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Coal Combustion Waste Impoundment
Round 6 - Dam Assessment Report

East Bend Station (Site # 002)

Fly Ash Dike
Duke Energy
Boone County, KY

Prepared for:

United States Environmental Protection Agency
Office of Resource Conservation and Recovery

Prepared by:

Dewberry & Davis, LLC
Fairfax, Virginia

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INTRODUCTION, SUMMARY CONCLUSIONS AND RECOMMENDATIONS

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

This assessment of the stability and functionality of the East Bend Station Fly Ash Dam management unit is based on a review of available documents and on the site assessment conducted by Dewberry personnel on Thursday, August 4, 2010. We found the supporting documentation lacking critical information (Section 1.1.3). Sections 1.2.1 and 1.2.3 provide a recommendation for providing critical technical documentation required to upgrade the fly ash pond embankment from POOR to SATISFACTORY. Section 1.2.6 provides four recommendations based on field observations that may help to maintain a safe and trouble-free operation.

In summary, the Greene County Fly Ash Dam is POOR for continued safe and reliable operation, with no recognized existing or potential management unity safety deficiencies.

PURPOSE AND SCOPE

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

In March 2009, the EPA sent letters to coal-fired electric utilities seeking information on the safety of surface impoundments and similar facilities that receive liquid-borne material that store or dispose of coal combustion waste. This letter was issued under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section

104(e), to assist the Agency in assessing the structural stability and functionality of such management units, including which facilities should be visited to perform a safety assessment of the berms, dikes, and dams used in the construction of these impoundments.

EPA requested that utility companies identify all management units including surface impoundments or similar diked or bermed management units or management units designated as landfills that receive liquid-borne material used for the storage or disposal of residuals or by-products from the combustion of coal, including, but not limited to, fly ash, bottom ash, boiler slag, or flue gas emission control residuals. Utility companies provided information on the size, design, age and the amount of material placed in the units. The EPA used the information received from the utilities to determine preliminarily which management units had or potentially could have High Hazard Potential ranking.

The purpose of this report is to evaluate the condition and potential of waste release from the selected High Hazard Potential management units. This evaluation included a site visit. Prior to conducting the site visit, a two-person team reviewed the information submitted to EPA, reviewed any relevant publicly available information from state or federal agencies regarding the unit hazard potential classification (if any) and accepted information provided via telephone communication with the management unit owner. Also, after the field visit additional information were received by Dewberry & Davis LLC about the John E. Amos Fly Ash Dam that were reviewed and used in preparation of this report.

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

This report presents the opinion of the assessment team as to the potential of catastrophic failure and reports on the condition of the management unit(s).

LIMITATIONS

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

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1.0 CONCLUSIONS AND RECOMMENDATIONS

1.1 CONCLUSIONS

Conclusions are based on visual observations from a one-day site visit, conducted on August 5, 2010, and review of technical documentation provided by Duke Energy.

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

Based on a lack of documentation of critical engineering to verify design slope stability analyses, the structural soundness of the Management unit is rated POOR.

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

Hydrologic and hydraulic data provided to Dewberry indicate adequate impoundment capacity to contain the 1-percent probability 6 hour/13.5 inch design event without overtopping the dike.

1.1.3 Conclusions Regarding the Adequacy of Supporting Technical Documentation

The supporting technical documentation is inadequate. The technical documentation lacks critical engineering analyses of dike slope stability.

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

The description of the management unit provided by Duke Energy was an accurate representation of what Dewberry observed in the field.

1.1.5 Conclusions Regarding the Field Observations

Dewberry staff was provided access to all areas in the vicinity of the management unit required to conduct a thorough field observation. The visible parts of the embankment dikes and outlet structures were observed to have no signs of overstress, significant settlement, shear failure, or other signs of instability, although visual observations were hampered by the presence of thick vegetation and mowing residuals in some areas. Embankments appear structurally sound. There are no apparent indications of unsafe conditions or conditions needing remedial action.

1.1.6 Conclusions Regarding the Adequacy of Maintenance and Methods of Operation

The current maintenance and methods of operations appear to be adequate for the fly ash management unit. There was no evidence of significant repairs or prior releases observed during the field inspection.

1.1.7 Conclusions Regarding Adequacy of the Surveillance and Monitoring Program

The surveillance program appears to be adequate. The management unit dikes are not instrumented. Installation of a dike monitoring program is not needed at this time, based on the size of the dikes, the portion of the impoundment currently used to store wet fly ash and stormwater, the history of satisfactory performance, and an ongoing, current inspection program.

1.1.8 Classification Regarding Suitability for Continued Safe and Reliable Operation

The facility classification is POOR for continued safe and reliable operation. The classification is due to the lack of critical technical documentation of engineering analyses verifying slope stability safety factors of the management unit dikes.

1.2 RECOMMENDATIONS

1.2.1 Recommendations Regarding the Structural Stability

Although observations made during the site visit do not indicate signs of overstress, significant settlement, shear failure, or other signs of instability, the structural stability cannot be evaluated without reviewing the results of engineering analyses of the slope stability factors of safety under various load conditions. It is recommended that if the original design analyses cannot be located, a new geotechnical engineering evaluation be conducted based on current standards, including seismic loading conditions.

1.2.2 Recommendations Regarding the Hydrologic/Hydraulic Safety

No recommendations appear warranted at this time.

1.2.3 Recommendations Regarding the Supporting Technical Documentation

Continued efforts to locate the original slope stability design documentation are recommended. If the original documentation cannot be located within a reasonable period of time, a geotechnical engineering evaluation is recommended to verify the embankment has an acceptable factor of safety for all anticipated loading conditions, including seismic loading.

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

No recommendations appear warranted at this time.

1.2.5 Recommendations Regarding the Field Observations

No recommendations appear warranted at this time.

1.2.6 Recommendations Regarding the Maintenance and Methods of Operation

Although the maintenance program appears to be adequate, the following recommendations should improve maintenance and ensure a trouble free operation:

- Add rip rap armoring to toe of embankment up-gradient slope in areas susceptible to erosion caused by wave action
- Grade depressed traffic tacks along the crest to prevent water ponding and reduce erosion rills
- Repair erosion rills on both the up-gradient and down-gradient slopes
- Increase frequency of mowing dike embankments to improve effectiveness of daily observations and monthly inspections.

1.2.7 Recommendations Regarding the Surveillance and Monitoring Program

No recommendations appear warranted at this time.

1.2.8 Recommendations Regarding Continued Safe and Reliable Operation

No recommendations appear warranted at this time.

1.3 PARTICIPANTS AND ACKNOWLEDGEMENT

1.3.1 List of Participants

Randy L. Clark – Duke Energy
J. R. Wood – Duke Energy
James J. Stieritz – Duke Energy
Tammy Jett – Duke Energy
Adam Deller – Duke Energy
Kenneth M. Zak – Duke Energy
Sheri Campbell – Duke Energy
Rhonda Herzog – Duke Energy
Jenny Burlach – Duke Energy
Ron Ehlers – Duke Energy
Hugh Ward, P.E. – Dewberry
Joseph P. Klein, III, P.E. - Dewberry

1.3.2 Acknowledgement and Signature

We acknowledge that the management unit referenced herein has been assessed on August 5, 2010.

Hugh A. Ward, PE (KY # 7164)	Joseph P. Klein, III, P.E., Geotechnical Engineer

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

2.1 LOCATION AND GENERAL DESCRIPTION

The East Bend Generating Station is located along the north bank of an eastward bend on the Ohio River in west-central Boone County, Kentucky, approximately 2.5 miles south of Rabbit Hash, KY (See Appendix A – Doc 01). The plant is operated by Duke Energy. The fly ash pond is located adjacent to the Ohio River on the east side of the main plant (See Appendix A – Doc 02).

The fly ash pond dike was designed in the mid-1970s by Sargent & Lundy Engineers. The fly ash pond dike is a compacted granular fill embankment with a compacted clay core. The ash pond dike is a "U" shape configuration with the main section parallel to the river and short sections on the east and west ends abutting natural soils on the north side.

Table 2.1: Summary of Dam Dimensions and Size[1]

	East Bend Station Ash Pond
Dam Height (ft)	50
Crest Width (ft)	12
Length (ft)	4200
Side Slopes (upstream) H:V	2:1
Side Slopes (downstream) H:V	2:1

[1] Based on design data on original construction drawings (Appendix A -Doc. 3)

The impoundment area is approximately 53.4 acres and has a total storage capacity of 2,975,000 cubic yards (1,844 acre-feet). An aerial photograph of the impoundment is provided in Appendix A – Document 4.

The fly ash pond is divided into two cells by an internal fly ash berm. The western cell operates as a primary ash settling basin. The eastern cell operates as a secondary clarifier basin. The cells are hydraulically connected by a corrugated metal pipe through the ash berm. Normal pool of water in the western cell is approximately 490.1 ft. Normal pool in the eastern cell is approximately 485.5 ft.

Construction drawings indicate the source of material for the embankment was plant area earthwork, and from borrow within the pond area if additional material was required (See Appendix A – Doc 03).

The East Bend Generating Station has two small ponds, identified on the construction drawings as Sludge Pond A and Sludge Pond B (See Appendix A – Doc 03). The ponds have a surface area of about 2.5 and 2.3 acres, respectively. The ponds are located adjacent to the southwest corner of the fly ash pond.

Plant management staff indicated that the sludge ponds are used for temporary storage during outages of the fly ash pond. When the fly ash pond is returned to service, materials placed in the sludge ponds are transferred to the fly ash pond.

The construction drawings indicate the incised sludge ponds were formed by excavation of existing materials. The sludge ponds do not have fill embankments forming the impoundment.

The sludge ponds are not currently on the Kentucky Division of Water Dam Identification list.

The sludge ponds are not included in this assessment.

2.2 SIZE AND HAZARD CLASSIFICATION

The classification for size, based on the height of the embankment and the impoundment storage capacity is "Intermediate" with the USACE Recommended Guidelines for Safety Inspection of Dams ER 1110-2106 criteria summarized in Table 2.2.a.

Table 2.2a: USACE ER 1110-2-106 Size Classification

	Impoundment	
Category	**Storage (Ac-ft)**	**Height (ft)**
Small	50 and < 1,000	25 and < 40
Intermediate	1,000 and < 50,000	40 and < 100
Large	> 50,000	> 100

Dewberry conducted a qualitative hazard classification based on the Federal Guidelines for Dam Safety, dated April, 2004. The hazard assessment classifications are summarized in Table 2.2.b

Table 2.2b: FEMA Federal Guidelines for Dam Safety Hazard Classification

	Loss of Human Life	**Economic, Environmental, Lifeline Losses**
Low	None Expected	Low and generally limited to owner
Significant	None Expected	Yes

High	Probable. One or more expected	Yes (but not necessary for classification)

There are no residences for several miles down-gradient of the fly ash impoundment on either the Kentucky or Indiana side of the Ohio River. Therefore, loss of human life is not probable in the event of a catastrophic dike failure. A catastrophic dike failure is likely to result is a release of fly ash slurry into the Ohio River resulting in economic and environmental losses. Therefore, Dewberry evaluated **the ash pond embankment as "significant hazard potential".**

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

Table 2.3: Maximum Capacity of Unit	
Ash Pond Name: East Bend Station	
Surface Area (acre)[1]	53.4
Current Storage Capacity (cubic yards)[1]	2,975,000
Current Storage Capacity (acre-feet)	1,844
Total Storage Capacity (cubic yards)[1]	734,100
Total Storage Capacity (acre-feet)	455
Crest Elevation (feet)	520
Normal Pond Level (feet)	490.1

[1] Data taken from *Dam Construction Permit Application Sheet* (See Appendix A – Doc. 03)

2.4 PRINCIPAL PROJECT STRUCTURES

2.4.1 Earth Embankment

The approximately 4,200 foot long, ash pond dike is composed of controlled compacted granular soil fill over a controlled compacted clay core. The crest width is 12 feet with grass and gravel surface to provide vehicle access. Both up-gradient and down-gradient slopes are 2H:1V. The slopes are vegetated with various species of grasses.

2.4.2 Outlet Structures

The impoundment primary outlet consists of a corrugated metal riser with an invert elevation of approximately 485.5. The original construction included a 48-inch diameter corrugated metal riser pipe and a 36-inch diameter outlet barrel. In the 1990s, a 40-inch diameter metal liner was installed in the riser pipe and a 28-inch diameter metal pipe liner installed

in the outlet barrel. The primary spillway outlet barrel is located in natural ground beneath the embankment and extends approximately 60 feet into the Ohio River at normal river pool elevation. There are two vent stacks along the primary spillway outlet barrel between the toe of the embankment and the bank of the Ohio River.

The impoundment emergency spillway is a concrete lined, rectangular open channel that crosses the top of the embankment near the southeast corner of the impoundment. The 12-foot wide and 1-foot deep emergency spillway has an invert elevation of 418.4. The emergency spillway discharges into a paved open channel ditch at the toe of the embankment.

2.5 CRITICAL INFRASTRUCTURE WITHIN FIVE MILES DOWN GRADIENT

A critical infrastructure inventory survey was not provided to Dewberry for review.

Based on available topographic maps, surface drainage in the vicinity of the fly ash pond is to the south-southeast toward the Ohio River. An eastward flowing bend in the Ohio River at the East Bend Plant site intercepts surface runoff approximately 800 feet south of the impoundment. Based on available aerial photographs and a brief driving tour of the area, Dewberry did not identify critical infrastructure assets within 5 miles down-gradient of the fly ash pond.

3.0 SUMMARY OF RELEVANT REPORTS, PERMITS, AND INCIDENTS

Duke Energy provided reports of two dam safety inspections: one conducted by the Kentucky Department for Environmental Protection, Division of Water on March 24, 2009; and the other, by a third party inspector, BBCM on July 21, (See Appendix A – Doc 05 and Doc 06, respectively).

The 2009 Kentucky Department for Environmental Protection, Division of Water report concluded that the embankment was constructed in accordance with approved plans and specifications. The inspection report identified certain technical documentation required to bring the dam into conformance with state law. The required documentation included:

- Flood routing analysis
- Survey information on the Elevation-Area-Capacity curves and data calculations
- Dam construction and design data sheet
- Survey elevation of survey marker at the crest near the primary spillway.

The flood routing analysis, Elevation-Area-Capacity curves and data calculations, and the dam construction and design data sheets were provided to the Kentucky Division of Water as part of the "Dam Construction Permit Application Sheet" dated May 19, 2009 prepared by BBCM (See Appendix A Doc 03).

The BBCM inspection concluded that based on observations made during a site visit and information reviewed, the East Bend Ash Pone is in Satisfactory condition. The report included several maintenance recommendations including:

- Grading areas around light poles located on the embankment crest to direct stormwater away from the pole foundations
- Monitor shoreline erosion along the up-gradient embankment toe in areas without rip-rap armoring
- Repair low area along the crest to prevent ponding
- Clear excess vegetation from areas within 15 feet of the down-gradient embankment toe

- Grade observed wet areas along the toe of the east embankment to promote positive drainage, and monitor areas after re-grading
- Remove scrap pipe along toe of east embankment
- Clean out vegetation from the concrete ditch along the down-gradient toe of the embankment and the emergency spillway
- Fill erosion channels on the up-gradient slopes with rip rap.
- Monitor ash divider dike for seepage and instability
- Re-grade low lying area on down-gradient west embankment slope adjacent to the crest
- Continue regular mowing embankments and down-gradient areas.

3.1 SUMMARY OF LOCAL, STATE, AND FEDERAL ENVIRONMENTAL PERMITS.

The East Bend fly ash pond embankment is regulated by the Kentucky Department for Environmental Protection, Division of Water and has been issued the identification number KYDW ID 1215. The dam was inspected by the Kentucky Division of Water in 2009 and is scheduled for another State inspection in 2011.

Discharge from the impoundment is regulated by the Kentucky Department for Environmental Protection, Division of Water and the impoundment has been issued a National Pollutant Discharge Elimination System Permit, Permit No. KY 040444 (See Appendix A – Doc 07). The NPDES permit was issued on April 1, 2004 and expired July 31, 2007. A permit renewal application is pending.

3.2 SUMMARY OF SPILL/RELEASE INCIDENTS

Data reviewed by Dewberry did not indicate any spills, unpermitted releases, or other performance problems with the embankment over the last 10 years.

4.0 SUMMARY OF HISTORY OF CONSTRUCTION AND OPERATION

4.1 SUMMARY OF CONSTRUCTION HISTORY

4.1.1 Original Construction

The East Bend Station fly ash pond was designed in the mid 1970s by Sargent and Lundy Engineers. The embankment was constructed to its final design crest elevation of 520. The primary spillway riser pipe was constructed to a Phase 1 elevation 485.5. The design included provisions to extend the primary riser to elevation 517.5 for construction of a second unit at the generating station. The second unit has not been constructed, and the primary spillway riser elevation remains at 485.5. (See Appendix A – Doc. 03)

4.1.2 Significant Changes/Modifications in Design since Original Construction

The dike has not been significantly changed or modified since the original construction.

The primary spillway has been modified since the original construction. A 40-inch diameter liner pipe was installed inside the 48-inch diameter primary spillway riser pipe, and a 28-inch diameter liner pipe was installed inside the 36-inch diameter primary spillway outlet pipe. The liner pipes were added in the early 1990s.

4.1.3 Significant Repairs/Rehabilitation since Original Construction

No information was provided regarding major repairs or rehabilitation to the embankment or outlet structures. No evidence of prior releases, failures or patchwork was observed on the earthen dike during Dewberry's visual assessment that indicates prior release or failures have occurred.

4.2 SUMMARY OF OPERATIONAL PROCEDURES

4.2.1 Original Operational Procedures

The impoundment was designed and operated for fly ash sedimentation and control, and for storage of stormwater runoff, cooling tower overboard water and miscellaneous plant drains.

Fly ash is transported by slurry to the west end of the impoundment for primary sedimentation. A fly ash dike separates the west and east ends of

the impoundment. Water flow from the west to east sections of the impoundment is by gravity via a pipe through the ash dike. The impoundment area in the east side of the ash dike is used for secondary treatment.

4.2.2 Significant Changes in Operational Procedures and Original Startup

No significant changes in operational procedures have been made to the ash pond since the original startup.

4.2.3 Current Operational Procedures

Current operational procedures, including maintenance and emergency action response actions are outlined in the "East Bend Operation Maintenance Manual and Emergency Action Plan" (See Appendix A – Doc 08).

4.2.4 Other Notable Events since Original Startup

No additional information was provided to Dewberry of other notable events impacting the operation of the impoundment.

5.0 FIELD OBSERVATIONS

5.1 PROJECT OVERVIEW AND SIGNIFICANT FINDINGS

Dewberry personnel Hugh Ward, P.E. and Joseph P. Klein, III, P.E. performed a site visit on Thursday August 5, 2010 in company with the participants.

The site visit began at 8:30 AM. The weather was warm and cloudy. A strong rain shower occurred immediately prior to the site visits. Photographs were taken of conditions observed. Please refer to photographs in Appendix B and the Dam Inspection Checklist in Appendix C. Selected photographs are included here for ease of visual reference. All pictures were taken by Dewberry personnel during the site visit.

Based on the observations during the site visit no significant findings were noted and the embankment appears to be performing in accordance with design expectations.

5.2 EARTH EMBANKMENT

5.2.1 Crest

The crest of the embankment had no signs of significant depressions, tension cracks or other indications of settlement or shear failure. Figure 5.2.1-1 shows the typical crest conditions. Photographs 1 and 2, Appendix B provide additional views of the embankment crest.

Figure 5.2.1-1: Photograph of Impoundment Dike Crest View to East

In scattered areas vehicle traffic along the crest has caused depressions in the gravel tracks allowing water to pond. Overflow from these small ponding areas is causing small erosion rills on both the up-gradient and down-gradient slopes of the embankment. Figure 5.2.1-2 shows a small area of ponding in the gravel travel track along the embankment crest.

Figure 5.2.1-2: Water Ponding in Small Depression in Gravel Travel Track along Embankment Crest.

5.2.2 Upstream/Inside Slope

The up-gradient slope of the embankment is vegetated with various species of tall grass and weeds. There were no observed scarps, sloughs, bulging, cracks, depressions or other indications of slope instability. Figure 5.2.2-1 shows a representative section of the up-gradient slope of the embankment.

Figure 5.2.2-1: Photo of Embankment Up-gradient Slope View to East

Small areas of sloughing or erosion were observed along the up-gradient slope. There was also evidence of animal burrows. Figures 5.2.2-2 and 5.2.2-3 show the conditions observed.

Figure 5.2.2-2: Photo of Small Erosion Rill on Up-gradient Slope

Figure 5.2.2-3: Evidence of Animal Burrow on Up-Gradient Slope

Areas of erosion repairs to the up-gradient slope were observed. The largest of the repairs were near the coal conveyor crossing. Storm water from broken gutters on the coal conveyor crossing caused areas of erosion beneath the conveyor. Figure 5.2.3-4 shows a typical repair area.

Figure 5.2.2-4: Erosion Repairs beneath Coal Conveyor Structure

A section of up-gradient embankment toe along the eastern edge of the impoundment has been armored with rip rap to protect against erosion. Figure 5.2.2-5 shows the protected toe area.

Figure 5.2.2-5: Rip Rap Armoring to Protect against Wave Erosion

Observations at the site indicate other areas of wave erosion that warrant armoring, including the areas adjacent to the previously installed rip rap. Figure 5.2.2-6 shows an area of wave erosion near the primary spillway riser.

Figure 5.2.2-6: Up-gradient Embankment Toe Wave Erosion near Primary Spillway Structure

5.2.3 Downstream/Outside Slope and Toe

The down-gradient slope of the embankment is vegetated with various species of tall grass and weeds. No major scarps, sloughs, bulging, cracks, depressions or other indications of slope instability or signs of uncontrolled seepage were observed. Figure 5.2.3-1 shows a representative section of the down--gradient slope of the embankment.

Figure 5.2.3-1: Photo of Embankment Down-gradient Slope View to East

The bottom portion near the east end of the down-gradient embankment is armored with rip rap as protection from erosion during flooding of the Ohio River. Figure 5.2.3-2 shows the rip rap armoring. The observed armoring is indicated on the drawings as part of the original design (See Appendix A – Doc 03)

Figure 5.2.3-2: Rip-Rap Protection at Bottom of Down-gradient Slope

Small areas of sloughing and small erosion rills were observed along the down-gradient embankment slope. Figures 5.2.3-2 shows a slough area.

Figure 5.2.3-2: Photo of Local Slough Area on Down-gradient Slope

Evidence of animal burrows was observed along the down-gradient slope. Animal burrowing activity on the down-gradient slope appeared to be higher than on the up-gradient slope. Figure 5.2.3-3 shows twin burrows observed on the down-gradient slope.

Figure 5.2.3-3: Photo of Adjacent Animal Burrows on the Down-gradient Slope

No areas of seepage or soft soils were observed along the toe of the down-gradient slope. There is a concrete lined ditch and adjacent paved roadway along the down-gradient toe of the main embankment section. Figure 5.2.3-4 shows a section of the down-gradient embankment toe.

Figure 5.2.3-4: Photo of Down-gradient Embankment Toe with Drainage Ditch and Adjacent Pavement

Photograph 3, Appendix B provides an additional view of the down-gradient embankment and toe.

5.2.4 Abutments and Groin Areas

Neither erosion nor uncontrolled seepage was observed along the groins or abutments. Groin slopes and abutments are protected with the same vegetative cover as the adjoining slopes. Figures 5.2.4-1 and 5.2.4-2 show typical conditions observed at the groins and abutments.

Figure 5.2.4-1: Photo of Interior Groin at Southwest Corner of Impoundment

Figure 5.2.4-1: Photo of Embankment Crest at Northeast Corner Abutment

Photographs 4 and 5, Appendix B provide additional views of the embankment groins and abutment.

5.3 OUTLET STRUCTURES

5.3.1 Overflow Structure

The impoundment overflow structure is located in the southeast corner of the impoundment. The original overflow structure consists of a 48-inch diameter corrugated metal riser protected by a timber frame. In the early 1990s a 40-inch diameter liner was installed in the original riser. The riser invert elevation is 485.5 ft. Access to the riser is provided by a fixed walkway. Outlet flow can be controlled by means of a manually operated valve. Figures 5.3.1-1and 5.3.102 shows the primary spillway riser structure and riser invert (Also see photos 6 and 7, Appendix B).

Figure 5.3.1-1: Photo of Primary Spillway Riser Structure

Figure 5.3.2-2: Photo of Primary Spillway Pipe Invert

5.3.2 Outlet Conduit

The original outfall pipe is a 36-inch diameter corrugated metal pipe. As part of the early 1990s work, a 28-inch diameter liner was installed in the outfall pipe. The outfall pipe is located in natural ground beneath the embankment. The outfall pipe remains below ground until discharging into the Ohio River. The outfall invert elevation is 441.6 ft which is approximately 12.6-ft. below the Ohio River normal pool elevation of 454.25 ft. There are two vent risers along the spillway outfall pipe between the toe of the embankment and the Ohio River. Observations in the vent pipes showed water to be flowing clear and unobstructed. Figure 5.3.2-1 shows outlet pipe vent pipe locations.

Figure 5.3.2-1: Photo of Primary Spillway Outlet Pipe Vents

5.3.3 Emergency Spillway

The emergency spillway consists of a 12ft. wide, 1 ft. deep concrete lined open channel crossing the embankment crest near the southeast corner of the impoundment. The invert elevation of the emergency spillway is 518.15. The emergency spillway discharges into the concrete lined drainage ditch at the toe of the embankment. Figure 5.3.3-1 shows the emergency spillway invert. Figure 5.3.3-2 shows the emergency spillway along the down-gradient slope of the embankment.

Figure 5.3.3-1: Photo of Emergency Spillway Invert.

Figure 5.3.3-2: Photo of Emergency Spillway on Down-gradient Slope of Embankment

Photograph 8, Appendix B provides an additional view of the emergency spillway.

5.3.4 Low Level Outlet

The East Bend fly ash impoundment does not have a low level outlet.

6.0 HYDROLOGIC/HYDRAULIC SAFETY

6.1 SUPPORTING TECHNICAL DOCUMENTATION

6.1.1 Flood of Record

No documentation has been provided about the flood of record.

6.1.2 Inflow Design Flood

BBCM conducted a hydrologic and hydraulic analysis of the capacity of the fly ash pond to store water from the design storm event (See Appendix A – Doc 3). The design storm was a 100-year (1% probability in a given year), 6-hour event with an intensity of 13.5 inches. The report estimate that the 1 percent probability storm can be retained in the fly ash pond, raising the water elevation to about 490.1, leaving a freeboard of about 29.9 feet.

6.1.3 Spillway Rating

The BBCM analyses (See Appendix A – Doc 3) includes a primary spillway discharge of 74.4 cubic feet per second for the design storm event.

6.1.4 Downstream Flood Analysis

No downstream flood analysis data were provided to Dewberry for review.

6.2 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

Supporting documentation reviewed by Dewberry is adequate to assess the hydrologic/hydraulic safety of the fly ash impoundment.

6.3 ASSESSMENT OF HYDROLOGIC/HYDRAULIC SAFETY

Based on the calculations provided in the hydrologic and hydraulic analyses (See Appendix A –Doc. 3) the Fly Ash Pond can retain the 1 percent probability storm event with a freeboard of approximately 29.9 feet. Hence a dike failure by overtopping seems improbable.

7.0 STRUCTURAL STABILITY

7.1 SUPPORTING TECHNICAL DOCUMENTATION

7.1.1 Stability Analyses and Load Cases Analyzed

No stability analyses were provided to Dewberry for review.

7.1.2 Design Parameters and Dam Materials

No data pertaining to embankment design parameters were provided to Dewberry for review.

Construction drawings provided for review (See Appendix A –Doc 3) indicate the embankment design is a compacted granular fill with a compacted clay core. Construction drawings indicate material for the embankment came from plant area earthwork, and from within the impoundment if required. The construction drawings are signed and sealed by a registered engineer licensed in the State of Kentucky.

7.1.3 Uplift and/or Phreatic Surface Assumptions

No documentation of uplift calculations or phreatic surface assumptions was provided to Dewberry for review.

7.1.4 Factors of Safety and Base Stresses

No documentation of embankment slope stability factors of safety or base stresses was provided to Dewberry for review.

7.1.5 Liquefaction Potential

No documentation of soil liquefaction analyses was provided to Dewberry for review.

7.1.6 Critical Geological Conditions

Documentation provided to Dewberry for review (See Appendix A – Doc 3) indicates the East Bend fly ash pond is located within the flood plain of the Ohio River. The embankment abuts a terrace of the ancestral Ohio River flood plain. The soil types and bedrock contact contours in the Ohio River Valley are generally the result of flow and meander of the river during and after periods of glaciation. The ash pond embankment is

located on a post-glaciation terrace of the upper terrace into which the embankment abuts.

Soils encountered near the embankment generally consist of:

- Approximately 10 feet of medium stiff to stiff silty clay
- Approximately 20 to 30 feet of loose fine and clayey fine sand,
- Medium dense to dense fine to course sand. The thickness of this stratum is typically 80 to 90 feet and expends to bedrock.

7.2 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

The technical documentation provided to Dewberry lacks critical engineering analyses data required to assess the structural stability of the fly ash pond embankment. If the original slope stability design calculations cannot be located new geotechnical engineering analyses should be conducted to verify the existing slope stability safety factors meet or exceed acceptable criteria.

7.3 ASSESSMENT OF STRUCTURAL STABILITY

Based on the lack of technical documentation, the structural stability of the ash pond embankment is rated as POOR.

8.0 ADEQUACY OF MAINTENANCE AND METHODS OF OPERATION

8.1 OPERATING PROCEDURES

The facility is operated for the storage of wet fly ash as well as water from other plant sources including storm runoff from the plant landfill and coal pile, cooling tower blowdown water, and water from miscellaneous plant drains. Coal combustion waste process water discharges into the west side of the impoundment which is separated from the east section by a fly ash dike. The west side of the impoundment is the primary sedimentation area. Decant water flows by gravity to the east section of the impoundment through a pipe in the fly ash dike. Figure 8.1-1 shows the fly ash dike and drain pipe.

Figure 8.1-1: Photo of Decant Water from West to East Sections of Impoundment

Water from the east section of the impoundment is discharged through the primary spillway.

8.2 MAINTENANCE OF THE DAM AND PROJECT FACILITIES

The "East Bend Ash Pond Operation Maintenance Manual and Emergency Action Plan" (See Appendix A – Doc 08) establishes general inspection and maintenance requirements for the impoundment dike. The required procedures include:

- A regular vegetative management program to facilitate visual inspections
- Repairs conducted as part of a regular maintenance program

- Daily "drive by" visits by plant laboratory personnel to supplement formal monthly inspections (See Appendix A –Doc. 4)

8.3 ASSESSMENT OF MAINTENANCE AND METHODS OF OPERATIONS

8.3.1 Adequacy of Operating Procedures

Based on the assessments of this report, operating procedures appear to be adequate.

8.3.2 Adequacy of Maintenance

The dam inspection report, including The Kentucky Division of Water "Inspection of East Bend Ash Pond Dam" dated October 9, 2009 and the BBCM "Annual Dam Inspection 2010", dated August 4, 2010 (See Appendix A – Docs. 4 and 6 respectively) and the Dam Inspection Checklist on August 5, 2010 by Dewberry (See Appendix C – Doc 11) reported no major maintenance issues. The 2010 MMCM report includes several maintenance recommendations but none that are considered critical or imminent. This indicates that the current maintenance plan is probably followed in practice and that adequate maintenance is provided for the dike and project facilities.

Although the maintenance program appears to be adequate, several recommendations have been made to improve the maintenance and ensure a trouble-free operation:

- Add rip rap armoring to toe of embankment up-gradient slope in areas susceptible to erosion caused by wave action
- Grade depressed traffic tracks along the crest to prevent water ponding and reduce erosion rills
- Repair erosion rills on both the up-gradient and down-gradient slopes
- Increase frequency of mowing dike embankments to improve effectiveness of daily observations and monthly inspections.

9.0 ADEQUACY OF SURVEILLANCE AND MONITORING PROGRAM

9.1 SURVEILLANCE PROCEDURES

Surveillance procedures are specified in the Duke Energy "Fossil Impoundment Dam Inspection Program", dated July 1, 2010 (See Appendix A – Doc 09). The program requirements include:

- Monthly Inspections: conducted by plant personnel and documented using checklists. Inspection findings are submitted to the Duke Energy Program Engineering Group for review.
    - Supplemental inspections are required after a rain event of 2-inches or greater in a 24 hour period.
- Annual Inspection: conducted by the Duke Energy Program Engineering Group. Checklists are used to document the inspection, conduct an engineering review, and develop recommendations if appropriate.
- Regulatory and Third Party Inspections: conducted on a two- to five-year basis by an official regulatory agency. Duke Energy Program Engineering is responsible for scheduling and assisting governmental agencies with regulatory or third party inspections.

9.2 INSTRUMENTATION MONITORING

The East Bend fly ash pond embankment does not have an instrumentation monitoring system

9.3 ASSESSMENT OF SURVEILLANCE AND MONITORING PROGRAM

9.3.1 Adequacy of Inspection Program

Based on the data reviewed by Dewberry, including observations during the site visit, the inspection program is adequate.

9.3.2 Adequacy of Instrumentation Monitoring Program

No instrumentation is present at the East Bend Station fly ash pond.

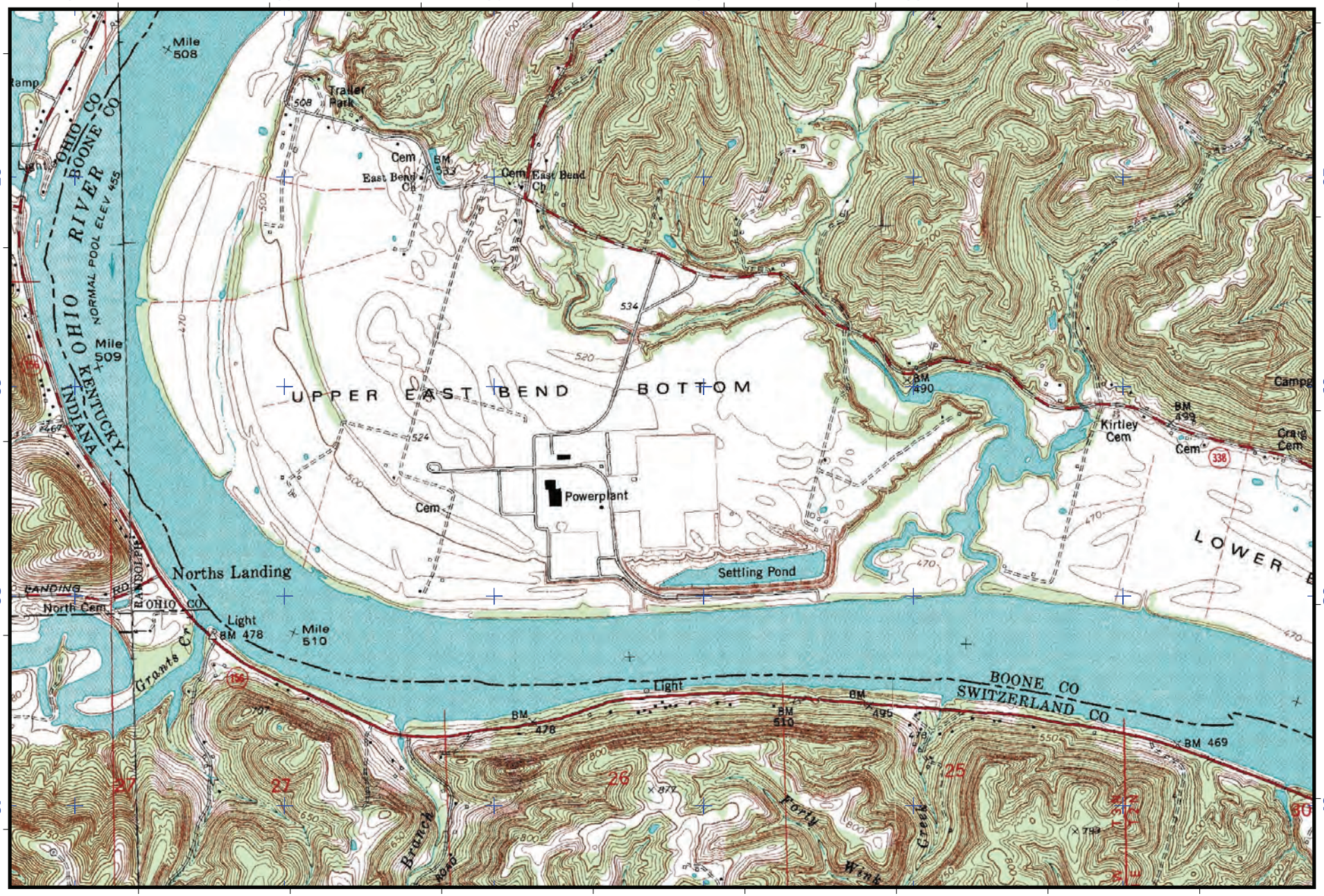
Based on the size of the embankment, the current inspection program, and the observations made during this site visit, an embankment monitoring program is not needed at this time.

EXHIBITS

THERE ARE NO EXHIBITS FOR THIS REPORT.

APPENDIX A


© 2010 Google
Image U.S. Geological Survey
© 2010 Europa Technologies
©2009 Google
Imagery Date: Aug 24, 2005
38°54'26.52" N 84°50'43.40" W elev 520 ft
Eye alt 7913 ft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6 87 000
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6 89 000
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38°53'30"
43 10 000
43 09 000
43 08 000
43 07 000
43 07 000m N
6 89 000m E
Mile 508
Trailer Park
Cem
BM 533
East Bend Ch
Cem
East Bend Ch
OHIO CO
BOONE CO
RIVER
NORMAL POOL ELEV 455
OHIO
KENTUCKY
INDIANA
Mile 509
534
520
524
UPPER EAST BEND BOTTOM
Powerplant
Cem
Settling Pond
BM 490
Kirtley Cem
BM 499
Cem
Craig Cem
Campg
LOWER
Norths Landing
LANDING
North Cem
RD
RANDOLPH
OHIO CO
Light
BM 478
Mile 510
Grants Cr
BOONE CO
SWITZERLAND CO
Light
BM 478
BM 510
BM 495
BM 469
Forty Wink Creek
Branch
Road
25
26
27
30
1:25000 Scale
0 0.25 0.5 0.75 1 Miles
0 0.25 0.5 0.75 1 Kilometers
Universal Transverse Mercator (UTM) Projection Zone16
North American Datum of 1983 (NAD83)
GN
MN 6°
TN 1°
Magnetic declination of 6W at center of map on August 3, 2010

May 19, 2009
011-09323-012

BBCM
SOLUTIONS TO BUILD ON

Mr. Jim Stieritz
Duke Energy
139 East Fourth Street
Cincinnati, Ohio 45201

Re: Ash Pond Reservoir Characterization
East Bend Station
Boone County, Kentucky

Mr. Stieritz:

In accordance with your request, BBCM has completed the Dam Construction Permit Application Data Sheet required by the Energy and Environment Cabinet, Division of Water. The required flood routing analysis and Elevation-Area-Capacity curves and data calculations are included as appendices to the Dam Data Sheet.

Our analyses were performed based on requirements for a Moderate Hazard dam, for which the design storm is a 13.5" rainfall event over 6 hours.

If you have any questions, do not hesitate to contact this office.

Respectfully submitted,

BBC&M ENGINEERING, INC.

Stephen J. Loskota, P.E.
Senior Project Engineer

Christopher K. Hall, P.G.
Senior Geologist

Submitted: via electronic mail
Attachments: Dam Construction Permit Application Data Sheet w/appendices

6190 Enterprise Court • Dublin, OH 43016-3293 • Phone 614.793.2226 • Fax 614.793.2410

Commonwealth Of Kentucky
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DIVISION OF WATER
14 Reilly Rd
Frankfort, Ky 40601

DAM CONSTRUCTION PERMIT APPLICATION DATA SHEET

Date: 5/18/09

The following is a general description of the design, including the various factors involved, the general plans, sections and specifications. Included in the drawings are vicinity maps and curves showing the hydraulic capacities. Items not pertinent to this project are deleted.

LOCATION AND PURPOSE:

1. County
   Boone
2. Stream
   Off-stream, Ohio River
3. Latitude 38° 54' 07" Longitude -84° 50' 28"
4. Purpose Ash Storage
5. Topographic Map (*7 ½ Quadrangle*) Name (*Attach Copy*)
   See Appendix A

SUMMARY OF DESIGN:

1. Drainage Area	176 Acres 0.275	Sq.Miles
2. Storage Capacity	1,844	Acre Feet
3. Maximum Height Of Dam	60	Feet
4. Spillway Capacity	222	C.F.S.
5. Top Of Dam Elevation	520	Feet, MSL
6. Normal Water Surface	485.5	Feet, MSL
7. Maximum Water Surface	490.1	Feet, MSL
8. Minimum Water Surface	484	Feet, MSL
9. Freeboard Above Maximum Water	29.9	Feet
10. Power Capacity		Feet
11. General Plans and Sections	See Appendix A (*Attach 1 Copy*)	

DESIGN DATA:

1. Geological Report, Author and Data — See Appendix B (*Attach Copy*)
2. Log Of Test Pits and Drill Holes — See Appendix B (*Attach Copy*)
3. Hydraulic Data, Capacities and requirements and by whom established — See Appendix C, Moderate Hazard Dam KYDEP
   a. Storage (Irrigation, Flood Etc.) — Ash Storage to El. 485.5 = 455 acre-feet
   b. Spillway — At Top of Embankment = 222 cfs

c. Outlet — N/A

d. Diversion — N/A

e. Area-Storage Capacity Curves For Various Elevations Of Water Surface — See Appendix C

4. Hydrologic Data

a. Hydrographs — See Appendix C for inflow & outflow hydrographs

b. Maximum Recorded Runoff — None recorded

c. Maximum Anticipated — 12.0 in.

d. Discharges (*100 Yr., Etc.*) — Inflow max = 1238 cfs Outflow max = 74 cfs

~~e. Design Values & Method — 13.5" in 6 hours SCS Type II Storm~~

5. Right Of Way Information — Dam entirely on Duke Energy Property

RESERVOIR:

1. General Dimensions:

Rectangular (3400' x 650')

2. Existing Structures:

Principal Spillway & Emergency Spillway

3. Proposed Structures:

None

4. Nature Of Land Flooded and Clearing Required:

Agricultural land, minimal clearing

5. House Elevations and Distance From Structure OR Proposed Site

N/A

6. Relocations Required (*Railroad, Highway, Telephone, Power, Pipeline, Etc.*)

None

7. Geology

See Appendix B

Commonwealth Of Kentucky
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DIVISION OF WATER
14 Reilly Rd
Frankfort, Ky 40601

DAM CONSTRUCTION PERMIT APPLICATION DATA SHEET

a. General Formations See Appendix B

b. Factors Relating To Reservoir Losses N/A

c. Contributing Springs None

d. Deleterious Mineral and Salt Deposits None

DAM SITE:

1. Geological Features, Formations:

   See Appendix B

2. Nature Of Stream Bed and Abutments:

   Alluvium

3. Interpretation of Test Pits and Drill Holes:

   See Appendix B

4. Percolation Tests, Ground Water:

   No percolation tests performed; groundwater level consistent with river level.

