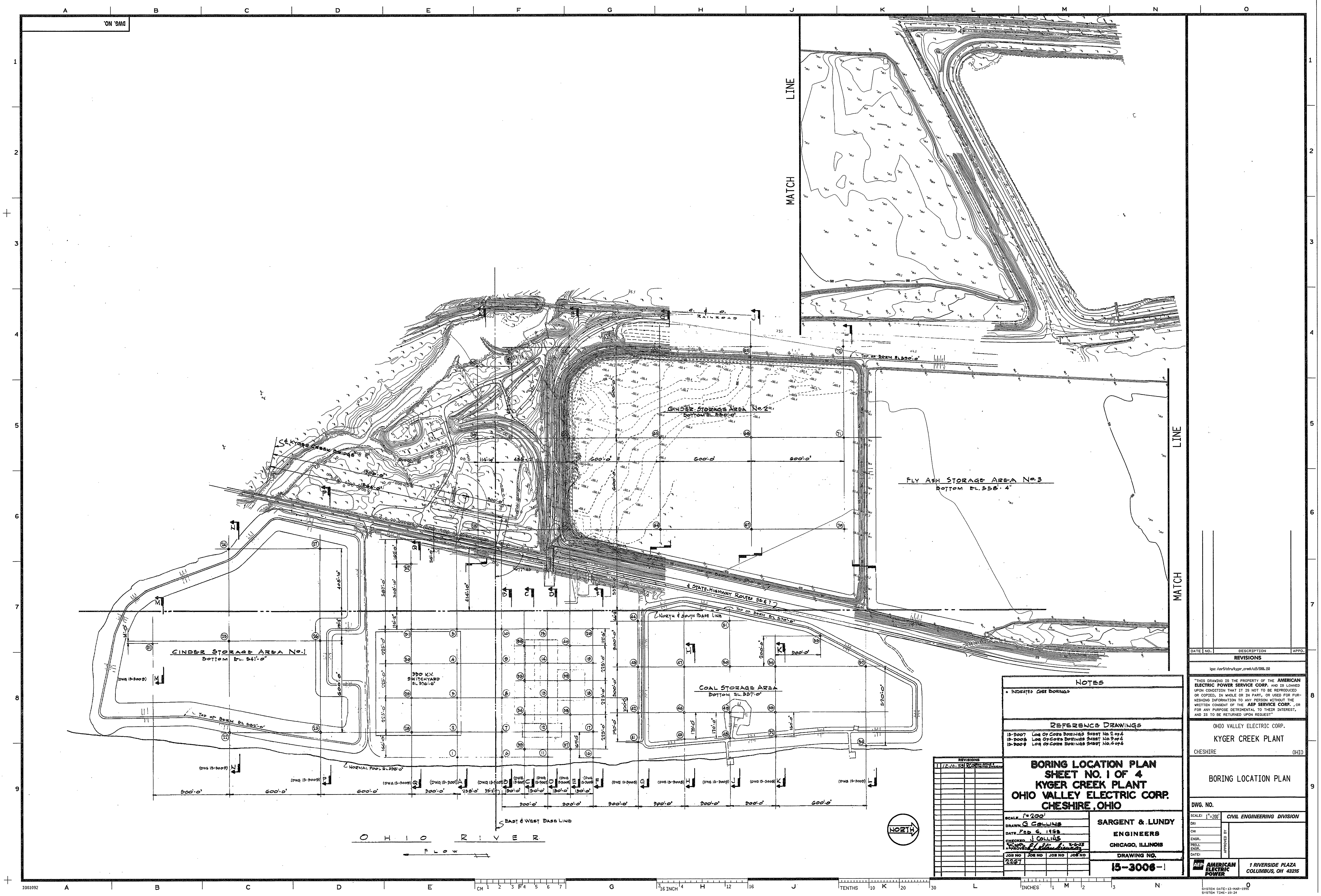
Soil Stratum	γ_{wet} (pcf)	Total		Effective	
		c, psf	Φ,degree	c', psf	Φ',degree
Embankment Clay Fill	125	350	20	100	32
Very Soft Clay	120	250	16	50	26
Soft to Medium Stiff Clay	125	300	16	100	28
Medium Stiff to Stiff Clay	125	350	16	100	30
Stiff to Very Stiff Clay	125	500	16	100	32
Medium Dense to Dense Granular Soils	125	0	28 to 35, mostly 35	0	28 to 35, mostly 35

ATTACHMENT C

DESIGN DRAWINGS

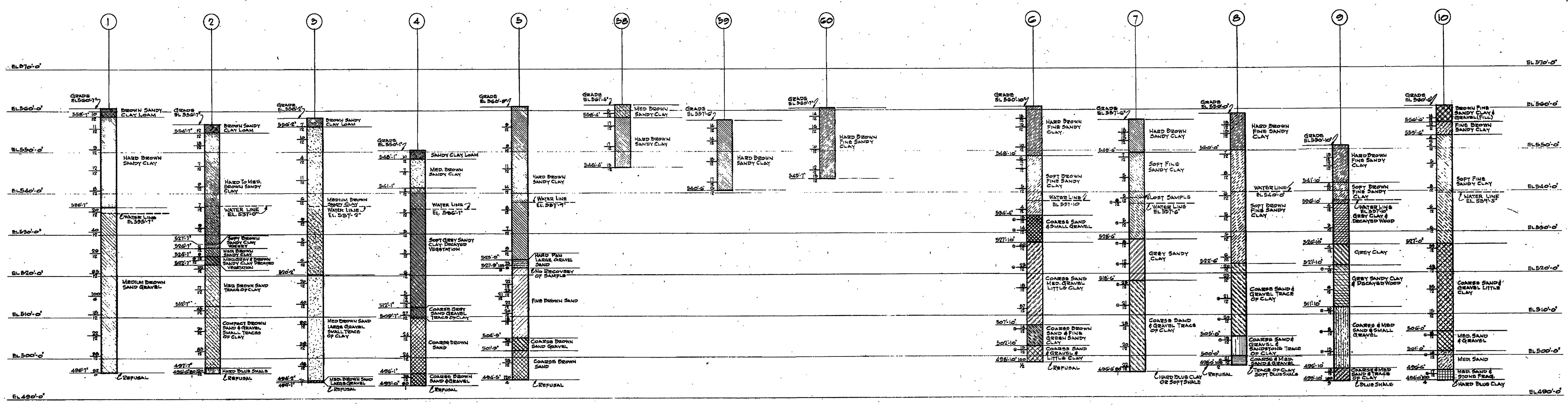


15-3004
SECTION G-G & G'-G'
KEY PLAN
CINDER STORAGE AREA NO. 1
BOTTOM AT EL 541'-0"
330 K.V.
SWITCHYARD
STATE HIGHWAY ROUTE 35
MATCH LINE
NORTH & SOUTH BASE LINE
EAST & WEST BASE LINE
NORMAL POOL EL 538'-0"
O H I O R I V E R
FLOW
FOR CONTINUATION SEE DWG. 15-3003
NORTH
NOTES
ALL WORK SHOWN ON THIS DRAWING SHALL BE IN ACCORDANCE WITH SPECIFICATIONS ON EXCAVATION & GRADING
VERIFY ALL DIMENSIONS IN FIELD.
REFERENCE DRAWINGS
15-3003 GRADING PLAN - PLANT AREA
15-3005 GRADING PLAN - CINDER STORAGE AREA No. 2
15-3012 GRADING PLAN - FLY ASH STORAGE AREA No. 3
15-3021 DRAINAGE SHAFT - CINDER STORAGE AREA No. 1, 2, 3
15-3022 DRAINAGE HEADWALLS - PLANS & SECTIONS
REVISIONS
2-9-53 REL. FOR CONST.
1 6-17-53 RCO REVISED BERM
2 7-20-53 RCO
3 10-1-53 RCO
4 6-4-54 DA
GRADING PLAN
CINDER STORAGE AREA NO. 1
KYGER CREEK PLANT
OHIO VALLEY ELECTRIC CORP.
CHESHIRE, OHIO
SCALE 1"=100'
DRAWN G. COLLINS
DATE 2-9-53
CHECKED M. LAZARUS
APPROVED 2-9-53
JOB NO. 2267
SARGENT & LUNDY
ENGINEERS
CHICAGO, ILLINOIS
DRAWING NO.
15-3004-4