DAM:

1. Features Governing Design:

   Topography, location of plant, Ohio River.

2. Water Surface Elevation, Storage Capacities, Freeboard, Etc.:

   See Summary of Design

3. Grouting Requirements:

   None

SPILLWAY:

1. Requirements:

   Pass design storm without overtopping dam. The modeled design storm is 13.5" in 6 hours.

2. a. Factors Governing Design and Location:
   Storage Capacity
   b. Maximum Spillway Velocity P. Spillway: Approx. 25 ft/s

3. Type: Principal Spillway: 40-inch diameter steel riser pipe and 28-inch diameter steel outlet barrel.
   Emergency Spillway: 12-foot wide by 1.5' deep concrete channel with 12:1 side slopes.

Commonwealth Of Kentucky
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DIVISION OF WATER
14 Reilly Rd
Frankfort, Ky 40601

DAM CONSTRUCTION PERMIT APPLICATION DATA SHEET

a. Controlled Or Uncontrolled — Uncontrolled

b. Lining — Principal spillway pipe: epoxy coated
Emergency spillway: concrete

c. Dimension — see #3 above

d. Elevation — Principal Spillway: El. 485.5
Emergency Spillway: El. 518.5

4. Gates, Gate Structure

a. Dimensions — N/A

b. Operation — N/A

5. Stilling Basin — N/A

a. General Description — N/A

b. Dimensions — N/A

6. Approaches — N/A

We Certify That The Above Statements Are True And Correct.

Owner **Date**

Engineer **Date**

PE Number

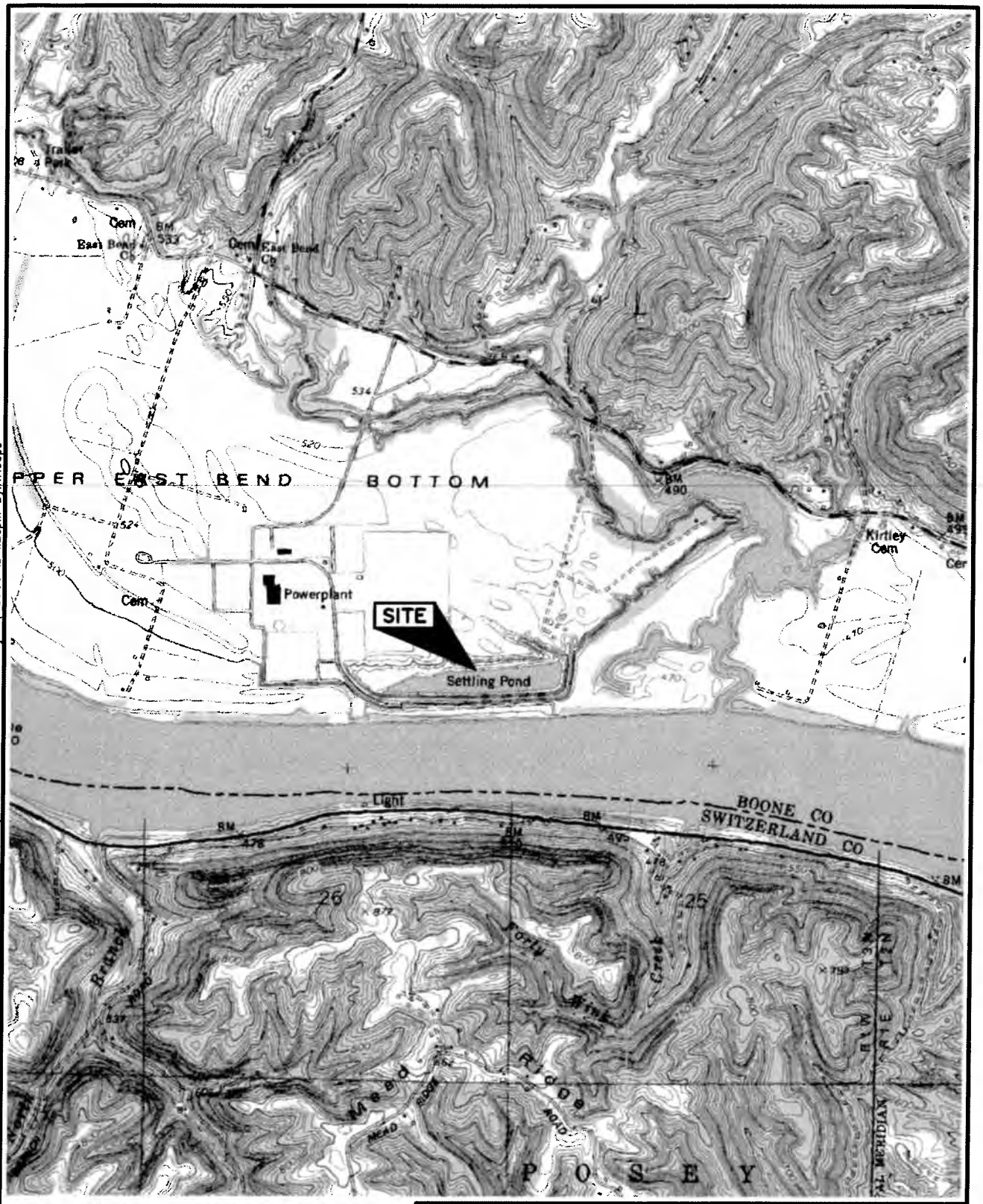
Seal

Commonwealth Of Kentucky
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DIVISION OF WATER
14 Reilly Rd
Frankfort, Ky 40601

DAM CONSTRUCTION PERMIT APPLICATION DATA SHEET

APPENDIX A

LOCATION MAP / DESIGN PLANS



LOCATION MAP

ASH POND RESERVOIR
EAST BEND STATION
BOONE COUNTY, KENTUCKY

Project: 011-09323-012	Drawn By: RSH
Drawing Date: 5/12/09	Approved By: SJL
Revision Date:	Scale: 1" = 2000'

0 2000' 4000'

BBCM
Columbus (614) 793-2226
Cleveland (216) 901-1000
Cincinnati (513) 771-8471
Dayton (937) 424-1011

BBCM Filename: I:\DEPTS\CADD\Drawings\Projects\011-09323-012\011-09323-005usgs.dwg Tab:8.5xIIP Plot Date:May 15, 2009 1:25pm By:RHoops

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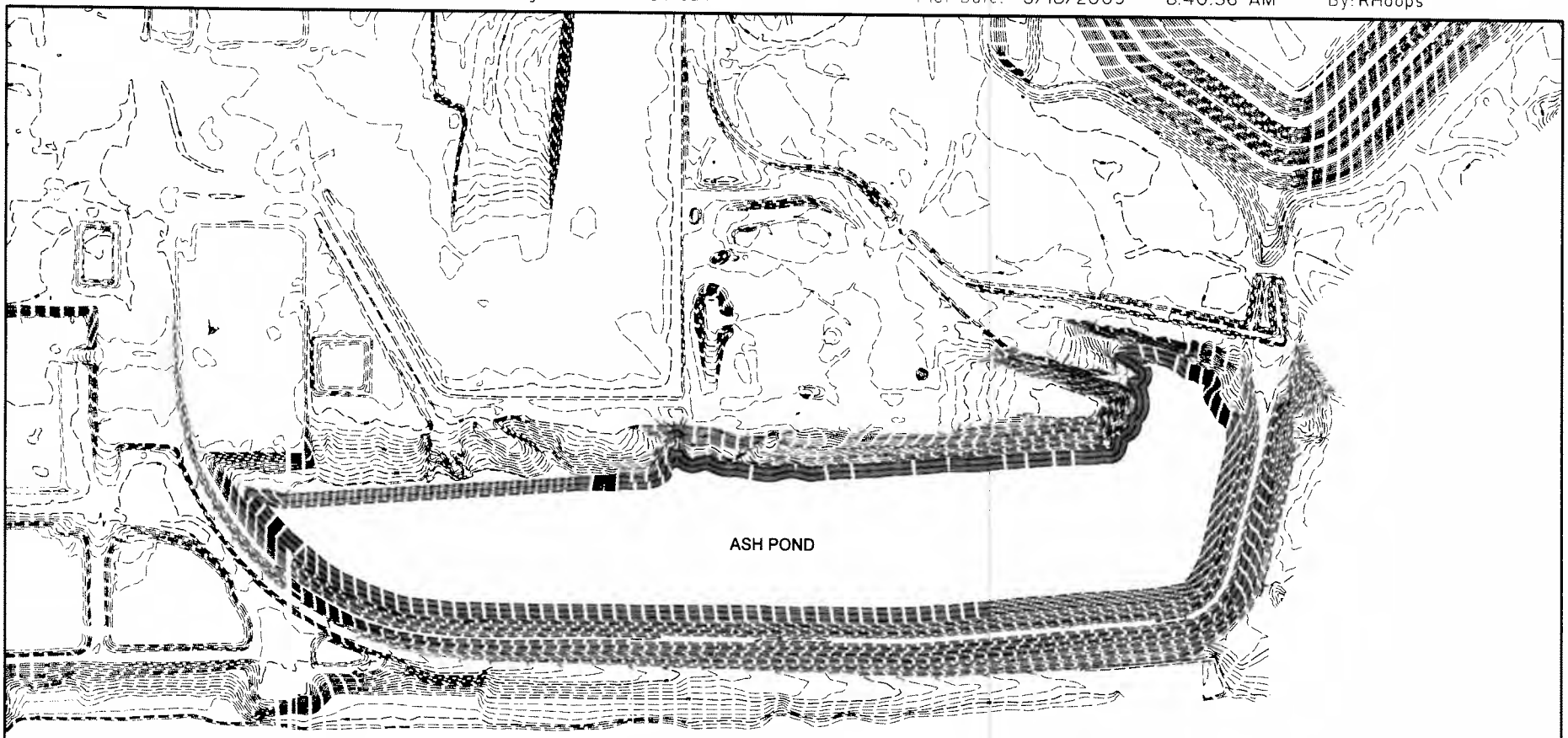


NOTE: TOPOGRAPHY SHOWN OBTAINED FROM SANDBORN COLUMBUS INC., FLYOVER DATED 12/15/2004

SCALE IN FEET

0 250 500

EXISTING TOPOGRAPHY

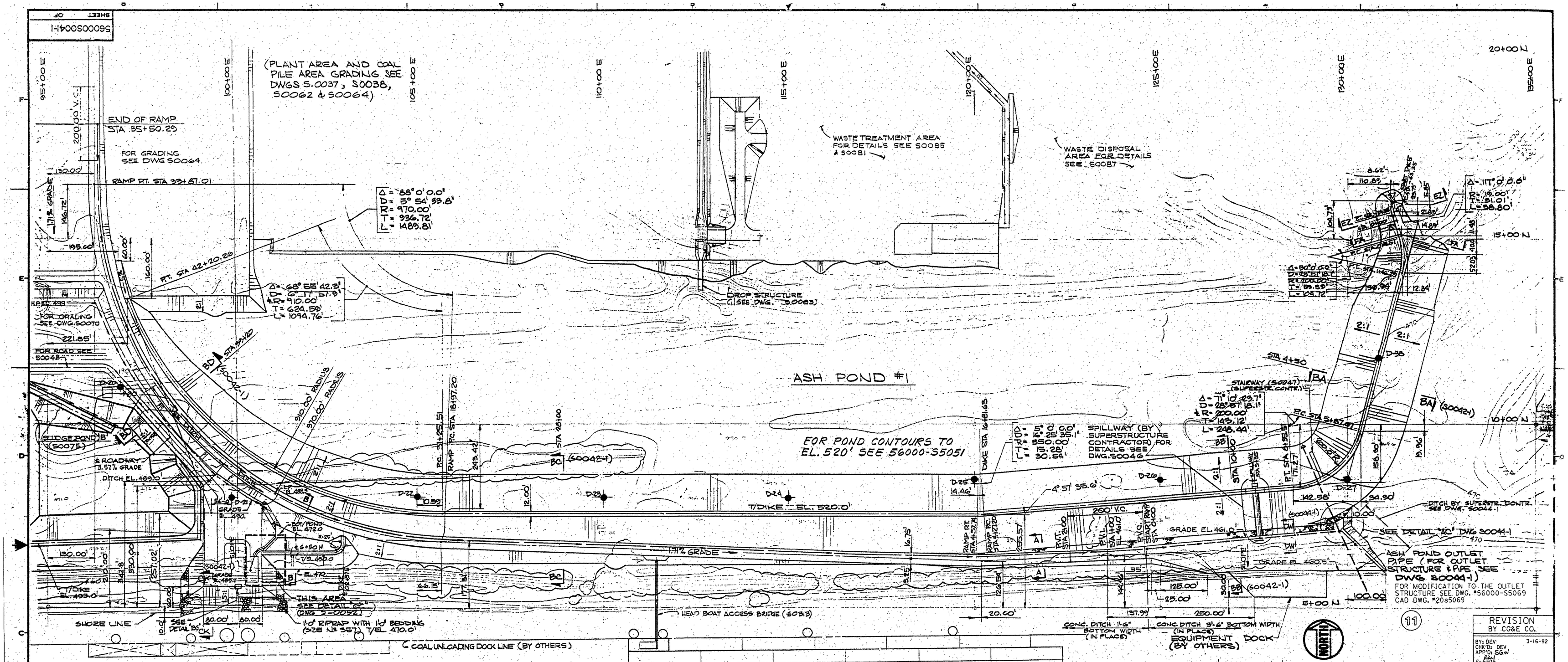
EAST BEND ASH POND
BOONE COUNTY, KENTUCKY

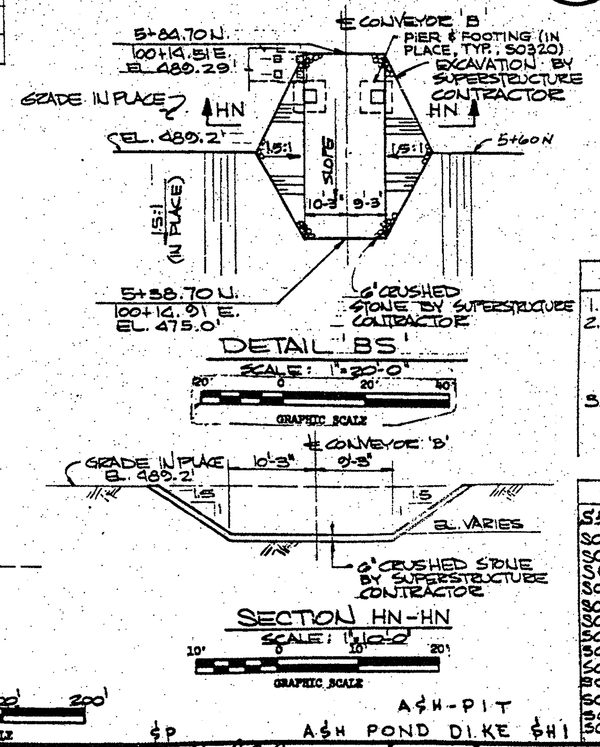
Project: 011-09323-012	Drawn By: RSH
Drawing Date: 05/14/09	Approved By: SJL
Revision Date:	Scale: 1" = 500'

BBCM
SOLUTIONS TO BUILD ON

Columbus (614) 793-2226
Cleveland (216) 901-1000
Cincinnati (513) 771-8471
Dayton (937) 424-1011

PLATE 2





NOTES

1. FOR GENERAL NOTES SEE DWG S0034
2. ALL SUPERSTRUCTURE WORK SHOWN ON THIS DRAWING SHALL BE DONE BY THE SUPERSTRUCTURE CONTRACTOR IN ACCORDANCE WITH PROJECT SPECIFICATION F-3050 UNLESS NOTED.
3. ALL WORK SHOWN ON THIS DRAWINGS SHALL BE DONE BY THE EARTHWORK CONTRACTOR IN ACCORDANCE WITH SPEC. F-3009 UNLESS NOTED.

REFERENCE DRAWINGS

S5051	ASH POND CONTS-1986
S0002	SOIL BORING LOCATION PLAN
S0034	SITE CLEARING PLAN
S0057	SITE GRADING PLAN SHEET 3
S0058	SITE GRADING PLAN SHEET 4
S0042-1	ASH POND DIKE TYP. SECT. SHEET 1
S0044-1	ASH POND OUTLET STRUCT. SHEET 1
S0062	PLANT GRADING PLAN SHEET 2.
S0064	PLANT GRADING PLAN SHEET 4.
S0046	ASH POND Nº1 EMERGENCY OVERFLOW SPILLWAY
S0320	TRANSFER HOUSE FDN. PLAN, SECTIONS & DETAILS.
S0075	LIME HANDLING & SLUDGE POND AREA EARTHWORK
S0083	CONC. DROP STRUCT. AT COAL PILE DITCH OUTFALL
S0047	ASH POND DIKE STAIRS AT OUTLET

DRAWING RELEASE RECORD

REV.	SPEC. NO.	DATE	DRAWN	CHECKED	ENGR. APPROVAL	DESCRIPTION	FILM
S	F-3009	12-11-75				FOR PROPOSAL	
—	F-3009	2-13-76				FOR EARTHWORK CONSTRUCTION	X
A	F-3009	3-2-76				CHANGED EQUIPMENT DOCK GRADING & RAMP STATIONS	X
B	F-3009	4-2-76	R. DeLeon			REMOVE GRADE ELEVATIONS.	X
C	F-3009	4-27-76				ADD ROADWAY SUBGRADES & DITCHES	X
D	F-3009	6-28-76				REVISED STRCT. END-OF-DIKE, ADD SECT. E2-E2 & FA-FA	X
E	F-3050	12-22-77				FOR SUPERSTRUCTURE CONSTRUCTION.	X
F	F-3050	5-19-78				ADDED EXCAVATION FOR CONVEYOR 'B' UNLOADER	X

DRAWING RELEASE RECORD

REV.	SPEC. NO.	DATE	DRAWN	CHECKED	ENGR. APPROVAL	DESCRIPTION	FILM
G	F-3009	11-05-79				ADDED RIPRAP & BEDDING ON EXTERIOR DIKE SLOPE BELOW 470'-0" ELEVATION	X
H	—	10-23-82				~~COMPLETE~~ - ADDED SETTLING POND & SECTION B.	X
						SENT TO CLIENT	

FOR CONTINUATION SEE C.G.&E.CO. REVISIONS

STATE OF KENTUCKY — STEVE RURKA 9231 — REGISTERED PROFESSIONAL ENGINEER

DRAWN	12-4-75	1"=100'-0" U.L. SCALE
CHECKED		1-26-76 DATE
ENGINEER		1-27-76 DATE
APPROVED		4-26-76 DATE

PROJECT NUMBER 4869-09

ASH POND DIKE PLAN SHEET 1
EAST BEND STATION UNIT 2
THE CINCINNATI GAS & ELECTRIC CO.
THE DAYTON POWER & LIGHT CO.
CINCINNATI, OHIO

SARGENT & LUNDY ENGINEERS CHICAGO

DRAWING NO. 56000S0041-1 REV. 11

SHEET OF

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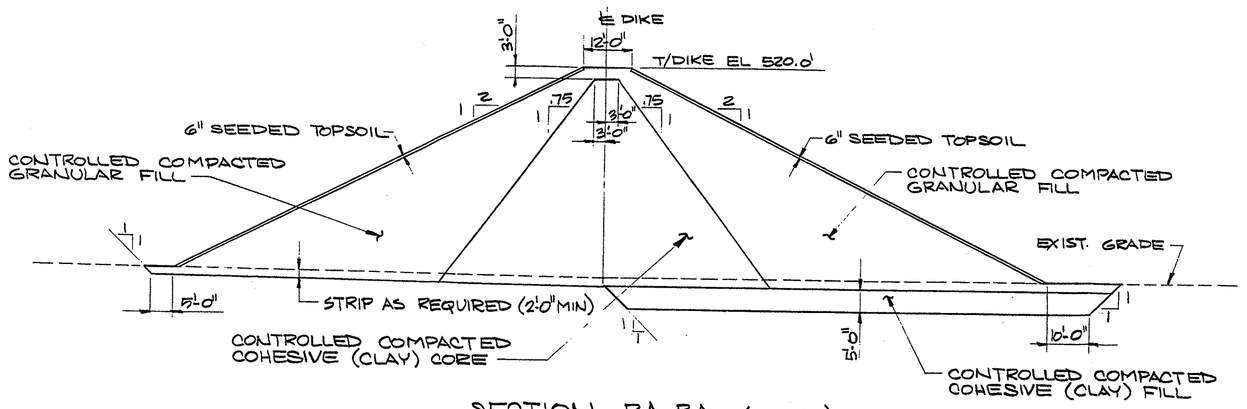
CAD FILENAME: 20s41x1.dgn

REVISION BY CG&E CO.
BY: DEV 3-16-92
CHK'D: DEV
APP'D: SGW
E-5305
W.O.: 512-4277
B.M.:
(RECORD)
ADDED REFERENCE NOTE FOR OUTLET STRUCT.
11

DO NOT USE L.O. & OR S FOR REVISION

56000S0041-1



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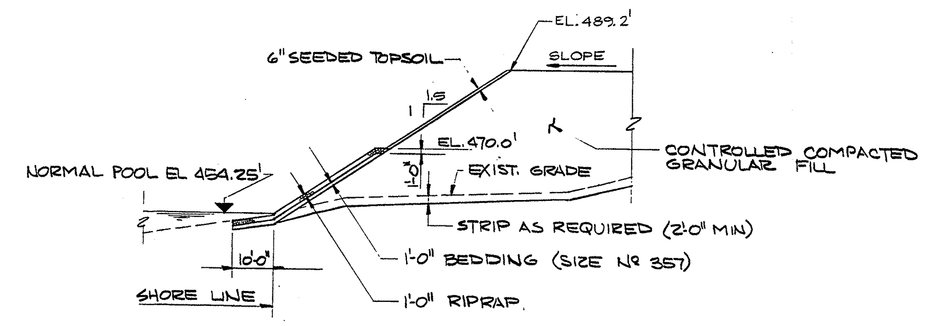

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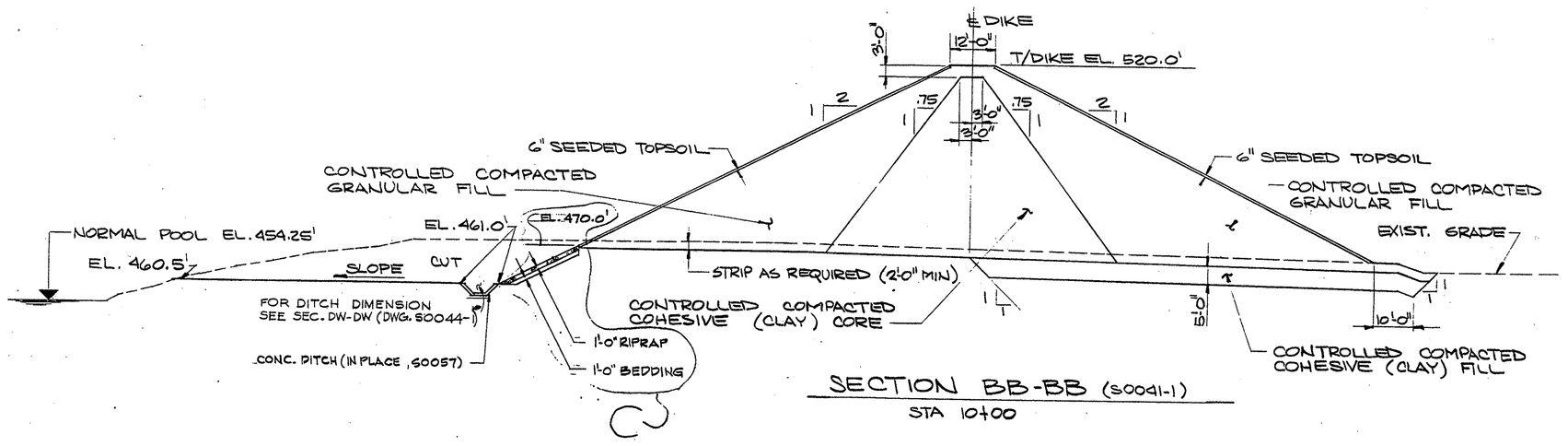

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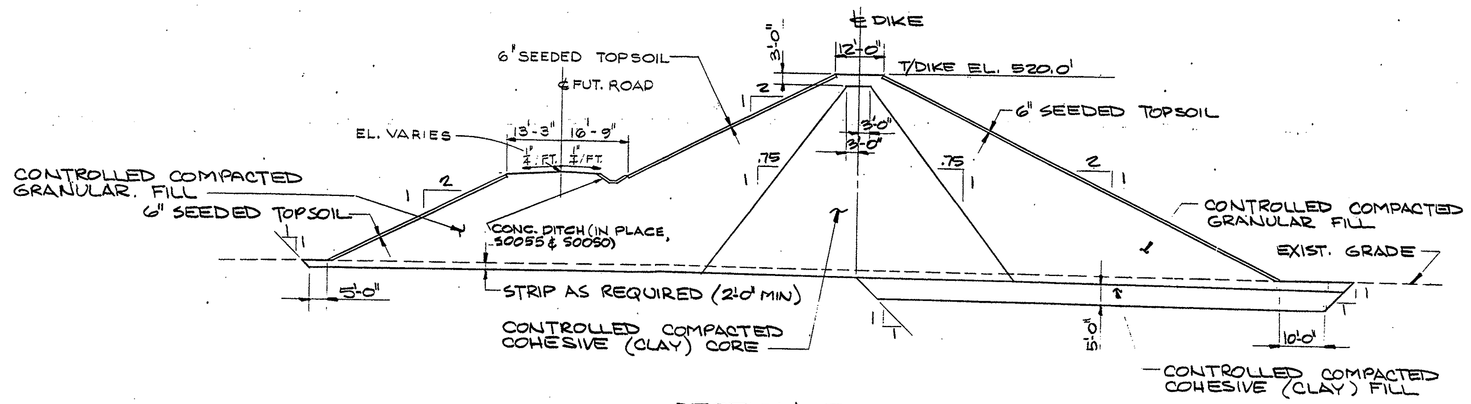

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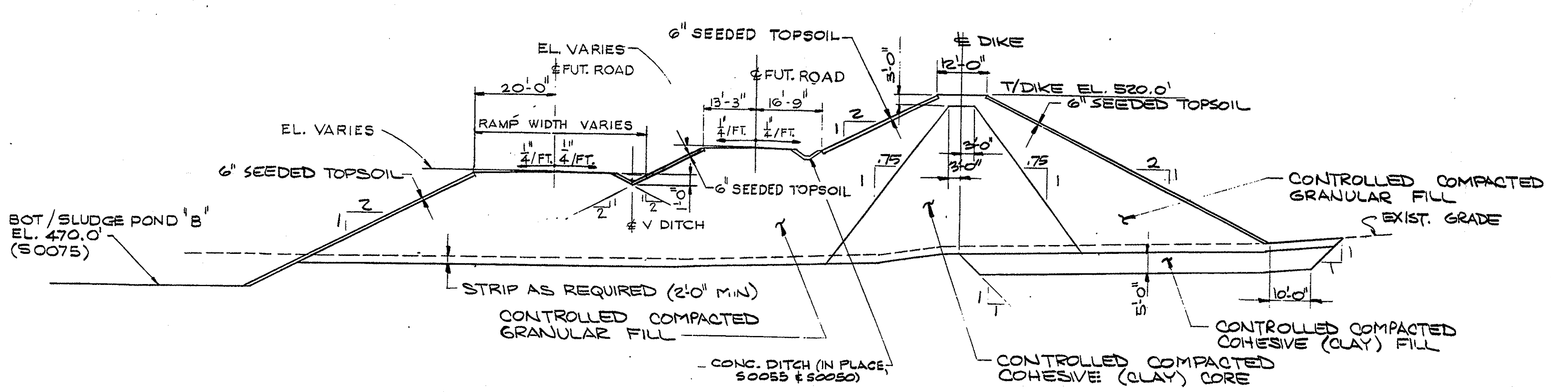


SECTION BD-BD (S0041-1)
STA 38+20

NOTES

1. FOR GENERAL NOTES SEE DWG. S0034.

REFERENCE DRAWINGS

S0034	SITE CLEARING PLAN
S0041-1	ASH POND DIKE PLAN SHEET 1
S0075	LIME HANDLING & SLUDGE POND AREA EARTHWORK

GRAPHIC SCALE 20' 0 20' 40'

℄ ASH-PIT
℄ ASH POND DIKE ℄H1

DRAWING RELEASE RECORD

REV.	SPEC. NO.	DATE	DRAWN	CHECKED	ENGR. APPROVAL	DESCRIPTION	FILM
—	F-3009	12-11-70				FOR PROPOSAL	
—	F-3009	2-13-76				FOR EARTHWORK CONSTRUCTION	
A	F-3009	3-2-76				CHANGED EQUIP. DOCK AREA GRADING ELEVATIONS	
B	F-3009	4-27-76				ADD FINISH GRADING, ROADWAY GRADING & DITCHES	
C	F-3009	11-05-78				ADDED RIPRAP & BEDDING TO EXTERIOR DIKE SLOPE BELOW EL. 470'	
C	—	11-15-84		—	—	SENT TO CLIENT	

DRAWING RELEASE RECORD

REV.	SPEC. NO.	DATE	DRAWN	CHECKED	ENGR. APPROVAL	DESCRIPTION	FILM

DO NOT USE I, O, Q OR X FOR REVISION

STATE OF KENTUCKY
STEVE RURKA
9231
REGISTERED PROFESSIONAL ENGINEER

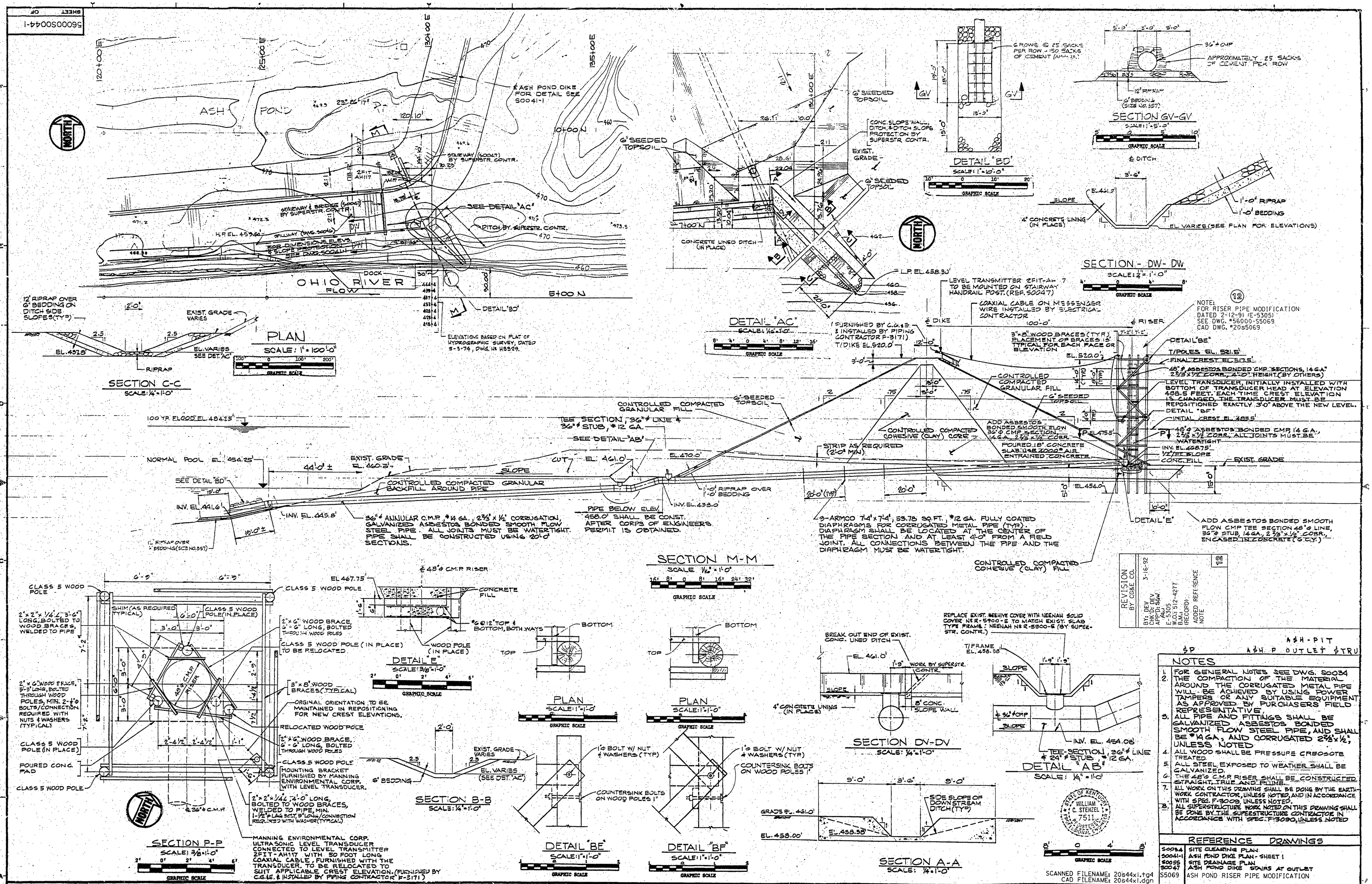
DRAWN	12-9-75	1"=20'-0" U.N. SCALE
CHECKED	1-26-76 DATE	PROJECT NUMBER 4869-09
ENGINEER	1-27-76 DATE	
APPROVED	1-28-76 DATE	

ASH POND DIKE TYPICAL SECTIONS SHEET 1
EAST BEND STATION UNIT 2
THE CINCINNATI GAS & ELECTRIC CO.
THE DAYTON POWER & LIGHT CO.
CINCINNATI, OHIO

SARGENT & LUNDY ENGINEERS CHICAGO

DRAWING NO. 56000S0042-1 REV. C
SHEET OF

Sheet SIZE 2-CC 4



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CAD FILENAME: 20s44x1.dgn

REVISION BY CG&E CO.	
BY: DEV	3-16-92
CHK: DEV	
APP'D: SGW	
FILE: E-5305	
W.O.: 512-4277	
B.M.:	
(RECORD)	
ADDED REFERENCE NOTE	12

A&H-PIT
℄P A&H P OUTLET ℄TRU

NOTES

1. FOR GENERAL NOTES SEE DWG. S0034
2. THE COMPACTION OF THE MATERIAL AROUND THE CORRUGATED METAL PIPE WILL BE ACHIEVED BY USING POWER TAMPERS OR ANY SUITABLE EQUIPMENT AS APPROVED BY PURCHASERS' FIELD REPRESENTATIVE.
3. ALL PIPE AND FITTINGS SHALL BE GALVANIZED ASBESTOS BONDED SMOOTH FLOW STEEL PIPE, AND SHALL BE #14 GA., AND CORRUGATED 2 2/3" x 1/2", UNLESS NOTED
4. ALL WOOD SHALL BE PRESSURE CREOSOTE TREATED.
5. ALL STEEL EXPOSED TO WEATHER SHALL BE GALVANIZED.
6. THE 48" ϕ C.M.P. RISER SHALL BE CONSTRUCTED STRAIGHT, TRUE AND PLUMB.
7. ALL WORK ON THIS DRAWING SHALL BE DONE BY THE EARTHWORK CONTRACTOR, UNLESS NOTED, AND IN ACCORDANCE WITH SPEC. F-3009, UNLESS NOTED.
8. ALL SUPERSTRUCTURE WORK NOTED ON THIS DRAWING SHALL BE DONE BY THE SUPERSTRUCTURE CONTRACTOR IN ACCORDANCE WITH SPEC. F-3030, UNLESS NOTED

REFERENCE DRAWINGS

S0034	SITE CLEARING PLAN
S0041-1	ASH POND DIKE PLAN - SHEET 1
S0055	SITE DRAINAGE PLAN
S0047	ASH POND DIKE STAIRS AT OUTLET
S5069	ASH POND RISER PIPE MODIFICATION

REV.	SPEC. NO.	DATE	DRAWN	CHECKED		
—	F-3009	12-11-75				FOR PROPOSAL
—	F-3009	2-13-76				FOR EARTHWORK CONSTRUCTION
A	F-3009	2-27-76			X	OUTLET STRUCT. PIPE & GRADING CHANGES
B	F-3009	4-27-76			X	REV. DITCH GRADING
C	F-3009	6-2-77			X	ADDED RIPRAP BEDDING & TREMIE CONCRETE
D	F-3009	8-25-77			X	REV. OUTLET STRUCTURE, RISER PIPE, & WOOD POLES
E	F-3009	1-13-78				RECORD REV.: SACKS ADDED TO PIPE IN LIEU OF TREMIE CONC.
F	F-3000	10-18-79				ADDED DITCH TO RIVER, RIPRAP & BEDDING; REV. M.H. COVER

DRAWING RELEASE RECORD

REV.	SPEC. NO.	DATE	DRAWN	CHECKED	ENGR. APPROVAL	DESCRIPTION	FILM
G	F-3009	11-05-79				ADDED RIPRAP & BEDDING ON EXTERIOR DIKE SLOPE BELOW EL 470' ALONG RIVER	X
H	F-3171	8-13-80				ADDED 2FIT-AH118 & TRANSDUCER MOUNTED BY F-3171	
J	F-3009	11-14-80				EXTENDED BANK PROTECTION OUTLET OF STORM DRAINAGE DITCH	
K	F-3009	11-26-80				DELETED BANK PROTECTION	X
L	F-3171	01-26-81	M. WATCH			RELOCATED 2FIT-AH117 (FORMERLY LABELED 2FIT-AH118)	X
—		11-15-82				SENT TO CLIENT	X

STATE OF KENTUCKY STEVE RURKA 9231 REGISTERED PROFESSIONAL ENGINEER

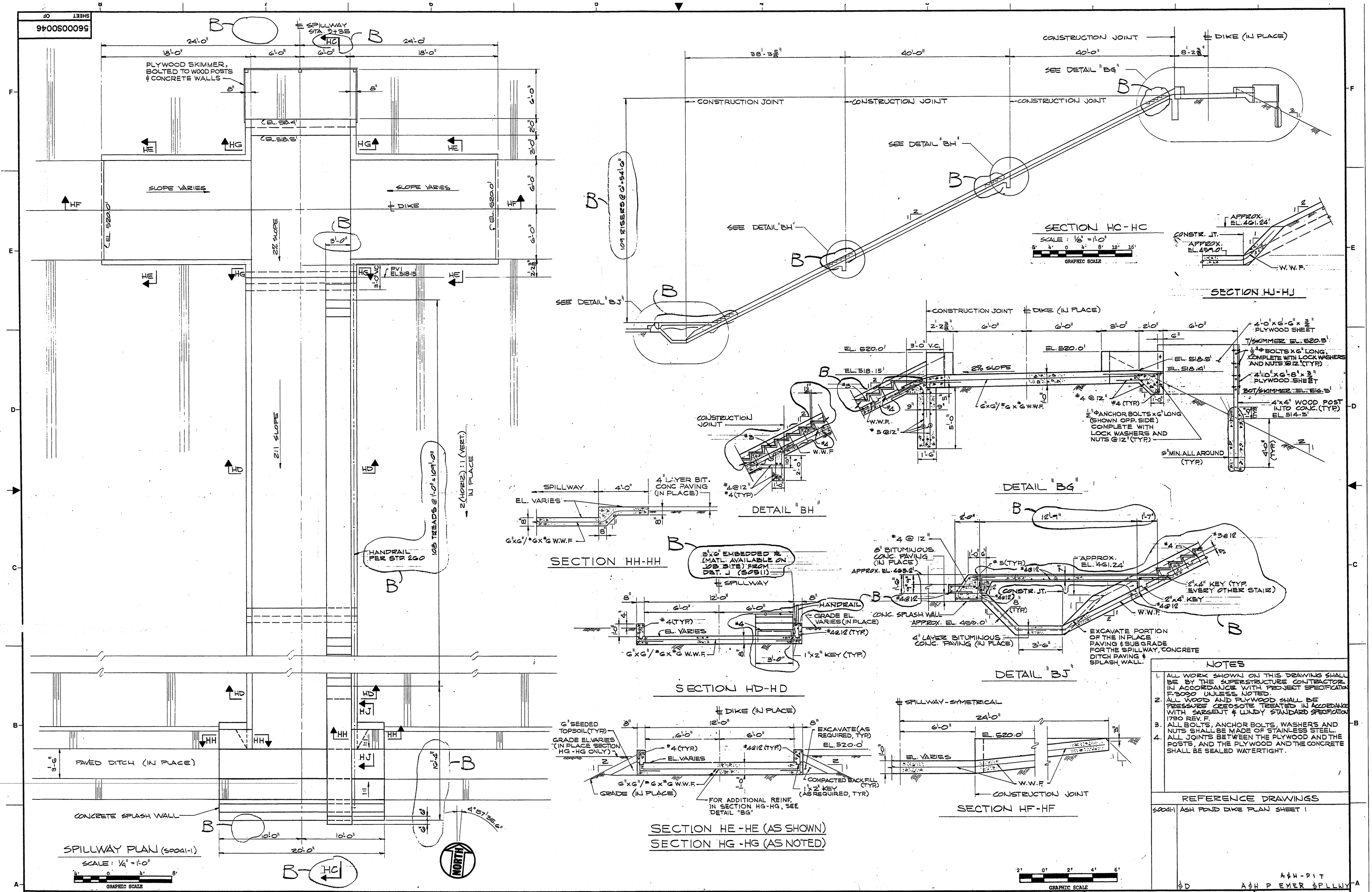
		AS NOTED SCALE
DRAWN	12-10-75	
CHECKED	1-26-76	DATE
ENGINEER	1-27-76	DATE
APPROVED	1-28-76	DATE

PROJECT NUMBER 4869-03

ASH POND OUTLET STRUCTURE SHEET 1
EAST BEND STATION UNIT 2
THE CINCINNATI GAS & ELECTRIC CO.
THE DAYTON POWER & LIGHT CO.
CINCINNATI, OHIO

SARGENT & LUNDY LLC CHICAGO

DWG. 56000S0044-1 REV. 12
SHEET OF



NOTES

1. ALL WORK SHOWN ON THIS DRAWING SHALL BE BY THE SUPERSTRUCTURE CONTRACTOR IN ACCORDANCE WITH PROJECT SPECIFICATION F-3090 UNLESS NOTED.
2. ALL WOOD AND PLYWOOD SHALL BE PRESSURE CREOSOTE TREATED IN ACCORDANCE WITH SARGENT & LUNDY STANDARD SPECIFICATION 1790 REV. F.
3. ALL BOLTS, ANCHOR BOLTS, WASHERS AND NUTS SHALL BE MADE OF STAINLESS STEEL.
4. ALL JOINTS BETWEEN THE PLYWOOD AND THE POSTS, AND THE PLYWOOD AND THE CONCRETE SHALL BE SEALED WATERTIGHT.

REFERENCE DRAWINGS

S0041-1 ASH POND DIKE PLAN SHEET 1

DRAWING RELEASE RECORD

REV.	DATE REL'D.	PREPARED	REVIEWED	APPROVED	PURPOSE	FILM
A	12-20-77				FOR SUPERSTRUCTURE CONSTRUCTION, SPEC. F-3090	X
B	6-18-80				ADDED ACCESS STAIRS, SPEC. NO. F-3090	X
B	11-15-82		—	—	SENT TO CLIENT	X

STATE OF KENTUCKY — STEVE RURKA — 9231 — REGISTERED PROFESSIONAL ENGINEER

SCALE: 3/8" = 1'-0" (U.N.)

PROJECT NUMBER: 4869-03

ASH POND NO. 1
EMERGENCY OVERFLOW SPILLWAY
EAST BEND STATION UNIT 2
THE CINCINNATI GAS & ELECTRIC CO.
THE DAYTON POWER & LIGHT CO.
CINCINNATI, OHIO

SARGENT & LUNDY ENGINEERS CHICAGO

DRAWING NO. 56000S0046 REV. B

SHEET OF

A&H-PIT
A&H P EMER SPLLWY

APPENDIX B

GEOLOGIC CONDITIONS

Geologic Conditions
Ash Pond Embankment
East Bend Station

The embankment for the ash pond at the East Bend Station is constructed within the flood plain of the Ohio River. The embankment abuts into a terrace within the ancestral floodplain of the Ohio River. The soil types and contours of the bedrock surface within the Ohio River Valley are largely the result of the flow and meander of the Ohio River during and after Pleistocene Continental Glaciation. The terraces present at the site are believed to be glacially derived. The lower terrace, on which the embankment is constructed, is the result of post glacial erosion by the Ohio River of the upper terrace, into which the embankment abuts.

Prior to continental glaciation, the Ohio River did not exist (at the East Bend site). Geologic literature indicates that the pre-glacial Kentucky River generally flowed northeast near the current location of the Ohio River Valley. Geologic mapping indicates that the Kentucky River flowed north (up) the current valley for Gunpowder Creek, then westward to the headwaters of the valley for Lick Creek, then southwest within Lick Creek Valley and across the East Bend Site, before turning to the northeast and flowing toward Rabbit Hash within the valley for the present day Ohio River. The generally northward flow of the Kentucky River was blocked by pre-Illinoisan ice sheets in Ohio, which caused a glacial lake to form within the Kentucky River Valley. Ultimately, a breach in the drainage divide caused the lake to drain to the southwest establishing the current Ohio River drainage-way. Meltwater from the pre-Illinoisan and subsequent ice sheets further eroded the breach, eroded the bedrock surface within the current Ohio River Valley, and deposited the majority of the soils currently present within the valley.

Soils in the upland area beyond the Ohio River Valley consist primarily of thin cohesive residual and colluvial deposits with relatively small isolated areas of glacial drift. Relatively minor quantities of alluvial, fluvial, and lacustrine deposits associated with of filled ancestral drainage ways can also be found in the upland areas. Soils within the Ohio River Valley bottom are primarily thick glacial outwash deposits, which generally consist of sand and gravel materials. Due to multiple glacial advances, thin discontinuous layers of glacial till and lacustrine deposits can be present within the outwash. Relatively thin recent alluvial and fluvial deposits are present near the ground surface as a result of the inter- and post-glacial meandering of the Ohio River and erosion of the adjacent upland areas.

Bedrock in the region is composed of alternating layers of limestone and shale of Ordovician Age. In the upland areas, the bedrock includes the Bull Fork Formation at the ridge tops overlying the Bellevue Tongue, Fairview, and Kope Formations. The bedrock beneath the unconsolidated deposits within the Ohio River Valley includes the Kope Formation overlying the Point Pleasant and Lexington Formations, which overlie the Black River Group. In the immediate vicinity of the site, it is estimated that the contacts between the bedrock units are as follows:

Fairview Formation	
	Elevation 650 feet MSL
Kope Formation	
	Elevation 435 feet MSL
Point Pleasant Formation	
	Elevation 285 feet MSL
Lexington Formation	

The uppermost bedrock beneath the Ohio River and along the majority of the buried valley wall beneath the site is believed to be the Point Pleasant Formation. The Point Pleasant Formation typically consists of 50 percent shale, which occurs in beds 10 to 24 inches thick, and 50 percent limestone, which occurs in beds up to about 10 inches thick.

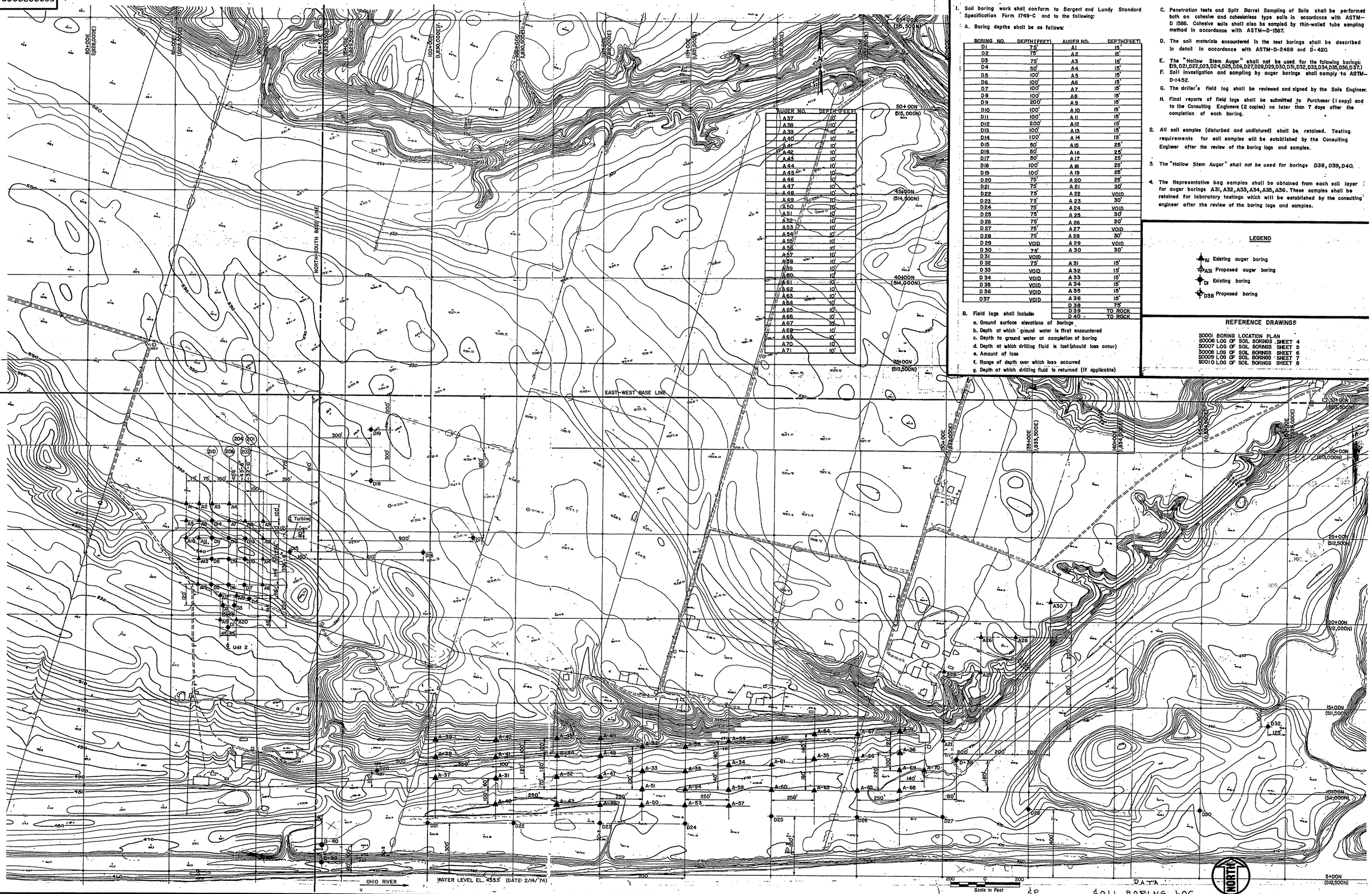
The locations of explorations and logs of the explorations near the embankment location are depicted on the following attached sheets:

> 56000S002 - Overall Plan of Explorations w/ summaries of types and depths of explorations;
> 56000S0041-1 – Plan of Borings near embankment (see Appendix A); and
> 056000S007, 8, 9, and 10 – Logs of Explorations.

The full descriptions of the stratigraphy encountered at each exploration are included on the logs of the explorations. The soils encountered near the embankment can be divided into 3 general stratigraphic units. The uppermost unit typically consists of medium-stiff to stiff silty clay which extends from the ground surface to a depth of about 10 feet. Underlying the silty clay is a unit of primarily of loose "dirty" fine sand which is typically about 20 to 30 feet thick. Medium-dense to dense fine to coarse sand underlies the fine sand deposit. The coarse sand is about 80 to 90 feet thick and extends to the bedrock surface. The bedrock surface is present near Elevation 350 to 360 feet MSL; the bedrock consists of limestone with shale layers.

Christopher K. Hall
Senior Geologist, BBCM
KY PG-2447

SHEET OF 5600S0002



AUGER NO.	DEPTH (FEET)
A37	10'
A38	10'
A39	10'
A40	10'
A41	10'
A42	10'
A43	10'
A44	10'
A45	10'
A46	10'
A47	10'
A48	10'
A49	10'
A50	10'
A51	10'
A52	10'
A53	10'
A54	10'
A55	10'
A56	10'
A57	10'
A58	10'
A59	10'
A60	10'
A61	10'
A62	10'
A63	10'
A64	10'
A65	10'
A66	10'
A67	10'
A68	10'
A69	10'
A70	10'
A71	10'

NOTES:

1. Soil boring work shall conform to Sargent and Lundy Standard Specification Form 1749-C and to the following:

A. Boring depths shall be as follows:

BORING NO.	DEPTH (FEET)	AUGER NO.	DEPTH (FEET)
D1	75'	A1	15'
D2	75'	A2	15'
D3	75'	A3	15'
D4	50'	A4	15'
D5	100'	A5	15'
D6	100'	A6	15'
D7	100'	A7	15'
D8	100'	A8	15'
D9	200'	A9	15'
D10	100'	A10	15'
D11	100'	A11	15'
D12	200'	A12	15'
D13	100'	A13	15'
D14	100'	A14	15'
D15	50'	A15	25'
D16	50'	A16	25'
D17	50'	A17	25'
D18	100'	A18	25'
D19	100'	A19	25
D20	75'	A20	25'
D21	75'	A21	30'
D22	75'	A22	VOID
D23	75'	A23	30'
D24	75'	A24	VOID
D25	75'	A25	30'
D26	75'	A26	30'
D27	75'	A27	VOID
D28	75'	A28	30'
D29	VOID	A29	VOID
D30	75'	A30	30'
D31	VOID		
D32	75'	A31	15'
D33	VOID	A32	15'
D34	VOID	A33	15'
D35	VOID	A34	15'
D36	VOID	A35	15'
D37	VOID	A36	15'
		D38	75'
		D39	TO ROCK
		D40	TO ROCK

B. Field logs shall include:
   a. Ground surface elevations of borings
   b. Depth at which ground water is first encountered
   c. Depth to ground water at completion of boring
   d. Depth at which drilling fluid is lost (should loss occur)
   e. Amount of loss
   f. Range of depth over which loss occurred
   g. Depth at which drilling fluid is returned (if applicable)

C. Penetration tests and Split Barrel Sampling of Soils shall be performed both on cohesive and cohesionless type soils in accordance with ASTM-D 1586. Cohesive soils shall also be sampled by thin-walled tube sampling method in accordance with ASTM-D-1587.

D. The soil materials encountered in the test borings shall be described in detail in accordance with ASTM-D-2488 and D-420.

E. The "Hollow Stem Auger" shall not be used for the following borings: D9, D21, D22, D23, D24, D25, D26, D27, D28, D29, D30, D31, D32, D33, D34, D35, D36, D37.)

F. Soil investigation and sampling by auger borings shall comply to ASTM-D-1452.

G. The driller's field log shall be reviewed and signed by the Soils Engineer.

H. Final reports of field logs shall be submitted to Purchaser (1 copy) and to the Consulting Engineers (2 copies) no later than 7 days after the completion of each boring.

2. All soil samples (disturbed and undisturbed) shall be retained. Testing requirements for soil samples will be established by the Consulting Engineer after the review of the boring logs and samples.

3. The "Hollow Stem Auger" shall not be used for borings D38, D39, D40.

4. The Representative bag samples shall be obtained from each soil layer for auger borings A31, A32, A33, A34, A35, A36. These samples shall be retained for laboratory testings which will be established by the consulting engineer after the review of the boring logs and samples.

LEGEND

- A1 Existing auger boring
- A31 Proposed auger boring
- D1 Existing boring
- D38 Proposed boring

REFERENCE DRAWINGS

S0001 BORING LOCATION PLAN
S0006 LOG OF SOIL BORINGS SHEET 4
S0007 LOG OF SOIL BORINGS SHEET 5
S0008 LOG OF SOIL BORINGS SHEET 6
S0009 LOG OF SOIL BORINGS SHEET 7
S0010 LOG OF SOIL BORINGS SHEET 8

DRAWING RELEASE RECORD

REV.	SPEC. NO.	DATE	DRAWN	CHECKED	ENGR. APPROVAL	DESCRIPTION	FILM
—	—	11/13/74	M. WARNER	Chas Zener		ISSUED FOR BORINGS.	
A	—	11/21/74	S. ORTEGA			" " " "	
B	—	4/3/75	D. SANCHEZ	C. SENER	PJL	ADD BORINGS.	
C	—	6/18/75	Paul H. Robertson	James A. Vesely	PJL	ADD AND REMOVE BORINGS; REVISE LEGEND	
D	—	9/2/75	J. R. Carey		PJL	CHANGED DRAWING No FORMERLY S-2	
D	—	7-2-76	M. Wolfe	James A. Vesely	PJL	ISSUED TO CG&E	
D	—	11-15-84	K. Kokoto	—	—	SENT TO CLIENT	

DRAWING RELEASE RECORD

REV.	SPEC. NO.	DATE	DRAWN	CHECKED	ENGR. APPROVAL	DESCRIPTION	FILM

DO NOT USE I, O, Q OR X FOR REVISION

STATE OF OHIO
STEVE RURKA
E-38863
REGISTERED PROFESSIONAL ENGINEER

R. KLEIN DRAWN	1" = 200' SCALE	PROJECT NUMBER 4869-03
Chas Zener CHECKED	11/13/1974 DATE	
Robert S Kroll ENGINEER	11-19-74 DATE	
S. Bunka APPROVED	11-14-74 DATE	

SOIL BORING LOCATION PLAN
EAST BEND STATION UNIT 2
THE CINCINNATI GAS & ELECTRIC CO.
THE DAYTON POWER & LIGHT CO.
CINCINNATI, OHIO

SARGENT & LUNDY ENGINEERS CHICAGO

DRAWING NO. 5600S0002 REV.

SHEET OF

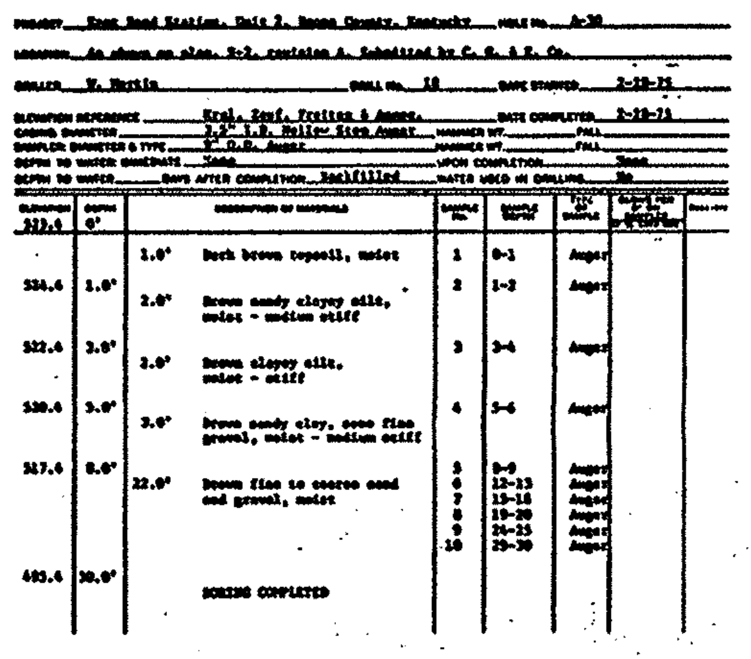
2-CC4

56000S0007
SHEET OF

BORING A-29

VOID

BORING A-30



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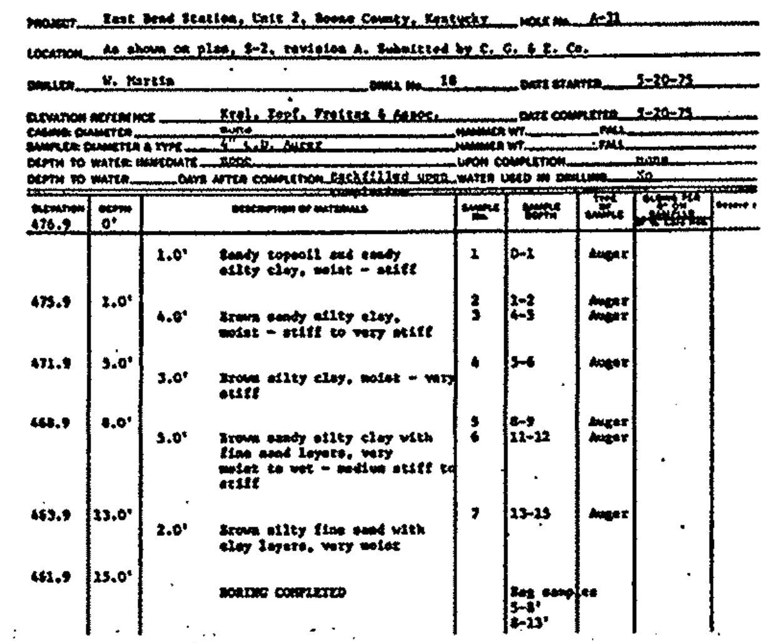
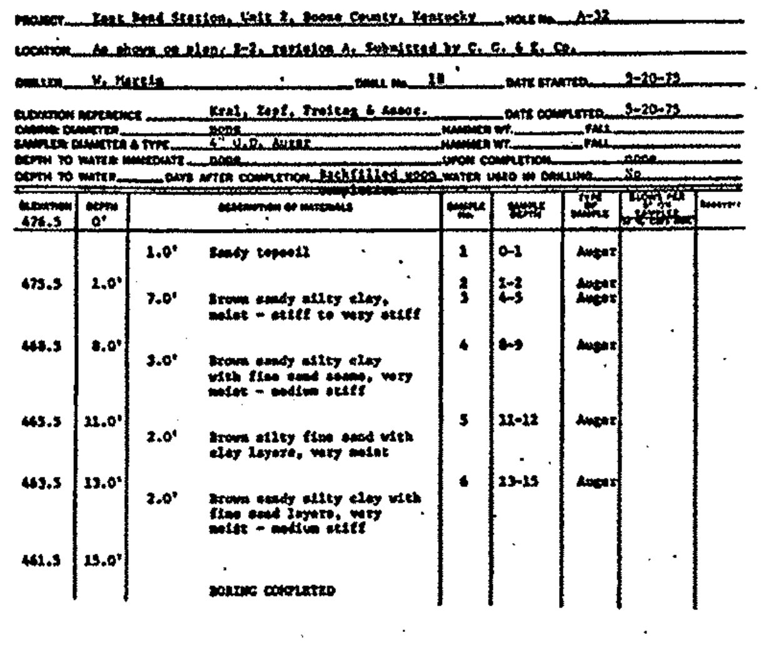


BORING A-32



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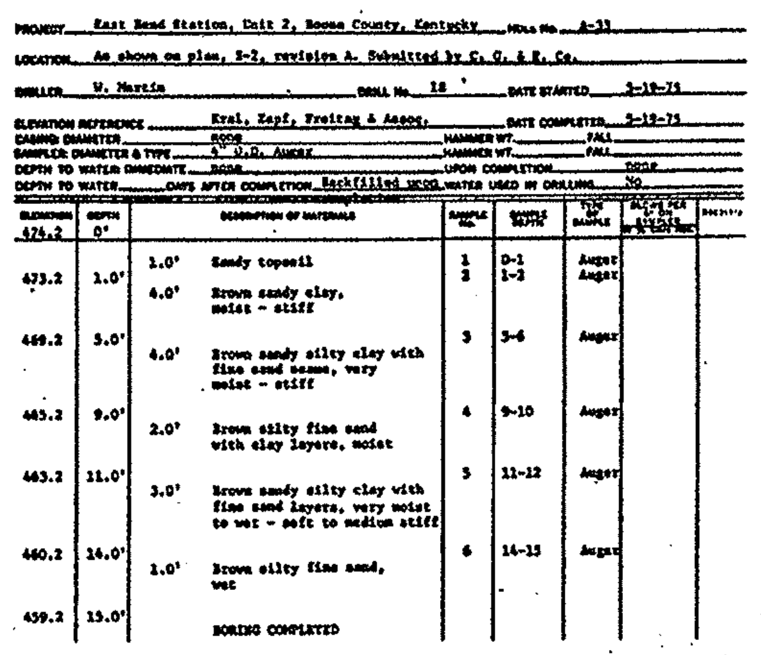

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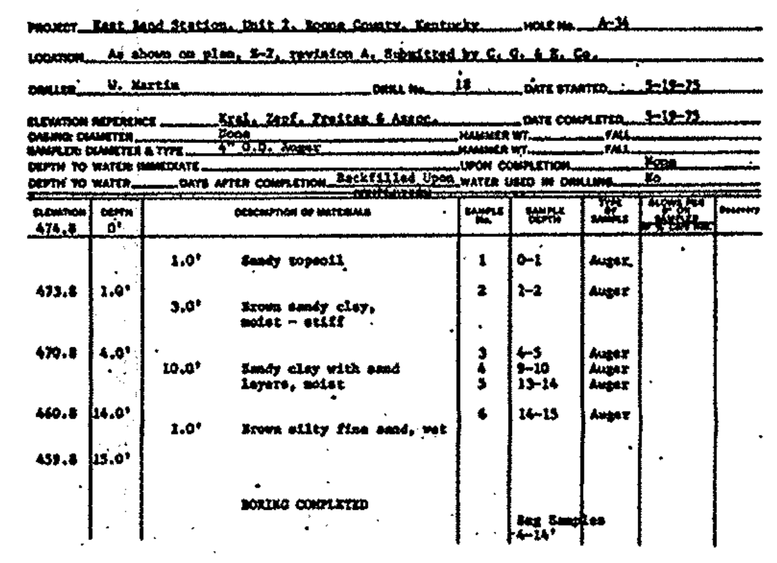

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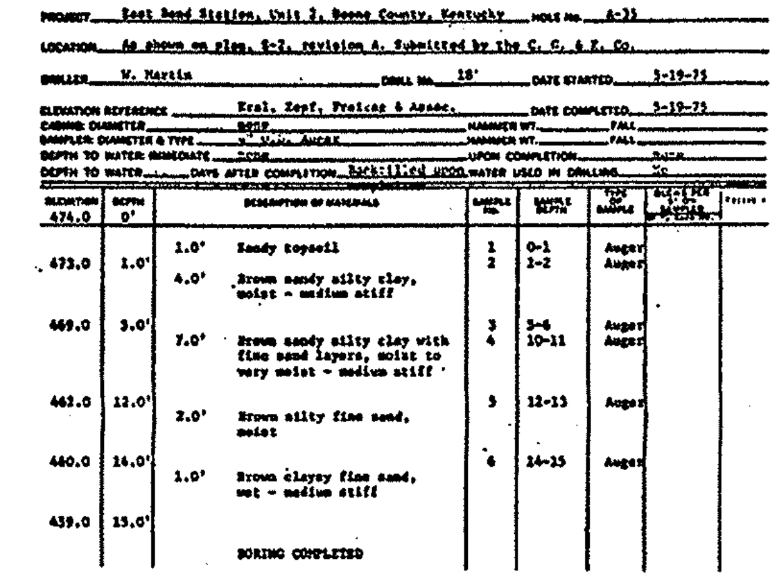

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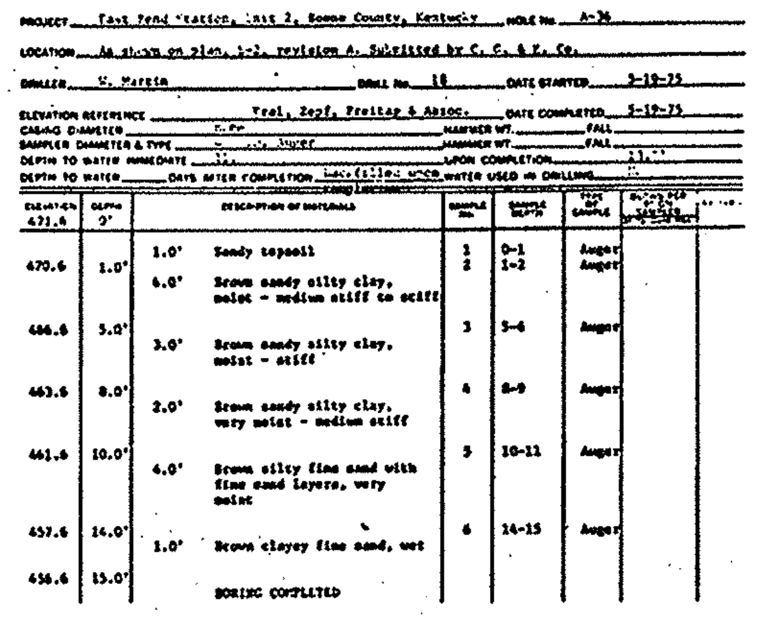
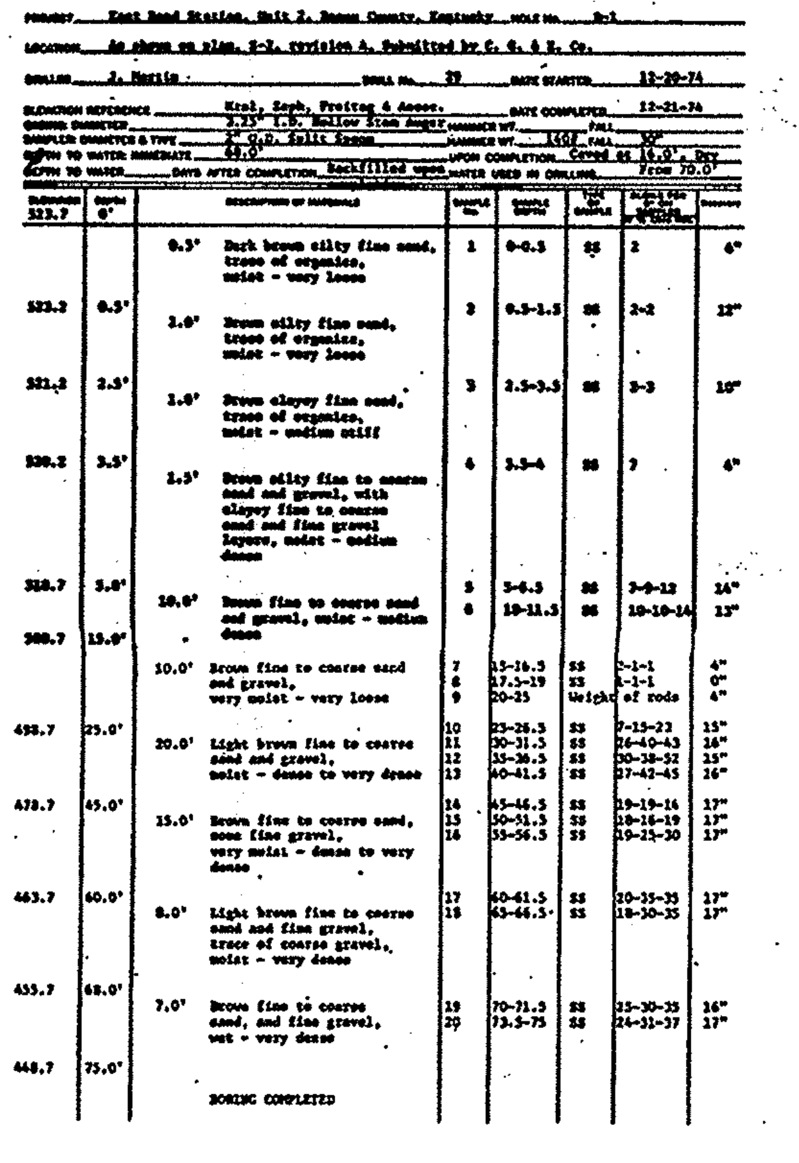


BORING D-1



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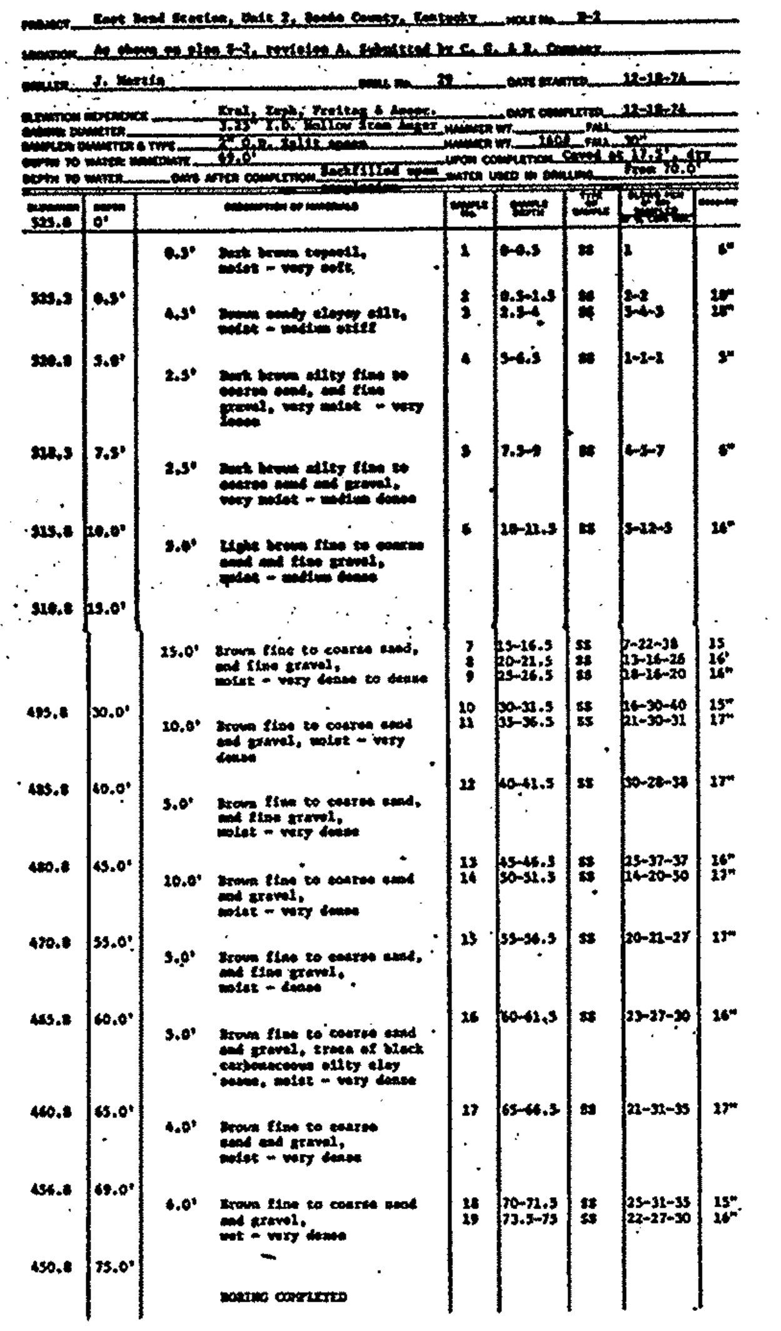
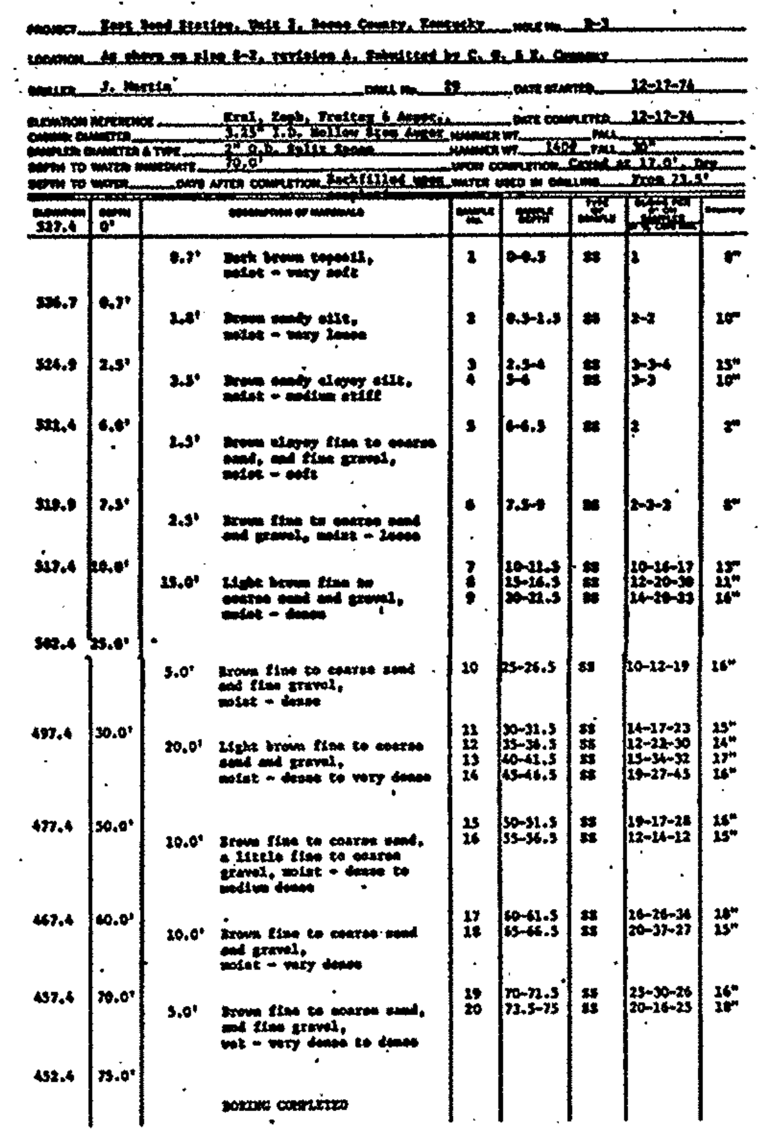
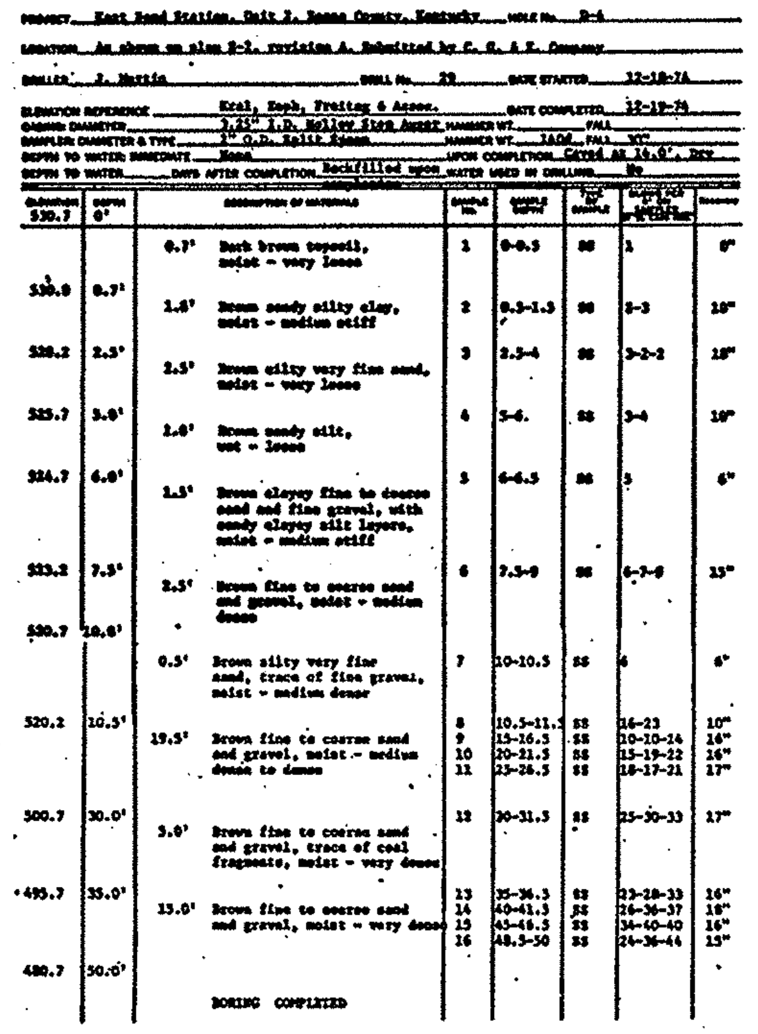


BORING D-3



BORING D-4



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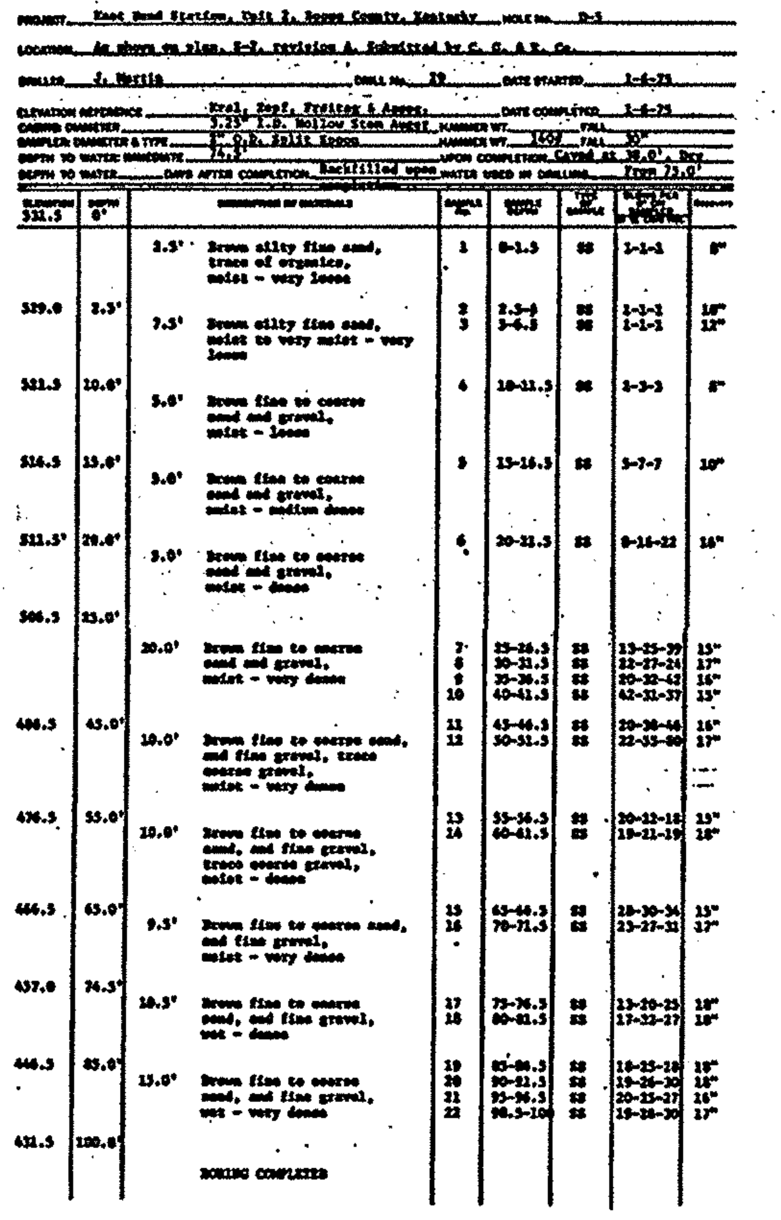