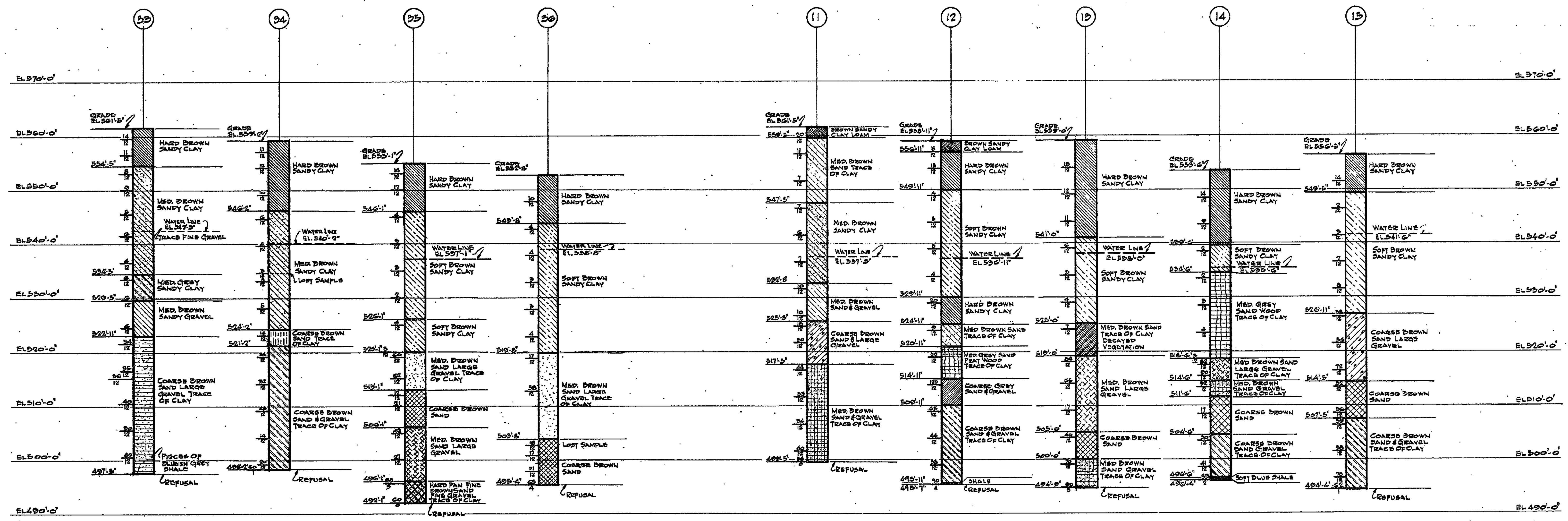
DWG. NO.
MATCH LINE
RAILROAD
TOP OF BERM EL. 580'-0"
CINDER STORAGE AREA No. 2
BOTTOM EL. 560'-0"
FLY ASH STORAGE AREA No. 3
BOTTOM EL. 558'-4"
℄ KYGER CREEK BRIDGES
℄ STATE HIGHWAY ROUTE 7
℄ NORTH & SOUTH BASE LINE
CINDER STORAGE AREA No. 1
BOTTOM EL. 541'-0"
330 K.V. SWITCHYARD
EL. 576'-0"
COAL STORAGE AREA
BOTTOM EL. 557'-0"
TOP OF BERM EL. 580'-0"
℄ NORMAL POOL EL. 538'-0"
℄ EAST & WEST BASE LINE
O H I O R I V E R
FLOW
NORTH
NOTES
• INDICATES CORE BORINGS
REFERENCE DRAWINGS
15-3007 LOG OF CORE BORINGS SHEET No. 2 of 4
15-3008 LOG OF CORE BORINGS SHEET No. 3 of 4
15-3009 LOG OF CORE BORINGS SHEET No. 4 of 4
REVISIONS
1 12-10-53 RCO
BORING LOCATION PLAN
SHEET NO. 1 OF 4
KYGER CREEK PLANT
OHIO VALLEY ELECTRIC CORP.
CHESHIRE, OHIO
SCALE 1"=200'
DRAWN G COLLINS
DATE FEB 6, 1953
CHECKED J COLLINS
APPROVED
JOB NO 2267
SARGENT & LUNDY
ENGINEERS
CHICAGO, ILLINOIS
DRAWING NO.
15-3006-1
DATE NO. DESCRIPTION APPD.
REVISIONS
igsc /usr5/stru/kyger_creek/u15/3006.150
"THIS DRAWING IS THE PROPERTY OF THE AMERICAN ELECTRIC POWER SERVICE CORP. AND IS LOANED UPON CONDITION THAT IT IS NOT TO BE REPRODUCED OR COPIED, IN WHOLE OR IN PART, OR USED FOR FURNISHING INFORMATION TO ANY PERSON WITHOUT THE WRITTEN CONSENT OF THE AEP SERVICE CORP., OR FOR ANY PURPOSE DETRIMENTAL TO THEIR INTEREST, AND IS TO BE RETURNED UPON REQUEST"
OHIO VALLEY ELECTRIC CORP.
KYGER CREEK PLANT
CHESHIRE OHIO
BORING LOCATION PLAN
DWG. NO.
SCALE: 1"=200'
CIVIL ENGINEERING DIVISION
DR:
CH:
ENGR.
PROJ. ENGR.
DATE:
APPROVED BY
AEP AMERICAN ELECTRIC POWER
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215
SYSTEM DATE-13-MAR-1995
SYSTEM TIME-15:24

15-3007



SECTION A-A

SECTION B-B



SECTION C-C

SECTION D-D

NOTES

FOR LOCATION OF SECTIONS SEE DWG. 15-3006
THE NOTATIONS 17/12 INDICATE THE NUMBER OF BLOWS (17) REQUIRED TO DRIVE SAMPLING PIPE 12" USING A 140 LB. WEIGHT FALLING 30"
⊙ INDICATES LOSS OF WATER AT THAT DEPTH

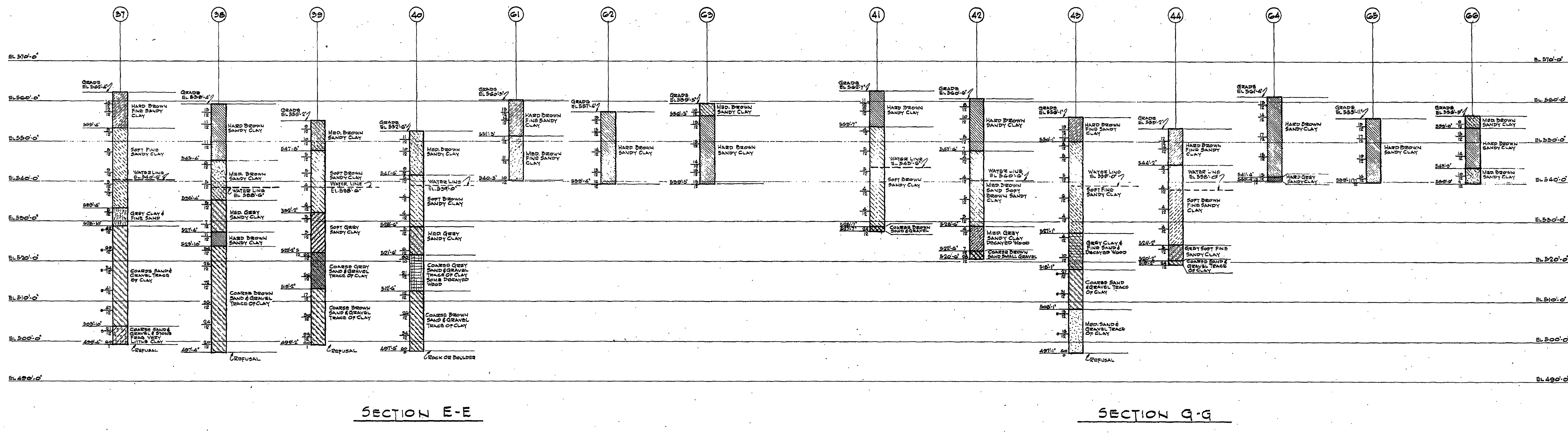
REFERENCE DRAWINGS

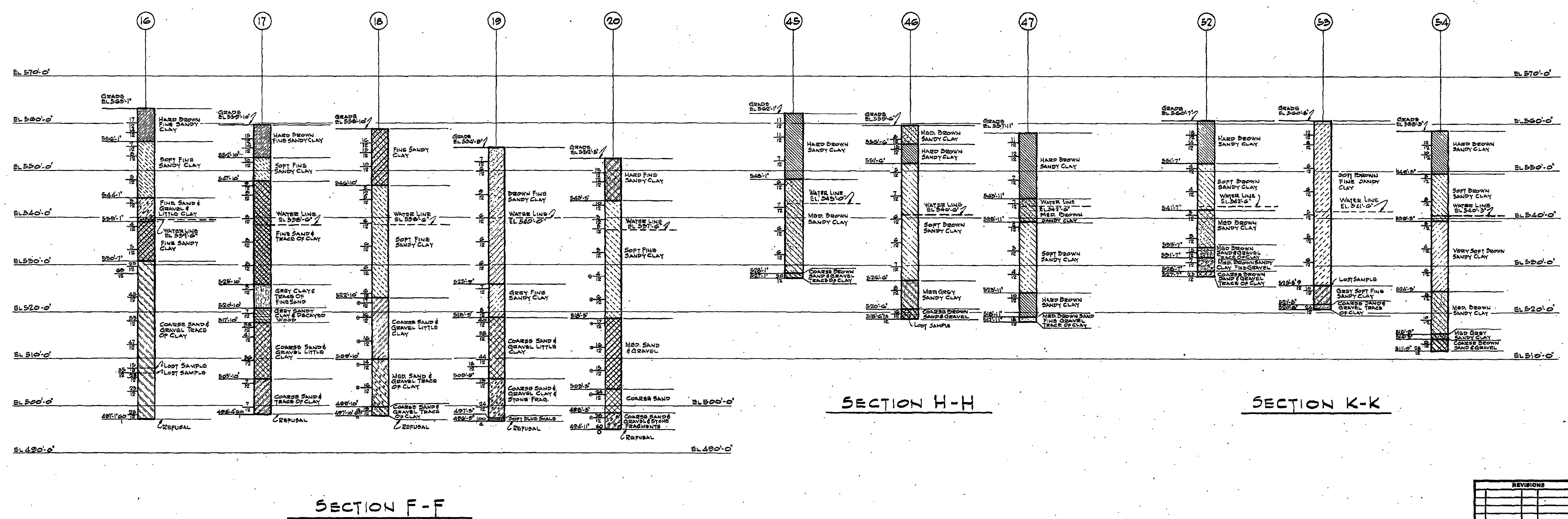
15-3006 CORE BORING LOCATION PLAN SHEET 1 OF 4
15-3008 LOG OF CORE BORINGS SHEET 3 OF 4
15-3009 " " " " SHEET 4 OF 4

REVISIONS

LOG OF BORINGS
SHEET NO. 2 OF 4
KYGER CREEK PLANT
OHIO VALLEY ELECTRIC CORP.
CHESHIRE, OHIO

SCALE 1"=10' VERTICAL	SARGENT & LUNDY ENGINEERS CHICAGO, ILLINOIS
DRAWN G. COLLINS	
DATE FEB. 6, 1953	
CHECKED J. COLLINS	
APPROVED E. J. Stankiewicz 2-6-53	
JOB NO. 2267	DRAWING NO. 15-3007





NOTES

FOR LOCATION OF SECTIONS SEE DWG 15-3006
THE NOTATION 17/12 INDICATE THE NUMBER OF BLOWS (17) REQUIRED TO DRIVE SAMPLING PIPE 12" USING A 140 LB. WEIGHT FALLING 30"
⊙ INDICATES LOSS OF WATER AT THAT DEPTH

REFERENCE DRAWINGS

15-3006 CORE BORING LOCATION PLAN SHEET 1 OF 4
15-3007 LOG OF CORE BORINGS SHEET 2 OF 4
15-3009 LOG OF CORE BORINGS SHEET 4 OF 4

REVISIONS

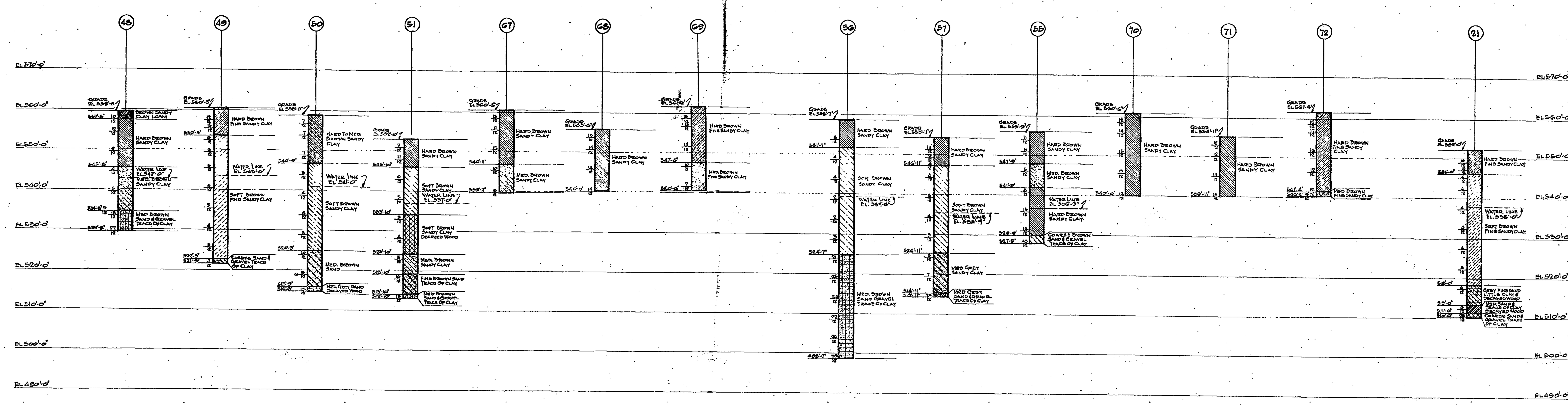
LOG OF BORINGS
SHEET NO. 3 OF 4
KYGER CREEK PLANT
OHIO VALLEY ELECTRIC CORP.
CHESHIRE, OHIO