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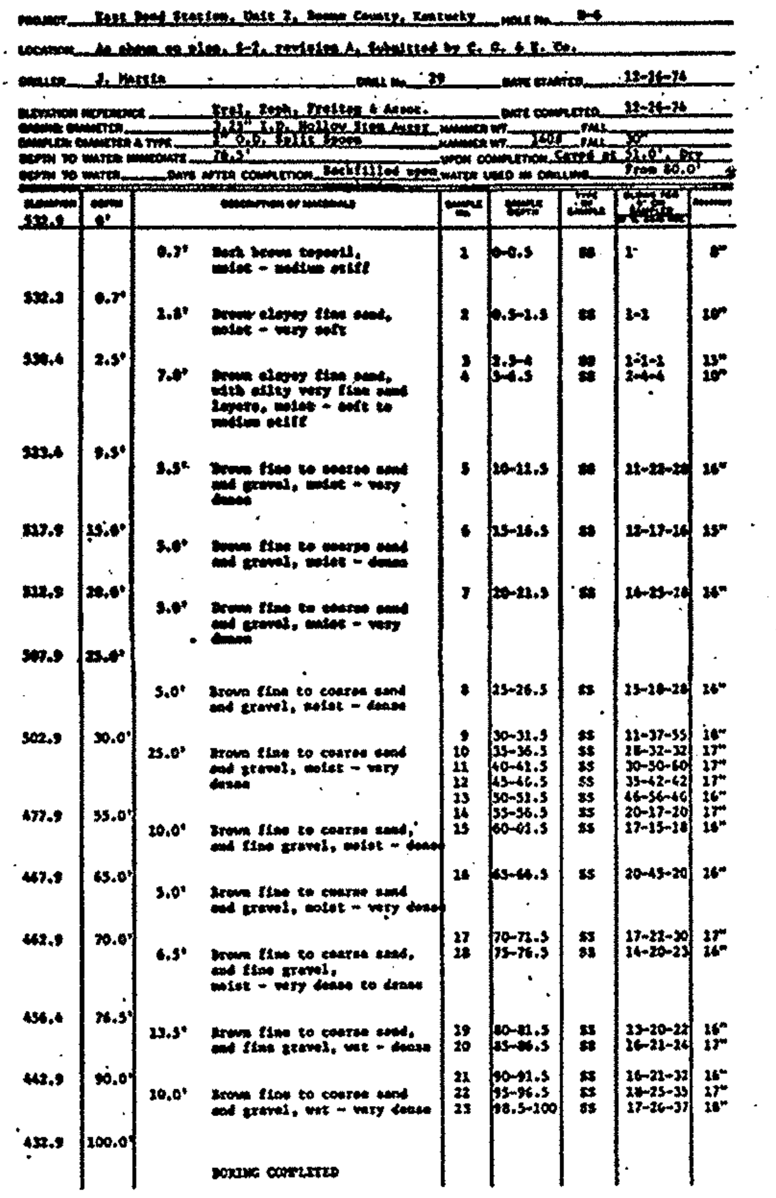

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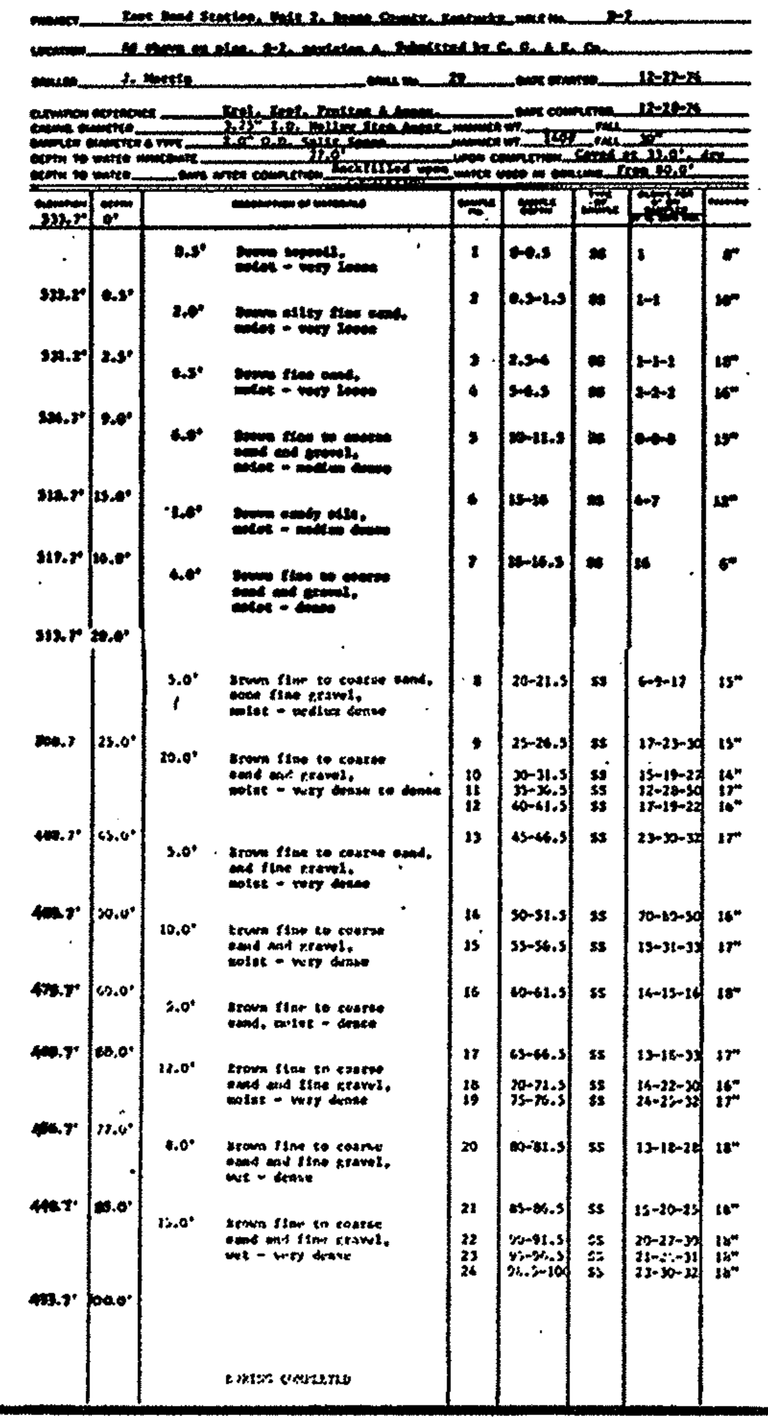

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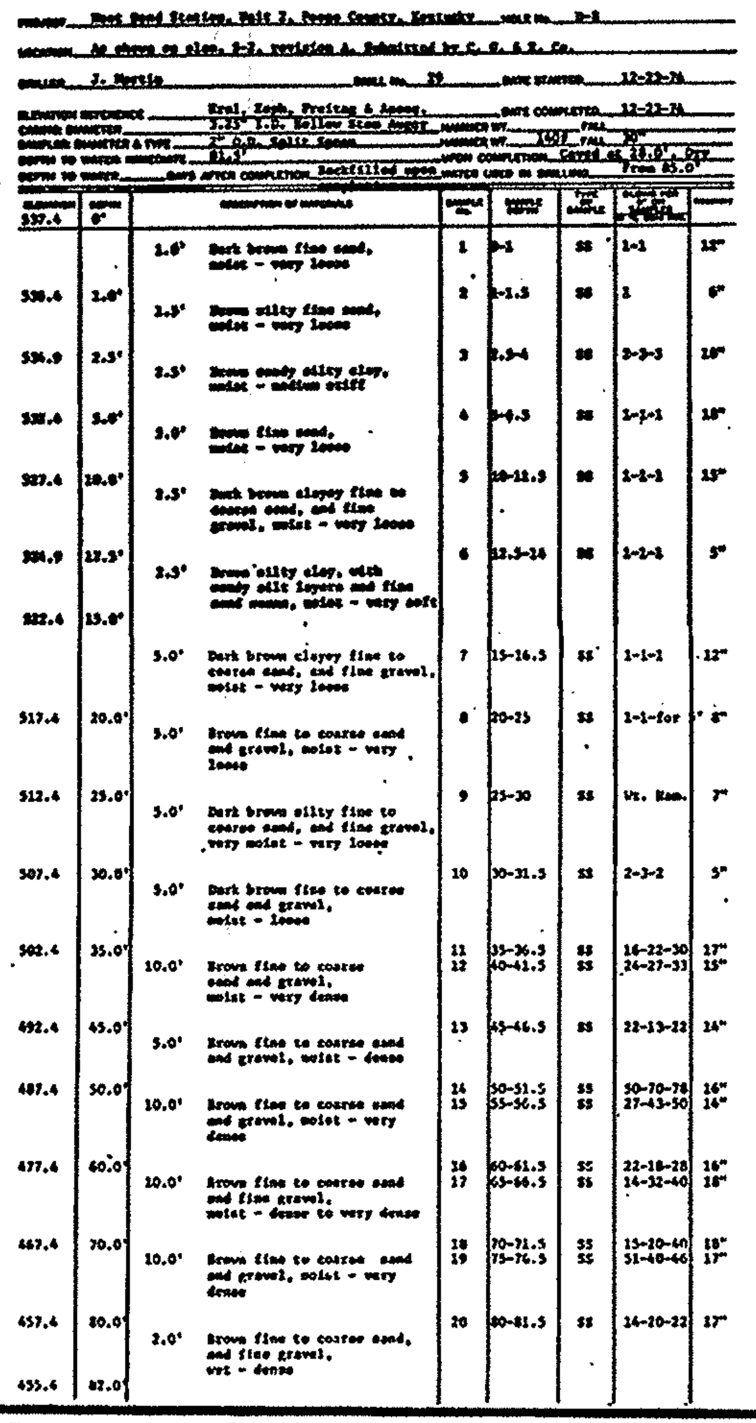

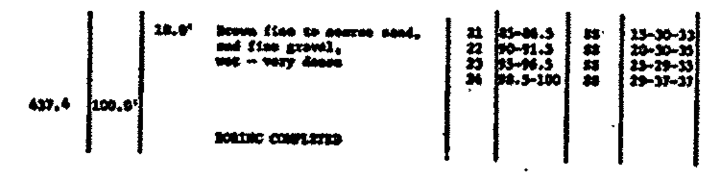

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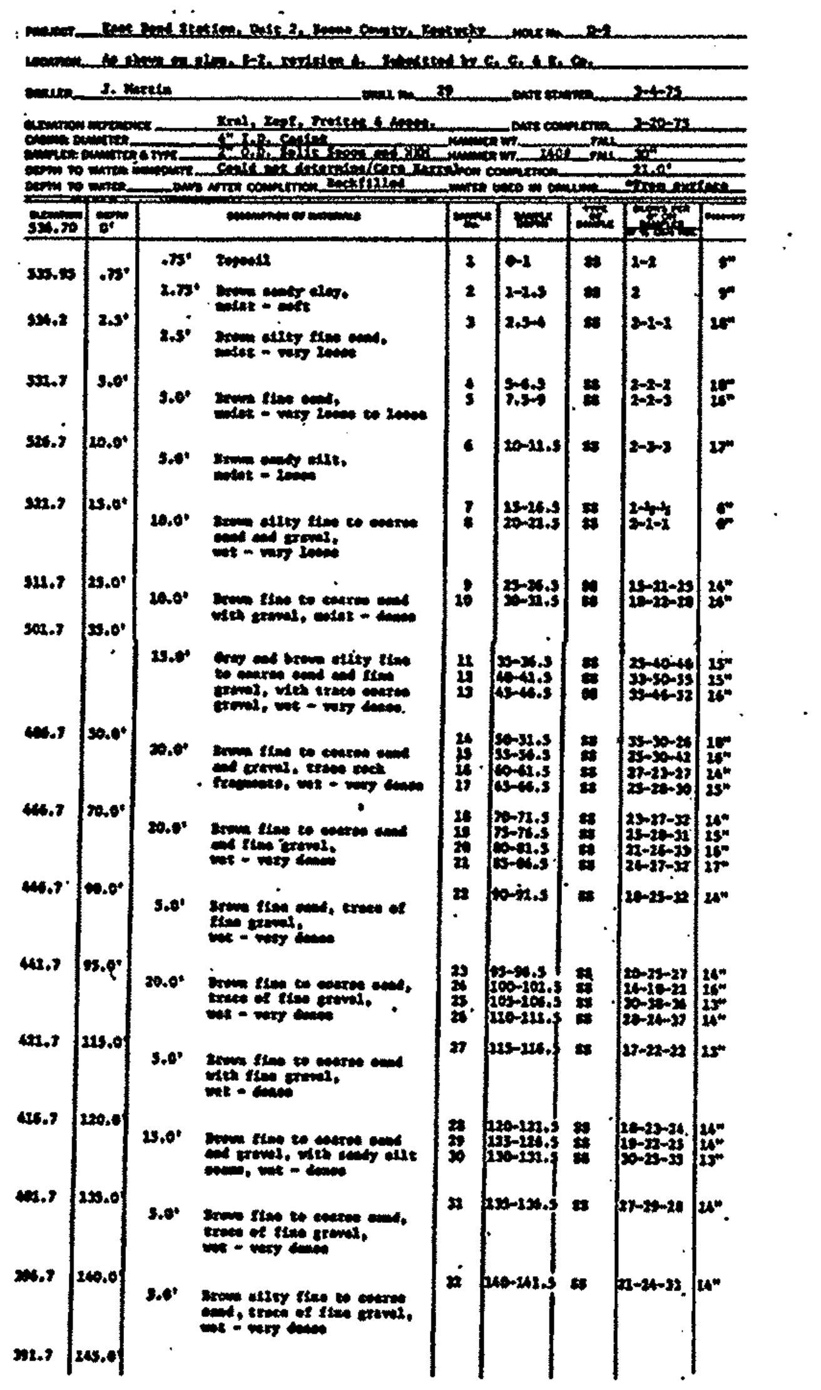
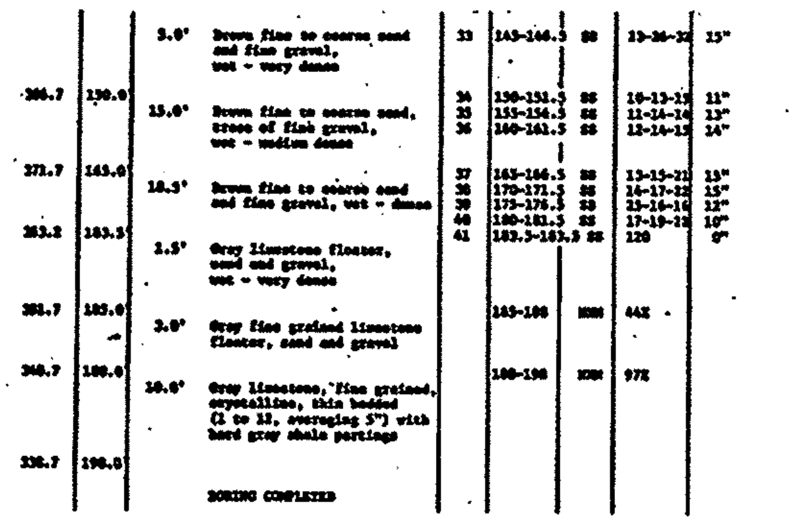
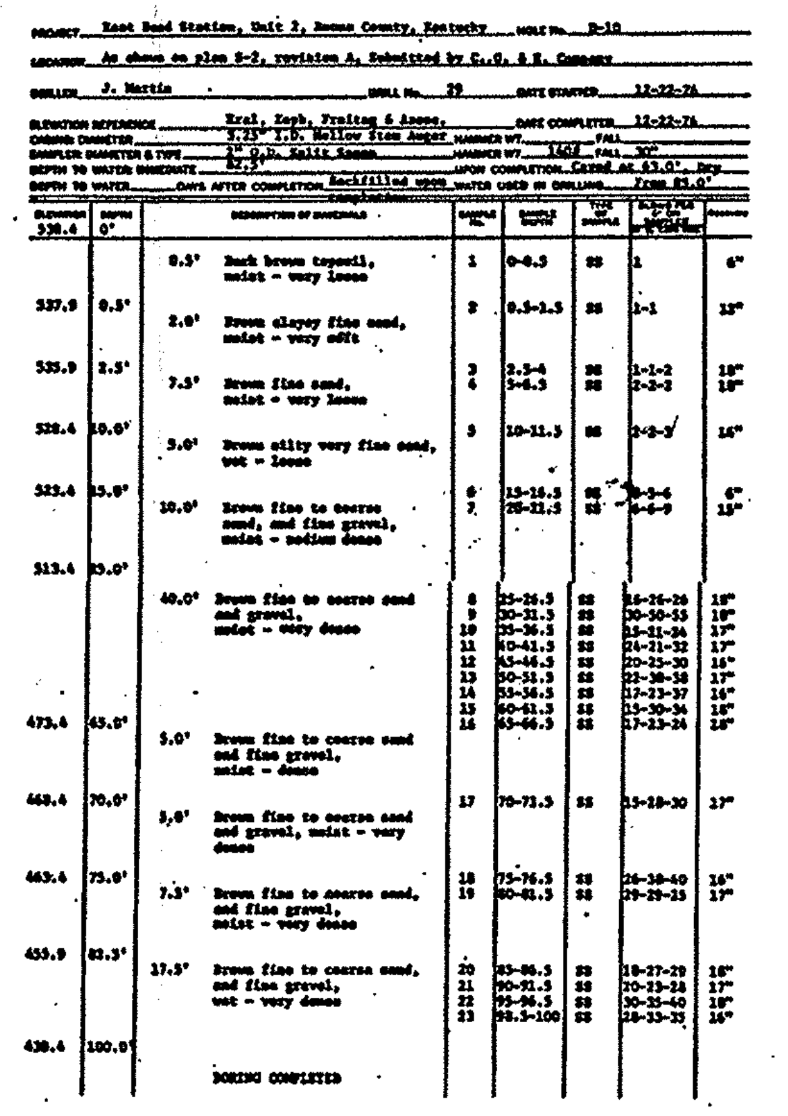
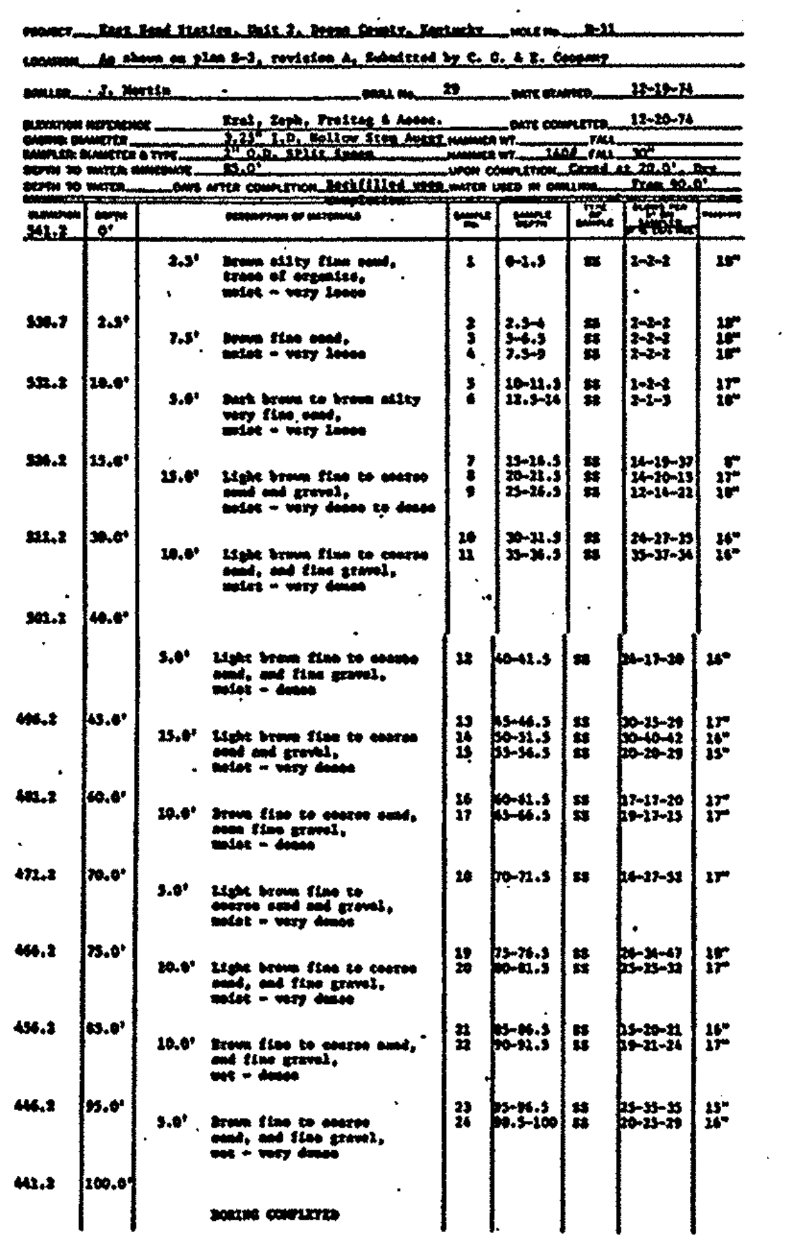




BORING D-10



BORING D-11



REFERENCE DRAWINGS

S0002	SOIL BORING LOCATION PLAN

S2

DATA
LOG SOIL BORG SHS

DRAWING RELEASE RECORD

REV.	SPEC. NO.	DATE	DRAWN	CHECKED	ENGR. APPROVAL	DESCRIPTION	FILM
—	—	2-4-76		J. Wesby	PJK	ISSUED TO CG&E	X
—	—	11-15-82	K. Roberts	—	—	SENT TO CLIENT	X

DRAWING RELEASE RECORD

REV.	SPEC. NO.	DATE	DRAWN	CHECKED	ENGR. APPROVAL	DESCRIPTION	FILM

STATE OF KENTUCKY
STEVE RURKA
9231
REGISTERED PROFESSIONAL ENGINEER

DRAWN 7-6-75
NONE SCALE
J. S. Wesby CHECKED 12-22-75 DATE
P.J. Kasik ENGINEER 12-22-75 DATE
S. Rurka APPROVED 12-22-75 DATE

PROJECT NUMBER
4869

LOG OF SOIL BORINGS
SHEET 5
EAST BEND STATION UNIT 2
THE CINCINNATI GAS & ELECTRIC CO.
THE DAYTON POWER & LIGHT CO.
CINCINNATI, OHIO

SARGENT & LUNDY
ENGINEERS
CHICAGO

DRAWING NO.
56000S0007
SHEET OF

DO NOT USE I, O, Q OR S FOR REVISION

SHEET OF

56000S0009

BORING D-26

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. D-26
LOCATION As shown on plan, S-2, revision A. Submitted by C. C. & E. Co.
DRILLER W. Martin DRILL No. 19 DATE STARTED 3-31-75
ELEVATION REFERENCE Eval. Dept. Testing & Assoc. DATE COMPLETED 3-31-75
CASING DIAMETER none HAMMER WT. FALL
SAMPLER DIAMETER & TYPE 2" O.D. Split Spoon HAMMER WT. 140# FALL 30"
DEPTH TO WATER IMMEDIATE Could not determine UPON COMPLETION 12.0'
DEPTH TO WATER DAYS AFTER COMPLETION Backfilled WATER USED IN DRILLING *From surface

ELEVATION	DEPTH	DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE SAMPLE	BLOWS PER 6"	REMARKS
471.1	0'						
	1.0'	Topsoil	1	0-1	SS	1-1	12"
470.2	1.9'	Brown silty clay, moist - stiff	2	1-1.5	SS	-4-	6"
	4.0'		3	2.5-4	SS	3-3-7	18"
466.2	5.0'	Brown sandy clay, moist - medium stiff	4	4-4.5	SS	3-4-5	18"
	2.5'						
463.7	7.5'	Brown silty fine sand, moist to wet - loose	5	7.5-9	SS	1-1-3	18"
	11.5'		6	10-11.5	SS	2-2-3	18"
			7	13-14.5	SS	1-2-3	18"
451.2	20.0'		8	20-21.5	SS	1-2-3	15"
	5.0'	Brown fine sand with clay layers, wet - loose					
446.2	25.0'		9	25-26.5	SS	3-4-4	16"
	5.0'	Brown fine sand, wet - loose					
441.2	30.0'		10	30-31.5	SS	3-4-4	18"
	5.0'	Brown fine sand with clay layers, wet - loose					
436.2	35.0'						
	2.0'	Gray silty fine sand, trace of organics, wet - loose	11	35-36.5	SS	3-4-5	15"
434.2	40.0'						
	2.0'	Gray silty fine sand, with clay lenses, wet - loose	12	40-41.5	SS	3-4-6	16"
432.2	42.0'						
	20.0'	Brown fine to coarse sand with fine gravel, wet - very dense to dense	13	45-46.5	SS	8-9-11	18"
			14	50-51.5	SS	10-12-15	14"
			15	55-56.5	SS	11-13-16	17"
			16	60-61.5	SS	12-16-18	18"
			17	65-66.5	SS	11-14-18	17"
			18	70-71.5	SS	8-12-15	14"
			19	73.5-75	SS	10-13-16	16"
396.2	75.0'						

BORING COMPLETED

BORING D-27

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. D-27
LOCATION As shown on plan, S-2, revision A. Submitted by C. C. & E. Co.
DRILLER J. Martin DRILL No. 39 DATE STARTED 3-31-75
ELEVATION REFERENCE Eval. Dept. Testing & Assoc. DATE COMPLETED 3-31-75
CASING DIAMETER 4" O.D. Casing HAMMER WT. FALL
SAMPLER DIAMETER & TYPE 2" O.D. Split Spoon HAMMER WT. 140# FALL 30"
DEPTH TO WATER IMMEDIATE Could not determine UPON COMPLETION 12.5'
DEPTH TO WATER DAYS AFTER COMPLETION Backfilled WATER USED IN DRILLING *From surface

ELEVATION	DEPTH	DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE SAMPLE	BLOWS PER 6"	REMARKS
471.3	0'						
	1.0'	Topsoil	1	0-1	SS	1-2	9"
470.3	1.0'	Dark brown silty loam, (topsoil) moist - very loose					
	3.3'	Brown silty clay, moist - medium stiff	2	1-1.5	SS	3	6"
468.0	3.3'						
	2.5'	Brown sandy clay, moist - medium stiff	3	2.5-4	SS	2-3-3	15"
	7.5'		4	5-6.5	SS	1-2-3	17"
463.8	7.5'	Brown silty fine sand, moist - medium stiff to stiff	5	7.5-9	SS	1-4-5	18"
	10.0'		6	10-11.5	SS	3-3-3	18"
461.3	10.0'						
	2.5'	Brown sandy silty clay, very moist - soft					
458.8	12.5'						
	12.5'	Brown silty fine sand, very moist to wet - very loose	7	12.5-14	SS	1-1-1	6"
			8	15-16.5	SS	1-1-2	15"
446.3	25.0'		9	20-21.5	SS	1-2-3	15"
	10.0'	Brown fine sand, wet - loose	10	25-26.5	SS	2-3-3	15"
			11	30-31.5	SS	2-3-3	17"
436.3	35.0'						
	9.0'	Gray silty fine sand with clay layers, wet - very loose to loose	12	35-36.5	SS	1-2-2	13"
			13	40-41.5	SS	2-3-4	14"
427.3	44.0'						
	11.0'	Brown fine to coarse sand with fine to coarse gravel, wet - very dense to dense	14	45-46.5	SS	32-32-32	14"
			15	50-51.5	SS	18-23-27	14"
416.3	55.0'						
	15.0'	Brown fine to coarse sand with fine gravel, wet - medium dense	16	55-56.5	SS	6-6-8	15"
			17	60-61.5	SS	7-8-8	15"
			18	65-66.5	SS	6-7-11	15"
401.3	70.0'						
	5.0'	Brown fine to coarse sand, wet - medium dense	19	70-71.5	SS	7-8-10	15"
			20	73.5-75	SS	9-10-12	17"
396.3	75.0'						

BORING COMPLETED

BORING D-28

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. D-28
LOCATION As shown on plan, S-2, revision A. Submitted by C. C. & E. Co.
DRILLER W. Martin DRILL No. 18 DATE STARTED 3-26-75
ELEVATION REFERENCE Eval. Dept. Testing & Assoc. DATE COMPLETED 3-26-75
CASING DIAMETER none HAMMER WT. FALL
SAMPLER DIAMETER & TYPE 2" O.D. Split Spoon HAMMER WT. 140# FALL 30"
DEPTH TO WATER IMMEDIATE Could not determine UPON COMPLETION 9.0'
DEPTH TO WATER DAYS AFTER COMPLETION Backfilled WATER USED IN DRILLING *From surface

ELEVATION	DEPTH	DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE SAMPLE	BLOWS PER 6"	REMARKS
463.7	0'						
	1.0'	Topsoil	1	0-1	SS	1-2	10"
462.7	1.0'	Dark brown silty loam, (topsoil) moist - very loose					
	3.0'	Brown silty clay, moist - medium stiff	2	1-1.5	SS	-3-	6"
459.7	4.0'	Dark brown silty clay, moist - medium stiff	3	2.5-4	SS	2-3-4	18"
	2.5'		4	3-4.5	SS	2-3-4	18"
457.2	6.5'	Brown sandy clay with layers of sand and gravel, (fill) moist - medium stiff	5	5-6.5	SS	3-4-6	17"
	3.0'		6	7-8.5	SS	3-4-6	18"
454.2	9.5'	Brown silty fine sand with clay layers, wet - very loose	7	10-11.5	SS	1-2-3	15"
	2.5'		8	12-13.5	SS	1-2-3	16"
451.7	12.0'	Gray silty clay with fine sand layers, wet - very loose	9	20-21.5	SS	1-2-2	18"
	3.0'		10	30-31.5	SS	1-2-2	16"
448.7	15.0'	Gray silty fine sand with clay layers, wet - loose	11	35-36.5	SS	2-3-4	18"
	6.0'	Gray silty clay with organics, moist - medium stiff					
442.7	21.0'	Gray fine to coarse sand with fine gravel, wet - medium dense	12	40-41.5	SS	6-9-10	14"
	6.0'						
436.7	27.0'	Brown fine to coarse sand with fine gravel, wet - medium dense	13	45-46.5	SS	7-9-11	13"
	3.0'						
433.7	30.0'	Brown fine to coarse sand with fine gravel, wet - medium dense	14	50-51.5	SS	8-9-12	15"
	3.0'						
430.7	33.0'	Brown fine to medium sand, wet - medium dense					
	2.0'	Brown fine to coarse sand with fine gravel, wet - medium dense	15	55-56.5	SS	9-12-13	14"
428.7	35.0'		16	60-61.5	SS	11-14-16	14"
	2.0'	Brown fine to coarse sand with fine gravel, wet - medium dense to dense	17	65-66.5	SS	9-13-15	13"
426.7	37.0'		18	70-71.5	SS	8-12-13	14"
	3.0'		19	73.5-75	SS	10-12-16	14"
423.7	40.0'						
	3.0'	Brown fine to coarse sand and fine gravel, wet - dense	20	75-76.5	SS	13-20-22	15"
420.7	43.0'						

BORING COMPLETED

BORING D-29

VOID

BORING D-30

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. D-30
LOCATION As shown on plan, S-2, revision A. Submitted by C. C. & E. Co.
DRILLER J. Martin DRILL No. 39 DATE STARTED 3-31-75
ELEVATION REFERENCE Eval. Dept. Testing & Assoc. DATE COMPLETED 3-31-75
CASING DIAMETER none HAMMER WT. FALL
SAMPLER DIAMETER & TYPE 2" O.D. Split Spoon HAMMER WT. 140# FALL 30"
DEPTH TO WATER IMMEDIATE Could not determine UPON COMPLETION 12.5'
DEPTH TO WATER DAYS AFTER COMPLETION Backfilled WATER USED IN DRILLING *From surface

ELEVATION	DEPTH	DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE SAMPLE	BLOWS PER 6"	REMARKS
469.2	0'						
	1.0'	Dark brown silty loam, (topsoil) moist - very loose	1	0-1	SS	1-1	9"
468.2	3.0'	Brown silty clay, moist - medium stiff	2	1-1.5	SS	4	6"
	4.0'	Dark brown silty clay, moist - medium stiff	3	2.5-4	SS	4-4-6	18"
464.2	5.0'						
	2.5'	Brown sleepy sandy silt, very moist - soft	4	3-4.5	SS	2-2-2	17"
462.0	7.5'						
	7.5'	Brown silty fine sand, wet - very loose	5	7.5-9	SS	1-1-2	15"
			6	10-11.5	SS	1-1-2	16"
454.5	15.0'						
	3.0'	Brown silty fine sand with clay, very moist - very loose	7	13-14.5	SS	1-1-3	13"
452.5	17.0'						
	8.0'	Brown silty clay with fine sand layers, very moist - soft	8	20-22	ST		24"
			9	23-25.5	SS	2-2-2	18"
444.5	25.0'						
	3.0'	Brown silty clay, very moist - medium stiff	9	25-26.5	SS	1-2-2	13"
439.5	30.0'						
	3.0'	Gray silty clay, moist - medium stiff	10	30-32	ST		24"
			10	32-33.5	SS	3-3-3	18"
436.5	33.0'						
	10.0'	Gray silty clay with fine sand lenses, very moist - medium stiff	11	35-36.5	SS	2-3-3	18"
			12	40-41.5	SS	2-3-3	18"
426.5	43.0'						
	20.0'	Brown fine to coarse sand, a little fine gravel, wet - medium dense	13	45-46.5	SS	7-10-13	16"
			14	50-51.5	SS	10-12-14	17"
			15	55-56.5	SS	8-8-12	15"
			16	60-61.5	SS	9-10-13	14"
406.5	63.0'						
	8.0'	Brown fine sand with fine gravel, wet - medium dense	17	65-66.5	SS	8-8-13	17"
			18	70-71.5	SS	8-8-13	17"
396.5	73.0'						
	2.0'	Brown fine to coarse sand and fine gravel, wet - dense	19	73.5-75	SS	13-20-22	15"
394.5	75.0'						

BORING COMPLETED

BORING D-31

VOID

BORING D-32

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. D-32
LOCATION As shown on plan, S-2, revision A. Submitted by C. C. & E. Co.
DRILLER J. Martin DRILL No. 39 DATE STARTED 3-31-75
ELEVATION REFERENCE Eval. Dept. Testing & Assoc. DATE COMPLETED 4-1-75
CASING DIAMETER 4" O.D. Casing HAMMER WT. FALL
SAMPLER DIAMETER & TYPE 2" O.D. Split Spoon HAMMER WT. 140# FALL 30"
DEPTH TO WATER IMMEDIATE Could not determine UPON COMPLETION 12.5'
DEPTH TO WATER DAYS AFTER COMPLETION Backfilled WATER USED IN DRILLING *From surface

ELEVATION	DEPTH	DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE SAMPLE	BLOWS PER 6"	REMARKS
467.8	0'						
	1.0'	Dark brown silty loam, (topsoil) moist - very loose	1	0-1	SS	2-2	10"
466.8	3.0'	Brown silty clay, moist - medium stiff to stiff	2	1-1.5	SS	2	6"
	2.5'						
464.3	5.5'	Dark brown silty clay, moist - medium stiff	3	2.5-4	SS	2-3-4	18"
			4	3-4.5	SS	2-3-4	18"
452.3	7.5'						
	2.5'	Brown silty clay, very moist - soft	5	7.5-9	SS	1-1-1	16"
453.8	10.0'						
	12.0'	Mottled brown silty clay, moist - medium stiff to stiff	21	10-12	ST		18"
			6	13-14.5	SS	3-3-3	18"
			7	15-16.5	SS	3-3-3	18"
			22	20-22	ST		24"
440.8	22.0'		8	22-23.5	SS	2-2-3	18"
	7.0'	Brown silty clay with fine sand layers, very moist - soft to medium stiff	9	25-26.5	SS	2-2-3	15"
432.8	29.0'						
	15.0'	Brown fine to coarse sand and gravel, wet - very dense to dense	10	30-31.5	SS	16-23-31	15"
			11	35-36.5	SS	13-16-31	17"
			12	40-41.5	SS	20-20-28	18"
417.8	45.0'						
	10.0'	Brown fine to coarse sand and gravel, wet - medium dense to dense	13	45-46.5	SS	12-15-15	18"
			14	50-51.5	SS	13-16-17	18"
407.8	55.0'						
	20.0'	Brown fine to coarse sand, trace of fine gravel, wet - medium dense	15	55-56.5	SS	8-12-13	16"
			16	60-61.5	SS	10-11-15	16"
			17	65-66.5	SS	12-14-13	13"
			18	70-71.5	SS	10-14-13	16"
367.8	75.0'		19	73.5-75	SS	13-16-16	16"

BORING COMPLETED

BORING D-33

VOID

BORING D-34

VOID

BORING D-35

VOID

BORING D-36

VOID

BORING D-37

VOID

BORING D-38

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. D-38
LOCATION As shown on plan, S-2, revision A. Submitted by C. C. & E. Co.
DRILLER W. Martin DRILL No. 18 DATE STARTED 5-30-75
ELEVATION REFERENCE Eval. Dept. Testing & Assoc. DATE COMPLETED 5-30-75
CASING DIAMETER none HAMMER WT. FALL
SAMPLER DIAMETER & TYPE 2" O.D. Split Spoon HAMMER WT. 140# FALL 30"
DEPTH TO WATER IMMEDIATE Could not determine UPON COMPLETION
DEPTH TO WATER DAYS AFTER COMPLETION Backfilled WATER USED IN DRILLING *From surface

ELEVATION	DEPTH	DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE SAMPLE	BLOWS PER 6"	REMARKS
468.8	0'						
	2.5'	Brown sandy silty clay with layers of sand and gravel, (fill) moist - medium stiff	1	0-1.5	SS	3-3-3	15"
466.3	2.5'	Brown silty clay with layers of sand and gravel, (possible fill) moist - medium stiff	2	2.5-4	SS	3-3-4	16"
463.8	5.0'		3	5-6.5	SS	3-4-6	17"
	10.0'	Brown silty clay, moist - medium stiff to stiff	4	7.5-9	SS	5-6-8	18"
			5	10-11.5	SS	5-6-7	18"
453.8	15.0'						
	5.0'	Brown sandy clay with clayey fine sand layers, wet - soft	6	13-14.5	SS	3-4-5	18"
448.8	20.0'						
	10.0'	Brown silty fine sand, wet - loose to medium dense	7	20-21.5	SS	3-4-5	15"
			8	25-26.5	SS	4-6-8	16"
438.8	30.0'						
	5.0'	Brown silty fine sand with gray clay layers, wet - loose	9	30-31.5	SS	3-4-5	15"
433.8	35.0'						
	5.0'	Gray sandy silty clay with organic and fine sand layers, wet - soft	10	35-36.5	SS	3-4-5	16"
428.8	40.0'						
	5.0'	Gray silty fine sand with organic layers, wet - medium dense	11	40-41.5	SS	3-7-11	16"
423.8	45.0'						
	4.0'	Organic (leaves) with fine sand lenses, moist - medium dense	12	43-44.5	SS	5-7-11	18"
419.8	49.0'						
	6.0'	Gray fine to coarse sand and fine gravel and wood, wet - medium dense	13	50-51.5	SS	8-5-11	14"
413.8	55.0'						
	5.0'	Gray fine to coarse sand and gravel, wet - medium dense	14	55-56.5	SS	10-12-13	12"
408.8	60.0'						
	15.0'	Brown fine to coarse sand and fine gravel, wet - medium dense to dense	15	60-61.5	SS	6-10-12	15"
			16	65-66.5	SS	5-12-13	12"
			17	70-71.5	SS	10-12-16	14"
			18	73.5-75	SS	11-16-20	14"
393.8	75.0'						

BORING COMPLETED

BORING D-39

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. D-39
LOCATION Offset 87.0', South from vertical grade by coordination of Mr. Phil Cash, JF Engineer & Lamy, Engineer, grades 6-30-75
DRILLER E. Alder DRILL No. 33 DATE STARTED 6-30-75
ELEVATION REFERENCE Eval. Dept. Testing & Associates DATE COMPLETED 6-30-75
CASING DIAMETER 3.25" I.D. Hollow Item Auger HAMMER WT. FALL
SAMPLER DIAMETER & TYPE 3.25" O.D. Split Spoon HAMMER WT. FALL
DEPTH TO WATER IMMEDIATE 3.0' UPON COMPLETION
DEPTH TO WATER DAYS AFTER COMPLETION 2.5' WATER USED IN DRILLING *From surface

ELEVATION	DEPTH	DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE SAMPLE	BLOWS PER 6"	REMARKS
458.1'	0'						
	2.5'	Dark brown silty clay, with fine sand lenses, trace of organics, moist - medium stiff	1	0-1.5	SS	1-2-3	18"
455.6'	2.5'						
	3.5'	Brown silty clay, with sandy silty clay lenses, moist to very moist - soft to medium stiff	2	2.5-4	SS	2-3-4	18"
			3	3-5	SS	1-1	12"
452.1'	6.0'						
	1.5'	Brown silty fine sand, wet - very loose	4	6-6.5	SS	2	6"
450.6'	7.5'						
	2.5'	Brown silty clay, with clayey sand and sandy clay layers, wet - soft	5	7.5-9	SS	1-1-1	18"
448.1'	10.0'						
	2.5'	Brown silty clay, with silty fine sand lenses, wet - soft.	6	10-11.5	SS	1-1-1	18"
445.6'	12.5'						
	5.0'	Brown silty clay, with fine sand layers, wet - soft	7	12.5-14	SS	1-2-2	18"
			8	15-16.5	SS	2-2-2	18"
			9	17.5-19	SS	2-2-2	18"
440.6'	17.5'						
	3.5'	Brown silty fine sand, with clay layers, very moist - very loose	10	20-21.5	SS	1-1-1	18"
			11	22-23.5	SS	2-3-3	18"
438.1'	20.0'						
	10.0'	Brown silty clay, with clayey fine sand and fine sand layers, very moist to wet - soft					
428.1'	30.0'		12	30-31.5	SS	3-3-5	14"
	3.0'	Brown silty fine to coarse sand and fine gravel, wet - loose					
423.1'	33.0'						
	30.0'	Brown fine to coarse sand and fine gravel, wet - medium dense to dense	13	35-36.5	SS	8-9-10	11"
			14	40-41.5	SS	3-5-12	14"
			15	42-43.5	SS	8-8-10	14"
			16	50-51.5	SS	13-16-16	17"
			17	55-56.5	SS	12-15-18	17"
			18	60-61.5	SS	12-15-19	14"
			19	65-66.5	SS	3-3-7	15"
393.1'	63.0'						
	3.0'	Brown fine to medium sand trace of fine gravel, very moist - medium dense					
390.1'	70.0'		20	70-71.5	SS	10-11-13	13"
	10.0'	Brown fine to coarse sand and fine gravel, trace of organics, wet - medium dense	21	73-74.5	SS	8-12-16	15"
378.1'	80.0'						
	16.5'	Brown fine to coarse sand and fine gravel, wet - medium dense to dense	22	80-81.5	SS	10-14-17	15"
			23	85-86.5	SS	10-14-17	16"
			24	90-91.5	SS	12-17-18	17"
			25	95-96.5	SS	12-16-18	8"
361.6'	96.5'						

Refusal at 96.5'

BORING COMPLETED

BORING D-40

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. D-40
LOCATION As shown on plan
DRILLER E. Alder DRILL No. 33 DATE STARTED 6-8-75
ELEVATION REFERENCE Eval. Dept. Testing & Associates DATE COMPLETED 6-16-75
CASING DIAMETER 3.25" I.D. Hollow Item Auger HAMMER WT. FALL
SAMPLER DIAMETER & TYPE 3.25" O.D. Split Spoon HAMMER WT. 140# FALL 30"
DEPTH TO WATER IMMEDIATE 71.5' UPON COMPLETION Dried at 17.0' dry
DEPTH TO WATER 1 DAYS AFTER COMPLETION Dried 217.0', dry WATER USED IN DRILLING *From surface

ELEVATION	DEPTH	DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE SAMPLE	BLOWS PER 6"	REMARKS
473.0'	0'						
	1.0'	Topsoil and dark brown silty clay loam, moist - very loose	1	0-1	SS	1-1	12"
472.0'	1.0'						
	3.5'	Brown silty clay loam, moist - medium stiff	2	1-1.5	SS	2	6"
470.5'	5.5'						
	2.5'	Brown silty clay, moist - very stiff	3	3.5-4	SS	3-3-4	18"
468.0'	5.0'						
	7.5'	Brown silty fine sand, moist - loose	4	5-6.5	SS	2-4-5	18"
			5	7.5-9	SS	2-4-5	18"
			6	10-11.5	SS	4-4-5	18"
460.5'	12.5'						
	26.5'	Brown fine sand, very moist to wet - loose	7	12.5-14	SS	2-4-5	15"
			8	15-16.5	SS	2-3-3	15"
			9	17.5-19	SS	2-2-3	16"
			10	20-21.5	SS	1-2-3	15"
			11	23-24.5	SS	1-2-3	14"
			12	25-26.5	SS	1-2-3	14"
			13	30-31.5	SS	1-2-3	8"
436.0'	39.0'						
	6.0'	Brown fine to coarse sand trace of fine gravel, wet - medium dense	14	40-41.5	SS	3-3-6	14"
430.0'	45.0'						
	3.0'	Brown fine to coarse sand and fine gravel, wet - medium dense	15	45-46.5	SS	4-4-8	16"
427.0'	50.0'						
	1.0'	Brown fine sand, trace of fine gravel, wet - medium dense	16	50-51.5	SS	5-4-10	15"
426.0'	51.0'						
	5.0'	Brown fine to coarse sand and fine gravel, wet - medium dense	17	55-56.5	SS	11-12-13	16"
421.0'	60.0'						
	3.0'	Gray and brown fine gravel and brown fine to coarse sand, wet - medium dense	18	60-61.5	SS	9-10-14	16"
418.0'	63.0'						
	10.0'	Brown fine to coarse sand, brown of fine gravel, wet - medium dense	19	65-66.5	SS	10-13-16	15"
			20	70-71.5	SS	12-13-15	17"
408.0'	73.0'						
	10.0'	Brown fine to coarse sand and fine gravel, wet - dense	21	75-76.5	SS	13-13-16	15"
			22	80-81.5	SS	18-19-22	17"
398.0'	83.0'						
	5.0'	Brown fine sand, wet - medium dense	23	85-86.5	SS	11-13-13	14"
393.0'	90.0'						
	23.0'	Brown fine to coarse sand and fine gravel, wet - dense to very dense	24	90-91.5	SS	11-13-17	16"
			25	95-96.5	SS	12-15-18	15"
			26	100-101.5	SS	19-20-27	15"
			27	105-106.5	SS	15-18-22	17"
			28	110-111.5	SS	20-26-27	14"
370.0'	113.0'						
	0.5'	Gray and brown fine gravel and brown to coarse sand, wet - very dense	29	115-113.5	SS	63	6"
357.5'	115.5'						
	0.5'	Light brown fine to coarse sand and fine gravel, moist - very dense	30	115-113.5	SS	100	3"
357.0'	115.8'						

Refusal at 115.8'

BORING COMPLETED

REFERENCE DRAWINGS	
S0002	SOIL BORING LOCATION PLAN

DATA
LOG SOIL BORG SH 7

DRAWING RELEASE RECORD

REV.	SPEC. NO.	DATE	DRAWN	CHECKED	ENGR. APPROVAL	DESCRIPTION	FILM
—	—	2-4-76	Wm. R. Burke	Jan. to J. Wesley	RJK	ISSUED TO CG&E	X
—	—	11-15-74	K. Kelly	—	—	SENT TO CLIENT	X

DRAWING RELEASE RECORD

REV.	SPEC. NO.	DATE	DRAWN	CHECKED	ENGR. APPROVAL	DESCRIPTION	FILM

STATE OF KENTUCKY
STEVE RURKA
9231
REGISTERED PROFESSIONAL ENGINEER

DRAWN 7-6-75
CHECKED 12-22-75 DATE
ENGINEER 12-22-75 DATE
APPROVED 12-22-75 DATE

NONE SCALE

PROJECT NUMBER 4869

LOG OF SOIL BORINGS
SHEET 7
EAST BEND STATION UNIT 2.
THE CINCINNATI GAS & ELECTRIC CO..
THE DAYTON POWER & LIGHT CO.
CINCINNATI, OHIO

SARGENT & LUNDY ENGINEERS CHICAGO

DRAWING NO. 56000S0009

SHEET OF

DO NOT USE 1, 0, 0 OR 2 FOR REVISION

56000S0008
SHEET OF

BORING D-12

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. D-12
LOCATION As shown on plan, S-2, revision A, Submitted by C. G. & E. Co.
DRILLER R. Alder and J. Martin DRILL No. 29 DATE STARTED 2-4-75
ELEVATION REFERENCE Kral, Zepf, Freitag & Assoc. DATE COMPLETED 3-4-75
CASING DIAMETER 3.25" I.D. Hollow Stem Auger HAMMER WT. FALL
SAMPLER DIAMETER & TYPE 2" O.D. Split Spoon and NX HAMMER WT. 140# FALL 30"
DEPTH TO WATER: IMMEDIATE 78.0' /Core Barrel UPON COMPLETION Caved at 55.0', dry
DEPTH TO WATER 1 DAYS AFTER COMPLETION Caved at 55.3', dry WATER USED IN DRILLING From 85.0'

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
536.3	0'	0.5'	Dark brown silty fine sand, trace of organics, moist - very loose	1	0-0.5	SS	1	6"
535.8	0.5'	7.0'	Brown silty fine sand, moist - very loose to loose	2 3 4	0.5-1.5 2.5-4 5-6.5	SS SS SS	1-2 1-2-2 3-3-3	10" 18" 18"
528.8	7.5'	2.5'	Brown silt, moist - loose	5	7.5-9	SS	2-3-4	18"
526.3	10.0'	5.0'	Brown fine to coarse sand and gravel, moist - loose	6 7	10-11.5 12.5-14	SS SS	3-3-4 2-2-3	9" 14"
521.3	15.0'	2.5'	Brown sandy silt, moist - loose	8	15-16.5	SS	2-3-5	3"
518.8	17.5'	12.5'	Gray fine to coarse sand and gravel, moist - very dense	9 10 11	17.5-19 20-21.5 25-26.5	SS SS SS	25-28-27 11-21-33 16-26-35	15" 15" 17"
506.3	30.0'	5.0'	Gray fine to coarse sand and gravel, very moist - dense	12	30-31.5	SS	15-16-18	14"
501.3	35.0'	15.0'	Gray fine to coarse sand and gravel, moist - very dense	13 14 15	35-36.5 40-41.5 45-46.5	SS SS SS	18-30-35 26-40-36 34-51-45	16" 16" 15"
486.3	50.0'	5.0'	Brown fine to coarse sand, a little fine to coarse gravel, moist - dense	16	50-51.5	SS	20-17-25	17"
481.3	55.0'	10.0'	Gray fine to coarse sand, and fine gravel, moist - dense to very dense	17 18	55-56.5 60-61.5	SS SS	17-17-22 28-35-27	15" 13"
471.3	65.0'	10.0'	Gray fine to coarse sand and gravel, moist - very dense	19 20	65-66.5 70-71.5	SS SS	20-25-26 28-34-36	17" 18"
461.3	75.0'	3.0'	Gray fine to coarse sand and gravel, moist - dense	21	75-76.5	SS	27-17-16	18"
458.3	78.0'	7.0'	Gray fine to coarse sand and gravel, wet - dense	22	80-81.5	SS	18-22-24	15"
451.3	85.0'	20.0'	Gray fine to coarse sand, and fine gravel, with silty fine to coarse sand, and fine gravel, layers, very moist - dense to very dense	23 24 25 26	85-86.5 90-91.5 95-96.5 100-101.5	SS SS SS SS	8-13-22 26-30-35 29-30-29 16-21-23	12" 14" 12" 15"
431.3	105.0'	5.0'	Brown silty fine to coarse sand, trace of fine gravel, very moist - very dense	27	105-106.5	SS	24-37-25	15"
426.3	110.0'	15.0'	Brown silty fine to coarse sand and gravel, wet - very dense	28 29 30	110-111.5 115-116.5 120-121.5	SS SS SS	37-47-41 25-40-39 40-63-57	14" 14" 9"
411.3	125.0'	5.0'	Brown silty fine sand, with silt seams, and fine to coarse gravel, wet - very dense	31	125-126.5	SS	16-34-22	10"
406.3	130.0'	10.0'	Brown silty fine to coarse sand and gravel, wet - very dense	32 33	130-131.5 135-136.5	SS SS	41-38-46 16-28-26	15" 12"
396.3	140.0'	15.0'	Brown fine to coarse sand, wet - dense	34 35 36	140-141.5 145-146.5 150-151.5	SS SS SS	11-15-16 15-17-21 16-17-19	16" 14" 16"
381.3	155.0'	5.0'	Brown fine sand, wet - dense	37	155-156.5	SS	17-19-18	18"
376.3	160.0'	10.0'	Brown fine to coarse sand with fine gravel, wet - very dense	38 39	160-161.5 165-166.5	SS SS	30-31-35 27-30-34	13" 15"
366.3	170.0'	14.0'	Brown fine to coarse sand, wet - dense	40 41 42	170-171.5 175-176.5 180-181.5	SS SS SS	20-22-22 18-20-28 11-15-28	18" 5" 18"
352.3	184.0'	10.0'	Light gray limestone, with occasional soft calcareous shale layers. (approximately 85% limestone, 15% shale) LIMESTONE-crystalline, fine to medium grained, trace fossiliferous, hard. Occurs in 0.2-6.0" layers		184-194	NXM	86%	
342.3	194.0'		BORING COMPLETED					

BORING D-13

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. D-13
LOCATION As shown on plan, S-2, revision A, Submitted by C. G. & E. Co.
DRILLER J. Martin DRILL No. 29 DATE STARTED 12-30-74
ELEVATION REFERENCE Kral, Zepf, Freitag & Assoc. DATE COMPLETED 12-30-74
CASING DIAMETER 3.25" I.D. Hollow Stem Auger HAMMER WT. FALL
SAMPLER DIAMETER & TYPE 2.0" O.D. Split Spoon HAMMER WT. 140# FALL 30"
DEPTH TO WATER: IMMEDIATE 70.0' UPON COMPLETION Caved at 32.0', dry
DEPTH TO WATER DAYS AFTER COMPLETION Backfilled upon completion WATER USED IN DRILLING From 80.0'

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
532.4'	0'	2.5'	Dark brown silty fine sand, trace of organics, moist - very loose	1	0-1.5	SS	1-1-1	18"
529.9'	2.5'	2.5'	Brown sandy silty clay, moist - medium stiff	2	2.5-4	SS	2-2-4	16"
527.4'	5.0'	1.0'	Brown clayey sandy silt, moist - medium stiff	3	5-6	SS	3-4	12"
526.4'	6.0'	4.0'	Brown clayey fine to coarse sand, a little fine gravel, moist - medium dense	4	6-6.5	SS	6	4"
522.4'	10.0'	5.0'	Brown fine to coarse sand and fine gravel, moist - medium dense	5	10-11.5	SS	2-5-7	10"
517.4'	15.0'	1.0'	Brown fine sand, trace of fine gravel, moist - loose	6	15-16	SS	4-2	10"
516.4'	16.0'	4.0'	Brown fine to coarse sand and gravel, moist - medium dense	7	16-16.5	SS	10	4"
512.4'	20.0'	10.0'	Brown fine to coarse sand and gravel, moist - dense	8 9	20-21.5 25-26.5	SS SS	15-19-15 15-19-21	15" 16"
502.4'	30.0'	5.0'	Brown fine to coarse sand and gravel, moist - very dense	10	30-31.5	SS	19-25-28	15"
497.4'	35.0'	15.0'	Brown fine to coarse sand, and fine gravel, trace of coarse gravel, moist - very dense	11 12 13	35-36.5 40-41.5 45-46.5	SS SS SS	25-35-28 23-35-38 18-25-26	16" 17" 18"
482.4'	50.0'	10.0'	Brown fine to coarse sand, and fine gravel, moist - dense	14 15	50-51.5 55-56.5	SS SS	25-25-21 23-27-22	17" 16"
472.4'	60.0'	15.0'	Brown fine to coarse sand, and fine gravel, moist - very dense	16 17 18	60-61.5 65-66.5 70-71.5	SS SS SS	15-25-30 23-23-32 17-24-29	17" 16" 17"
457.4'	75.0'	1.5'	Brown fine to coarse sand and fine gravel, moist - dense	19	75-76.5	SS	11-24-17	14"
455.9'	76.5'	8.5'	Brown fine to coarse sand and fine gravel, wet - dense	20	80-81.5	SS	15-17-20	15"
447.4'	85.0'	15.0'	Brown fine to coarse sand and fine gravel, wet - very dense	21 22 23 24	85-86.5 90-91.5 95-96.5 98.5-100	SS SS SS SS	17-28-32 19-26-30 24-29-33 26-30-32	16" 17" 16" 18"
432.4'	100.0'		BORING COMPLETED					

BORING D-14

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. D-14
LOCATION As shown on plan, S-2, revision A, Submitted by C. G. & E. Co.
DRILLER J. Martin DRILL No. 29 DATE STARTED 12-31-74
ELEVATION REFERENCE Kral, Zepf, Freitag & Assoc. DATE COMPLETED 1-1-75
CASING DIAMETER 3.25" I.D. Hollow Stem Auger HAMMER WT. FALL
SAMPLER DIAMETER & TYPE 2.0" O.D. Split Spoon HAMMER WT. 140# FALL 30"
DEPTH TO WATER: IMMEDIATE 76.0' UPON COMPLETION Caved at 39.0', dry
DEPTH TO WATER DAYS AFTER COMPLETION Backfilled upon completion WATER USED IN DRILLING From 80.0'

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
532.9'	0'	2.5'	Brown silty fine sand, moist - very loose	1	0-1.5	SS	1-1-1	18"
530.4'	2.5'	2.5'	Brown sandy silt, moist - very loose	2	2.5-4	SS	1-1-1	15"
527.9'	5.0'	1.0'	Brown clayey sandy silt, moist - medium stiff	3	5-6	SS	2-2	10"
526.9'	6.0'	1.5'	Brown sandy silty clay, some fine gravel, with clayey fine to coarse sand and fine gravel layers, moist - soft	4	6-6.5	SS	2	4"
525.4'	7.5'	2.5'	Brown fine to coarse sand and gravel, moist - loose	5	7.5-9	SS	2-2-3	8"
522.9'	10.0'	5.0'	Brown fine to coarse sand and gravel, moist - medium dense	6	10-11.5	SS	6-7-5	12"
517.9'	15.0'	5.0'	Brown fine to coarse sand, a little fine gravel, moist - medium dense	7	15-16.5	SS	8-9-11	17"
512.9'	20.0'	5.0'	Brown fine to coarse sand and gravel, moist - very dense	8	20-21.5	SS	21-30-37	17"
507.9'	25.0'	10.0'	Brown fine to coarse sand and gravel, moist - dense	9 10	25-26.5 30-31.5	SS SS	22-18-29 10-15-18	16" 17"
497.9'	35.0'	15.0'	Brown fine to coarse sand and gravel, moist - very dense	11 12 13	35-36 40-41.5 45-46.5	SS SS SS	22-27-37 38-48-42 20-25-30	16" 17" 16"
482.9'	50.0'	10.0'	Brown fine to coarse sand and fine gravel, moist - very dense	14 15	50-51.5 55-56.5	SS SS	25-29-24 20-25-32	17" 17"
472.9'	60.0'	15.0'	Brown fine to coarse sand and gravel, moist - very dense	16 17 18	60-61.5 65-66.5 70-71.5	SS SS SS	50-50-42 21-27-35 25-32-35	16" 17" 17"
457.9'	75.0'	1.0'	Brown fine to coarse sand and fine gravel, moist - dense	19	75-76.5	SS	17-19-12	15"
456.9'	76.0'	9.0'	Brown fine to coarse sand and fine gravel, with fine sand layers, wet - dense	20	80-81.5	SS	14-17-21	17"
447.9'	85.0'	15.0'	Brown fine to coarse sand, a little fine gravel, trace of coarse gravel, wet - very dense	21 22 23 24	85-86.5 90-91.5 95-96.5 98.5-100	SS SS SS SS	14-17-21 25-30-33 21-27-30 19-28-31	18" 17" 17" 18"
432.9'	100.0'		BORING COMPLETED					

BORING D-15

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. D-15
LOCATION As shown on plan S-2, revision A, Submitted by C. G. & E. Company
DRILLER J. Martin DRILL No. 29 DATE STARTED 12-21-74
ELEVATION REFERENCE Kral, Zepf, Freitag & Assoc. DATE COMPLETED 12-22-74
CASING DIAMETER 3.25" I.D. Hollow Stem Auger HAMMER WT. FALL
SAMPLER DIAMETER & TYPE 2" O.D. Split Spoon HAMMER WT. 140# FALL 30"
DEPTH TO WATER: IMMEDIATE None UPON COMPLETION None
DEPTH TO WATER DAYS AFTER COMPLETION Backfilled upon completion WATER USED IN DRILLING No

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
527.8	0'	1.0'	Dark brown silty fine sand, moist - very loose	1	0-1	SS	1-1	12"
526.8	1.0'	1.5'	Dark brown sandy clayey silt, moist - soft	2	1-1.5	SS	2	6"
525.3	2.5'	2.5'	Brown clayey silt, moist - medium stiff	3	2.5-4	SS	2-3-3	18"
522.8	5.0'	2.5'	Brown fine sand, moist - loose	4	5-6.5	SS	2-2-2	16"
520.3	7.5'	5.0'	Brown fine to coarse sand and gravel, moist - medium dense	5 6	7.5-9 10-11.5	SS SS	3-3-7 6-10-12	14" 16"
515.3	12.5'	2.5'	Brown fine sand, trace fine gravel, very moist - loose	7	12.5-14	SS	2-3-3	5"
512.8	15.0'	20.0'	Light brown fine to coarse sand and fine gravel, trace of coarse gravel, moist - dense to very dense	8 9 10 11	15-16.5 20-21.5 25-26.5 30-31.5	SS SS SS SS	5-11-19 25-20-18 12-15-20 24-30-26	14" 16" 17" 16"
492.8	35.0'	5.0'	Light brown fine to coarse sand, and fine gravel, moist - dense	12	35-36.5	SS	20-22-26	17"
487.8	40.0'	8.5'	Light brown fine to coarse sand and fine gravel, trace of coarse gravel, moist - dense	13 14	40-41.5 45-46.5	SS SS	11-22-38 15-17-20	16" 16"
479.3	48.5'	1.5'	Light brown fine to coarse sand, and fine gravel, moist - dense	15	48.5-50	SS	19-22-26	17"
477.8	50.0'		BORING COMPLETED					

BORING D-16

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. D-16
LOCATION As shown on plan, S-2, revision A, Submitted by C. G. & E. Co.
DRILLER J. Martin DRILL No. 29 DATE STARTED 1-7-75
ELEVATION REFERENCE Kral, Zepf, Freitag & Assoc. DATE COMPLETED 1-7-75
CASING DIAMETER 3.25" I.D. Hollow Stem Auger HAMMER WT. FALL
SAMPLER DIAMETER & TYPE 2" O.D. Split Spoon HAMMER WT. 140# FALL 30"
DEPTH TO WATER: IMMEDIATE None UPON COMPLETION Caved at 20.0', Dry
DEPTH TO WATER DAYS AFTER COMPLETION Backfilled upon completion WATER USED IN DRILLING No

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
526.5	0'	0.5'	Dark brown topsoil, very moist - soft	1	0-0.5	SS	1	6"
526.0	0.5'	2.0'	Brown clayey sandy silt, moist - soft	2	0.5-1.5	SS	1-2	12"
524.0	2.5'	2.5'	Brown sandy silty clay, with sandy clay layers, a little fine gravel, moist - medium stiff	3	2.5-4	SS	3-4-5	15"
521.5	5.0'	2.5'	Brown clayey fine to coarse sand and gravel, moist - soft	4	5-6.5	SS	1-1-1	3"
519.0	7.5'	2.5'	Brown fine to coarse sand, and fine gravel, moist - medium dense	5	7.5-9	SS	5-7-9	8"
516.5	10.0'	5.0'	Brown fine to coarse sand, and fine gravel, trace of coarse gravel, moist - medium dense	6	10-11.5	SS	9-13-14	15"
511.5	15.0'	15.0'	Brown fine to coarse sand and gravel, moist - dense	7 8 9	15-16.5 20-21.5 25-26.5	SS SS SS	14-15-24 6-19-23 17-14-12	15" 17" 16"
496.5	30.0'	10.0'	Brown fine to coarse sand and gravel, moist - very dense	10 11	30-31.5 35-36.5	SS SS	16-23-32 25-35-26	10" 16"
486.5	40.0'	5.0'	Brown fine to coarse sand and gravel, moist - very dense	12	40-41.5	SS	10-8-10	15"
481.5	45.0'	5.0'	Brown fine to coarse sand and gravel, moist - very dense	13 14	45-46.5 48.5-50	SS SS	20-22-29 21-25-20	16" 17"
476.5	50.0'		BORING COMPLETED					

BORING D-17

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. D-17
LOCATION As shown on plan, S-2, revision A, Submitted by C. G. & E. Co.
DRILLER J. Martin DRILL No. 29 DATE STARTED 1-7-75
ELEVATION REFERENCE Kral, Zepf, Freitag & Assoc. DATE COMPLETED 1-7-75
CASING DIAMETER 3.25" I.D. Hollow Stem Auger HAMMER WT. FALL
SAMPLER DIAMETER & TYPE 2" O.D. Split Spoon HAMMER WT. 140# FALL 30"
DEPTH TO WATER: IMMEDIATE None UPON COMPLETION Caved at 19.0', Dry
DEPTH TO WATER DAYS AFTER COMPLETION Backfilled upon completion WATER USED IN DRILLING No

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
526.0	0'	0.5'	Dark brown topsoil, moist - soft	1	0-0.5	SS	1	6"
525.5	0.5'	2.0'	Brown sandy silty clay, moist - medium stiff	2	0.5-1.5	SS	1-2	10"
523.5	2.5'	2.0'	Brown sandy silty clay, with sandy clay layers, a little fine gravel, moist - medium stiff	3	2.5-4	SS	3-5-6	15"
521.5	4.5'	5.5'	Brown fine to coarse sand and gravel, moist - medium dense	4	5-6.5	SS	3-5-7	14"
516.0	10.0'	5.0'	Brown fine to coarse sand and gravel, moist - dense	5	10-11.5	SS	13-20-24	17"
511.0	15.0'	20.0'	Brown fine to coarse sand and gravel, moist - very dense	6 7 8 9	15-16.5 20-21.5 25-26.5 30-31.5	SS SS SS SS	20-24-35 16-20-32 22-30-29 25-35-60	15" 17" 16" 17"
491.0	35.0'	10.0'	Brown fine to coarse sand, and fine gravel, moist - dense	10 11	35-36.5 40-41.5	SS SS	21-28-20 23-20-20	16" 17"
481.0	45.0'	5.0'	Brown fine to coarse sand, and fine gravel, moist - very dense	12 13	45-46.5 48.5-50	SS SS	23-25-28 20-27-31	17" 17"
476.0	50.0'		BORING COMPLETED					

BORING D-18

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. D-18
LOCATION As shown on plan, S-2, revision A, Submitted by C. G. & E. Co.
DRILLER W. Martin DRILL No. 18 DATE STARTED 2-26-75
ELEVATION REFERENCE Kral, Zepf, Freitag & Assoc. DATE COMPLETED 2-26-75
CASING DIAMETER 3.5" I.D. Hollow Stem Auger HAMMER WT. FALL
SAMPLER DIAMETER & TYPE 2" O.D. Split Spoon HAMMER WT. 140# FALL 30"
DEPTH TO WATER: IMMEDIATE 70.0' UPON COMPLETION Caved at 50.0'
DEPTH TO WATER DAYS AFTER COMPLETION Backfilled WATER USED IN DRILLING From 70.0'

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
527.6	0'	1.0'	Dark brown topsoil, very moist - very loose	1	0-1	SS	1-2	10"
526.6	1.0'	1.5'	Brown clayey silt, moist - medium stiff	2	1-1.5	SS	-3-	4"
525.1	2.5'	2.5'	Brown silty clay, moist - medium stiff	3	2.5-4	SS	3-3-4	16"
522.6	5.0'	2.5'	Brown fine to coarse sand and gravel, moist - loose	4	5-6.5	SS	4-5-6	10"
520.1	7.5'	22.5'	Brown fine to coarse sand and gravel, moist - dense to very dense	5 6 7 8 9 10 11	7.5-9 10-11.5 12.5-14 15-16.5 17.5-19 20-21.5 25-26.5	SS SS SS SS SS SS SS	11-18-20 15-24-20 10-16-27 29-38-46 21-54-65 20-37-53 11-13-20	13" 13" 14" 12" 13" 14" 15"
497.6	30.0'	5.0'	Brown fine sand, moist - dense	12	30-31.5	SS	9-14-21	16"
492.6	35.0'	30.0'	Brown fine to coarse sand and gravel, moist - dense to very dense	13 14 15 16 17 18	35-36.5 40-41.5 45-46.5 50-51.5 55-56.5 60-61.5	SS SS SS SS SS SS	11-23-25 15-18-34 28-39-52 25-36-47 16-25-34 21-33-47	14" 14" 14" 13" 16" 16"
462.6	65.0'	5.0'	Brown fine to medium sand, moist - dense	19	65-66.5	SS	14-15-16	15"
457.6	70.0'	10.0'	Brown fine gravel, some fine to coarse sand, wet - very dense	20 21	70-71.5 75-76.5	SS SS	21-32-38 18-31-35	14" 13"
447.6	80.0'	5.0'	Brown fine to coarse sand, some fine to coarse gravel, wet - very dense	22	80-81.5	SS	22-28-33	14"
442.6	85.0'	15.0'	Brown fine to coarse sand, trace of fine gravel, wet - very dense	23 24 25 26	85-86.5 90-91.5 95-96.5 98.5-100	SS SS SS SS	19-26-35 22-38-48 26-36-44 23-35-43	13" 13" 16" 13"
427.6	100.0'		BORING COMPLETED					

BORING D-19

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. D-19
LOCATION As shown on plan, S-2, revision A, Submitted by C. G. & E. Co.
DRILLER W. Martin DRILL No. 18 DATE STARTED 2-27-75
ELEVATION REFERENCE Kral, Zepf, Freitag & Assoc. DATE COMPLETED 2-27-75
CASING DIAMETER 3.5" I.D. Hollow Stem Auger HAMMER WT. FALL
SAMPLER DIAMETER & TYPE 2" O.D. Split Spoon HAMMER WT. 140# FALL 30"
DEPTH TO WATER: IMMEDIATE 72.0' UPON COMPLETION Caved at 61.0'
DEPTH TO WATER DAYS AFTER COMPLETION Backfilled WATER USED IN DRILLING From 75.0'

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
530.0	0'	1.0'	Dark brown topsoil, very moist - very loose	1	0-1	SS	1-1	11"
529.0	1.0'	4.0'	Brown sandy clayey silt, moist - medium stiff	2 3	1-1.5 2.5-4	SS SS	-3- 2-3-4	6" 18"
525.0	5.0'	2.5'	Brown clayey fine to coarse sand and gravel, moist - very loose	4	5-6.5	SS	2-2-2	6"
522.5	7.5'	5.0'	Brown fine to coarse sand and gravel, moist - medium dense	5 6	7.5-9 10-11.5	SS SS	9-11-17 9-11-9	12" 11"
517.5	12.5'	42.5'	Brown fine to coarse sand and gravel, moist - dense to very dense	7 8 9 10 11 12 13 14 15 16	12.5-14 15-16.5 17.5-19 20-21.5 25-26.5 30-31.5 35-36.5 40-41.5 45-46.5 50-51.5	SS SS SS SS SS SS SS SS SS SS	12-18-20 18-28-30 21-24-28 22-32-27 12-19-18 17-30-35 35-47-58 32-38-41 16-12-10 26-38-42	12" 12" 13" 14" 14" 13" 12" 14" 14" 11"
475.0	55.0'	5.0'	Brown fine sand, moist - medium dense	17	55-56.5	SS	7-8-13	16"
470.0	60.0'	10.0'	Brown fine to coarse sand, some fine gravel, moist - very dense	18 19	60-61.5 65-66.5	SS SS	11-25-33 17-28-30	15" 15"
460.0	70.0'	2.0'	Brown fine sand, moist - dense	20	70-71.5	SS	9-14-22	14"
458.0	72.0'	13.0'	Brown fine to coarse sand, and fine gravel, wet - very dense	21 22	75-76.5 80-81.5	SS SS	22-41-45 21-38-44	14" 15"
445.0	85.0'	5.0'	Brown fine to coarse sand, trace of fine gravel, wet - very dense	23	85-86.5	SS	26-34-40	14"
440.0	90.0'	5.0'	Brown fine to medium sand, wet - very dense	24	90-91.5	SS	22-36-41	13"
435.0	95.0'	5.0'	Brown fine to coarse sand, and fine gravel, wet - very dense	25 26	95-96.5 98.5-100	SS SS	34-44-47 31-41-47	14" 13"
430.0	100.0'		BORING COMPLETED					

BORING D-20

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. D-20
LOCATION As shown on plan, S-2, revision A, Submitted by C. G. & E. Co.
DRILLER W. Martin DRILL No. 18 DATE STARTED 3-4-75
ELEVATION REFERENCE Kral, Zepf, Freitag & Assoc. DATE COMPLETED 3-4-75
CASING DIAMETER 3.5" I.D. Hollow Stem Auger HAMMER WT. FALL
SAMPLER DIAMETER & TYPE 2" O.D. Split Spoon HAMMER WT. 140# FALL 30"
DEPTH TO WATER: IMMEDIATE 28.0' UPON COMPLETION Caved at 26.0'
DEPTH TO WATER DAYS AFTER COMPLETION Backfilled WATER USED IN DRILLING From 37.0'

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
484.4	0'	2.5'	Brown silty fine sand, very moist - very loose	1	0-1.5	SS	1-1-1	16"
481.9	2.5'	2.5'	Brown clayey fine sand, very moist - loose	2	2.5-4	SS	2-3-4	17"
479.4	5.0'	2.5'	Brown fine sand, moist - very loose	3	5-6.5	SS	2-2-2	18"
476.9	7.5'	2.5'	Brown sandy silt, moist - loose	4	7.5-9	SS	2-3-4	18"
474.4	10.0'	5.0'	Grayish brown fine to coarse sand and gravel, moist - medium dense	5 6	10-11.5 12.5-14	SS SS	5-11-13 10-12-15	14" 15"
469.4	15.0'	2.5'	Grayish brown fine sand, moist - medium dense	7	15-16.5	SS	5-7-11	16"
466.9	17.5'	7.5'	Grayish brown fine to coarse sand and gravel, moist - medium dense	8 9	17.5-19 20-21.5	SS SS	10-13-14 6-9-10	14" 14"
459.4	25.0'	3.0'	Gray and brown fine to coarse sand, a little fine gravel, moist - medium dense	10	25-26.5	SS	6-9-15	15"
456.4	28.0'	22.0'	Brown fine to coarse sand, and fine gravel, wet - medium dense to dense	11 12 13 14	30-31.5 35-36.5 40-41.5 45-46.5	SS SS SS SS	6-11-13 15-21-24 13-15-14 14-17-22	15" 14" 12" 13"
434.4	50.0'	10.0'	Brown fine to coarse sand and gravel, wet - very dense to dense	15 16	50-51.5 55-56.5	SS SS	16-24-32 12-15-18	13" 14"
424.4	60.0'	15.0'	Brown fine to coarse sand, and fine gravel, wet - dense to very dense	17 18 19 20	60-61.5 65-66.5 70-71.5 73.5-75	SS SS SS SS	16-18-21 14-23-26 16-24-30 15-22-27	12" 12" 13" 13"
409.4	75.0'		BORING COMPLETED					

BORING D-21

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. D-21
LOCATION As shown on plan, S-2, revision A, Submitted by C. G. & E. Co.
DRILLER W. Martin DRILL No. 18 DATE STARTED 3-5-75
ELEVATION REFERENCE Kral, Zepf, Freitag & Assoc. DATE COMPLETED 3-11-75
CASING DIAMETER None HAMMER WT. FALL
SAMPLER DIAMETER & TYPE 2" O.D. Split Spoon HAMMER WT. 140# FALL 30"
DEPTH TO WATER: IMMEDIATE Could not determine UPON COMPLETION 13.5'
DEPTH TO WATER DAYS AFTER COMPLETION Backfilled upon completion WATER USED IN DRILLING *From surface

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
470.7	0'	1.0'	Topsoil, moist - very loose	1	0-1	SS	1-1	11"
469.7	1.0'	6.5'	Brown silty clay, moist - stiff to very stiff	2 3 4	1-1.5 2.5-4 5-6.5	SS SS SS	-4- 4-6-8 6-9-12	6" 18" 18"
463.2	7.5'	5.0'	Brown clayey fine sand with clay layers, wet - medium dense	5 6	7.5-9 10-11.5	SS SS	5-6-7 4-5-7	18" 18"
458.2	12.5'	2.5'	Brown fine sand with clay layers, wet - medium dense	7	12.5-14	SS	4-5-6	14"
455.7	15.0'	2.5'	Brown clayey fine sand with layers of clay and fine sand, wet - very loose	8	15-16.5	SS	2-2-2	18"
453.2	17.5'	17.5'	Brown fine sand with clay layers, wet - medium dense to loose	9 10 11 12	17.5-19 20-21.5 25-26.5 30-31.5	SS SS SS SS	3-5-7 3-4-5 3-5-6 3-4-5	16" 16" 16" 17"
435.7	35.0'	5.0'	Brown fine to coarse sand, wet - medium dense	13	35-36.5	SS	4-6-8	14"
430.7	40.0'	20.0'	Brown fine to coarse sand with fine gravel, wet - medium dense to dense	14 15 16 17	40-41.5 45-46.5 50-51.5 55-56.5	SS SS SS SS	11-12-14 11-13-15 7-10-12 9-15-18	13" 12" 12" 13"
410.7	60.0'	5.0'	Brown fine to coarse sand with silt layers, wet - dense	18	60-61.5	SS	13-15-16	14"
405.7	65.0'	5.0'	Brown fine sand, wet - dense	19	65-66.5	SS	12-21-26	14"
400.7	70.0'	5.0'	Brown fine to coarse sand, trace of fine gravel, wet - dense	20 21	70-71.5 73.5-75	SS SS	8-12-20 11-14-23	14" 13"
395.7	75.0'		BORING COMPLETED					

BORING D-22

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. D-22
LOCATION As shown on plan, S-2, revision A, Submitted by C. G. & E. Co.
DRILLER W. Martin DRILL No. 18 DATE STARTED 3-20-75
ELEVATION REFERENCE Kral, Zepf, Freitag & Assoc. DATE COMPLETED 3-21-75
CASING DIAMETER None HAMMER WT. FALL
SAMPLER DIAMETER & TYPE 2" O.D. Split Spoon HAMMER WT. 140# FALL 30"
DEPTH TO WATER: IMMEDIATE Could not determine UPON COMPLETION Caved at 10.0'
DEPTH TO WATER DAYS AFTER COMPLETION Backfilled WATER USED IN DRILLING *From surface

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
472.3	0'	1.0'	Topsoil	1	0-1	SS	1-2	11"
471.3	1.0'	1.5'	Brown sandy clay, moist - medium stiff	2	1-1.5	SS	-4-	6"
469.8	2.5'	2.5'	Brown silty fine sand, very moist - loose	3	2.5-4	SS	3-4-5	14"
467.3	5.0'	2.5'	Brown silty fine sand, wet - loose	4	5-6.5	SS	2-3-3	15"
464.8	7.5'	7.5'	Brown fine sand, wet - loose	5 6	7.5-9 10-11.5	SS SS	2-3-3 2-3-4	15" 14"
457.3	15.0'	15.0'	Brown fine sand with clay layers, wet - loose	7 8 9	15-16.5 20-21.5 25-26.5	SS SS SS	2-3-5 2-3-3 3-4-4	13" 16" 12"
442.3	30.0'	5.0'	Brown fine sand, wet - loose	10	30-31.5	SS	4-5-6	14"
437.3	35.0'	5.0'	Brown fine to coarse sand, wet - very loose	11	35-36.5	SS	1-2-2	15"
432.3	40.0'	20.0'	Brown fine to coarse sand with fine gravel, wet - medium dense	12 13 14 15	40-41.5 45-46.5 50-51.5 55-56.5	SS SS SS SS	5-6-5 7-9-12 8-12-16 9-12-18	14" 14" 13" 13"
412.3	60.0'	5.0'	Brown fine sand, wet - medium dense	16	60-61.5	SS	8-10-12	14"
407.3	65.0'	5.0'	Brown fine to medium sand, wet - medium dense	17	65-66.5	SS	9-11-13	13"
402.3	70.0'	5.0'	Brown fine to coarse sand with fine gravel, wet - medium dense	18 19	70-71.5 73.5-75	SS SS	8-9-12 7-9-13	15" 14"
397.3	75.0'		BORING COMPLETED					

BORING D-23

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. D-23
LOCATION As shown on plan, S-2, revision A, Submitted by C. G. & E. Co.
DRILLER J. Martin DRILL No. 29 DATE STARTED 3-20-75
ELEVATION REFERENCE Kral, Zepf, Freitag & Assoc. DATE COMPLETED 3-21-75
CASING DIAMETER 4" I.D. Hollow Stem Auger HAMMER WT. FALL
SAMPLER DIAMETER & TYPE 2" O.D. Split Spoon HAMMER WT. 140# FALL 30"
DEPTH TO WATER: IMMEDIATE Could not determine UPON COMPLETION 10.0'
DEPTH TO WATER DAYS AFTER COMPLETION Backfilled WATER USED IN DRILLING *From surface

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
470.5	0'	0.8'	Brown silty clay loam, (topsoil) very moist - very loose	1	0-1	SS	½-½	9"
469.7	0.8'	4.2'	Mottled brown silty clay, moist - medium stiff to stiff	2 3	1-1.5 2.5-4	SS SS	1 3-5-7	9" 18"
465.5	5.0'	2.5'	Brown sandy clay, moist - very stiff	4	5-6.5	SS	7-10-13	18"
463.0	7.5'	12.5'	Brown fine sand, moist - to wet - loose	5 6 7	7.5-9 10-11.5 15-16.5	SS SS SS	4-5-4 5-5-5 2-3-4	15" 17" 14"
450.5	20.0'	10.0'	Brown silty fine sand with clay layers, wet - loose	8 9	20-21.5 25-26.5	SS SS	3-3-4 2-3-3	15" 16"
440.5	30.0'	10.0'	Brown silty clay with fine sand layers, wet - soft	10 11	30-31.5 35-36.5	SS SS	2-3-3 2-5-7	17" 10"
430.5	40.0'	5.0'	Brown fine to coarse sand and fine gravel, wet - loose	12	40-41.5	SS	4-4-4	12"
425.5	45.0'	5.0'	Brown fine to coarse sand, wet - loose	13	45-46.5	SS	3-2-3	7"
420.5	50.0'	10.0'	Brown fine to coarse sand and gravel, wet - medium dense to dense	14 15	50-51.5 55-56.5	SS SS	8-10-12 14-20-16	14" 16"
410.5	60.0'	10.0'	Brown fine to coarse sand with a little fine gravel, wet - medium dense	16 17	60-61.5 65-66.5	SS SS	14-12-12 8-9-11	15" 14"
400.5	70.0'	5.0'	Brown fine to coarse sand and fine gravel, wet - medium dense	18 19	70-71.5 73.5-75	SS SS	9-9-12 9-10-13	12" 10"
395.5	75.0'		BORING COMPLETED					