SCALE 1" = 10' VERTICAL
DRAWN G. COLLINS
DATE 2-6-53
CHECKED J. COLLINS
RNS APPROVED E. J. Stankiewicz 2-6-53

JOB NO.	JOB NO.	JOB NO.	JOB NO.
2267			

SARGENT & LUNDY
ENGINEERS
CHICAGO, ILLINOIS

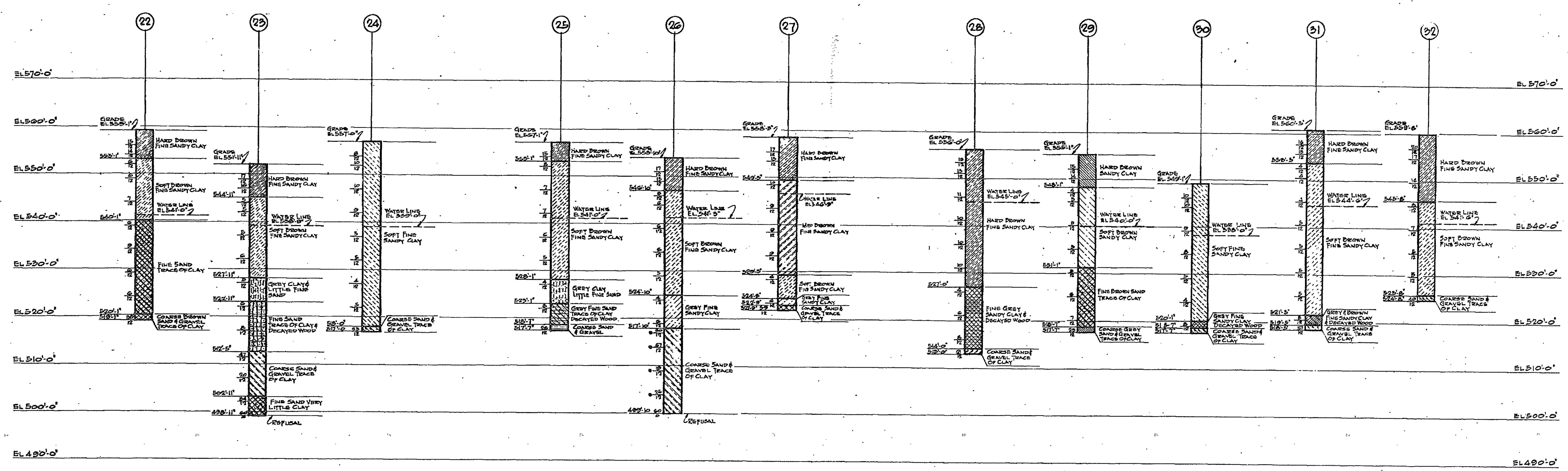
DRAWING NO.
15-3008



SECTION J-J

SECTION L-L

SECTION M-M



SECTION N-N

SECTION P-P

SECTION Q-Q

NOTES

FOR LOCATION OF SECTIONS SEE DWG. 15-3006
THE NOTATIONS 17/12 INDICATE THE NUMBER OF BLOWS (17) REQUIRED TO DRIVE SAMPLING PIPE 12" USING A 140 LB. WEIGHT FALLING 30"
⊗ INDICATES LOSS OF CIRCULATING WATER, ALL LOSSES VERY SLIGHT

REFERENCE DRAWINGS

15-3006 CORE BORING LOCATION PLAN. SHEET 1 OF 4
15-3007 LOG OF CORE BORINGS SHEET 2 OF 4
15-3008 LOG OF CORE BORINGS SHEET 3 OF 4

REVISIONS

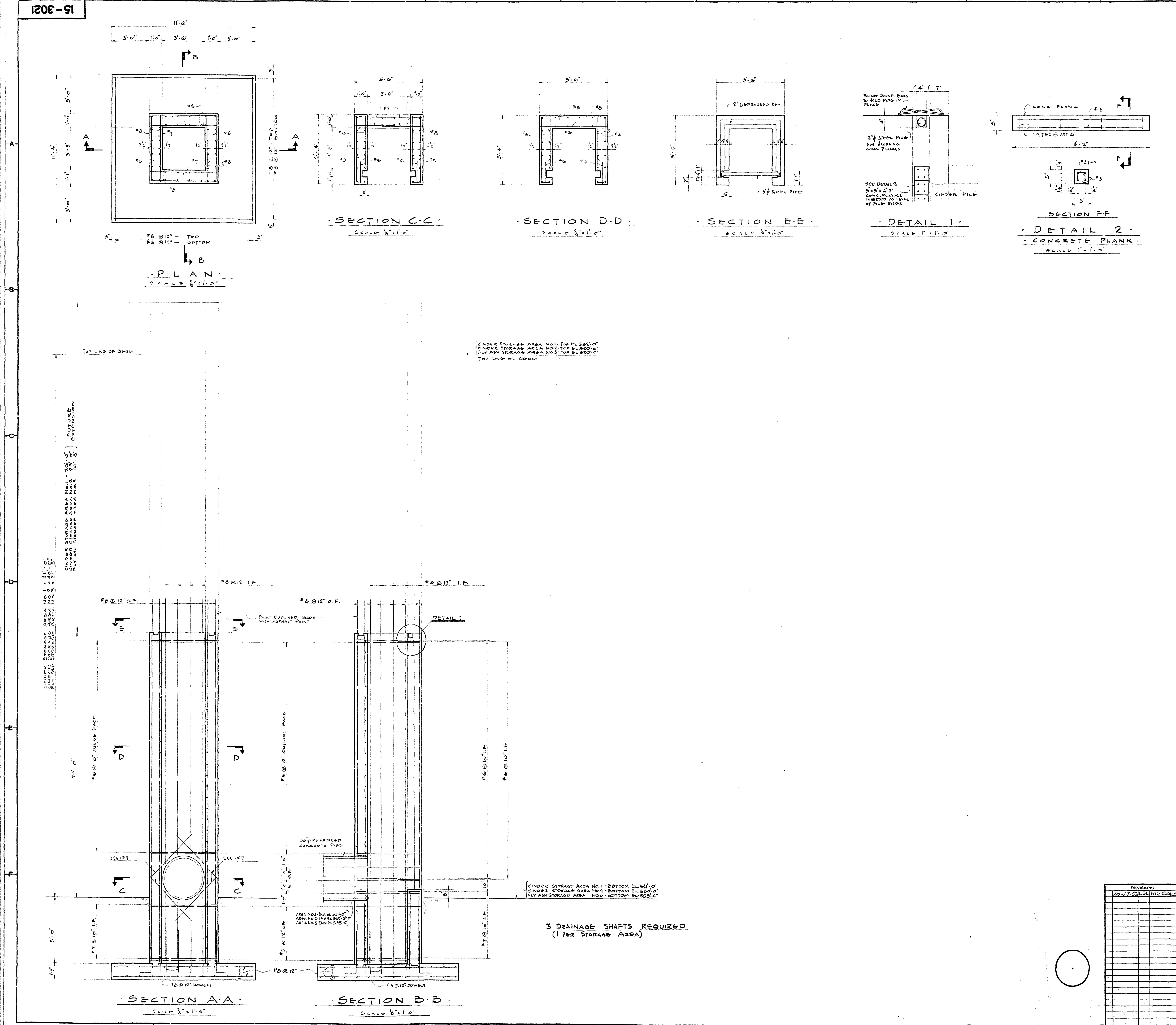
LOG OF BORINGS
SHEET NO. 4 OF 4
KYGER CREEK PLANT
OHIO VALLEY ELECTRIC CORP.
CHESHIRE, OHIO

SCALE 1" = 10' VERTICAL
DRAWN G. COLLINS
DATE 2-6-53
CHECKED J. COLLINS
APPROVED E. J. Stankiewicz 2-6-53

JOB NO.	JOB NO.	JOB NO.	JOB NO.
2267			

SARGENT & LUNDY
ENGINEERS
CHICAGO, ILLINOIS

DRAWING NO.
15-3009



· BILL OF MATERIAL ·

DATE REL	ITEM	QUAN.	DESCRIPTION	FABRICATOR	REMARKS
	1	3	3"φ STEEL PIPE - 4'-3" LG.		

· REINFORCING STEEL ·

FABRICATOR	TONNAGE	FABRICATORS DWG. NOS.
WEST VIRGINIA STEEL CO.		

· NOTES ·

· REFERENCE DRAWINGS ·

15-3004 GRADING PLAN - CINDER STORAGE AREA No. 1
15-3005 GRADING PLAN - CINDER STORAGE AREA No. 2
15-3012 GRADING PLAN - FLY ASH STORAGE AREA No. 3

REVISIONS		
10-27-53	LEL	FOR CONST

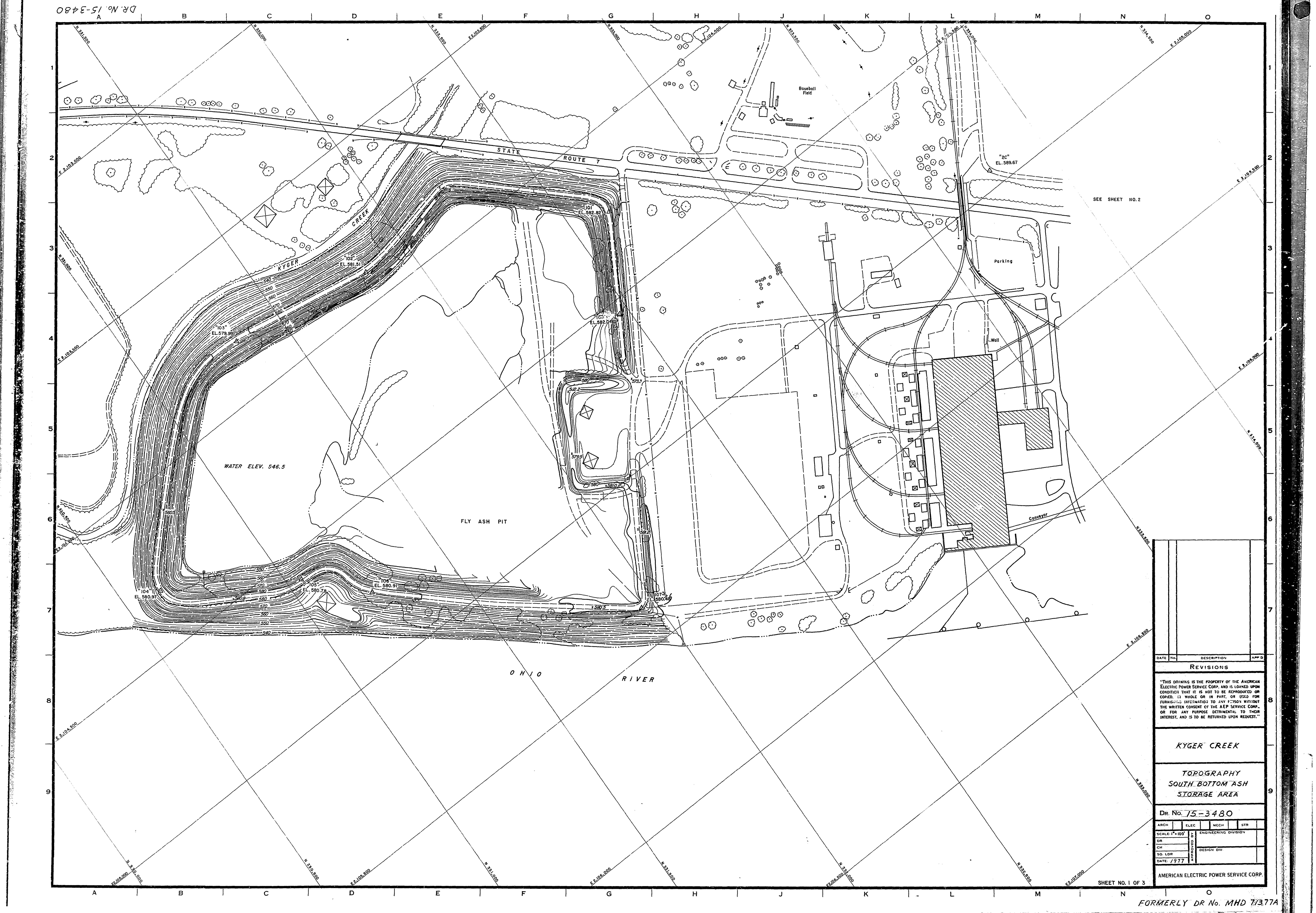
DRAINAGE SHAFT
CINDER STORAGE AREA NO. 1, 2 & 3
KYGER CREEK PLANT
OHIO VALLEY ELECTRIC CORP.
CHESHIRE, OHIO

SCALE: AS NOTED
DRAWN: R.C. ODEGARD
DATE: 10-27-53
CHECKED: L.E. LEDERER
APPROVED: R.N. Bergstrom 11-6-53

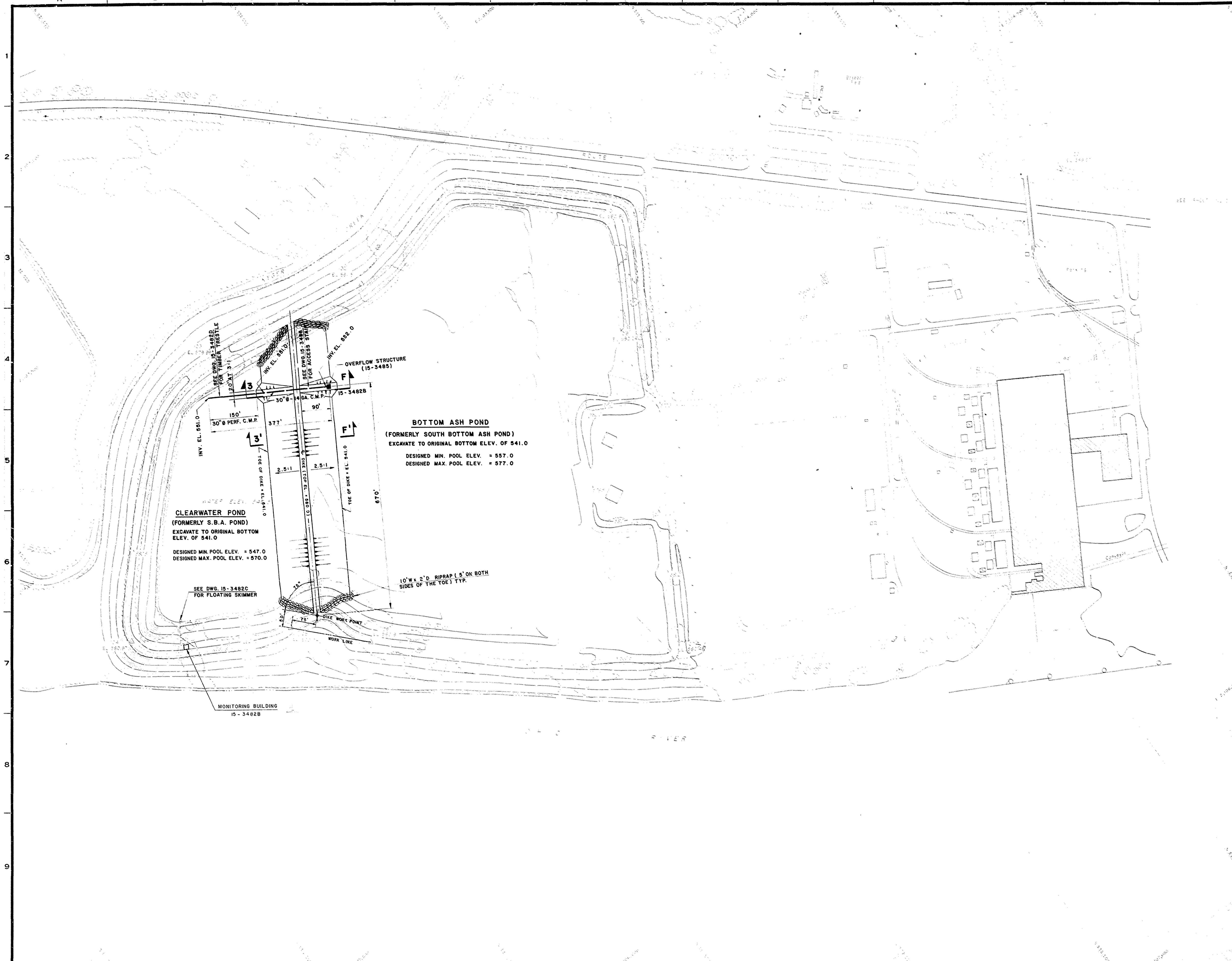
SARGENT & LUNDY
ENGINEERS
CHICAGO, ILLINOIS

JOB NO.	JOB NO.	JOB NO.	JOB NO.
2267			

DRAWING NO. 15-3021


DR. No. 15-3480
STATE ROUTE 7
KYGER CREEK
Baseball Field
"2C" EL. 589.67
SEE SHEET NO. 2
Parking
Wall
Conveyor
101 EL. 582.83
102 EL. 581.51
103 EL. 579.91
104 EL. 580.97
105 EL. 580.78
106 EL. 580.91
107 580.46
WATER ELEV. 546.5
FLY ASH PIT
OHIO RIVER
DATE
No.
DESCRIPTION
APP'D
REVISIONS
"THIS DRAWING IS THE PROPERTY OF THE AMERICAN ELECTRIC POWER SERVICE CORP. AND IS LOANED UPON CONDITION THAT IT IS NOT TO BE REPRODUCED OR COPIED, IN WHOLE OR IN PART, OR USED FOR FURNISHING INFORMATION TO ANY PERSON WITHOUT THE WRITTEN CONSENT OF THE AEP SERVICE CORP., OR FOR ANY PURPOSE DETRIMENTAL TO THEIR INTEREST, AND IS TO BE RETURNED UPON REQUEST."
KYGER CREEK
TOPOGRAPHY
SOUTH BOTTOM ASH
STORAGE AREA
DR. No. 15-3480
ARCH
ELEC
MECH
STR
SCALE: 1" = 100'
DR.
CH
SQ. LDR
DATE: 1977
APPROVED BY
ENGINEERING DIVISION
DESIGN DIV.
AMERICAN ELECTRIC POWER SERVICE CORP.
SHEET NO. 1 OF 3
FORMERLY DR No. MHD 71377A

DR. No. 15-3480A



DATE	NO.	DESCRIPTION	APP'D
6/13/91	2	ADDED MONITORING BLDG.	S.F.
5-15-90	1	REV'D. DIKE CROSS SLOPE, ADDED RIPRAP & OTHER IMPORTANT CALL-OUTS	S.F.

REVISIONS

KYGER CREEK PLANT

ASH POND MODIFICATIONS BOTTOM ASH AND CLEARWATER PONDS PLAN

DR. No. 15-3480A-2

ARCH — ELEC — MECH — STR

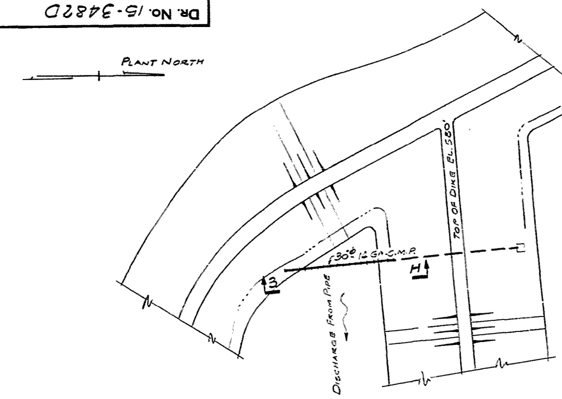
SCALE: 1" = 100'
DR. J.B.T.
CH.
SQ. LDR. A.S.P.
DATED 5-90

APPROVED BY: ENGINEERING DIVISION; DESIGN DIV.