BORING D-24

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. D-24
LOCATION As shown on plan, S-2, revision A, Submitted by C. G. & E. Co.
DRILLER W. Martin DRILL No. 18 DATE STARTED 3-21-75
ELEVATION REFERENCE Kral, Zepf, Freitag & Assoc. DATE COMPLETED 3-24-75
CASING DIAMETER None HAMMER WT. FALL
SAMPLER DIAMETER & TYPE 2" O.D. Split Spoon HAMMER WT. 140# FALL 30"
DEPTH TO WATER: IMMEDIATE Could not determine UPON COMPLETION 12.0'
DEPTH TO WATER DAYS AFTER COMPLETION Backfilled WATER USED IN DRILLING *From surface

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
471.3	0'	1.0'	Topsoil	1	0-1	SS	1-1	11"
470.3	1.0'	6.5'	Brown silty clay, moist - stiff to very stiff.	2 3 4	1-1.5 2.5-4 5-6.5	SS SS SS	-3- 6-7-12 6-8-11	3" 18" 18"
463.8	7.5'	2.5'	Brown sandy clay with clayey fine sand layers, very moist - medium stiff	5	7.5-9	SS	3-4-5	18"
461.3	10.0'	5.0'	Brown silty fine sand with clay layers, wet - loose	6	10-11.5	SS	3-3-4	16"
456.3	15.0'	20.0'	Brown silty fine sand with clay layers, wet - very loose to loose	7 8 9 10	15-16.5 20-21.5 25-26.5 30-31.5	SS SS SS SS	2-2-2 2-3-3 2-3-4 3-4-5	16" 15" 16" 15"
436.3	35.0'	5.0'	Gray silty fine sand with loamy layers, wet - loose	11	35-36.5	SS	2-3-3	16"
431.3	40.0'	30.0'	Brown fine to coarse sand with fine gravel, wet - medium dense to dense	12 13 14 15 16 17	40-41.5 45-46.5 50-51.5 55-56.5 60-61.5 65-66.5	SS SS SS SS SS SS	8-9-10 11-10-11 10-12-17 11-14-16 12-15-18 11-13-16	14" 13" 14" 14" 13" 10"
401.3	70.0'	5.0'	Brown fine to coarse sand, trace of fine gravel, wet - medium dense	18 19	70-71.5 73.5-75	SS SS	9-11-14 10-13-15	15" 14"
396.3	75.0'		BORING COMPLETED					

BORING D-25

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. D-25
LOCATION As shown on plan, S-2, revision A, Submitted by C. G. & E. Co.
DRILLER J. Martin DRILL No. 29 DATE STARTED 3-23-75
ELEVATION REFERENCE Kral, Zepf, Freitag & Assoc. DATE COMPLETED 3-24-75
CASING DIAMETER 4" I.D. Hollow Stem Auger HAMMER WT. FALL
SAMPLER DIAMETER & TYPE 2" O.D. Split Spoon HAMMER WT. 140# FALL 30"
DEPTH TO WATER: IMMEDIATE Could not determine UPON COMPLETION 13.0'
DEPTH TO WATER DAYS AFTER COMPLETION Backfilled WATER USED IN DRILLING *From surface

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
471.1	0'	1.0'	Dark brown silty clay loam, (topsoil) moist - very loose	1	0-1	SS	1-1	8"
470.1	1.0'	4.0'	Mottled brown silty clay, moist - medium stiff to stiff	2 3	1-1.5 2.5-4	SS SS	3 3-5-5	6" 15"
466.1	5.0'	5.0'	Brown and grey silty clay, moist - very stiff	4 5	5-6.5 7.5-9	SS SS	6-10-15 5-7-10	18" 18"
461.1	10.0'	3.0'	Brown sandy clay, moist - medium stiff	6	10-11.5	SS	3-3-6	18"
458.1	13.0'	22.0'	Brown silty fine sand with thin clay layers, wet - loose to very loose	7 8 9 10	15-16.5 20-21.5 25-26.5 30-31.5	SS SS SS SS	1-2-2 2-2-3 2-1-2 1-2-2	18" 17" 16" 16"
436.1	35.0'	5.0'	Gray silty fine sand, wet - loose	11	35-36.5	SS	2-2-2	15"
431.1	40.0'	5.0'	Brown fine to coarse sand with clay layers, trace of fine gravel, wet - loose	12	40-41.5	SS	3-3-4	8"
426.1	45.0'	10.0'	Brown silty fine to coarse sand and gravel, wet - medium dense	13 14	45-46.5 50-51.5	SS SS	9-11-13 8-12-12	15" 16"
416.1	55.0'	15.0'	Brown fine to coarse sand with fine gravel, wet - medium dense	15 16 17	55-56.5 60-61.5 65-66.5	SS SS SS	12-8-13 13-13-15 8-11-12	15" 16" 14"
401.1	70.0'	5.0'	Brown fine to coarse sand with fine to coarse gravel, wet - dense	18 19	70-71.5 73.5-75	SS SS	13-15-18 12-15-18	12" 15"
396.1	75.0'							

BORING COMPLETED

REFERENCE DRAWINGS
S0002 SOIL BORING LOCATION PLAN

DATA
LOG SOIL BORG SH6
S2

DRAWING RELEASE RECORD

REV.	SPEC. NO.	DATE	DRAWN	CHECKED	ENGR. APPROVAL	DESCRIPTION	FILM
—	—	2-4-76		James S. Wesley	DJK	ISSUED TO CG&E	✓
—	—	11-15-84	K. Roberts			SENT TO CLIENT	X

DRAWING RELEASE RECORD

REV.	SPEC. NO.	DATE	DRAWN	CHECKED	ENGR. APPROVAL	DESCRIPTION	FILM

STEVE RURKA 9231

DRAWN 7-6-75 SCALE NONE
CHECKED 12-22-75 DATE
ENGINEER 12-22-75 DATE
APPROVED 12-22-75 DATE

PROJECT NUMBER 4869

LOG OF SOIL BORINGS
SHEET 6
EAST BEND STATION UNIT 2
THE CINCINNATI GAS & ELECTRIC CO.
THE DAYTON POWER & LIGHT CO.
CINCINNATI, OHIO

SARGENT & LUNDY
ENGINEERS
CHICAGO

DRAWING NO. 56000S0008
SHEET OF

DO NOT USE I, O, Q OR Z FOR REVISION

56000S0010 SHEET OF

BORING A-37

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-37
LOCATION As shown on plan
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-12-75
ELEVATION REFERENCE DATE COMPLETED 7-12-75
CASING: DIAMETER None HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4" O.D. Flight Auger HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE none UPON COMPLETION none
DEPTH TO WATER 1 DAYS AFTER COMPLETION none WATER USED IN DRILLING no

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
	0'							
		1.5'	Brown sandy silty loam, slightly moist	1	0-1.5	Auger		
	1.5'							
		2.5'	Brown clayey fine sand, moist - soft to medium stiff	2	2-4	Auger		
	4.0'							
		2.0'	Brown silty clay, moist - medium stiff	3	4-6	Auger		
	6.0'							
		2.0'	Brown sandy silty clay, moist - medium stiff	4	6-8	Auger		
	8.0'							
		2.0'	Brown clayey fine sand, moist - soft	5	8-10	Auger		
	10.0'							
			BORING COMPLETED					

BORING A-38

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-38
LOCATION As shown on drawing No. S-2, Rev. "C", Submitted by Sargent & Lundy, Engineers
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-12-75
ELEVATION REFERENCE Kral, Zepf, Freitag & Assoc. DATE COMPLETED 7-12-75
CASING: DIAMETER None HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4.0" O.D. Flight Augers HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE None UPON COMPLETION None
DEPTH TO WATER 1 DAYS AFTER COMPLETION None WATER USED IN DRILLING No

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
490.6	0'							
		2.5'	Brown silty fine sand, moist	1	0-1.5	Auger		
488.1	2.5'							
		4.5'	Brown sandy silty clay, moist - medium stiff	2 3	2.5-4 5-7	Auger Auger		
483.6	7.0'							
		3.0'	Brown clayey sand, very moist - soft	4 5	7-9 9-10	Auger Auger		
480.6	10.0'							
			BORING COMPLETED					

BORING A-39

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-39
LOCATION As shown on drawing No. S-2, Rev. "C", Submitted by Sargent & Lundy, Engineers
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-12-75
ELEVATION REFERENCE Kral, Zepf, Freitag & Assoc. DATE COMPLETED 7-12-75
CASING: DIAMETER None HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4.0" O.D. Flight Augers HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE None UPON COMPLETION None
DEPTH TO WATER 1 DAYS AFTER COMPLETION None WATER USED IN DRILLING No

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
499.2	0'							
		10.0'	Brown silty fine sand	1 2 3 4 5	0-1.5 2.5-4 5-7.5 7-9 9-10	Auger Auger Auger Auger Auger		
489.2	10.0'							
			BORING COMPLETED					

BORING A-40

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-40
LOCATION As shown on plan
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-12-75
ELEVATION REFERENCE DATE COMPLETED 7-12-75
CASING: DIAMETER none HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4" O.D. Flight Auger HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE none UPON COMPLETION none
DEPTH TO WATER 1 DAYS AFTER COMPLETION none WATER USED IN DRILLING No

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
	0'							
		1.5'	Gray silty fine sand, very moist	1	0-1.5	Auger		
	1.5'							
		1.0'	Gray sandy silty clay, very moist - very soft	2	1.5-2.5	Auger		
	2.5'							
		1.5'	Gray silty clay, moist - soft	3	2.5-4	Auger		
	4.0'							
		1.5'	Gray silty clay, moist - stiff to very stiff	4	4-5.5	Auger		
	5.5'							
		4.5'	Brown sandy silty clay, moist - stiff	5 6 7	5.5-7.5 7.5-8.5 8.5-10	Auger Auger Auger		
	10.0'							
			BORING COMPLETED					

BORING A-41

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-41
LOCATION As shown on drawing S-2, Rev. "C", Submitted by Sargent & Lundy, Engineers
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-12-75
ELEVATION REFERENCE Kral, Zepf, Freitag & Assoc. DATE COMPLETED 7-12-75
CASING: DIAMETER None HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4.0" O.D. Flight Augers HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE None UPON COMPLETION None
DEPTH TO WATER 1 DAYS AFTER COMPLETION None WATER USED IN DRILLING No

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
484.4	0'							
		1.5'	Brown sandy silt, dry	1	0-1.5	Auger		
482.9	1.5'							
		8.5'	Brown silty fine sand, moist to very moist	2 3 4 5	1.5-3 3-5 5-7 7-10	Auger Auger Auger Auger		
474.4	10.0'							
			BORING COMPLETED					

BORING A-42

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-42
LOCATION As shown on plan
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-13-75
ELEVATION REFERENCE DATE COMPLETED 7-13-75
CASING: DIAMETER none HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4" O.D. Flight Auger HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE none UPON COMPLETION none
DEPTH TO WATER DAYS AFTER COMPLETION Backfilled WATER USED IN DRILLING No

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
	0'							
		1.0'	Brown sandy silty loam dry	1	0-1	Auger		
	1.0'							
		4.0'	Brown silt, fine sand and fine to coarse gravel, slightly moist	2 3	1-2.5 2.5-5	Auger Auger		
	5.0'							
		5.0'	Brown silty fine to medium sand, trace of fine to coarse gravel, some cobbles - moist	4 5	5-7.5 7.5-10	Auger Auger		
	10.0'							
			BORING COMPLETED					

BORING A-43

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-43
LOCATION As shown on plan
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-12-75
ELEVATION REFERENCE DATE COMPLETED 7-12-75
CASING: DIAMETER None HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4" O.D. Flight Auger HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE none UPON COMPLETION none
DEPTH TO WATER 1 DAYS AFTER COMPLETION none WATER USED IN DRILLING No

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
	0'							
		1.5'	Brown silty fine sand, moist	1	0-1.5	Auger		
	1.5'							
		2.5'	Brown sandy silty clay, very moist - soft	2	2.5-4	Auger		
	4.0'							
		4.0'	Gray silty clay, moist - medium stiff to stiff	3 4	4-6.5 6.5-8	Auger Auger		
	8.0'							
		2.0'	Brown sandy silty clay, moist - medium stiff	5 6	8-9 9-10	Auger Auger		
	10.0'							
			BORING COMPLETED					

BORING A-44

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-44
LOCATION As shown on drawing No. S-2, Rev. "C", Submitted by Sargent & Lundy, Engineers
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-13-75
ELEVATION REFERENCE Kral, Zepf, Freitag & Assoc. DATE COMPLETED 7-13-75
CASING: DIAMETER None HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4" O.D. Flight Augers HAMMER WT. 140# FALL 30"
DEPTH TO WATER: IMMEDIATE None UPON COMPLETION None
DEPTH TO WATER 1 DAYS AFTER COMPLETION None WATER USED IN DRILLING No

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
482.2	0'							
		3.0'	Brown fine sandy silt, slightly moist	1 2	0-1.5 1.5-3	Auger Auger		
479.2	3.0'							
		4.0'	Brown silty fine sand, moist	3 4	3-5 5-7	Auger Auger		
475.2	7.0							
		3.0'	Brown clayey fine sand, moist - soft	5	7-10	Auger		
472.2	10.0'							
			BORING COMPLETED					

BORING A-45

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-45
LOCATION As shown on plan
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-13-75
ELEVATION REFERENCE DATE COMPLETED 7-13-75
CASING: DIAMETER none HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4" O.D. Flight Auger HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE none UPON COMPLETION none
DEPTH TO WATER DAYS AFTER COMPLETION Backfilled WATER USED IN DRILLING No

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
	0'							
		1.0'	Brown sandy silty loam, dry	1	0-1	Auger		
	1.0'							
		1.5'	Brown sandy clay and fine gravel, moist - medium stiff	2 3	1-2 2-5	Auger Auger		
	2.5'							
		2.5'	Fine to coarse gravel and brown silty fine to medium sand, moist					
	5.0'							
		5.0'	Brown silty fine to coarse sand and gravel with cobbles and some boulders, moist	4 5	5-7 7.5-10	Auger Auger		
	10.0'							
			BORING COMPLETED					

BORING A-46

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-46
LOCATION As shown on plan
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-12-75
ELEVATION REFERENCE DATE COMPLETED 7-12-75
CASING: DIAMETER none HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4" O.D. Flight Auger HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE none UPON COMPLETION none
DEPTH TO WATER 1 DAYS AFTER COMPLETION none WATER USED IN DRILLING No

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
	0'							
		4.0'	Brown and gray silty clay, moist - soft to medium stiff	1 2	0-1.5 2.5-4	Auger Auger		
	4.0'							
		3.0'	Gray to brown silty clay, moist - medium stiff to stiff	3 4	4-6.5 6.5-7.5	Auger Auger		
	7.0'							
		3.0'	Brown sandy silty clay, moist - medium stiff	5 6	7.5-8.5 8.5-10	Auger Auger		
	10.0'							
			BORING COMPLETED					

BORING A-47

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-47
LOCATION As shown on drawing No. S-2, Rev. "C", Submitted by Sargent & Lundy, Engineers
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-12-75
ELEVATION REFERENCE Kral, Zepf, Freitag & Assoc. DATE COMPLETED 7-12-75
CASING: DIAMETER None HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4" O.D. Flight Augers HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE None UPON COMPLETION None
DEPTH TO WATER 1 DAYS AFTER COMPLETION None WATER USED IN DRILLING No

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
476.2	0'							
		2.5'	Brown sandy silt, dry to moist	1	0-1.5	Auger		
473.7	2.5'							
		5.0'	Brown clayey fine sand, moist - soft to medium stiff	2 3	2.5-4 5-6.5	Auger Auger		
468.7	7.5'							
		2.5'	Brown silty fine sand with sandy silty clay lenses, moist	4 5	7.5-9 9-10	Auger Auger		
466.2	10.0'							
			BORING COMPLETED					

BORING A-48

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-48
LOCATION As shown on drawing No. S-2, Rev. "C", Submitted by Sargent & Lundy, Engineers
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-12-75
ELEVATION REFERENCE Kral, Zepf, Freitag & Assoc. DATE COMPLETED 7-12-75
CASING: DIAMETER None HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4.0" O.D. Flight Augers HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE None UPON COMPLETION None
DEPTH TO WATER 1 DAYS AFTER COMPLETION None WATER USED IN DRILLING No

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
481.4	0'							
		1.5'	Brown fine sandy silt, moist	1	0-1.5	Auger		
479.9	1.5'							
		1.5'	Brown silty fine sand, moist	2	1.5-3	Auger		
478.4	3.0'							
		7.0'	Brown clayey fine sand, moist - soft	3 4 5	3-5 5-7 7-10	Auger Auger Auger		
471.4	10.0'							
			BORING COMPLETED					

BORING A-49

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-49
LOCATION As shown on plan
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-13-75
ELEVATION REFERENCE DATE COMPLETED 7-13-75
CASING: DIAMETER none HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4" O.D. Flight Auger HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE none UPON COMPLETION none
DEPTH TO WATER DAYS AFTER COMPLETION Backfilled WATER USED IN DRILLING No

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
	0'							
		2.5'	Brown sandy silty loam, dry to moist	1 2	0-1 1-2.5	Auger Auger		
	2.5'							
		2.5'	Brown clayey sandy silt, moist - soft to medium stiff	3	2.5-5	Auger		
	5.0'							
		5.0'	Brown silty fine to coarse sand and fine to coarse gravel, cobbles, some boulders, moist	4 5	5-7.5 7.5-10	Auger Auger		
	10.0'							
			BORING COMPLETED					

BORING A-50

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-50
LOCATION As shown on drawing No. S-2, Rev. "C", Submitted by Sargent & Lundy, Engineers
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-11-75
ELEVATION REFERENCE Kral, Zepf, Freitag & Assoc. DATE COMPLETED 7-11-75
CASING: DIAMETER None HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4.0" O.D. Flight Augers HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE None UPON COMPLETION None
DEPTH TO WATER 1 DAYS AFTER COMPLETION None WATER USED IN DRILLING No

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
470.5	0'							
		0.5'	Brown sandy silty loam, dry	1	0-0.5	Auger		
470.0	0.5'							
		6.5'	Brown clayey fine sand, moist - soft to medium stiff	2 3 4	0.5-1.5 2.5-4 5-6.5	Auger Auger Auger		
463.5	7.0'							
		3.0'	Brown silty fine sand, very moist	5 6	7-8.5 8.5-10	Auger Auger		
460.5	10.0'							
			BORING COMPLETED					

BORING A-51

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-51
LOCATION As shown on plan
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-13-75
ELEVATION REFERENCE DATE COMPLETED 7-13-75
CASING: DIAMETER none HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4" O.D. Flight Auger HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE none UPON COMPLETION none
DEPTH TO WATER DAYS AFTER COMPLETION Backfilled WATER USED IN DRILLING No

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
	0'							
		1.5'	Brown fine sandy loam, dry	1	0-1.5	Auger		
	1.5'							
		2.5'	Brown clayey sandy silt, very moist	2	2.5-4	Auger		
	4.0'							
		4.5'	Gray to brown and gray silty clay, moist - medium stiff to stiff	3 4	4-6 7-8.5	Auger Auger		
	8.5'							
		1.5'	Gray silty clay, moist - stiff	5	9-10	Auger		
	10.0'							
			BORING COMPLETED					

BORING A-52

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-52
LOCATION As shown on drawing No. S-2, Rev. "C", Submitted by Sargent & Lundy, Engineers
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-12-75
ELEVATION REFERENCE Kral, Zepf, Freitag & Assoc. DATE COMPLETED 7-12-75
CASING: DIAMETER None HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4.0" O.D. Flight Augers HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE None UPON COMPLETION None
DEPTH TO WATER 1 DAYS AFTER COMPLETION None WATER USED IN DRILLING No

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
482.2	0'							
		2.5'	Brown sandy silt, trace of fine gravel, moist	1	0-1.5	Auger		
479.7	2.5'							
		4.5'	Brown silty fine sand, trace of fine gravel, moist	2 3	2.5-5 5-6.5	Auger Auger		
475.2	7.0'							
		3.0'	Brown fine to coarse sand and gravel, some cobbles, moist	4 5	7-8.5 8.5-10	Auger Auger		
472.2	10.0'							
			BORING COMPLETED					

BORING A-53

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-53
LOCATION As shown on drawing No. S-2, Rev. "C", Submitted by Sargent & Lundy, Engineers
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-11-75
ELEVATION REFERENCE Kral, Zepf, Freitag & Assoc. DATE COMPLETED 7-11-75
CASING: DIAMETER None HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4.0" O.D. Flight Augers HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE None UPON COMPLETION None
DEPTH TO WATER 1 DAYS AFTER COMPLETION None WATER USED IN DRILLING No

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
470.9	0'							
		0.5'	Brown silty loam, dry	1	0-0.5	Auger		
470.4	0.5'							
		2.0'	Brown silty clay, moist - medium stiff to stiff	2	0.5-1.5	Auger		
468.4	2.5'							
		6.0'	Brown clayey fine sand, moist - soft to medium stiff	3 4 5	2.5-4 5-6.5 7-8.5	Auger Auger Auger		
462.4	8.5'							
		1.5'	Brown sandy silty clay, moist - soft	6	8.5-10	Auger		
460.9	10.0'							
			BORING COMPLETED					

BORING A-54

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-54
LOCATION As shown on plan
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-13-75
ELEVATION REFERENCE DATE COMPLETED 7-13-75
CASING: DIAMETER none HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4" O.D. Flight Auger HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE none UPON COMPLETION none
DEPTH TO WATER 0 DAYS AFTER COMPLETION Backfilled WATER USED IN DRILLING no

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
	0'							
		1.0'	Brown sandy silty loam, dry	1	0-1	Auger		
	1.0'							
		1.0'	Brown silty clay, moist - medium stiff	2	1-2	Auger		
	2.0'							
		2.0'	Brown clayey sandy silt, wet - soft	3	2-4	Auger		
	4.0'							
		4.0'	Gray to brown and gray silty clay, moist - medium stiff to stiff	4 5	4-6 6-8	Auger Auger		
	8.0'							
		2.0'	Gray sandy silty clay, very moist - soft	6	8-10	Auger		
	10.0'							
			BORING COMPLETED					

BORING A-55

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-55
LOCATION As shown on plan
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-13-75
ELEVATION REFERENCE DATE COMPLETED 7-13-75
CASING: DIAMETER none HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4" O.D. Flight Auger HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE none UPON COMPLETION none
DEPTH TO WATER 0 DAYS AFTER COMPLETION Backfilled WATER USED IN DRILLING no

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
	0'							
		1.0'	Brown fine sandy silty loam, moist	1	0-1	Auger		
	1.0'							
		5.5'	Brown silty fine sand, moist	2 3 4 5	1-2 2.5-4 5-6.5 6.5-7.5	Auger Auger Auger Auger		
	6.5'							
		1.0'	Brown silty fine sand with clayey sand layers, moist					
	7.5'							
		2.5'	Brown silty fine sand, moist	6	7.5-10	Auger		
	10.0'							
			BORING COMPLETED					

BORING A-56

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-56
LOCATION As shown on plan
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-12-75
ELEVATION REFERENCE DATE COMPLETED 7-12-75
CASING: DIAMETER none HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4" O.D. Flight Auger HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE none UPON COMPLETION none
DEPTH TO WATER 1 DAYS AFTER COMPLETION none WATER USED IN DRILLING No

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
	0'							
		1.5'	Brown sandy silt, slightly moist to moist	1	0-1.5	Auger		
	1.5'							
		7.5'	Brown sandy clayey silt, moist - soft to medium stiff	2 3 4 5 6	1.5-2.5 2.5-5 5-6.5 7.5-9 9-10	Auger Auger Auger Auger Auger		
	9.0'							
		1.0'	Brown sandy silty clay, moist - medium stiff					
	10.0'							
			BORING COMPLETED					

BORING A-57

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-57
LOCATION As shown on drawing No. S-2, Rev. "C", Submitted by Sargent & Lundy, Engineers
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-11-75
ELEVATION REFERENCE Kral, Zepf, Freitag & Assoc. DATE COMPLETED 7-11-75
CASING: DIAMETER None HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4.0" O.D. Flight Augers HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE None UPON COMPLETION None
DEPTH TO WATER 1 DAYS AFTER COMPLETION None WATER USED IN DRILLING No

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
470.7	0'							
		0.5'	Brown silty loam, dry to slightly moist	1	0-1	Auger		
470.2	0.5'							
		2.0'	Brown sandy silty clay, slightly moist - medium stiff	2	1-2.5	Auger		
468.2	2.5'							
		4.0'	Brown silty fine sand, very moist	3 4 5	2.5-4 4-5.5 5.5-6.5	Auger Auger Auger		
464.2	6.5'							
		3.5'	Brown clayey fine sand, very moist	6 7	6.5-8 8-10	Auger Auger		
460.7	10.0'							
			BORING COMPLETED					

BORING A-58

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-58
LOCATION As shown on drawing No. S-2, Rev. "C", Submitted by Sargent & Lundy, Engineers
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-11-75
ELEVATION REFERENCE Kral, Zepf, Freitag & Assoc. DATE COMPLETED 7-11-75
CASING: DIAMETER None HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4.0" O.D. Flight Augers HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE None UPON COMPLETION None
DEPTH TO WATER 1 DAYS AFTER COMPLETION None WATER USED IN DRILLING No

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
469.1	0'							
		2.0'	Brown silty clay, moist - medium stiff	1 2	0-1 1-2	Auger Auger		
467.1	2.0'							
		4.0'	Gray and brown silty clay, moist - medium stiff to stiff	3 4	2-4 4-6	Auger Auger		
463.1	6.0'							
		4.0'	Brown sandy silty clay, with fine sand lenses, moist - medium stiff to stiff	5 6	6-8 8-10	Auger Auger		
459.1'	10.0'							
			BORING COMPLETED					

BORING A-59

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-59
LOCATION As shown on plan
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-12-75
ELEVATION REFERENCE DATE COMPLETED 7-12-75
CASING: DIAMETER none HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4" O.D. Flight Auger HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE none UPON COMPLETION none
DEPTH TO WATER 1 DAYS AFTER COMPLETION none WATER USED IN DRILLING No

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
	0'							
		1.5'	Light brown sandy silty loam, slightly moist	1	0-1.5	Auger		
	1.5'							
		8.5'	Brown sandy silt, moist	2 3 4 5	1.5-3.5 3.5-5.5 5.5-7.5 7.5-10	Auger Auger Auger Auger		
	10.0'							
			BORING COMPLETED					

BORING A-60

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-60
LOCATION As shown on drawing No. S-2, Rev. "C", Submitted by Sargent & Lundy, Engineers
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-11-75
ELEVATION REFERENCE Kral, Zepf, Freitag & Assoc. DATE COMPLETED 7-11-75
CASING: DIAMETER None HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4.0" O.D. Flight Augers HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE None UPON COMPLETION None
DEPTH TO WATER 1 DAYS AFTER COMPLETION None WATER USED IN DRILLING No

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
470.2	0'							
		1.0'	Brown silty loam, dry	1	0-1	Auger		
469.2	1.0'							
		1.5'	Brown sandy silty clay, moist - medium stiff	2	1-2.5	Auger		
467.7	2.5'							
		7.5'	Brown clayey fine sand, moist - soft to medium stiff	3 4 5	4-6.5 6.5-8 8-10	Auger Auger Auger		
460.2	10.0'							
			BORING COMPLETED					

BORING A-61

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-61
LOCATION As shown on drawing No. S-2, Rev. "C", Submitted by Sargent & Lundy, Engineers
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-12-75
ELEVATION REFERENCE Kral, Zepf, Freitag & Assoc. DATE COMPLETED 7-12-75
CASING: DIAMETER None HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4.0" O.D. Flight Augers HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE None UPON COMPLETION None
DEPTH TO WATER 1 DAYS AFTER COMPLETION None WATER USED IN DRILLING No

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
472.9	0'							
		1.0'	Brown sandy silt, dry	1	0-1	Auger		
471.9	1.0'							
		1.0'	Brown silty fine sand, moist	2	1-2	Auger		
470.9	2.0'							
		5.0'	Brown clayey fine sand, moist - soft to medium stiff	3 4	2-4 5-7	Auger Auger		
465.9	7.0'							
		3.0'	Brown silty fine sand, moist	5	7-10	Auger		
462.9	10.0'							
			BORING COMPLETED					

BORING A-62

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-62
LOCATION As shown on plan
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-12-75
ELEVATION REFERENCE DATE COMPLETED 7-12-75
CASING: DIAMETER none HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4" O.D. Flight Auger HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE none UPON COMPLETION none
DEPTH TO WATER 1 DAYS AFTER COMPLETION none WATER USED IN DRILLING no

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
	0'							
		1.5'	Brown sandy silty loam, moist	1	0-1.5	Auger		
	1.5'							
		1.5'	Brown sandy silt, moist	2	1.5-3	Auger		
	3.0'							
		7.0'	Brown silty fine sand with clayey fine sand seams, moist	3 4 5	3-5 5-7 7-10	Auger Auger Auger		
	10.0'							
			BORING COMPLETED					

BORING A-63

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-63
LOCATION As shown on drawing No. S-2, Rev. "C", Submitted by Sargent & Lundy, Engineers
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-11-75
ELEVATION REFERENCE Kral, Zepf, Freitag & Assoc. DATE COMPLETED 7-11-75
CASING: DIAMETER None HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4.0" O.D. Flight Augers HAMMER WT. 140# FALL 30"
DEPTH TO WATER: IMMEDIATE None UPON COMPLETION None
DEPTH TO WATER 1 DAYS AFTER COMPLETION None WATER USED IN DRILLING No

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
470.2	0'							
		1.5'	Brown fine sandy silty loam, dry	1	0-1.5	Auger		
468.7	1.5'							
		5.0'	Brown sandy silty clay, with fine sand lenses, moist - medium stiff to stiff	2 3	1.5-3 3-5	Auger Auger		
463.7	6.5'							
		3.5'	Brown clayey fine sand, with sandy silt lenses, moist - soft	4 5	6.5-8.5 8.5-10	Auger Auger		
460.2	10.0'							
			BORING COMPLETED					

BORING A-64

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-64
LOCATION As shown on plan
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-13-75
ELEVATION REFERENCE DATE COMPLETED 7-13-75
CASING: DIAMETER none HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4" O.D. Flight Auger HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE none UPON COMPLETION none
DEPTH TO WATER 0 DAYS AFTER COMPLETION Backfilled WATER USED IN DRILLING no

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
	0'							
		1.5'	Brown sandy silty loam, dry	1	0-1.5	Auger		
	1.5'							
		1.0'	Brown sandy silt, slightly moist	2	1.5-2.5	Auger		
	2.5'							
		7.5'	Brown silty fine sand, trace of fine gravel, moist	3 4 5	2.5-4 5-7.5 7.5-10	Auger Auger Auger		
	10.0'							
			BORING COMPLETED					

BORING A-65

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-65
LOCATION As shown on drawing No. S-2, Rev. "C", Submitted by Sargent & Lundy, Engineers
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-11-75
ELEVATION REFERENCE Kral, Zepf, Freitag & Assoc. DATE COMPLETED 7-11-75
CASING: DIAMETER None HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4.0" O.D. Flight Augers HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE None UPON COMPLETION None
DEPTH TO WATER 1 DAYS AFTER COMPLETION None WATER USED IN DRILLING No

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
469.3	0'							
		1.5'	Brown fine sandy silty loam	1	0-1.5	Auger		
467.8	1.5'							
		3.0'	Brown silty clay, moist - medium stiff to stiff	2	1.5-3.5	Auger		
464.8	4.5'							
		1.5'	Brown clayey fine sand, moist - soft to medium dense	3	4.5-6	Auger		
463.3	6.0'							
		2.0'	Brown silty fine sand, moist	4	6-8	Auger		
461.3	8.0'							
		2.0'	Brown clayey fine sand, moist - soft	5	8-10	Auger		
459.3	10.0'							
			BORING COMPLETED					

BORING A-66

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-66
LOCATION As shown on plan
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-13-75
ELEVATION REFERENCE DATE COMPLETED 7-13-75
CASING: DIAMETER none HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4" O.D. Flight Auger HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE none UPON COMPLETION none
DEPTH TO WATER 0 DAYS AFTER COMPLETION Backfilled WATER USED IN DRILLING No

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
	0'							
		1.0'	Brown silty sandy loam, moist	1	0-1	Auger		
	1.0'							
		3.5'	Brown clayey fine sand, moist - soft	2 3	1-2.5 2.5-4.5	Auger Auger		
	4.5'							
		5.5'	Brown silty fine sand, moist to very moist	4 5 6	4.5-6 6-8 8-10	Auger Auger Auger		
	10.0'							
			BORING COMPLETED					

BORING A-67

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-67
LOCATION As shown on plan
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-13-75
ELEVATION REFERENCE DATE COMPLETED 7-13-75
CASING: DIAMETER none HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4" O.D. Flight Auger HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE none UPON COMPLETION none
DEPTH TO WATER 0 DAYS AFTER COMPLETION Backfilled WATER USED IN DRILLING No

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
	0'							
		1.0'	Brown sandy silty loam, slightly moist	1	0-1.5	Auger		
	1.0'							
		4.0'	Brown clayey silt, slightly moist - soft to medium stiff	2 3	1.5-2.5 2.5-5	Auger Auger		
	5.0'							
		2.0'	Brown sandy silt, trace of fine gravel, slightly moist	4	5-7	Auger		
	7.0'							
		3.0'	Brown clayey fine to coarse sand, trace of fine gravel, moist	5	7-10	Auger		
	10.0'							
			BORING COMPLETED					

BORING A-68

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-68
LOCATION As shown on plan
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-13-75
ELEVATION REFERENCE DATE COMPLETED 7-13-75
CASING: DIAMETER none HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4" O.D. Flight Auger HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE none UPON COMPLETION none
DEPTH TO WATER DAYS AFTER COMPLETION Backfilled WATER USED IN DRILLING No

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
	0'							
		1.5'	Brown silty loam, dry	1	0-1.5	Auger		
	1.5'							
		5.0'	Brown clay, moist - stiff to very stiff	2 3 4	1.5-3.5 3.5-5 5-6.5	Auger Auger Auger		
	6.5'							
		3.5'	Brown clayey sandy silt, very moist	5 6	6.5-8 8-10	Auger Auger		
	10.0'							
			BORING COMPLETED					

BORING A-69

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-69
LOCATION As shown on plan
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-13-75
ELEVATION REFERENCE DATE COMPLETED 7-13-75
CASING: DIAMETER none HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4" O.D. Flight Auger HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE none UPON COMPLETION
DEPTH TO WATER DAYS AFTER COMPLETION Backfilled WATER USED IN DRILLING

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
	0'							
		1.5'	Brown sandy silty loam, moist	1	0-1.5	Auger		
	1.5'							
		2.0'	Brown clayey silt, slighty moist - medium stiff	2	1.5-3.5	Auger		
	3.5'							
		6.5'	Brown clayey sandy silt, moist - soft to medium stiff	3 4 5	3.5-5 5-7 7-10	Auger Auger Auger		
	10.0'							
			BORING COMPLETED					

BORING A-70

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-70
LOCATION As shown on plan
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-13-75
ELEVATION REFERENCE DATE COMPLETED 7-13-75
CASING: DIAMETER none HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4" O.D. Flight Auger HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE none UPON COMPLETION none
DEPTH TO WATER DAYS AFTER COMPLETION Backfilled WATER USED IN DRILLING no

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
	0'							
		1.5'	Brown silty loam, dry	1	0-1.5	Auger		
	1.5'							
		6.0'	Brown sandy silt, dry to slightly moist	2 3 4 5 6	1.5-2.5 2.5-5 5-6.5 6.5-7.5 7.5-10	Auger Auger Auger Auger Auger		
	7.5'							
		2.5'	Brown clayey sandy silt, moist - soft					
	10.0'							
			BORING COMPLETED					

BORING A-71

PROJECT East Bend Station, Unit 2, Boone County, Kentucky HOLE No. A-71
LOCATION As shown on plan
DRILLER C. B. Young DRILL No. 26 DATE STARTED 7-13-75
ELEVATION REFERENCE DATE COMPLETED 7-13-75
CASING: DIAMETER none HAMMER WT. FALL
SAMPLER: DIAMETER & TYPE 4" O.D. Flight Auger HAMMER WT. FALL
DEPTH TO WATER: IMMEDIATE none UPON COMPLETION none
DEPTH TO WATER 0 DAYS AFTER COMPLETION Backfilled WATER USED IN DRILLING no

ELEVATION	DEPTH		DESCRIPTION OF MATERIALS	SAMPLE No.	SAMPLE DEPTH	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER	RECOVERY
	0'							
		1.5'	Brown sandy silty loam, trace of fine gravel, slightly moist	1	0-1.5	Auger		
	1.5'							
		1.0'	Brown sandy silt, trace of fine gravel, slightly moist	2	1.5-2.5	Auger		
	2.5'							
		4.5'	Brown clayey silt, trace of fine gravel, slightly moist	3 4	2.5-5 5-7	Auger Auger		
	7.0'							
		3.0'	Brown silty fine to coarse sand and gravel, slightly moist	5	7-10	Auger		
	10.0'							
			BORING COMPLETED					

REFERENCE DRAWINGS	
S0002	SOIL BORING LOCATION PLAN

$Z LOG SOIL BORG SH8 DATA

DRAWING RELEASE RECORD

REV.	SPEC. NO.	DATE	DRAWN	CHECKED	ENGR. APPROVAL	DESCRIPTION	FILM
—	—	2-4-76		J. A. Wesby	PJK	ISSUED TO CG&E	X
—	—	11-15-82	K Kalaitz	—	—	SENT TO CLIENT	X

DRAWING RELEASE RECORD

REV.	SPEC. NO.	DATE	DRAWN	CHECKED	ENGR. APPROVAL	DESCRIPTION	FILM

STEVE RURKA 9231

M. J. Dicastro
DRAWN 8-19-75 NONE SCALE
J. A. Wesby
CHECKED 12-22-75 DATE
P. J. Karik
ENGINEER 12-22-75 DATE
APPROVED 12-22-75 DATE

PROJECT NUMBER 4869-03

LOG OF SOIL BORINGS
SHEET 8
EAST BEND STATION UNIT 2
THE CINCINNATI GAS & ELECTRIC CO.
THE DAYTON POWER & LIGHT CO.
CINCINNATI, OHIO

SARGENT & LUNDY
ENGINEERS
CHICAGO

DRAWING NO. 56000S0010
SHEET OF

DO NOT USE I, O, Q OR X FOR REVISION

APPENDIX C

HYDRAULIC & HYDROLOGIC DATA

Hydraulic & Hydrologic Calculations Summary

The ash pond at East Bend Station is currently classified as a Moderate Hazard Dam. These structures must pass a design storm consisting of a 13.5-inches, 6-hour storm event per the Kentucky Energy and Environmental Cabinet, Department for Environmental Protection, Division of Water (DOW). Calculations and data for the analyses of the ash pond are contained in this appendix.

The drainage area to the pond was outlined and measured. Runoff coefficients were assigned based on SCS Curve numbers. A curve numbers of 88 was used based on land use and soil type. The land use was classified as "Industrial" and the hydrologic soil group was "B" (silt loam). Time of concentration and lag times for the drainage area was calculated following the guidelines in Part 630 Hydrology of the National Engineering Handbook and Technical Release 55 (TR-55): Urban Hydrology for Small Watersheds. Influent to the pond from the plant (6 cfs) was negligible compared to the design storm inflow.

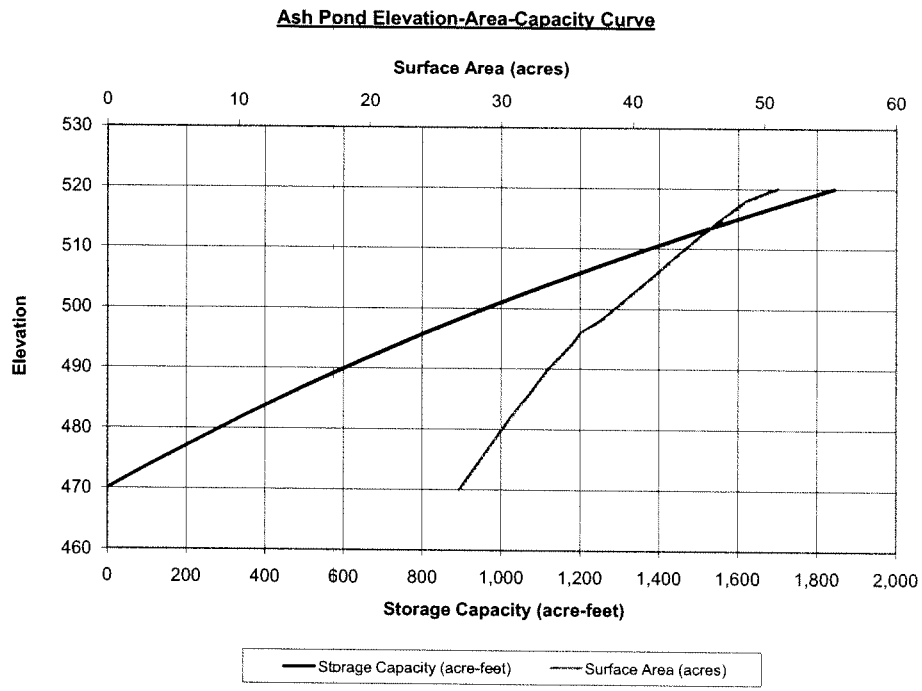
Hydrologic reservoir routing through the pond was calculated using TR-55 and the HEC-1 computer program developed by the U.S. Army Corps of Engineers, with user inputs for drainage area, runoff coefficient, storage and outflow ratings, and time of concentration or lag time. A detailed HEC-1 output file is contained in this appendix.