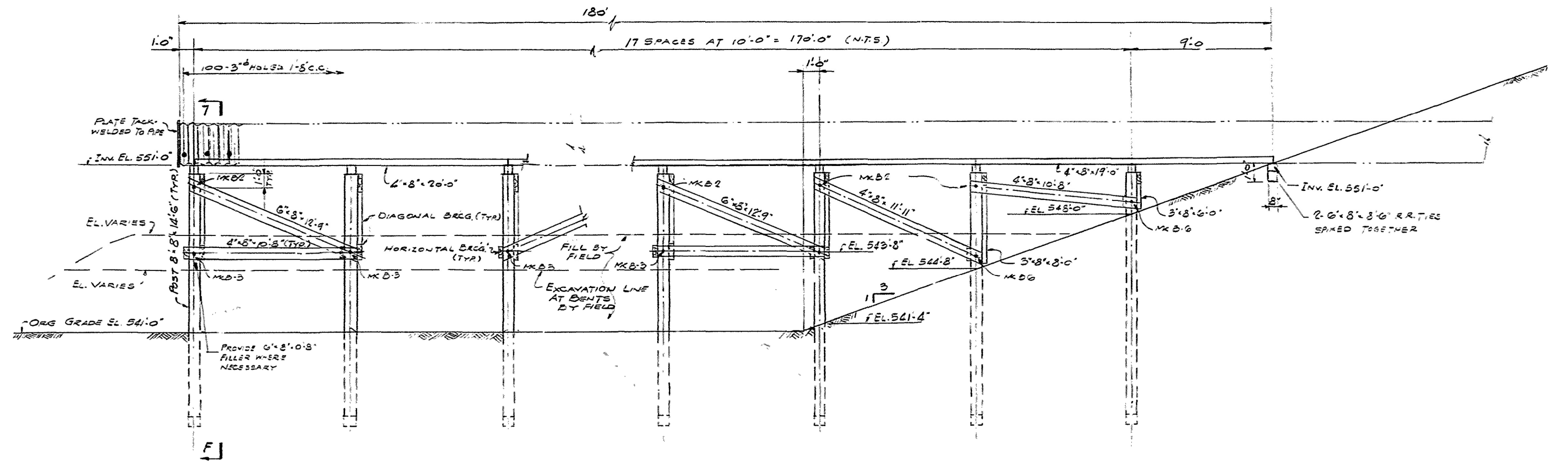
AMERICAN ELECTRIC POWER SERVICE CORP.

SHEET NO. 1 OF 3

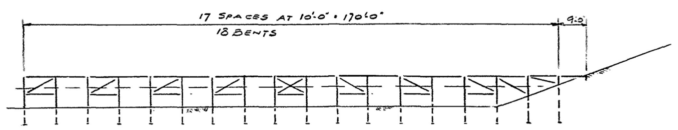
DR. NO. 15-3482D



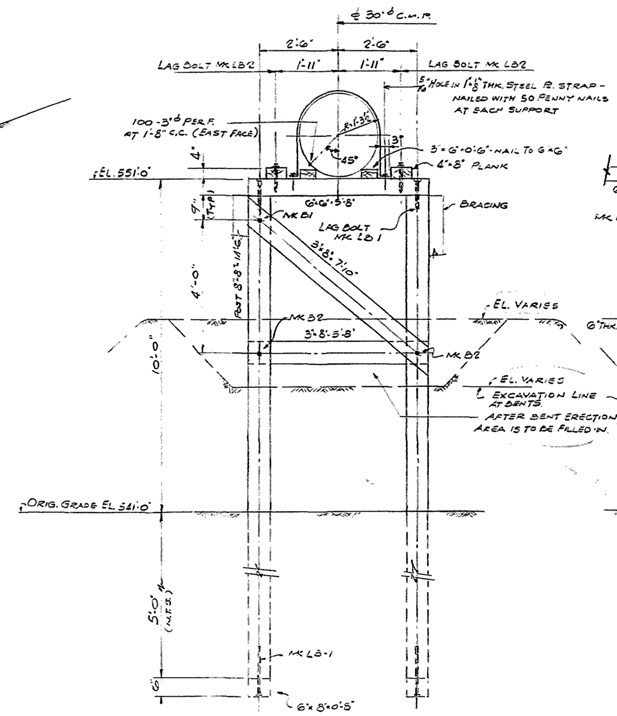
KEY PLAN
FOR LOCATION SEE DWG. 15-3480A
SCALE: 1"=100'



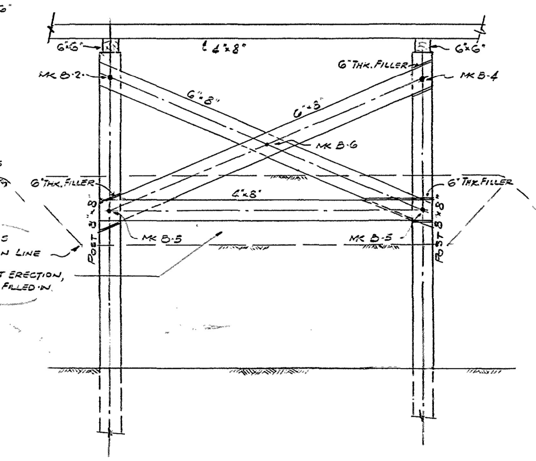
ELEVATION 3-H
SCALE: 1/8"=1'-0"



ELEVATION OF BRACING - EAST FACE - AS SHOWN
DO. - WEST FACE - OPP. HAND
SCALE: 1"=20'



ELEVATION 7-F
SCALE: 1/2"=1'-0"



ELEVATION OF CENTER PANEL
SCALE: 1/2"=1'-0"

GENERAL NOTES

DO NOT SCALE THIS DWG.

ALL TIMBER TO BE DOUGLAS FIR OR SOUTHERN YELLOW PINE SELECT STRUCTURAL SIZES & ALL TO BE CREOSOTED.

BACKFILL AROUND POSTS SHALL BE WELL COMPACTED.

CREOSOTING TO CONFORM TO SPEC. AWPA C-2, LATEST REVISION.

ALL STEEL TO BE A-36 (UNO) & TO RECEIVE ONE (1) FIELD COAT OF BITUMASTIC PAINT.

ALL BOLTS SHALL BE A-36, HOT DIPPED GALVANIZED AS PER ASTM A153-53.

MATERIAL

TIMBER BY: BURKE-PARSONS-BOWLBY
ORDER NO. 02519-761-OX
BOLTS AND STRAPS
BY: AL-STEEL FABRICATORS, INC.
ORDER NO: 02543-761-0

30"Φ 16GA. C.M.P. (375 L.F.) BY ARMCO
ORDER NO. 00731-761-0

REFERENCE DRAWINGS

15-3480A - ASH POND MODIF. BOTTOM ASH & CLEARWATER PONDS.
15-3482B - ASH POND MODIF. SECTS. & DET.

TIMBER SCHEDULE

NO.	SIZE	LENGTH	TOTAL LENGTH	REMARKS	NO. OF BOARD FT.
36	8"×8"	14'-6"	522'-0"	POSTS	2,784.0
16	4"×8"	20'-0"	320'-0"	PLANKS	853.3
2	4"×8"	19'-0"	38'-0"	DO.	101.3
18	6"×6"	5'-8"	102'-0"	BEAMS	306.0
34	3"×8"	5'-8"	192'-8"	HORIZ. BRCG.	385.3
32	3"×8"	7'-10"	250'-8"	DIAG. BRCG.	501.3
18	6"×8"	13'-10"	249'-0"	DO.	996.0
2	4"×8"	11'-9"	23'-6"	DO.	62.7
2	4"×8"	10'-8"	21'-4"	DO.	56.9
38	3"×6"	0'-6"	19'-0"	SADDLE BLOCK	28.5
16	4"×8"	10'-8"	170'-8"	HORIZ. BRCG.	455.1
1	3"×8"	8'-0"	8'-0"	DIAG. BRCG.	16.0
1	3"×8"	6'-0"	6'-0"	DO.	12.0
36	6"×8"	0'-8"	24'-0"	POST BEARING BLOCKS	96.5
20	6"×8"	0'-8"	13'-4"	FILLER BLOCKS	53.6

TOTAL = 6,708.5
SAY 6710 B.F.

BOLT SCHEDULE

MARK	QTY.	SIZE	LENGTH	TYPE	REMARKS
LB1	72	7/8"Φ	1'-0"	LAG BOLT	SQUARE HEAD 5" THREADS
B1	36	DO.	1'-0"	SQ. HD. SQ. NUT.	2 WASHERS 5" THREADS
B2	66	DO.	1'-3"	DO.	DO.
B3	28	DO.	1'-6½"	DO	DO.
B4	2	DO.	1'-8½"	DO	DO.
B5	4	DO.	2'-0"	DO	DO.
B6	10	DO.	1'-1"	DO.	DO.
LB2	54	3/8"Φ	0'-8"	LAG BOLT	SQUARE HEAD 3" THREAD

NOTE:
SOME QUANTITIES AND LENGTHS OF THE ABOVE LISTED TIMBER AND BOLTS ARE EXCESSIVE. THIS IS DUE TO A PREVIOUS DESIGN WHICH MATERIAL WAS ORDERED FROM. FIELD IS TO ADJUST.

CHARGE TO CIA-2123 (OVEC.)

REVISIONS

DATE	NO.	DESCRIPTION	APPD.
10/14/80	1	CHANGED AMOUNT OF BRACING & ADDED NOTE. LM	S.F.

KYGER CREEK PLANT

ASH POND MODIFICATIONS
TIMBER SUPPORT TRESTLE
FOR 30"Φ C.M.P. FROM
BOTTOM ASH POND

DR. NO. 15-3482D-1

MATERIAL	RELEASE DATE
STRUCT. STEEL	—
REINF. STEEL	—
DECKING	—
GRATING	—
STAIR TREADS	—
HANDRAILING	—
TIMBER	6-12-80
BOLTS	6-2-80

NOTE: CHECKER IS RESPONSIBLE TO SEE THAT THE ABOVE APPLICABLE MATERIALS TO BE ORDERED ARE BROUGHT TO HIS SQUAD LEADERS' ATTENTION.

ARCH. — ELEC — MECH. — STR.
SCALE: AS NOTED
DR. R. MACK
CH. J.B.T.
SQ. LDR. T.S.
DATE: 5-13-80
APPROVED BY: ENGINEERING DIV; DESIGN DIV

AMERICAN ELECTRIC POWER SERVICE CORP.

AEP3046XY

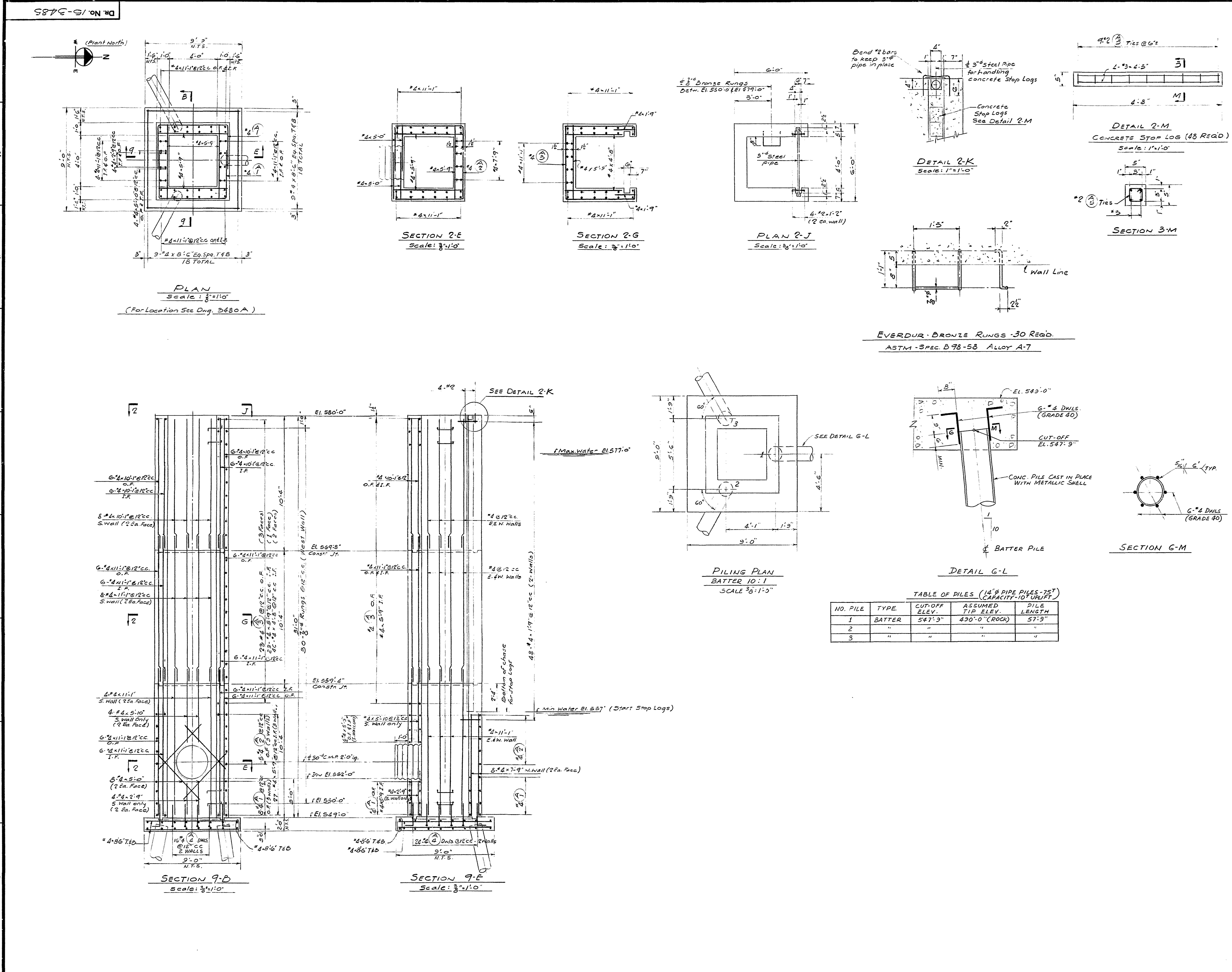


TABLE OF PILES (14"φ PIPE PILES - 75T CAPACITY - 10T UPLIFT)

NO. PILE	TYPE	CUT-OFF ELEV.	ASSUMED TIP ELEV.	PILE LENGTH
1	BATTER	547'-9"	490'-0" (ROCK)	57'-9"
2	"	"	"	"
3	"	"	"	"

GENERAL NOTES

Do Not Scale This Drawing.

For General Notes See SDS 151

REFERENCE DRAWINGS

15-3480A - Bottom Ash & Clear Water Ponds

Reinforcing Schedule R.S. 351
By:
ORDER 00732
Concrete = 23.0 Cu. Yds.

3"φ x 5'-2" pipe - By Field

30"φ 14 Ga. C.M.P. 2'-0" lg.
By: By Field

Rungs (Bronze)
By: Esco Iron Works
Ord. No. 05150-761-CX

DATE	NO.	DESCRIPTION	APPD.

REVISIONS

KYGER CREEK PLANT

ASH POND MODIFICATIONS
BOTTOM ASH POND
OVERFLOW STRUCTURE

DR. NO. 15-3485

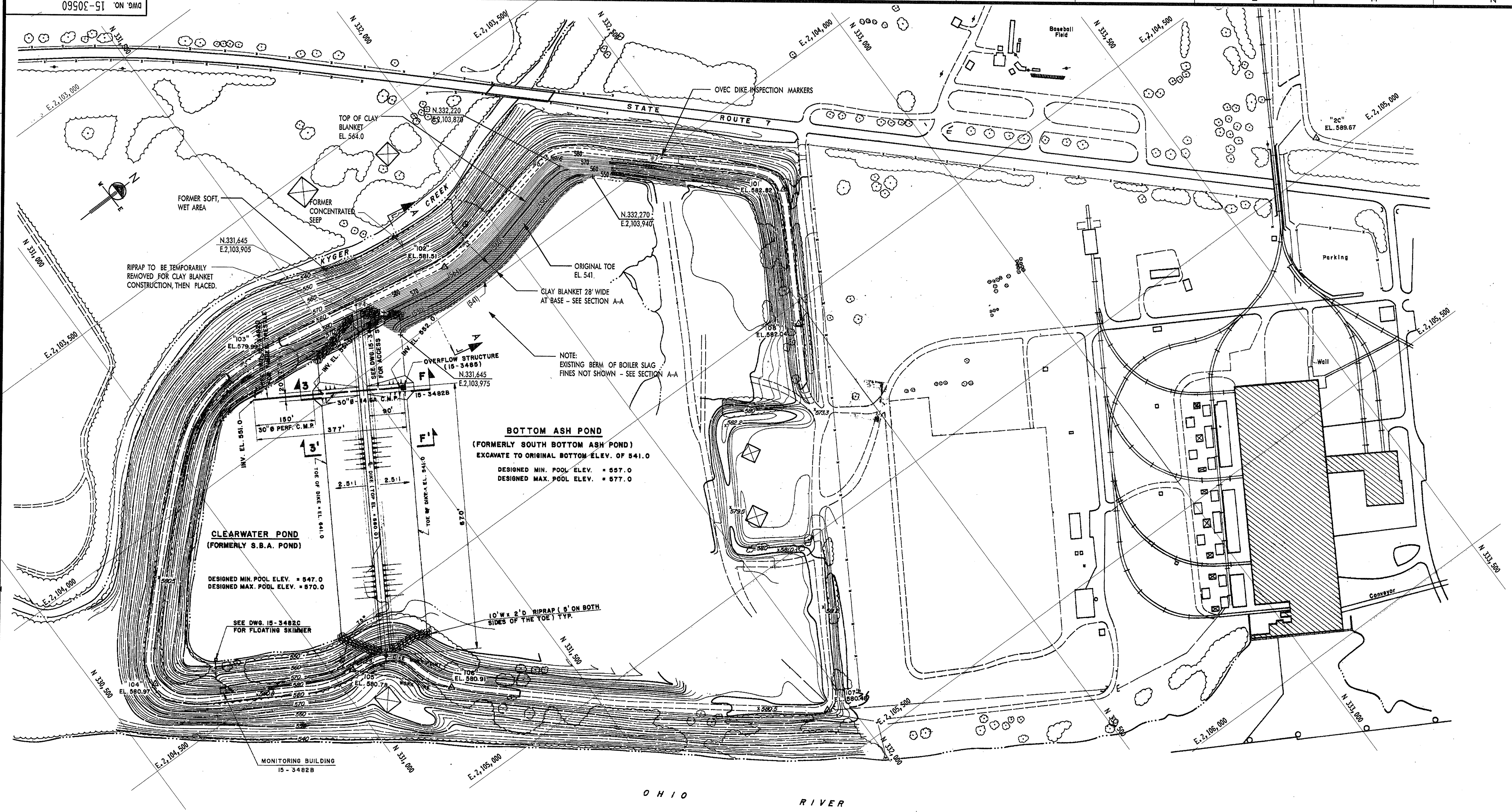
ARCH. | ELEC. | MECH. | STR.

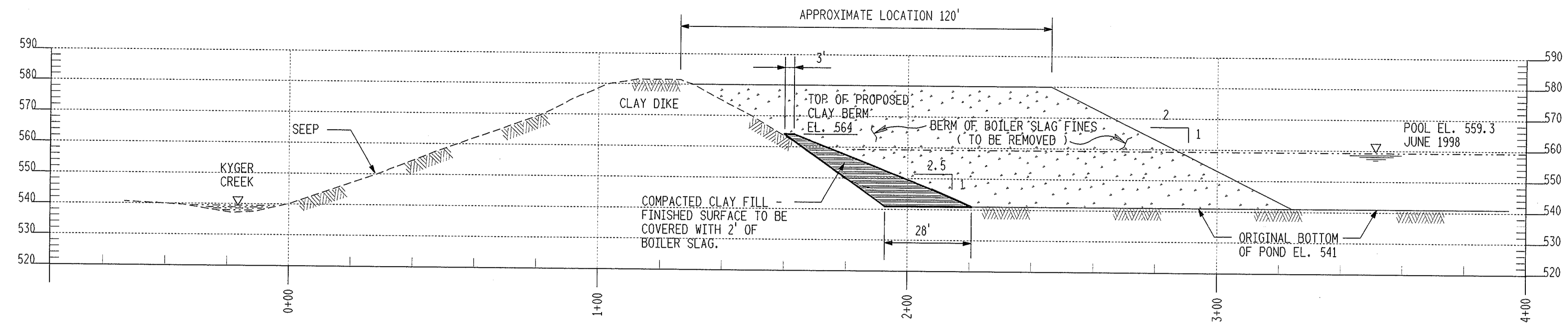
SCALE: As Noted
DR: R. Mack
CH. RGD
SQ. LDR.
DATE:

APPROVED BY: ENGINEERING DIV / DESIGN DIV

AMERICAN ELECTRIC POWER SERVICE CORP.

DWG. NO. 15-30560





SECTION A-A

SCALE: 1" = 20'

CLAY BERM QUANTITY

APPROXIMATE CLAY NEEDED = 8177 CU. YDs.

GENERAL NOTES

LEGEND

- EXISTING PAVED ROAD
- EXISTING UNPAVED ROAD
- EXISTING FENCE
- EXISTING RAILROAD
- EXISTING WATERWAY/DITCH
- EXISTING WOODS
- 580 EXISTING CONTOURS
- x 580.9 EXISTING SPOT ELEVATIONS
- (580) PROPOSED CONTOURS
- SECTION LOCATIONS
- FLOW DIRECTION IN DITCHES
- COMPACTED CLAY FILL

REFERENCE DRAWINGS

15-3480 TOPOGRAPHY - SOUTH BOTTOM ASH POND STORAGE AREA (1977)

15-3480A ASH POND MODIFICATIONS BOTTOM ASH AND CLEARWATER PONDS (1981)

DATE	NO.	DESCRIPTION	APPD.
8/5/98	0	ISSUED FOR CONSTRUCTION	CST

REVISIONS

OHIO VALLEY ELECTRIC CORP.