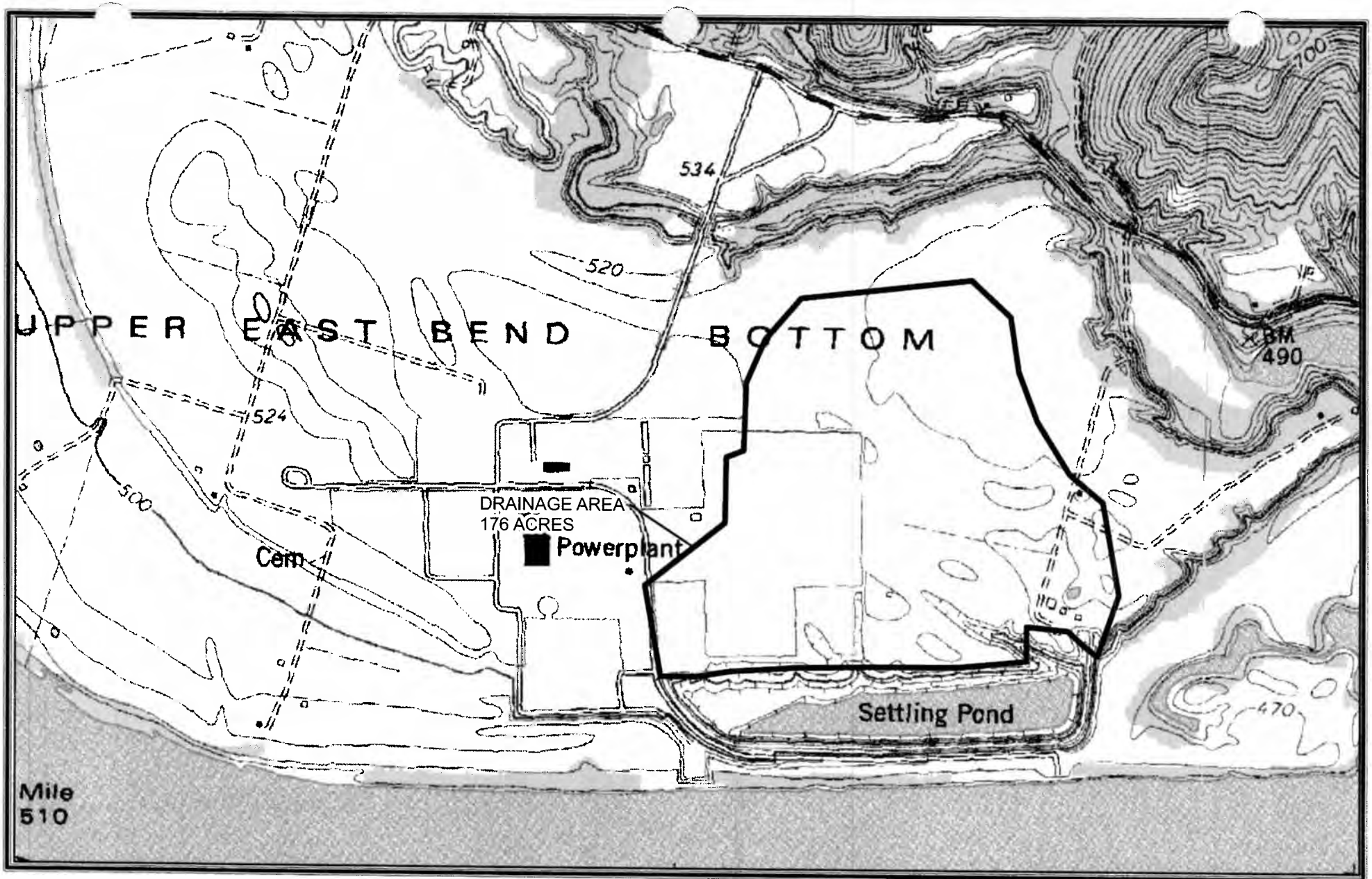
Spillway capacity calculations were performed using equations for orifice flow, weir flow, and full pipe flow. These calculations are contained on the following pages.

Based on the results of the analyses, a normal pool water level at El. 485.5 will reach El. 490.1 based on the design storm. This is below the top of embankment (El. 520).

	Ash Pond - Storage Volume Computations						
	Elevation	Area s.f.	Area acres	Avg Area acres	Distance feet	Volume ac-ft	Cum Vol ac-ft
Bottom	470	1,167,670	26.81				0.0
				27.45	4	109.81	
	474	1,224,078	28.10				109.8
				28.77	4	115.08	
	478	1,282,396	29.44				224.9
				30.07	4	120.28	
	482	1,337,283	30.70				345.2
				31.44	4	125.77	
	486	1,401,992	32.19				470.9
				32.88	4	131.50	
	490	1,462,148	33.57				602.4
				34.46	4	137.83	
	494	1,539,756	35.35				740.3
				35.69	2	71.37	
	496	1,569,278	36.03				811.7
				36.77	2	73.54	
	498	1,633,983	37.51				885.2
				38.07	2	76.13	
	500	1,682,325	38.62				961.3
				39.16	2	78.33	
	502	1,729,548	39.70				1,039.6
				40.25	2	80.49	
	504	1,776,670	40.79				1,120.1
				41.32	2	82.63	
	506	1,822,836	41.85				1,202.8
				42.37	2	84.74	
	508	1,868,640	42.90				1,287.5
				43.43	2	86.86	
	510	1,914,903	43.96				1,374.4
				44.51	2	89.01	
	512	1,962,407	45.05				1,463.4
				45.63	2	91.26	
	514	2,012,664	46.20				1,554.6
				46.78	2	93.56	
	516	2,062,897	47.36				1,648.2
				47.97	2	95.95	
	518	2,116,583	48.59				1,744.1
				49.79	2	99.57	
Crest	520	2,220,828	50.98				1,843.7

Note: Areas taken from topography obtained from Sandborn Columbus Inc., flyover dated 12/15/2004.





N

NOTE: MAPPING SHOWN FROM USGS QUADRANGLE, RISING SUN, KENTUCKY

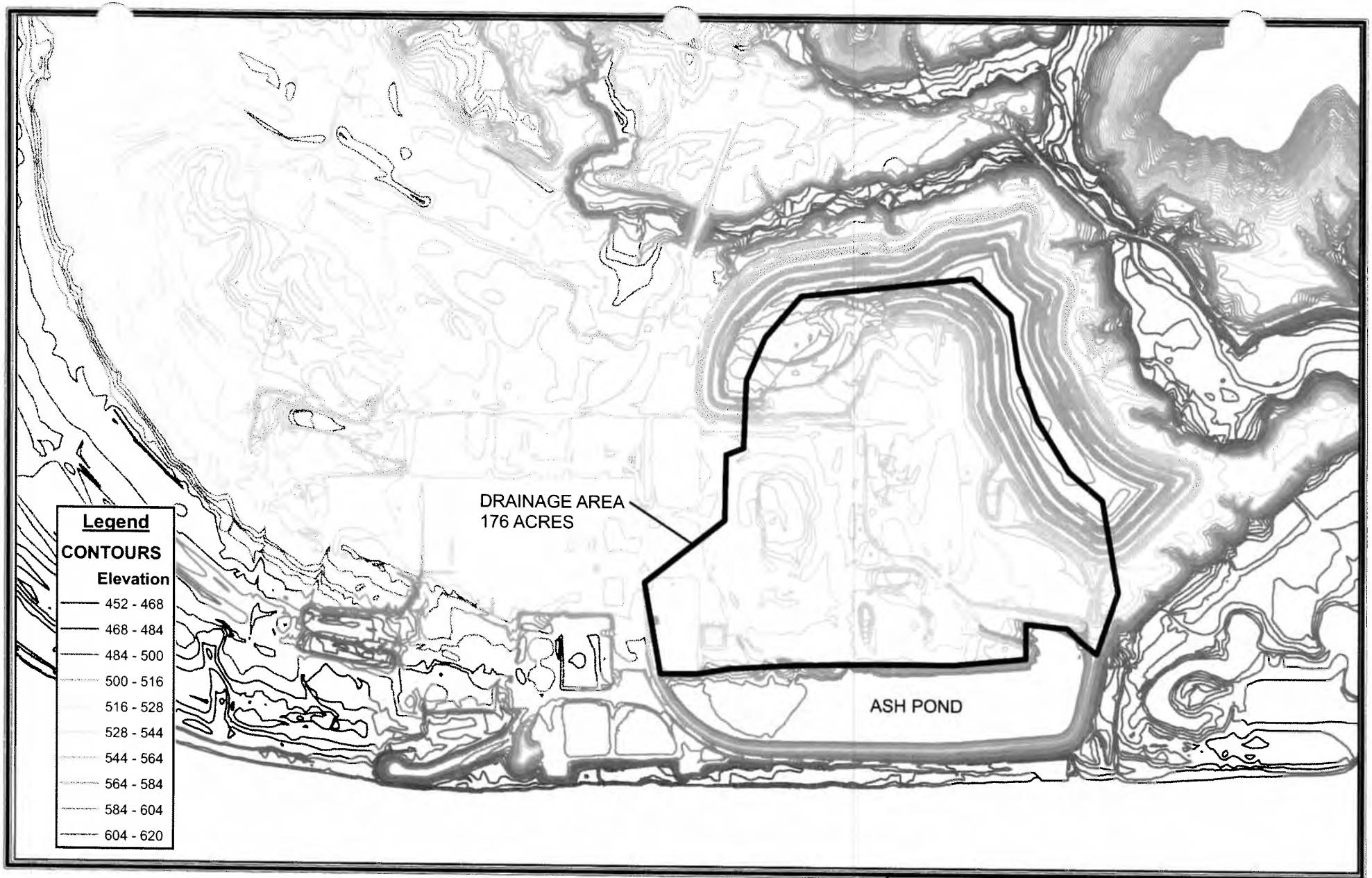
0 500 1,000 2,000 Feet

ASH POND - DRAINAGE AREA

East Bend Station
Boone County, Kentucky

Project: 011-09323-012	Drawn By: AJS
Drawing Date: 5/14/09	Approved By: SJL
File: 011-09323-012\Base.mxd	

Columbus (614) 793-2226
Cleveland (216) 901-1000
Cincinnati (513) 771-8471
Dayton (937) 424-1011



N

NOTE: MAPPING SHOWN FROM BOONE COUNTY AUDITOR, 2-FT CONTOUR INTERVAL.

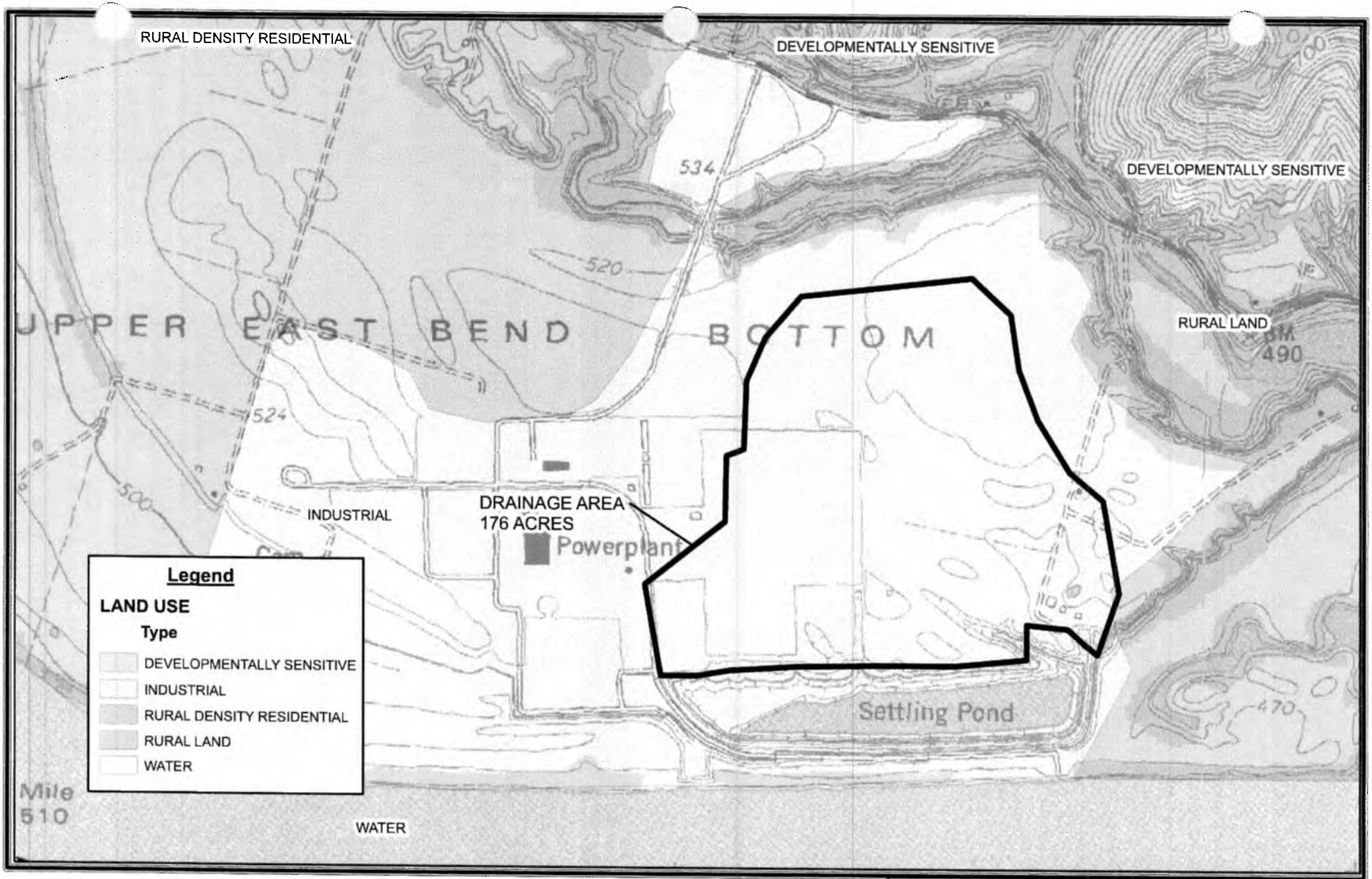
0 500 1,000 2,000 Feet

ASH POND - DRAINAGE AREA

East Bend Station
Boone County, Kentucky

Project: 011-09323-012	Drawn By: AJS
Drawing Date: 5/14/09	Approved By: SJL
File: 011-09323-012\Base.mxd	

Columbus
(614) 793-2226
Cleveland
(216) 901-1000
Cincinnati
(513) 771-8471
Dayton
(937) 424-1011



N

NOTE: LAND USE INFORMATION SHOWN FROM BOONE COUNTY AUDITOR

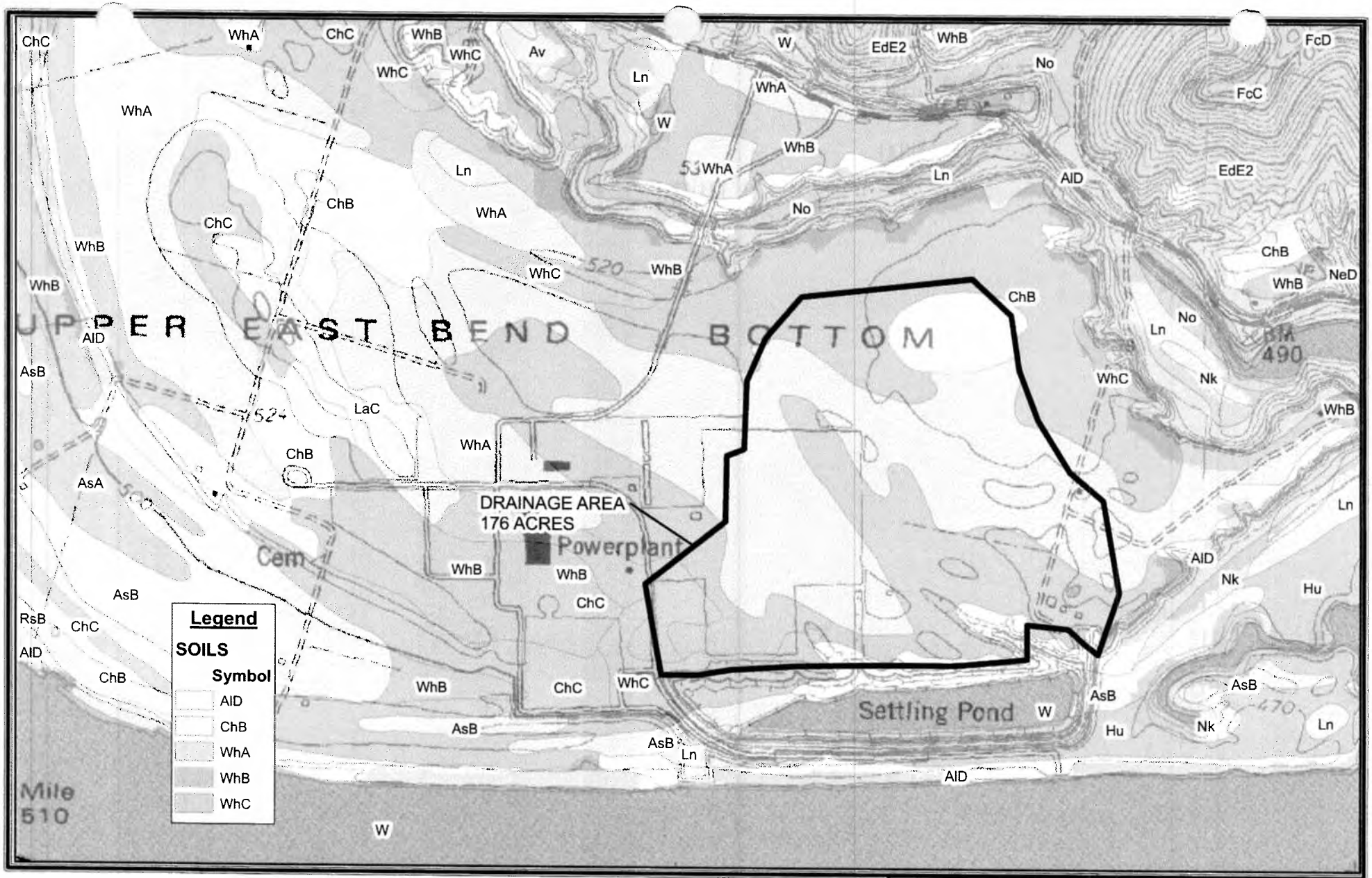
0 500 1,000 2,000 Feet

ASH POND - LAND USE MAP

East Bend Station
Boone County, Kentucky

Project: 011-09323-012	Drawn By: AJS
Drawing Date: 5/14/09	Approved By: SJL
File: 011-09323-012\Base.mxd	

Columbus (614) 793-2226
Cleveland (216) 901-1000
Cincinnati (513) 771-8471
Dayton (937) 424-1011



N

NOTE: SOILS INFORMATION SHOWN FROM USDA SOIL SURVEY

0 500 1,000 2,000 Feet

ASH POND - SOILS SURVEY MAP

East Bend Station
Boone County, Kentucky

Project: 011-09323-012	Drawn By: AJS
Drawing Date: 5/14/09	Approved By: SJL
File: 011-09323-012\Base.mxd	

Columbus (614) 793-2226
Cleveland (216) 901-1000
Cincinnati (513) 771-8471
Dayton (937) 424-1011

Project: 011 09323.012		By: AJS	Date: 14-May-09
Location: East Bend Ash Pond, Boone County, KY		Checked:	Date:

PIPE 1 - CALCULATE T_c AND T_L

Based off of Worksheet 3 in Appendix D of 210-VI-TR-55, Second Ed., June 1986

Overland (Sheet) Flow

Segment	1			
Surface Description	Grass-Short			
Manning's roughness coefficient, n	0.15			
Flow Length, L	300		ft	
2-year, 24-hour rainfall, P_2	3.00		in	
Top/Bottom elevation of segment	612 570		ft	
Land Slope, s	0.14		ft/ft	
Travel Time, T_t	0.186			0.186 hr

$$T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$$

Shallow Concentrated Flow

Segment	2			
Surface Description (Paved or Unpaved)	Unpaved			
Flow Length, L	2700		ft	
Top/Bottom elevation of segment	570 520		ft	
Watercourse slope, s	0.0185		ft/ft	
Average velocity, V (equation in Appendix F)	2.19		ft/s	
Travel Time, T_t	0.342			0.342 hr

$$T_t = \frac{L}{3600\ V}$$

Channel Flow

Segment				
Base Width, b			ft	
Side Slopes, w			ft/ft	
Depth, d			ft	
Cross sectional flow area, a			ft^2	
Wetted Perimeter, p_w			ft	
Hydraulic Radius, r			ft	
Top/Bottom elevation of segment			ft	
Channel Slope, s			ft/ft	
Manning's roughness coefficient, n				
Velocity, V			ft/s	
Flow Length, L			ft	
Travel Time, T_t				hr

$$T_L = 0.6T_c$$

Area Time of Concentration, T_c	0.528	hr
Area Lag Time, T_L	0.32	hr
Area Lag Time, T_L	19.008	min

Runoff to Ash Pond
SCS runoff curve number method

$$S=\frac{1000}{CN}-10$$

6-hour
design storm
P = 13.5 in.
for Moderate Hazard Dam
per KYDEP DOW

Type II Storm
Initial abstraction: $I_a=0.2S$

Runoff depth, $Q=\frac{(P-0.2S)^2}{P+0.8S}$

CN = 88

			0.2S	0.8S	
For CN = 88	S =	1.363636	0.3	1.1	Q = 12.0 in.

Runoff Volume in Acre-feet, V
Area = 176 acres

Runoff Volume in Acre-feet
CN=88 V = 175.9

Ash Pond Capacity - Principal Spillway @ Normal Pool El. 485.5						
Pond Elevation	Riser Weir	Riser Orifice	Pipe Inlet Flow	Pressure Pipe Flow	**Control Flow**	Control Type
feet	cfs	cfs	cfs	cfs	**cfs**	
470.00	0.0	0.0	0.0	49.4	**0.0**	Riser Weir
475.00	0.0	0.0	49.6	56.7	**0.0**	Riser Weir
480.00	0.0	0.0	66.6	63.2	**0.0**	Riser Weir
485.00	0.0	0.0	80.0	69.0	**0.0**	Riser Weir
485.50	0.0	0.0	81.2	69.6	**0.0**	Riser Weir
486.00	12.2	29.0	82.4	70.2	**12.2**	Riser Weir
487.00	63.3	50.2	84.8	71.3	**50.2**	Riser Orifice
488.00	136.1	64.8	87.1	72.3	**64.8**	Riser Orifice
489.00	225.5	76.6	89.3	73.4	**73.4**	Pressure Pipe Flow
490.00	328.7	86.9	91.5	74.4	**74.4**	Pressure Pipe Flow
495.00	1008.3	126.2	101.7	79.5	**79.5**	Pressure Pipe Flow
500.00	1901.3	156.0	111.0	84.2	**84.2**	Pressure Pipe Flow
505.00	2965.3	180.9	119.5	88.7	**88.7**	Pressure Pipe Flow
510.00	4176.0	202.7	127.5	93.0	**93.0**	Pressure Pipe Flow
515.00	5517.5	222.5	135.0	97.0	**97.0**	Pressure Pipe Flow
518.50	6528.0	235.3	138.6	99.0	**99.0**	Pressure Pipe Flow
520.00	6978.1	240.6	142.1	101.0	**101.0**	Pressure Pipe Flow

Total Ash Pond Outflow Capacity			
Pond Elevation	Principal Spillway	Emergency Spillway	**Total Outflow**
feet	cfs	cfs	**cfs**
470.00	0.0		**0.0**
475.00	0.0		**0.0**
480.00	0.0		**0.0**
485.00	0.0		**0.0**
485.50	0.0		**0.0**
486.00	12.2		**12.2**
487.00	50.2		**50.2**
488.00	64.8		**64.8**
489.00	73.4		**73.4**
490.00	74.4		**74.4**
495.00	79.5		**79.5**
500.00	84.2		**84.2**
505.00	88.7		**88.7**
510.00	93.0		**93.0**
515.00	97.0		**97.0**
518.50	99.0	0	**99.0**
520.00	101.0	121	**222.0**

Ash Pond 40" Riser Pipe Rating
Riser Weir Flow - Normal Pool

$$Q = C_{SCW} L H^{\frac{3}{2}}$$

$$C_{SCW} = 3.27 + 0.4\left(\frac{H}{H_c}\right)$$

for $H/H_c < 0.3$, C_{SCW} becomes 3.33

Inside D= 39.500 in

Inside D= 3.2917 ft

L= 10.3 ft

g= 32.2

Crest Elevation= 485.5

Elevation	H	Q
485.50	0.00	0.0
486.00	0.50	12.2
487.00	1.50	63.3
488.00	2.50	136.1
489.00	3.50	225.5
490.00	4.50	328.7
495.00	9.50	1008.3
500.00	14.50	1901.3
505.00	19.50	2965.3
510.00	24.50	4176.0
515.00	29.50	5517.5
518.50	33.00	6528.0
520.00	34.50	6978.1

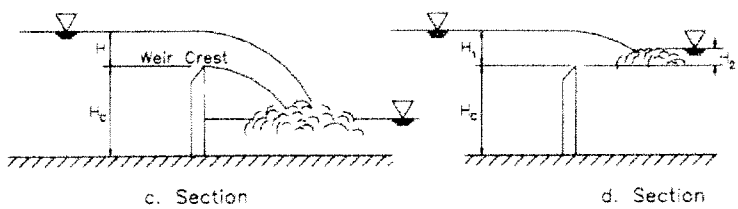


Figure 8-13. Sharp crested weirs.

Reference:
FHWA-SA-96-078
Urban Drainage Design Manual
Hydraulic Engineering Circular 22
November, 1996

Ash Pond 40" Riser Pipe Rating
Orifice Control - Normal Pool

$$Q = CA\sqrt{2gh_1}$$

for C=0.6 orifice equation becomes:

$$Q = 3.78D^2\sqrt{h_1}$$

d= 39.500 INCHES
Orifice Elevation = 485.5

Headwater Elevation (ft.)	Orifice	
	Discharge (cfs)	Velocity (ft/s)
485.50	*0.0*	0.0
486.00	*29.0*	3.4
487.00	*50.2*	5.9
488.00	*64.8*	7.6
489.00	*76.6*	9.0
490.00	*86.9*	10.2
495.00	*126.2*	14.8
500.00	*156.0*	18.3
505.00	*180.9*	21.3
510.00	*202.7*	23.8
515.00	*222.5*	26.2
518.50	*235.3*	27.7
520.00	*240.6*	28.3

Reference:
FHWA-SA-96-078
Urban Drainage Design Manual
Hydraulic Engineering Circular 22
November, 1996

Ash Pond 28" Barrel Pipe Rating
Pipe Inlet Control

$$Q = CA\sqrt{2gh_1}$$

for C=0.6 orifice equation becomes:

$$Q = 3.78D^2\sqrt{h_1}$$

d= 27.500 INCHES

Orifice Elevation = 468.75

Headwater Elevation (ft.)	Orifice	
	Discharge (cfs)	Velocity (ft/s)
470.00	*0.0*	0.0
475.00	*49.6*	12.0
480.00	*66.6*	16.2
485.00	*80.0*	19.4
485.50	*81.2*	19.7
486.00	*82.4*	20.0
487.00	*84.8*	20.6
488.00	*87.1*	21.1
489.00	*89.3*	21.7
490.00	*91.5*	22.2
495.00	*101.7*	24.7
500.00	*111.0*	26.9
505.00	*119.5*	29.0
510.00	*127.5*	30.9
515.00	*135.0*	32.7
517.50	*138.6*	33.6
518.00	*139.3*	33.8
518.50	*140.0*	34.0
519.00	*140.7*	34.1
519.50	*141.4*	34.3
520.00	*142.1*	34.5

Reference:
FHWA-SA-96-078
Urban Drainage Design Manual
Hydraulic Engineering Circular 22
November, 1996

28" Pressure Pipe Flow Computed with the Energy Equation

Manning's n= 0.012
Inlet Invert: 468.75
Inlet Centroid: *469.90*
Outlet Invert (z_2): 441.6
OutletCentroid (z_2): *442.75*
Entrance Coefficent K_e= 0.5
Outlet Coefficent K_o= 1.0
Bend Coefficent K_b= 0.6
Pipe Diameter in inches= 27.500
Pipe Diameter in feet (D)= *2.29*
Pipe Length in feet (L)= 450
Darcy-Weisbach *f*= *0.020*

The Darcy-Weisbach friction factor is related to Manning's n through the following equation:

(3 bends)
$$f = \frac{185\ n^2}{D^{\frac{1}{3}}}$$

The Energy Equation is:

$$\frac{p_1}{\gamma}+\frac{v_1^2}{2g}+z_1=\frac{p_2}{\gamma}+\frac{v_2^2}{2g}+z_2+\sum h_L$$

Where:

$$\sum h_L=\frac{v^2}{2g}\left(f\frac{L}{D}+K_e+K_o+K_b\right)$$

Because p_1, v_1 and p_2 all are equal to 0 the energy equation becomes:

$$z_1-z_2=\frac{v^2}{2g}+\frac{v^2}{2g}\left(f\frac{L}{D}+K_e+K_o+K_b\right)$$

Solving for v gives:

$$v=\sqrt{\frac{2g(z_1-z_2)}{\left(1+\left(f\frac{L}{D}+K_e+K_o+K_b\right)\right)}}$$

Determine flow rate Q by:

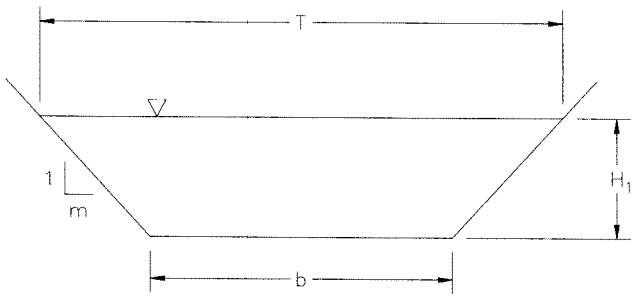
$$Q = VA$$

Assuming tailwater at OH River
Normal Pool El: 454.25

Headwater Elevation (z_1) (ft)	Outlet Velocity (ft/s)	Outlet Flow Rate (ft^3/s)
470.00	11.98	49.41
475.00	13.75	56.72
480.00	15.32	63.18
485.00	16.74	69.04
485.50	16.87	69.60
486.00	17.01	70.16
487.00	17.27	71.25
488.00	17.54	72.33
489.00	17.79	73.40
490.00	18.05	74.44
495.00	19.27	79.48
500.00	20.42	84.22
505.00	21.50	88.70
510.00	22.54	92.96
515.00	23.53	97.04
517.50	24.01	99.02
518.00	24.10	99.41
518.50	24.20	99.80
519.00	24.29	100.19
519.50	24.38	100.57
520.00	24.48	100.96

East Bend Ash Pond - Emergency Overflow Spillway Rating
Trapezoidal Broad Crested Weir Equation (French, 1985):

$$Q_2 = C_D\left(Ty_c + my_c^2\right)\left[2g\left(H_1 - y_c\right)\right]^{\frac{1}{2}}$$



Definition of Critical Depth:

$$y_c = \left(\frac{Q_1^2}{b^2 g}\right)^{\frac{1}{3}}$$

Solve for Q:

$$Q_1 = b\sqrt{g}\, y_c^{\frac{3}{2}}$$

Determine weir flow by equating Q_1 to Q_2 by varying y_c.

Input: **b= 12** **m= 12** **C_D= 0.85**
Weir Crest Elevation= 518.5

Headwater Elevation	H_1 (ft)	y_c (ft)	Q_1 (cfs)	T (ft)	C_D	Q_2 (cfs)	Q_1-Q_2 (cfs)	Q (cfs)
518.50	0.00	0.00	0.0	12	0.85	0.0	0	**0**
519.00	0.50	0.45	20.4	24	0.85	20.4	3.5945E-05	**20**
519.50	1.00	0.96	63.8	36	0.85	63.8	0.00018892	**64**
520.00	1.50	1.47	120.9	48	0.85	120.9	0.00046436	**121**

```
1****************************************
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 *                                    *                                                    *
*
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                                    *    U.S. ARMY CORPS OF ENGINEERS
*
 *               JUN   1998             *                                                    *    HYDROLOGIC ENGINEERING CENTER
*
 *            VERSION 4.1               *                                                    *          609 SECOND STREET
*
 *                                      *                                                    *       DAVIS, CALIFORNIA 95616
*
 *  RUN DATE   15MAY09  TIME  16:59:30  *                                                    *           (916) 756-1104
*
 *                                      *                                                    *
*
 ****************************************
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X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X               X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X               X
X     X  X        X     X         X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


```
          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 *** FREE ***
             1          ID   EAST BEND ASH POND
             2          ID   BBC&M Job# 011 09323.012
             3          ID   MODERATE HAZARD DAM - DESIGN STORM = 13.5IN.
             4          ID   COMPUTER GENERATED HYDROGRAPH SCS 6-HOUR DISTRIBUTION
             5          ID   FILE: Ash Pond Normal Pool
             6          IT      15       0       0     200
             7          IO       2       0
             8          IN      12

             9          KK COMPUTERUNOFF FROM ASH POND DRAINAGE AREA
            10          PB    13.5
            11          PC   .0130    .027    .042    .059    .078    .099    .122    .147     .18     .23
            12          PC     .38     .53    .625     .67    .705    .736    .764     .79    .814    .836
            13          PC    .856    .875   .8931   .9103   .9267   .9423   .9573   .9719   .9861     1.0
            14          BA   0.275
            15          LS       0      88
            16          UD    0.32

            17          KK   ROUTEFLOW THROUGH PIKE LAKE DAM
            18          RS       1    ELEV   485.5
            19          SV       0   109.8   224.9   345.2   470.9   602.4   740.3   811.7   885.2   961.3
            20          SV  1039.6  1120.1  1202.8  1287.5  1374.4  1463.4  1554.6  1648.2  1744.1  1843.7
            21          SE     470     474     478     482     486     490     494     496     498     500
            22          SE     502     504     506     508     510     512     514     516     518     520
            23          SQ       0       0       0       0       0    12.2    50.2    64.8    73.4    74.4
            24          SQ    79.5    84.2    88.7    93.0    97.0    99.0   222.0
            25          SE     470     475     480     485   485.5     486     487     488     489     490
            26          SE     495     500     505     510     515   518.5     520
            27          ST     520
            28          ZZ
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1****************************************
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 *                                    *                                                    *
*
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                                    *    U.S. ARMY CORPS OF ENGINEERS
*
 *               JUN   1998             *                                                    *    HYDROLOGIC ENGINEERING CENTER
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*
 *                                      *                                                    *       DAVIS, CALIFORNIA 95616
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 *  RUN DATE   15MAY09  TIME  16:59:30  *                                                    *           (916) 756-1104
*
 *                                      *                                                    *
*
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 ****************************************
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                        EAST BEND ASH POND
                        BBC&M Job# 011 09323.012
                        MODERATE HAZARD DAM - DESIGN STORM = 13.5IN.
                        COMPUTER GENERATED HYDROGRAPH SCS 6-HOUR DISTRIBUTION
                        FILE: Ash Pond Normal Pool

   7 IO          OUTPUT CONTROL VARIABLES
                       IPRNT           2  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                        NMIN          15  MINUTES IN COMPUTATION INTERVAL
                       IDATE      1    0  STARTING DATE
                       ITIME        0000  STARTING TIME
                          NQ         200  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE      3    0  ENDING DATE
                      NDTIME        0145  ENDING TIME
                       ICENT          19  CENTURY MARK

                  COMPUTATION INTERVAL     .25 HOURS
                       TOTAL TIME BASE   49.75 HOURS

          ENGLISH UNITS
               DRAINAGE AREA          SQUARE MILES
               PRECIPITATION DEPTH    INCHES
               LENGTH, ELEVATION      FEET
               FLOW                   CUBIC FEET PER SECOND
               STORAGE VOLUME         ACRE-FEET
               SURFACE AREA           ACRES
               TEMPERATURE            DEGREES FAHRENHEIT


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
***


            **************
            *            *
   9 KK     *   COMPUTE  *     RUNOFF FROM ASH POND DRAINAGE AREA
            *            *
            **************

   8 IN          TIME DATA FOR INPUT TIME SERIES
                       JXMIN          12  TIME INTERVAL IN MINUTES
                      JXDATE      1    0  STARTING DATE
                      JXTIME           0  STARTING TIME

              SUBBASIN RUNOFF DATA

  14 BA          SUBBASIN CHARACTERISTICS
                       TAREA         .28  SUBBASIN AREA

                 PRECIPITATION DATA

  10 PB                STORM       13.50  BASIN TOTAL PRECIPITATION

  11 PI            INCREMENTAL PRECIPITATION PATTERN
                      .02       .02       .02       .03       .03       .04       .05       .16       .17       .09
                      .05       .04       .03       .03       .03       .03       .02       .02       .02       .02
                      .02       .02       .02       .00

  15 LS          SCS LOSS RATE
                       STRTL         .27  INITIAL ABSTRACTION
                      CRVNBR       88.00  CURVE NUMBER
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

  16 UD          SCS DIMENSIONLESS UNITGRAPH
                        TLAG         .32  LAG

                                                        ***

                                                   UNIT HYDROGRAPH
                                              8 END-OF-PERIOD ORDINATES
              177.      294.      143.       58.       23.        9.        4.        2.