KYGER CREEK PLANT

CHESHIRE OHIO

BOTTOM ASH AND CLEARWATER PONDS
SOUTH BOTTOM ASH STORAGE AREA

DWG. NO. 15-30560-0

SCALE: 1"=100' CIVIL ENGINEERING DIVISION

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DATE: 8/5/98
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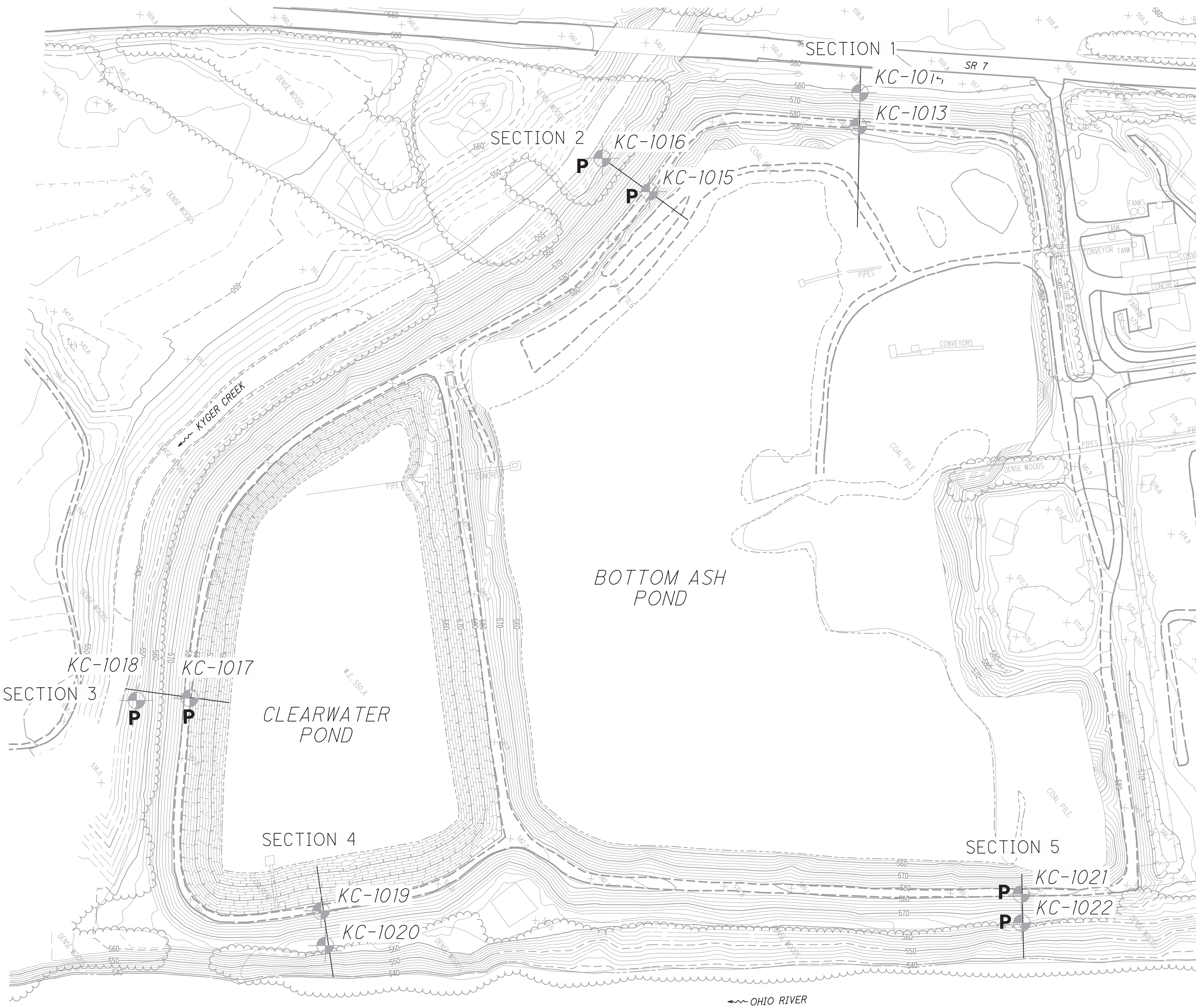
AEP AMERICAN ELECTRIC POWER — 1 RIVERSIDE PLAZA COLUMBUS, OH 43215

ATTACHMENT D

INSTRUMENTATION LOCATION MAP



AS-DRILLED BORING LOCATIONS

Boring No.	Installation	NORTHING	EASTING	ELEVATION (RISER)	ELEVATION (CASING)	ELEVATION (GROUND)
KC-1013		332435.80	2104006.56	-	-	581.27
KC-1014		332476.01	2103962.06	-	-	558.59
KC-1015	PIEZOMETER	332073.06	2103860.39	580.07	580.41	580.41
KC-1016	PIEZOMETER	332045.57	2103760.75	546.70	546.87	543.80
KC-1017	PIEZOMETER	330862.99	2104039.31	579.69	580.07	580.07
KC-1018	PIEZOMETER	330786.90	2103981.94	550.10	550.35	547.34
KC-1019		330803.17	2104482.03	-	-	580.73
KC-1020		330769.60	2104534.81	-	-	559.51
KC-1021	PIEZOMETER	331789.94	2105253.04	579.92	580.18	580.18
KC-1022	PIEZOMETER	331758.02	2105293.51	565.54	565.75	562.69

Horizontal coordinates are State Plane Grid, Ohio South Zone, and reference the North American Datum of 1927 (NAD 27)

Elevations shown reference the National Geodetic Vertical Datum of 1929 (NGVD 29)

Control points used to establish the coordinates on the respective datums were provided to DLZ by the owner (OVEC/AEP) at the time of the survey.

AS-DRILLED BORING

P PIEZOMETERS INSTALLED IN BORINGS AS INDICATED IN TABLE ABOVE

NOTE: TOPOGRAPHIC SURVEY INFORMATION SHOWN ON THIS PLAN IS FOR REFERENCE ONLY. TOPO INFORMATION WAS PROVIDED BY AEP/OVEC AND IS BASED ON AERIAL MAPPING (1994) AND FIELD SURVEY (1997). CURRENT ELEVATIONS MAY BE DIFFERENT THAN THOSE SHOWN ON PLAN.

EXHIBIT 5

0 50 100 200 HORIZONTAL SCALE IN FEET

DRAWN RKL CHECKED SJR

BOTTOM ASH POND GENERAL SITE PLAN

KYGER CREEK

2 / 6

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ATTACHMENT E

HYDROLOGY AND HYDROLOGIC REPORT

Hydrologic and Hydraulic Analysis Related to Compliance Requirements
South Fly Ash Pond, Boiler Slag Pond and Clearwater Pond
Kyger Creek Power Plant, Gallia County, Ohio

General

The intent of this section is to ascertain the compliance of the South Fly Ash Pond, Boiler Slag Pond, and Clearwater Pond with the recently mandated coal combustion residuals (CCR) rules with regard to the hydrologic and hydraulic capacity requirements for surface impoundments (Ref 1). All three impoundments are up ground reservoirs which function as tailings ponds for the Ohio Valley Electric Corporation's (OVEC's) Kyger Creek Power Plant. A site map is shown in Figure 1.

The CCR rules require that the impoundments undergo periodic hazard potential classification. Currently, South Fly Ash Pond and Boiler Slag Pond (which includes Clearwater Pond) are listed under the Class II Hazard Classification for dams in the State of Ohio. This classification is somewhat different from the hazard classification listed in Section 257.73 (a) (2) of the CCR but may be construed as equivalent to a significant hazard potential CCR surface impoundment. As per Section 257.82 (a) (3) (ii) the inflow design flood for a significant hazard CCR surface impoundment is the 1,000-yr flood. However, since the primary classification is the State of Ohio Class II Hazard classification, the minimum design flood for such structures as per Ohio Administrative Code Rule 1501:21-13-02 is the 50% probable maximum flood (50% PMF). In addition, the 50% PMP depths for this location are larger than the 1000-yr rainfall depths for the same duration and thus the use of the 50% PMP for this analysis is conservative. Consequently, the inflow design flood chosen to determine the hydraulic capacity requirement is the 50% PMF.

The CCR rules also only state that the CCR unit must adequately manage the flow into and from the unit during and after the inflow design flood. No specific criterion for freeboard in the CCR unit is specifically listed. However, Ohio Administrative Code Rule 1501:21-13-07 for Class II dams that are up ground reservoirs specifically states that the minimum elevation of the embankment crest shall be 5 feet higher than the elevation of the designed maximum operating pool level. As part of this compliance certification, checks are conducted to verify that the 5 ft freeboard criterion for the top of dam as compared to the operating pool level is met. In addition, surcharge elevations associated with the inflow of the 50% PMF with maximum operating pool as the initial condition are also determined to ensure adequate storage capacity of the tailings ponds.

PMP Estimates

The rainfall depth for the 6-hr 1 sq. mile PMP for the Kyger Creek Plant as per the latest guidelines (Ref 2) developed by the Ohio Department of Natural Resources (ODNR) is 19 inches. Since the drainage areas to the ponds are relatively small and the associated time of concentrations will be much less than 6 hours, it is reasonable to use the 6-hr 1 sq. mile value for the PMP. It should be noted that the point 1000-yr 6-hr rainfall depth for the area is 5.6 inches as compared to the 0.5 PMP depth of 9.5 inches.

Topographic Data

Topographic data for all three ponds were generated using the 2007 LiDAR information for the project site that is available online from the Ohio Geographically Referenced Information Program (OGRIP) website. The drainage areas and elevation-area data for each of the ponds were developed using the above data. It should be noted that the elevations with the LiDAR data are referenced to the NAVD 88 vertical datum. Since the historical information for the ponds are based on the NGVD 29 datum, all elevations based on this data are converted to the NGVD 29 elevations by adding 0.7 ft, which is the appropriate correction factor for the project area. All elevations in this document are referenced to the NGVD 29 datum unless otherwise expressly stated.

Historic Data and Previous Studies

Historic data on the tailing ponds were primarily taken from several previous studies (Refs 3 and 4). This includes outlet structure information and normal pool elevations. Information was also obtained from communications with OVEC and American Electric Power (AEP) personnel. A site visit was also conducted on 7/22/15 to observe the various facilities on site.

South Fly Ash Pond

The drainage area for the South Fly Ash Pond is approximately 67.7 acres. The outlet structure for South Fly Ash Pond is located near the south west corner of the pond and consists of a 36-inch concrete pipe, with a 42 inch by 39 inch concrete riser pipe with the principal spillway at elevation 582 ft. As per OVEC and AEP personnel, the maximum operating pool is at elevation 585 ft.

The site visit revealed that the Kyger Creek Plant's coal yard drainage as well as storm drainage from a portion of the plant site is pumped to the pond. This information is not available from any of the previous reports. Discussions with OVEC and AEP personnel revealed that originally four Goyne pumps each rated at 5,000 GPM delivered the drainage flow to the ponds. Currently, only two are working and there are no current plans to replace the other two. For the purpose of this study, it is assumed that two pumps will be active during storm events. The combined coal yard/plant drainage area is approximately 38 acres as per OVEC and AEP personnel.

Conservatively, it is assumed that the outlet structure is blocked during the occurrence of the 0.5 PMP event, the initial pond elevation is at the maximum operating pool, and that the direct inflow to the reservoir from the 0.5 PMP rainfall and the associated pumped drainage from the coal yard/plant area are instantaneously imposed on the pond.

Assuming no losses, the direct inflow volume to the pond = 0.5*19/12*67.7 = 53.6 ac-ft. Drainage volume to the pond from the pumps will be the minimum of the pump delivery or the flow volume associated with the drainage area. Maximum pump delivery during the 6-he PMP will be the rated pump capacity multiplied by the 6-hr duration. Maximum pump volume = 5,000*2*60*6/7.48/43,560 = 11.0 ac-ft. Assuming no losses, the maximum volume from the 38 acre coal yard/plant drainage area during the 0.5 PMP = 0.5*19/12*38 = 30 ac-ft. It appears that flow from the drainage area will be limited by the pump capacity which may not be the case in reality since there will be losses associated with the rainfall over the coal/plant yard. A runoff coefficient of approximately 0.37 will make the runoff volume almost the same as the pump capacity. Conservatively, the total volume to the pond can be estimated as 53.6+11.0 = 64.6 ac-ft.

The resulting water surface elevation is calculated to be 586.0 ft (see Table 1). The top elevation of the embankment around the pond is considered to be at elevation 590 ft, though the 2007 LIDAR data indicate variations in the elevations. Therefore, the freeboard for the 0.5 PMP event (assuming the initial water level is at maximum operating pool) is of the order of 4 ft.

Also, there is a freeboard of 5 ft above the maximum operating level, which satisfies the minimum freeboard requirements of the State of Ohio for up ground reservoirs.

Boiler Slag Pond

The drainage area for the Boiler Slag Pond is approximately 30.1 acres. The outlet structure for Boiler Slag Pond is located at the southern end of the pond adjacent to the west end of the splitter dike between Boiler Slag Pond and the associated Clearwater Pond. The outlet consists of a 36-inch concrete pipe with a 42 inch by 39 inch concrete riser pipe with the principal spillway at elevation 557 ft. Water entering the outlet structure is discharged to Clearwater Pond, through a 30-inch CMP which passes through the splitter dike. There is no drainage from other sources entering Boiler Slag Pond. The maximum operating pool level is reported by OVEC and AEP personnel to be approximately 558 ft.

Conservatively, it is assumed that the outlet structure is blocked during the occurrence of the 0.5 PMP event, the initial pond elevation is at maximum operating pool, and that the inflow to the reservoir is only from the 0.5 PMP rainfall. Assuming no losses, the direct inflow volume to the pond = 0.5*19/12*30.1 = 23.8 ac-ft. The initial storage in the pond corresponding to the maximum operating pool elevation of 558.0 ft is 17.7 ac-ft, so the total storage in the pond corresponding to the 0.5 PMP is 41.5 ac-ft. The resulting water surface elevation in the pond due to the 0.5 PMP event is 559.3 ft.

The top elevation of the embankment around the pond is considered to be at elevation 582 ft, though the 2007 LIDAR data indicate variations in the elevations. Therefore, the freeboard for the 0.5 PMP event is of the order of 22.7 ft. The detailed calculations are shown in Table 2.

Clearwater Pond

The drainage area for the Clearwater Pond is 9.9 acres. The outlet structure for Clearwater Pond is located at the southeast corner of the pond and is discharged to the Ohio River through a 30-inch CMP. Details of the outlet structure do not appear to be available. The maximum operating pool level is reported by OVEC and AEP personnel to be approximately 553 ft. The only incoming flow to Clearwater Pond is from direct rainfall to the pond as well as the inflow from Boiler Slag Pond.

Clearwater Pond is not strictly a CCR unit since the purpose of Boiler Slag Pond is to store CCRs.

Assuming no losses, the combined inflow volume from the drainage areas of both Boiler Slag Pond and Clearwater Pond is = 0.5*19/12*(30.1+9.99) = 31.7 ac-ft. It is also assumed that the initial storage of 17.7 ac-ft in Boiler Slag Pond corresponding to the maximum operating pool there will drain to Clearwater Pond. In addition, since the initial elevation in Clearwater Pond is assumed to be at the maximum operating level of 553 ft, there is an initial storage in Clearwater Pond of 5.5 ac-ft. Thus the total storage volume in Clearwater Pond for these conditions assuming that the outlet is blocked is 54.9 ac-ft.

It should be noted that if the pool elevation at Clearwater Pond exceeds 557 ft (spillway elevation at Boiler Slag Pond), the storage in Boiler Slag Pond above this elevation will also be activated in addition to the storage in Clearwater Pond. The resulting water surface elevation in the pond for the 0.5 PMP event assuming that the outlet is blocked is 558.6 ft.

The top elevation of the embankment around the pond is considered to be at elevation 582 ft, though the 2007 LIDAR data indicate variations in the elevations. Therefore, the freeboard for the 0.5 PMP event is of the order of 23.4 ft. The detailed calculations are shown in Table 3.

Summary and Conclusions

A summary table of the water level conditions in the three ponds is given in Table 4. It is concluded that South Fly Ash Pond, Boiler Slag Pond and Clearwater Pond have sufficient storage capacity and freeboard to satisfy the minimum requirements of CCR rules as well as the dam safety requirements of the State of Ohio.

References

1. Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities; Final Rule, 40 CFR Parts 257 and 261, Environmental Protection Agency, Part II, Federal Register, Vol. 80, No.74, Friday, April 17, 2015..

2. Probable Maximum Precipitation Study for the State of Ohio, Ohio Department of Natural Resources, February 2013.

3. Assessment of Dam Safety of Coal Combustion Surface Impoundments (Task 3) Final Report, Ohio Valley Electric Corporation, Kyger Creek Power Station, Gallipolis, Ohio, February 24, 2010.

4. Report on Dam Safety Inspection, Kyger Creek Fly Ash and Bottom Ash Ponds, Kyger Creek Generation Plant, Addison, Ohio, February 1985.

Figure 1 Areal View of Project Site

Table 1: Detailed Calculations for South Fly Ash Pond

South Fly Ash Pond

Drainage Area 67.7 acres

Feature	Elevation (ft)	Surface Area (ac)	Incr Storage (ac-ft)
Principal Spillway	582.0	64.3	0.0
	582.7	64.6	45.1
	583.7	64.9	109.8
	584.7	65.2	174.9
	585.0	65.3	194.4
	585.7	65.5	240.2
	586.7	65.9	305.9
	587.7	66.3	371.9
	588.7	66.8	438.5
	589.7	68.1	505.9
Top of Dam	590.0	68.7	526.4

Inflow Volumes

(Calculations assume that outlet structure is inoperable)

50% 6hr-1sq mile PMP volume to South Fly Ash Pond	53.6	ac-ft
Coal yard drainage max pump vol for 6 hrs	11.0	ac-ft
Drainage volume from 38 acre coal yard for 50% 6-hr PMP	30.1	ac-ft
Combined flow volume from 50% 6-hr PMP to South Fly Ash Pond	64.6	ac-ft
Storage in South Fly Ash Pond due to 50% 6-hr PMP	64.6	ac-ft
Assumed initial level (maximum operating pool)	585.0	ft
Initial storage	194.4	ac-ft
Total storage in South Fly Ash Pond	259.0	ac-ft
Max South Fly Ash Pond elevation	586.0	ft
Freeboard	4.0	ft

Table 2: Detailed Calculations for Boiler Slag Pond

Boiler Slag Pond

Drainage Area 30.1 acres

Feature	Elevation (ft)	Surface Area (ac)	Incr Storage (ac-ft)
Principal Spillway	557.0	16.7	0.0
	560.7	19.5	67.0
	570.7	26.3	296.0
	579.7	29.0	544.5
Top of Dam	582.0	29.2	611.4

Inflow Volumes

(Calculations assume that outlet structure is inoperable)

50% 6hr-1sq mile PMP volume	23.8	ac-ft
Storage in Boiler Slag Pond due to 50% 6-hr PMP	23.8	ac-ft
Assumed initial level (maximum operating pool)	558.0	ft
Initial storage (curve fit)	17.7	ac-ft
Total storage in Boiler Slag Pond	41.5	ac-ft
Max Boiler Slag Pond elevation (curve fit)	559.3	ft
Freeboard	22.7	ft

Table 3: Detailed Calculations for Clearwater Pond

<u>Clearwater Pond</u>

Drainage Area 9.99 acres

Feature	Elevation (ft)	Surface Area (ac)	Incremental Storage (ac-ft)	Add Storage Boiler Slag Pond (ac-ft)	Total Storage (ac-ft)
Principal Spillway	552.0	5.7	0.0		0.0
	552.7	5.8	4.0		4.0
	556.7	6.4	28.4		28.4
	557.0	6.4	30.4	0.0	30.4
	560.7	6.9	54.9	67.0	122.0
	570.7	8.2	130.5	296.0	426.5
	579.7	9.6	210.7	544.5	755.2
Top of Dam	582.0	10.3	233.6	611.4	845.0

<u>Inflow Volumes</u>

(Calculations assume that outlet structure is inoperable)

50% 6hr-1sq mile PMP volume from Clearwater Pond	7.9	ac-ft
50% 6hr-1sq mile PMP volume from Boiler Slag Pond	23.8	ac-ft
Initial flow volume in Boiler Slag Pond	17.7	ac-ft
Combined Flow Volume to Clearwater Pond	49.4	ac-ft
Assumed initial level (maximum operating pool)	553.0	ft
Initial storage (curve fit)	5.5	ac-ft
Total storage in Clearwater Pond	54.9	ac-ft
Max Clearwater Pond elevation (curve fit)	558.6	ft
Freeboard	23.4	ft

Table 4: Summary Table of Elevations

Summary Table

Feature	Elevation (ft) – NGVD 29: Normal Pool	Elevation (ft) – NGVD 29: Max Operating Pool	Elevation (ft) – NGVD 29: 50% PMP Elevation	Freeboard (ft): 50% PMP Event	Freeboard (ft): Max Operating Pool	Top of Embankment Elevation(ft) – NGVD 29
South Fly Ash Pond	582.0	585.0	586.0	4.0	5.0	590.0
Boiler Slag Pond	557.0	558.0	559.3	22.7	24.0	582.0
Clearwater Pond	552.0	553.0	558.6	23.4	29.0	582.0

Note: Initial pond elevation for 50% PMP event assumed to be the maximum operating pool