*****************************************************************************************************************************
***

                                                HYDROGRAPH AT STATION  COMPUTE

*****************************************************************************************************************************
***
                                                                  *
       DA MON HRMN  ORD    RAIN    LOSS  EXCESS     COMP Q        *       DA MON HRMN  ORD    RAIN    LOSS  EXCESS     COMP Q
```

							*							
1	0000	1	.00	.00	.00	0.	*	2	0100	101	.00	.00	.00	0.
1	0015	2	.24	.24	.00	0.	*	2	0115	102	.00	.00	.00	0.
1	0030	3	.27	.23	.04	6.	*	2	0130	103	.00	.00	.00	0.
1	0045	4	.31	.19	.12	32.	*	2	0145	104	.00	.00	.00	0.
1	0100	5	.35	.15	.20	77.	*	2	0200	105	.00	.00	.00	0.
1	0115	6	.40	.12	.28	128.	*	2	0215	106	.00	.00	.00	0.
1	0130	7	.48	.11	.38	185.	*	2	0230	107	.00	.00	.00	0.
1	0145	8	.74	.11	.63	276.	*	2	0245	108	.00	.00	.00	0.
1	0200	9	2.22	.17	2.05	623.	*	2	0300	109	.00	.00	.00	0.
1	0215	10	2.38	.09	2.29	1129.	*	2	0315	110	.00	.00	.00	0.
1	0230	11	1.28	.03	1.25	1238.	*	2	0330	111	.00	.00	.00	0.
1	0245	12	.67	.01	.65	951.	*	2	0345	112	.00	.00	.00	0.
1	0300	13	.54	.01	.53	654.	*	2	0400	113	.00	.00	.00	0.
1	0315	14	.47	.01	.46	481.	*	2	0415	114	.00	.00	.00	0.
1	0330	15	.43	.01	.42	385.	*	2	0430	115	.00	.00	.00	0.
1	0345	16	.39	.00	.38	329.	*	2	0445	116	.00	.00	.00	0.
1	0400	17	.35	.00	.34	289.	*	2	0500	117	.00	.00	.00	0.
1	0415	18	.32	.00	.32	257.	*	2	0515	118	.00	.00	.00	0.
1	0430	19	.30	.00	.30	235.	*	2	0530	119	.00	.00	.00	0.
1	0445	20	.29	.00	.28	219.	*	2	0545	120	.00	.00	.00	0.
1	0500	21	.27	.00	.27	206.	*	2	0600	121	.00	.00	.00	0.
1	0515	22	.26	.00	.25	194.	*	2	0615	122	.00	.00	.00	0.
1	0530	23	.25	.00	.24	184.	*	2	0630	123	.00	.00	.00	0.
1	0545	24	.24	.00	.24	177.	*	2	0645	124	.00	.00	.00	0.
1	0600	25	.05	.00	.05	138.	*	2	0700	125	.00	.00	.00	0.
1	0615	26	.00	.00	.00	72.	*	2	0715	126	.00	.00	.00	0.
1	0630	27	.00	.00	.00	30.	*	2	0730	127	.00	.00	.00	0.
1	0645	28	.00	.00	.00	12.	*	2	0745	128	.00	.00	.00	0.
1	0700	29	.00	.00	.00	5.	*	2	0800	129	.00	.00	.00	0.
1	0715	30	.00	.00	.00	2.	*	2	0815	130	.00	.00	.00	0.
1	0730	31	.00	.00	.00	1.	*	2	0830	131	.00	.00	.00	0.
1	0745	32	.00	.00	.00	0.	*	2	0845	132	.00	.00	.00	0.
1	0800	33	.00	.00	.00	0.	*	2	0900	133	.00	.00	.00	0.
1	0815	34	.00	.00	.00	0.	*	2	0915	134	.00	.00	.00	0.
1	0830	35	.00	.00	.00	0.	*	2	0930	135	.00	.00	.00	0.
1	0845	36	.00	.00	.00	0.	*	2	0945	136	.00	.00	.00	0.
1	0900	37	.00	.00	.00	0.	*	2	1000	137	.00	.00	.00	0.
1	0915	38	.00	.00	.00	0.	*	2	1015	138	.00	.00	.00	0.
1	0930	39	.00	.00	.00	0.	*	2	1030	139	.00	.00	.00	0.
1	0945	40	.00	.00	.00	0.	*	2	1045	140	.00	.00	.00	0.
1	1000	41	.00	.00	.00	0.	*	2	1100	141	.00	.00	.00	0.
1	1015	42	.00	.00	.00	0.	*	2	1115	142	.00	.00	.00	0.
1	1030	43	.00	.00	.00	0.	*	2	1130	143	.00	.00	.00	0.
1	1045	44	.00	.00	.00	0.	*	2	1145	144	.00	.00	.00	0.
1	1100	45	.00	.00	.00	0.	*	2	1200	145	.00	.00	.00	0.
1	1115	46	.00	.00	.00	0.	*	2	1215	146	.00	.00	.00	0.
1	1130	47	.00	.00	.00	0.	*	2	1230	147	.00	.00	.00	0.
1	1145	48	.00	.00	.00	0.	*	2	1245	148	.00	.00	.00	0.
1	1200	49	.00	.00	.00	0.	*	2	1300	149	.00	.00	.00	0.
1	1215	50	.00	.00	.00	0.	*	2	1315	150	.00	.00	.00	0.
1	1230	51	.00	.00	.00	0.	*	2	1330	151	.00	.00	.00	0.
1	1245	52	.00	.00	.00	0.	*	2	1345	152	.00	.00	.00	0.
1	1300	53	.00	.00	.00	0.	*	2	1400	153	.00	.00	.00	0.
1	1315	54	.00	.00	.00	0.	*	2	1415	154	.00	.00	.00	0.
1	1330	55	.00	.00	.00	0.	*	2	1430	155	.00	.00	.00	0.
1	1345	56	.00	.00	.00	0.	*	2	1445	156	.00	.00	.00	0.
1	1400	57	.00	.00	.00	0.	*	2	1500	157	.00	.00	.00	0.
1	1415	58	.00	.00	.00	0.	*	2	1515	158	.00	.00	.00	0.
1	1430	59	.00	.00	.00	0.	*	2	1530	159	.00	.00	.00	0.
1	1445	60	.00	.00	.00	0.	*	2	1545	160	.00	.00	.00	0.
1	1500	61	.00	.00	.00	0.	*	2	1600	161	.00	.00	.00	0.
1	1515	62	.00	.00	.00	0.	*	2	1615	162	.00	.00	.00	0.
1	1530	63	.00	.00	.00	0.	*	2	1630	163	.00	.00	.00	0.
1	1545	64	.00	.00	.00	0.	*	2	1645	164	.00	.00	.00	0.
1	1600	65	.00	.00	.00	0.	*	2	1700	165	.00	.00	.00	0.
1	1615	66	.00	.00	.00	0.	*	2	1715	166	.00	.00	.00	0.
1	1630	67	.00	.00	.00	0.	*	2	1730	167	.00	.00	.00	0.
1	1645	68	.00	.00	.00	0.	*	2	1745	168	.00	.00	.00	0.
1	1700	69	.00	.00	.00	0.	*	2	1800	169	.00	.00	.00	0.
1	1715	70	.00	.00	.00	0.	*	2	1815	170	.00	.00	.00	0.
1	1730	71	.00	.00	.00	0.	*	2	1830	171	.00	.00	.00	0.
1	1745	72	.00	.00	.00	0.	*	2	1845	172	.00	.00	.00	0.
1	1800	73	.00	.00	.00	0.	*	2	1900	173	.00	.00	.00	0.
1	1815	74	.00	.00	.00	0.	*	2	1915	174	.00	.00	.00	0.
1	1830	75	.00	.00	.00	0.	*	2	1930	175	.00	.00	.00	0.
1	1845	76	.00	.00	.00	0.	*	2	1945	176	.00	.00	.00	0.
1	1900	77	.00	.00	.00	0.	*	2	2000	177	.00	.00	.00	0.
1	1915	78	.00	.00	.00	0.	*	2	2015	178	.00	.00	.00	0.
1	1930	79	.00	.00	.00	0.	*	2	2030	179	.00	.00	.00	0.
1	1945	80	.00	.00	.00	0.	*	2	2045	180	.00	.00	.00	0.
1	2000	81	.00	.00	.00	0.	*	2	2100	181	.00	.00	.00	0.
1	2015	82	.00	.00	.00	0.	*	2	2115	182	.00	.00	.00	0.
1	2030	83	.00	.00	.00	0.	*	2	2130	183	.00	.00	.00	0.
1	2045	84	.00	.00	.00	0.	*	2	2145	184	.00	.00	.00	0.
1	2100	85	.00	.00	.00	0.	*	2	2200	185	.00	.00	.00	0.
1	2115	86	.00	.00	.00	0.	*	2	2215	186	.00	.00	.00	0.
1	2130	87	.00	.00	.00	0.	*	2	2230	187	.00	.00	.00	0.
1	2145	88	.00	.00	.00	0.	*	2	2245	188	.00	.00	.00	0.
1	2200	89	.00	.00	.00	0.	*	2	2300	189	.00	.00	.00	0.
1	2215	90	.00	.00	.00	0.	*	2	2315	190	.00	.00	.00	0.
1	2230	91	.00	.00	.00	0.	*	2	2330	191	.00	.00	.00	0.
1	2245	92	.00	.00	.00	0.	*	2	2345	192	.00	.00	.00	0.
1	2300	93	.00	.00	.00	0.	*	3	0000	193	.00	.00	.00	0.
1	2315	94	.00	.00	.00	0.	*	3	0015	194	.00	.00	.00	0.

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        1    2330  95    .00    .00    .00        0.       *       3    0030  195    .00    .00    .00        0.
        1    2345  96    .00    .00    .00        0.       *       3    0045  196    .00    .00    .00        0.
        2    0000  97    .00    .00    .00        0.       *       3    0100  197    .00    .00    .00        0.
        2    0015  98    .00    .00    .00        0.       *       3    0115  198    .00    .00    .00        0.
        2    0030  99    .00    .00    .00        0.       *       3    0130  199    .00    .00    .00        0.
        2    0045 100    .00    .00    .00        0.       *       3    0145  200    .00    .00    .00        0.
                                                                  *

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     TOTAL RAINFALL =   13.50, TOTAL LOSS =    1.51, TOTAL EXCESS =   11.99

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     49.75-HR
+   (CFS)       (HR)
                          (CFS)
+    1238.      2.50                 353.         89.         43.         43.
                        (INCHES)   11.941      11.991      11.991      11.991
                         (AC-FT)     175.        176.        176.        176.

                        CUMULATIVE AREA =     .28 SQ MI


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
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            *            *
   17 KK    *     ROUTE  *     FLOW THROUGH PIKE LAKE DAM
            *            *
            **************

               HYDROGRAPH ROUTING DATA

   18 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        ELEV  TYPE OF INITIAL CONDITION
                       RSVRIC      485.50  INITIAL CONDITION
                            X         .00 WORKING R AND D COEFFICIENT

   19 SV            STORAGE          .0     109.8     224.9     345.2     470.9     602.4     740.3     811.7     885.2
961.3
                                 1039.6    1120.1    1202.8    1287.5    1374.4    1463.4    1554.6    1648.2    1744.1
1843.7

   21 SE          ELEVATION      470.00    474.00    478.00    482.00    486.00    490.00    494.00    496.00    498.00
500.00
                                 502.00    504.00    506.00    508.00    510.00    512.00    514.00    516.00    518.00
520.00

   23 SQ          DISCHARGE          0.        0.        0.        0.        0.       12.       50.       65.       73.
74.
                                    80.       84.       89.       93.       97.       99.      222.

   25 SE          ELEVATION      470.00    475.00    480.00    485.00    485.50    486.00    487.00    488.00    489.00
490.00
                                 495.00    500.00    505.00    510.00    515.00    518.50    520.00

   27 ST          TOP OF DAM
                       TOPEL      520.00  ELEVATION AT TOP OF DAM
                      DAMWID         .00  DAM WIDTH
                        COQD         .00  WEIR COEFFICIENT
                        EXPD         .00  EXPONENT OF HEAD

                                                        ***

                                   COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

                                        (INCLUDING FLOW OVER DAM)

          STORAGE        .00    109.80    138.57    224.90    285.05    345.20    439.48    455.19    470.90    503.77
          OUTFLOW        .00       .00       .00       .00       .00       .00       .00       .00     12.20     50.20
        ELEVATION     470.00    474.00    475.00    478.00    480.00    482.00    485.00    485.50    486.00    487.00

          STORAGE     536.65    569.53    602.40    740.30    776.00    811.70    885.20    961.30   1039.60   1120.10
          OUTFLOW      64.80     73.40     74.40     78.48     79.50     80.44     82.32     84.20     86.00     87.80
        ELEVATION     488.00    489.00    490.00    494.00    495.00    496.00    498.00    500.00    502.00    504.00

          STORAGE    1161.45   1202.80   1287.50   1374.40   1463.40   1554.60   1601.40   1648.20   1744.10   1769.00
          OUTFLOW      88.70     89.56     91.28     93.00     94.60     96.20     97.00     97.57     98.71     99.00
        ELEVATION     505.00    506.00    508.00    510.00    512.00    514.00    515.00    516.00    518.00    518.50

          STORAGE    1843.70
          OUTFLOW     222.00
        ELEVATION     520.00

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                                   HYDROGRAPH AT STATION    ROUTE
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DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	455.2	485.5	1		1645	68	67.	543.7	488.2	2		0930	135	22.	479.6	486.3
1		0015	2	0.	455.2	485.5	1		1700	69	66.	542.4	488.2	2		0945	136	22.	479.2	486.3
1		0030	3	0.	455.3	485.5	1		1715	70	66.	541.0	488.1	2		1000	137	21.	478.7	486.2
1		0045	4	0.	455.6	485.5	1		1730	71	66.	539.6	488.1	2		1015	138	21.	478.3	486.2
1		0100	5	1.	456.8	485.5	1		1745	72	65.	538.3	488.0	2		1030	139	20.	477.9	486.2
1		0115	6	3.	458.8	485.6	1		1800	73	65.	536.9	488.0	2		1045	140	20.	477.4	486.2
1		0130	7	5.	462.0	485.7	1		1815	74	64.	535.6	488.0	2		1100	141	19.	477.0	486.2
1		0145	8	9.	466.6	485.9	1		1830	75	64.	534.3	487.9	2		1115	142	19.	476.6	486.2
1		0200	9	18.	475.6	486.1	1		1845	76	63.	533.0	487.9	2		1130	143	18.	476.3	486.2
1		0215	10	38.	493.1	486.7	1		1900	77	63.	531.7	487.8	2		1145	144	18.	475.9	486.2
1		0230	11	56.	516.6	487.4	1		1915	78	62.	530.4	487.8	2		1200	145	18.	475.5	486.1
1		0245	12	65.	537.9	488.0	1		1930	79	61.	529.1	487.8	2		1215	146	17.	475.2	486.1
1		0300	13	69.	553.1	488.5	1		1945	80	61.	527.8	487.7	2		1230	147	17.	474.8	486.1
1		0315	14	72.	563.4	488.8	1		2000	81	60.	526.6	487.7	2		1245	148	16.	474.5	486.1
1		0330	15	73.	570.8	489.0	1		2015	82	60.	525.3	487.7	2		1300	149	16.	474.1	486.1
1		0345	16	74.	576.7	489.2	1		2030	83	59.	524.1	487.6	2		1315	150	16.	473.8	486.1
1		0400	17	74.	581.5	489.4	1		2045	84	59.	522.9	487.6	2		1330	151	15.	473.5	486.1
1		0415	18	74.	585.6	489.5	1		2100	85	58.	521.7	487.5	2		1345	152	15.	473.2	486.1
1		0430	19	74.	589.2	489.6	1		2115	86	58.	520.5	487.5	2		1400	153	14.	472.9	486.1
1		0445	20	74.	592.4	489.7	1		2130	87	57.	519.3	487.5	2		1415	154	14.	472.6	486.1
1		0500	21	74.	595.2	489.8	1		2145	88	57.	518.1	487.4	2		1430	155	14.	472.3	486.0
1		0515	22	74.	597.8	489.9	1		2200	89	56.	517.0	487.4	2		1445	156	13.	472.0	486.0
1		0530	23	74.	600.2	489.9	1		2215	90	56.	515.8	487.4	2		1500	157	13.	471.7	486.0
1		0545	24	74.	602.4	490.0	1		2230	91	55.	514.7	487.3	2		1515	158	13.	471.5	486.0
1		0600	25	74.	604.1	490.0	1		2245	92	55.	513.5	487.3	2		1530	159	13.	471.2	486.0
1		0615	26	74.	604.7	490.1	1		2300	93	54.	512.4	487.3	2		1545	160	12.	470.9	486.0
1		0630	27	74.	604.2	490.1	1		2315	94	54.	511.3	487.2	2		1600	161	12.	470.7	486.0
1		0645	28	74.	603.1	490.0	1		2330	95	53.	510.2	487.2	2		1615	162	12.	470.5	486.0
1		0700	29	74.	601.8	490.0	1		2345	96	53.	509.1	487.2	2		1630	163	12.	470.2	486.0
1		0715	30	74.	600.3	489.9	2		0000	97	52.	508.0	487.1	2		1645	164	11.	470.0	486.0
1		0730	31	74.	598.8	489.9	2		0015	98	52.	507.0	487.1	2		1700	165	11.	469.7	486.0
1		0745	32	74.	597.2	489.8	2		0030	99	51.	505.9	487.1	2		1715	166	11.	469.5	486.0
1		0800	33	74.	595.7	489.8	2		0045	100	51.	504.9	487.0	2		1730	167	11.	469.3	485.9
1		0815	34	74.	594.2	489.7	2		0100	101	50.	503.8	487.0	2		1745	168	11.	469.1	485.9
1		0830	35	74.	592.6	489.7	2		0115	102	49.	502.8	487.0	2		1800	169	11.	468.9	485.9
1		0845	36	74.	591.1	489.7	2		0130	103	48.	501.8	486.9	2		1815	170	10.	468.7	485.9
1		0900	37	74.	589.6	489.6	2		0145	104	47.	500.8	486.9	2		1830	171	10.	468.5	485.9
1		0915	38	74.	588.1	489.6	2		0200	105	46.	499.8	486.9	2		1845	172	10.	468.3	485.9
1		0930	39	74.	586.5	489.5	2		0215	106	45.	498.9	486.9	2		1900	173	10.	468.1	485.9
1		0945	40	74.	585.0	489.5	2		0230	107	43.	498.0	486.8	2		1915	174	10.	467.9	485.9
1		1000	41	74.	583.5	489.4	2		0245	108	42.	497.1	486.8	2		1930	175	10.	467.7	485.9
1		1015	42	74.	582.0	489.4	2		0300	109	41.	496.2	486.8	2		1945	176	10.	467.5	485.9
1		1030	43	74.	580.4	489.3	2		0315	110	40.	495.4	486.7	2		2000	177	9.	467.3	485.9

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   1    1045  44      74.    578.9   489.3 *  2     0330 111      40.    494.5   486.7 *  2     2015 178       9.    467.1
485.9
   1    1100  45      74.    577.4   489.2 *  2     0345 112      39.    493.7   486.7 *  2     2030 179       9.    466.9
485.9
   1    1115  46      74.    575.9   489.2 *  2     0400 113      38.    492.9   486.7 *  2     2045 180       9.    466.7
485.9
   1    1130  47      74.    574.4   489.1 *  2     0415 114      37.    492.2   486.6 *  2     2100 181       9.    466.6
485.9
   1    1145  48      74.    572.8   489.1 *  2     0430 115      36.    491.4   486.6 *  2     2115 182       9.    466.4
485.9
   1    1200  49      73.    571.3   489.1 *  2     0445 116      35.    490.7   486.6 *  2     2130 183       9.    466.2
485.9
   1    1215  50      73.    569.8   489.0 *  2     0500 117      34.    490.0   486.6 *  2     2145 184       8.    466.0
485.8
   1    1230  51      73.    568.3   489.0 *  2     0515 118      33.    489.3   486.6 *  2     2200 185       8.    465.9
485.8
   1    1245  52      73.    566.8   488.9 *  2     0530 119      33.    488.6   486.5 *  2     2215 186       8.    465.7
485.8
   1    1300  53      72.    565.3   488.9 *  2     0545 120      32.    487.9   486.5 *  2     2230 187       8.    465.5
485.8
   1    1315  54      72.    563.8   488.8 *  2     0600 121      31.    487.3   486.5 *  2     2245 188       8.    465.4
485.8
   1    1330  55      72.    562.3   488.8 *  2     0615 122      30.    486.6   486.5 *  2     2300 189       8.    465.2
485.8
   1    1345  56      71.    560.8   488.7 *  2     0630 123      30.    486.0   486.5 *  2     2315 190       8.    465.1
485.8
   1    1400  57      71.    559.4   488.7 *  2     0645 124      29.    485.4   486.4 *  2     2330 191       8.    464.9
485.8
   1    1415  58      70.    557.9   488.6 *  2     0700 125      28.    484.8   486.4 *  2     2345 192       7.    464.8
485.8
   1    1430  59      70.    556.4   488.6 *  2     0715 126      28.    484.2   486.4 *  3     0000 193       7.    464.6
485.8
   1    1445  60      70.    555.0   488.6 *  2     0730 127      27.    483.7   486.4 *  3     0015 194       7.    464.5
485.8
   1    1500  61      69.    553.6   488.5 *  2     0745 128      26.    483.1   486.4 *  3     0030 195       7.    464.3
485.8
   1    1515  62      69.    552.1   488.5 *  2     0800 129      26.    482.6   486.4 *  3     0045 196       7.    464.2
485.8
   1    1530  63      68.    550.7   488.4 *  2     0815 130      25.    482.1   486.3 *  3     0100 197       7.    464.1
485.8
   1    1545  64      68.    549.3   488.4 *  2     0830 131      24.    481.5   486.3 *  3     0115 198       7.    463.9
485.8
   1    1600  65      68.    547.9   488.3 *  2     0845 132      24.    481.0   486.3 *  3     0130 199       7.    463.8
485.8
   1    1615  66      67.    546.5   488.3 *  2     0900 133      23.    480.5   486.3 *  3     0145 200       7.    463.6
485.8
   1    1630  67      67.    545.1   488.3 *  2     0915 134      23.    480.1   486.3 *
                                             *                                             *

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 PEAK OUTFLOW IS       74. AT TIME   6.25 HOURS


  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     49.75-HR
+   (CFS)       (HR)
                              (CFS)
+      74.      6.25                 74.         66.         41.         41.
                            (INCHES)      2.508       8.926      11.420      11.420
                            (AC-FT)        37.        131.        167.        167.

 PEAK STORAGE   TIME                         MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR     49.75-HR
+  (AC-FT)      (HR)
      605.      6.25                595.        553.        512.        512.

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR     49.75-HR
+   (FEET)      (HR)
    490.07      6.25              489.78      488.50      487.26      487.26

                        CUMULATIVE AREA =     .28 SQ MI

1
                                                RUNOFF SUMMARY
                                        FLOW IN CUBIC FEET PER SECOND
                                      TIME IN HOURS,  AREA IN SQUARE MILES

                                     PEAK   TIME OF     AVERAGE FLOW FOR MAXIMUM PERIOD      BASIN     MAXIMUM     TIME OF
         OPERATION       STATION     FLOW    PEAK                                           AREA      STAGE     MAX STAGE
+                                                          6-HOUR     24-HOUR     72-HOUR

         HYDROGRAPH AT
+                        COMPUTE     1238.    2.50         353.         89.         43.        .28

         ROUTED TO
+                          ROUTE       74.    6.25          74.         66.         41.        .28
+                                                                                                          490.07        6.25
1                                SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION    ROUTE
                            (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)
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PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	485.50	520.00	520.00
STORAGE	455.	1844.	1844.
OUTFLOW	0.	222.	222.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	490.07	.00	605.	74.	.00	6.25	.00

*** NORMAL END OF HEC-1 ***


© 2010 Google
© 2010 Europa Technologies
Image U.S. Geological Survey
©2009 Google
Imagery Date: Aug 24, 2005
38°54'10.43" N 84°50'31.67" W elev 515 ft
Eye alt 5422 ft

STEVEN L. BESHEAR
GOVERNOR

LEONARD K. PETERS
SECRETARY

ENERGY AND ENVIRONMENT CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
DIVISION OF WATER
200 FAIR OAKS LANE
FRANKFORT, KENTUCKY 40601
www.kentucky.gov

October 9, 2009

Mr. James J. Stieritz
Duke Energy Corporation
139 E. 4th Street, Room 552-A
Cincinnati, OH 45202

RE: **Inspection of East Bend Ash Pond Dam**
AI 176
KY 1215 in Boone County
Class: Moderate Hazard, Class B

Dear Mr. Stieritz:

We have reviewed the as-built plans and information submitted by your engineers for the above referenced structure. Based on our review and an on-site inspection on March 24, 2009, we have determined that this structure has been constructed in accordance with the approved plans and specifications.

This dam is in the Division of Water's active inventory as a moderate hazard structure and has been assigned inventory number **KY 1215**. Moderate hazard structures are presently being inspected every two years. Periodic inspections are deemed necessary for the activities of this class of operation.

Kentucky Revised Statutes Chapter 151 (KRS 151) and associated regulations establish minimum maintenance and design criteria for dams. KRS 151.125 gives the Division of Water authority to require any measures necessary to bring the dam into compliance with statutes and regulations. As the owner you are required to maintain the dam to assure public safety.

Should you have any questions concerning this matter, please contact me at (502) 564-3410.

Sincerely,

Gary Wells

Gary Wells, PE
Dam Safety and Floodplain Compliance
Division of Water

STEVEN L. BESHEAR
GOVERNOR

LEONARD K. PETERS
SECRETARY

ENERGY AND ENVIRONMENT CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
DIVISION OF WATER
200 FAIR OAKS LANE
FRANKFORT, KENTUCKY 40601
www.kentucky.gov

Received 4/8/09

March 25, 2009

Mr. James J. Stieritz
Duke Energy Corporation
139 East Fourth St, Room 552-A
Cincinnati, OH 45202

Re: Scheduled Inspection
East Bend Power Plant
Boone County, KY.
Hazard Class: MODERATE

Dear Duke Energy Corporation:

On March 24, 2009, personnel from the Energy and Environment Cabinet, Division of Water, inspected the above referenced structure. A copy of the inspection report is enclosed. The Division of Water is responsible for performing safety inspections of dams in Kentucky.

Kentucky Revised Statutes Chapter 151 (KRS 151) and associated regulations establish minimum maintenance and design criteria for dams. KRS 151.125 gives the Division of Water authority to require any measures necessary to bring the dam into compliance with statutes and regulations. As the owner you are required to maintain the dam to assure public safety. The following information must be provided to us to bring the dam into compliance with state law.

1) This structure has been classified as a Moderate Hazard dam because, in the event of failure, the plant could no longer operate to supply power to customers, especially to facilities requiring emergency care such as to hospitals. If you wish to reclassify this structure as a Low Hazard Dam, you must demonstrate and provide evidence to Division of Water of an alternate power source for customers when the plant is offline.
2) A flood routing analysis required by the hydraulic capacity requirements for each dam per KRS 151.293 **must be performed**. The Division of Water will upon request, assist the engineering in preparing the flood routing. However, the information below in item #3 must be submitted for the analysis.
3) Provide survey information on the Elevation-Area-Capacity curves and data calculations per "Design Criteria For Dams & Associated Structures – Engineering Memo. No. 5". The area must be in acres and the capacity storage in acre-ft. The data must be to the top of the dam elevation (see enclosed format example).
4) Provide Dam Construction Design Data Sheet that can be downloaded off the website: http://www.water.ky.gov/permitting, click on the link that says "Dam Construction". Next, click on the link that says 'Download Page' and select 'Dam Data Sheet Application (.pdf format). This should be filled out completely and submitted.
5) Provide the survey elevation of the survey marker found on the crest near the principal spillway tower.

Submit this information within thirty (30) days from the date of this letter or contact us directly. All plans are to be prepared and submitted by a registered professional engineer licensed to practice in Kentucky. If you need more time to comply with providing the above information stated in this letter, you must make a request in writing to the Division of Water. Failure to comply and/or to reply to any of the above measures could result in enforcement action and the assessment of penalties. Your cooperation and attention to this matter is appreciated. If you have any questions or need additional information, please contact me at (502) 564-3410, Ext. 4595.

Sincerely,

Gary Wells

Gary Wells, PE, Engineer
Dam Safety and Floodplain Compliance
Division of Water

Enclosure

STEVEN L. BESHEAR
GOVERNOR

LEONARD K. PETERS
SECRETARY

ENERGY AND ENVIRONMENT CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
DIVISION OF WATER
200 FAIR OAKS LANE, 4TH FLOOR
FRANKFORT, KENTUCKY 40601
www.kentucky.gov

CERTIFICATE OF INSPECTION FOR DAM AND APPURTENANT WORKS

Note: The Division of Water does not intend this report to be taken as an assurance that no other problems exist at this site or that this dam is safe. The reports sole intent is to provide you a factual account of the conditions observed at the site during the inspection. If you have questions, write this office at the above listed address or call (502) 564-3410.

ID of Dam:	pending	**Hazard Class:**	Moderate
Name of Dam:	East Bend Power Plant	**Owner:**	Duke Energy Corporation
Agency Interest:	pending		
HUC #11:	05090203150		James Stieritz
County:	Boone	**Address:**	139 East Fourth St, Room 552-A
Inspection Date:	March 24, 2009	**City:**	Cincinnati
		State:	OH
Weather:	60 Deg, Cloudy	**Zip:**	45202
		Phone:	513-287-2269
Inspection Type:	Dams		

Persons Present at Inspection: Gary Wells, Mortaza Rabiee, James Stieritz, Rhonda Herzog, Tammy Jett.

Height of Dam:	59 feet	**Normal Pool Elevation (MSL): 485.5'**
Latitude Dec Deg:	38.901038	**Current Pool Elevation (MSL): 486.0'**
Longitude Dec Deg:	-84.84262	**Emer. Spillway Elevation (MSL): 518.5'**

Type of Dam: EARTHFILL EMBANKMENT WITH CLAY CORE ABOUT 4000 FT. LONG. WITH A TOP WIDTH OF 12 FT. NO BERMS. SIDESLOPES ARE BOTH 2:1

Upstream Slope of Dam: The upstream slope has a grass and a thick weed/brush cover. No signs of slides, sloughs, or animal burrows were found. Irregular shape slopes due to erosion were found around concrete piers of the coal removal tipple.

Crest of Dam: The crest has a gravel road with grass sides. A few potholes were noted. There are no signs of slides, sloughs, trees, or animal burrows.

Downstream Slope of Dam: The downstream slope has a grass and a thick weed/brush cover. There are no signs of slides, slumps, sloughs, trees, or animal burrows. There was no seepage found at the toe.

Toe Drains: N/A

CERTIFICATE OF INSPECTION
FOR

KY ID: pending

Principal Spillway: 48" DIA CMP SET BELOW A WOODEN MOUNTED TOWER SPILLWAY THAT MAINTAINS POOL AT ELEVATION 485.5' (THIS ELEVATION IS SHOWN ON PLAN DRAWING). A 36" DIA. CMP. IS OUTLET PIPE THAT DISCHARGES INTO THE OHIO RIVER. A 36" BLOW-OFF VALVE IS LOCATED AT TOE. .

Principal Spillway Comment: Inlet pipe was clear of debris and water was discharging. The outlet pipe is in Ohio River and could not be seen. When plant is offline, the Ohio River will deposit sediment at the outlet opening. Clean and clear away any sediment from the outlet opening.

Stilling Basin: N/A

Emergency Spillway: CONCRETE LINED 12 FT. WIDE AND 1.0 FT. DEEP WITH A CREST AT 518.5'. OUTLET SLOPE IS 2:1.

Emergency Spillway Comments: The channel is a concrete lined configuration and cascades downstream to the Ohio River. The inlet and outlet are clear.

Drawdown System: None

Does Hazard Classification need to be Reevaluated? This structure has been classified as a Moderate Hazard dam because, in the event of failure, the plant could no longer operate to supply power to customers, especially to facilities requiring emergency care such as to hospitals. If you wish to reclassify this structure as a Low Hazard Dam, you must demonstrate and provide evidence to Division of Water of an alternate power source for customers when the plant is offline. Being that this is the only source of power supply for customers requires a higher standard of care be taken to preserve such an important public utility.

Were Photographs Taken? Yes

General Comments and Recommendations:
Hydrologic reservoir routing methods must be used to determine the resulting maximum pool elevation in the reservoir from the freeboard hydrograph. DOW requires that the maximum pool resulting from hydrologic routing of the freeboard hydrograph not exceed the settled elevation of the top of embankment. Overtopping is not permitted for earth embankments, because flow over the dam can result in erosion of the embankment material and rapid loss of pool. A hydrologic analysis **must be performed** to verify that the existing spillway is adequate to prevent overtopping of the dam for the freeboard hydrograph. The moderate hazard structure must provide the storage necessary to contain the entire storm runoff without probable damage to the structure or creating an unacceptable hazard to life or property. This Moderate Hazard Dam must have the capacity to pass a freeboard hydrograph design storm of 13.5" rainfall in a 6-hour duration without overtopping the dam. The Division of Water will upon request, assist the engineering in preparing the flood routing. However, the information for the elevation-area-capacity and data must be submitted for the analysis.

Inspector: Gary Wells, PE
Reviewer: Gary Wells, PE

Date: March 25, 2009

STAGE-STORAGE DATA:

ELEV (ft)	AREA (acres)	DEPTH (ft)	STORAGE (ac-ft)	CUMULATIVE (ac-ft)
540	0.29	-	0.000	0
545	1.85	5	5.347	5.347
550	4.53	5	15.962	21.309
554	5.04	4	19.149	40.458

WATERSHED DATA:

Drainage Area = 122 ac

Flow Path Information

length(ft)	type	tc (hr)	remarks
100	sheet flow	0.17	Manning's n=0.15; 2% slope; 2-yr,24hr=2.88"
4,100	channel flow	0.18	d=3';w=3';1:1sides;slope=2%;n=0.05
	total tc=	0.35 hr	

Curve Number Information

Description	Area (ac)	CN
meadow	2	74
residential	9	83
woods	111	70

71 = composite CN

Rainfall amount obtained from http://hdsc.nws.noaa.gov/hdsc/pfds/index.html

ANNUAL DAM INSPECTION 2010
ASH POND

Kentucky Energy and Environmental Cabinet
Department for Environmental Protection
Division of Water
Dam Inventory No. 1215
Class: Moderate Hazard, Class B

EAST BEND STATION
6293 Beaver Road
Rabbit Hash, Kentucky 41091

CONFIDENTIAL

August 4, 2010
013-00442-015

BBCM
SOLUTIONS TO BUILD ON

Mr. Adam Deller
Duke Energy
139 East Fourth Street
Cincinnati, OH 45202

Re: Inspection of Ash Pond
East Bend Power Station
Rabbit Hash, Kentucky

CONFIDENTIAL

Mr. Deller:

BBC&M Engineering, Inc. (BBCM) has completed a visual assessment of the Ash Pond located at the East Bend Power Station in Rabbit Hash, Kentucky. BBCM also reviewed the past inspection report prepared by the Kentucky Department for Environmental Protection. While on site, BBCM observed the general conditions of the impoundment, the ash pond embankments (east, south and west), abutment(s), inlet and outlet structures and spillway(s). Attached is our report with our field observations, recommendations, site plan, photographs and inspection checklist for the East Bend Ash Pond (KY 1215).

We appreciate having been given the opportunity to continue to be of service on this project. Please contact our office with any questions or comments.

Respectfully submitted,

BBC&M ENGINEERING, INC.
Cincinnati, Ohio

Benjamin C. Dusina, P.E.
Project Engineer

FOR Joseph M. Troxell, P.E.
Senior Engineer

Submitted: 2 copies via US Mail
1 copy via e-mail – Mr. Adam Deller (Adam.Deller@duke-energy.com)

11699 Chesterdale Road • Cincinnati, OH 45246-3917 • Phone 513.771.8471 • Fax 513.771.8475

TABLE OF CONTENTS

CONFIDENTIAL

1.0 Introduction

BBC&M Engineering, Inc. (BBCM) visited the East Bend Station near Rabbit Hash, Kentucky on July 21, 2010. The site visit was performed by Mr. Joseph Troxell, P.E. and Mr. Benjamin Dusina, P.E. of BBCM. BBCM observed the existing East Bend Ash Pond (KY 1215) on this date. The ash pond is classified as a Moderate Hazard, Class B structure by the Kentucky Department for Environmental Protection (KDEP). The KDEP performed a visual inspection of the ash pond on March 24, 2009.

On the day of the site visit, the temperature varied from 81 to 88 degrees Fahrenheit and there was no precipitation. Between July 14 and July 21, there was precipitation on two of the days that totaled approximately 0.5 inches. Weather information was obtained from the Waterloo, Burlington, Kentucky weather station operated by Weather Underground (www.wunderground.com). A history of weather data for the month prior to July 21, 2010 is included as Plate 2 of the Appendix.

2.0 Summary of Visual Inspection Terms

The summary of the visual observations uses terms to describe the general appearance or condition of an observed item, activity or structure. The meaning of these terms is as follows:

Good	A condition or activity that is generally better or slightly better than what is minimally expected or anticipated from a design or maintenance point of view.
Fair or Satisfactory	A condition or activity that generally meets what is minimally expected or anticipated from a design or maintenance point of view.
Poor	A condition or activity that is generally below what is minimally expected or anticipated from a design or maintenance point of view.
Minor	A reference to an observed item (e.g., erosion, seepage, vegetation, etc.) where the current maintenance condition is below what is normal or desired, but which is not currently causing concern from a structure safety or stability point of view.
Excessive	A reference to an observed item (e.g., erosion, seepage, vegetation, etc.) where the current maintenance condition is above or worse than what is normal or desired, and which may have affected the ability of the observer to properly evaluate the structure or particular area being observed or which may be a concern from a structure safety or stability point of view.

3.0 Observations

The ash pond was built into an existing, natural hillside which forms the north side of the pond, with constructed embankments making up the east, south and west sides of the pond. The embankments have a clay core with granular zones on the upstream and downstream sides. A bench for an access road runs along the west embankment. It is understood that the ash pond was commissioned in 1980. The crest elevation of the three embankments is approximately El. 520. The crest is covered with a gravel roadway along the alignment. There is an internal divider dike composed of ash running from the north shore to the south embankment within the ash pond. The normal pool elevations are approximately El. 503.7 upstream of the internal ash dike and El. 490.9 downstream of the ash dike. The slopes of the upstream and downstream faces of the three embankments are approximately 2H:1V (horizontal:vertical) and are grass covered.

The influent structures are located along the north side of the impoundment. An additional inlet pipe is located through the internal ash dike, near the south embankment. The primary spillway is located in the southeast corner of the ash pond and consists of a 48-inch CMP pipe riser with a 40-inch steel liner. The riser pipe is connected to a 36-inch outlet pipe with a 28-inch steel liner. It is understood that the pipe liners were installed in 1991. The primary spillway outlets into the Ohio River, and is submerged below the normal pool El. 454.25. The emergency spillway is located on the south embankment and consists of 12-foot wide concrete, open-channel spillway. The emergency spillway outlets into a concrete lined drainage ditch located at the toe of the south embankment. The top of the concrete which forms the control section of the emergency spillway is approximately El. 518.5.

Based on visual observations during our site visit, the embankments appear to be in Satisfactory condition. BBCM noted the following items during our site visit:

1. Light poles on downstream slope along the crest of south and west embankments;
2. Minor to excessive erosion from wave action was observed along the east and south embankment upstream slopes (see Photos 4, 14 and 18);
3. Minor low areas observed in gravel areas on the embankment crest (see Photo 5);
4. Approximately 350 linear feet of rip rap placed as wave action armor on upstream slope of the east embankment (see Photo 6);
5. Excessive vegetation beyond the toe of the east embankment (see Photo 7) and on the downstream slope below the access road running along the toe of the south embankment (see Photos 16 and 17);
6. Marsh area was observed beyond the toe of the east embankment (see Photo 8);
7. Scrap pipe located along the toe of the east embankment (see Photo 9);
8. Minor vegetation within the concrete drainage channel and emergency spillway (see Photos 24 and 26);
9. Excessive vegetation at the mouth of the concrete channel located along the toe of the south embankment (see Photo 27);

10. Minor erosion channels were observed on the upstream slopes of the east and south embankments (see Photo 31);
11. Inlet channel flowing adjacent to the south embankment (see Photo 33);
12. Rip rap placed on upstream slope of the west embankment (see Photos 40, 42 and 45);
13. Low area on the downstream slope of the west embankment, adjacent to the crest (see Photo 44).

4.0 Conclusions and Recommendations

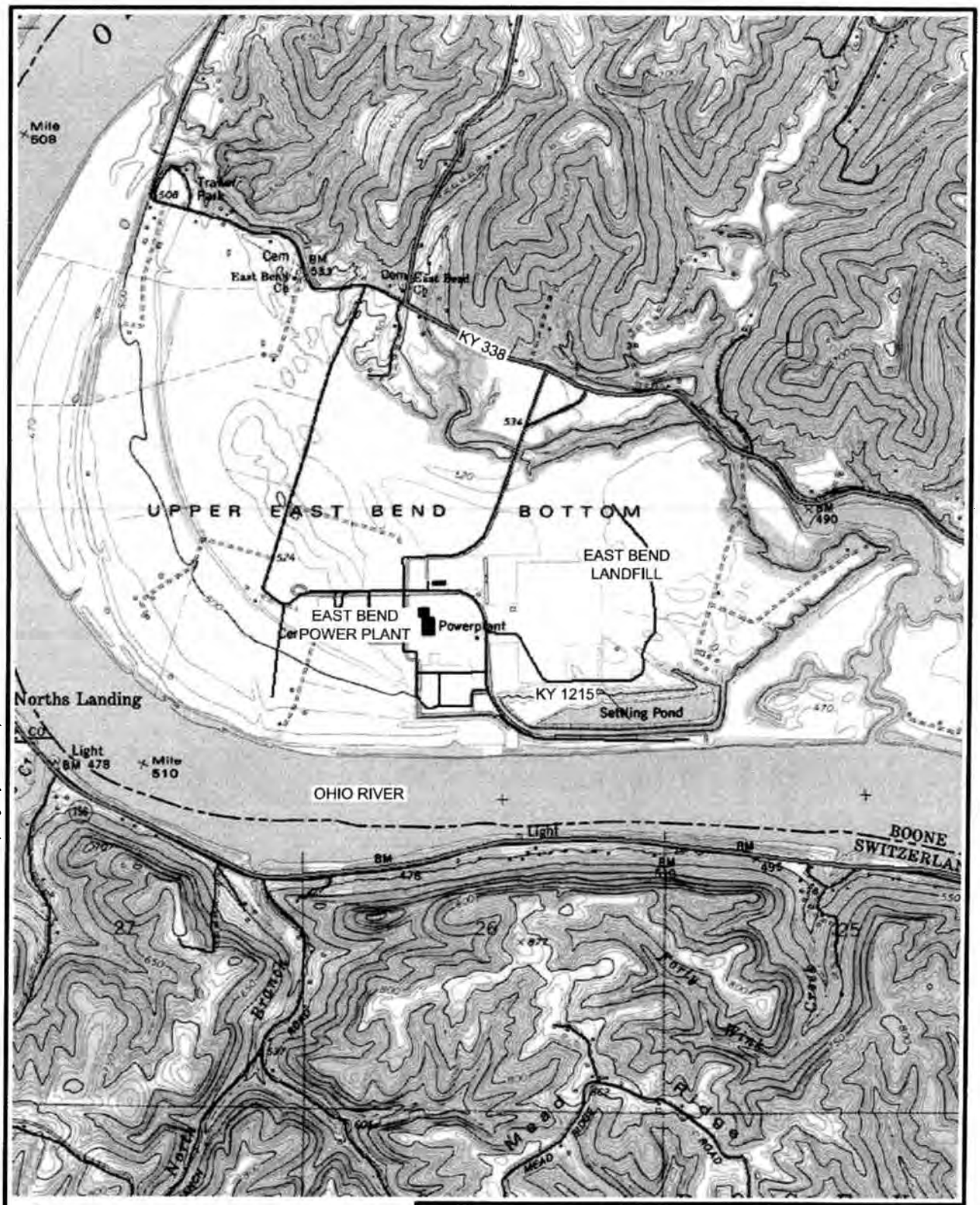
Based on observations made during our site visit and review of the information provided to BBCM by Duke Energy, it appears the East Bend Ash Pond (KY 1215) is in Satisfactory condition.

BBCM offers the following recommendations:

1. In general, penetrations into an earthen embankment are discouraged since any penetration can introduce a seepage conduit. There are multiple light poles installed along the south and west embankment. It is recommended that, at a minimum, the embankment be graded around the poles to provide positive drainage away from the light poles, even if this requires mounding some earthen materials around the pole and grading to promote drainage.
2. Monitor shoreline for erosion since no armor is present over the majority of the upstream slopes. If erosion increases, additional engineering evaluations may be necessary. Rip rap armor should be placed where excessive erosion was observed along the upstream slope due to wave action. Additionally, the area of flowing water, near the inlet pipe located through the interior ash dike, should be monitored. If erosion begins in this area, rip rap armor should be installed.
3. Repair low areas on the crest of the embankment to prevent standing water. The low areas, while relatively minor, may serve to collect standing water. It is preferable that positive grades be maintained to promote runoff from the crest into the impoundment.
4. Clear excessive vegetation 15 feet beyond the toe of the east embankment and along the 2H:1V slopes below the roadway along the toe of the south embankment. The excessive vegetation hinders visual observations in these areas. These areas should be visually monitored for seepage.
5. Re-grade wet areas along the toe of the east embankment to promote positive drainage and continue to monitor these areas. If any wet areas return after being re-graded, they may be related to seepage either under or through the embankment and additional engineering evaluation may be necessary.
6. Remove the scrap pipe along the toe of the east embankment.
7. Clean out vegetation from within the concrete drainage ditch along the south embankment, the emergency spillway and in the mouth area of the concrete drainage ditch.
8. The erosion channels observed on the upstream slopes of the east and south embankments should be filled with rip rap.

9. Monitor the ash divider dike for seepage and instability during inspection of embankments.
10. Re-grade the low lying area on the downstream slope, adjacent to the crest, on the west embankment.
11. Continue regular mowing of the embankments and downstream areas to keep vegetation short and allow for visual observation of the embankments. In areas that are not accessible with a mower, a hand-held trimmer may be used. Regular mowing will prevent woody vegetation from being established.

ATTACHMENTS



SITE MAP

East Bend Power Plant
Boone Co., Kentucky

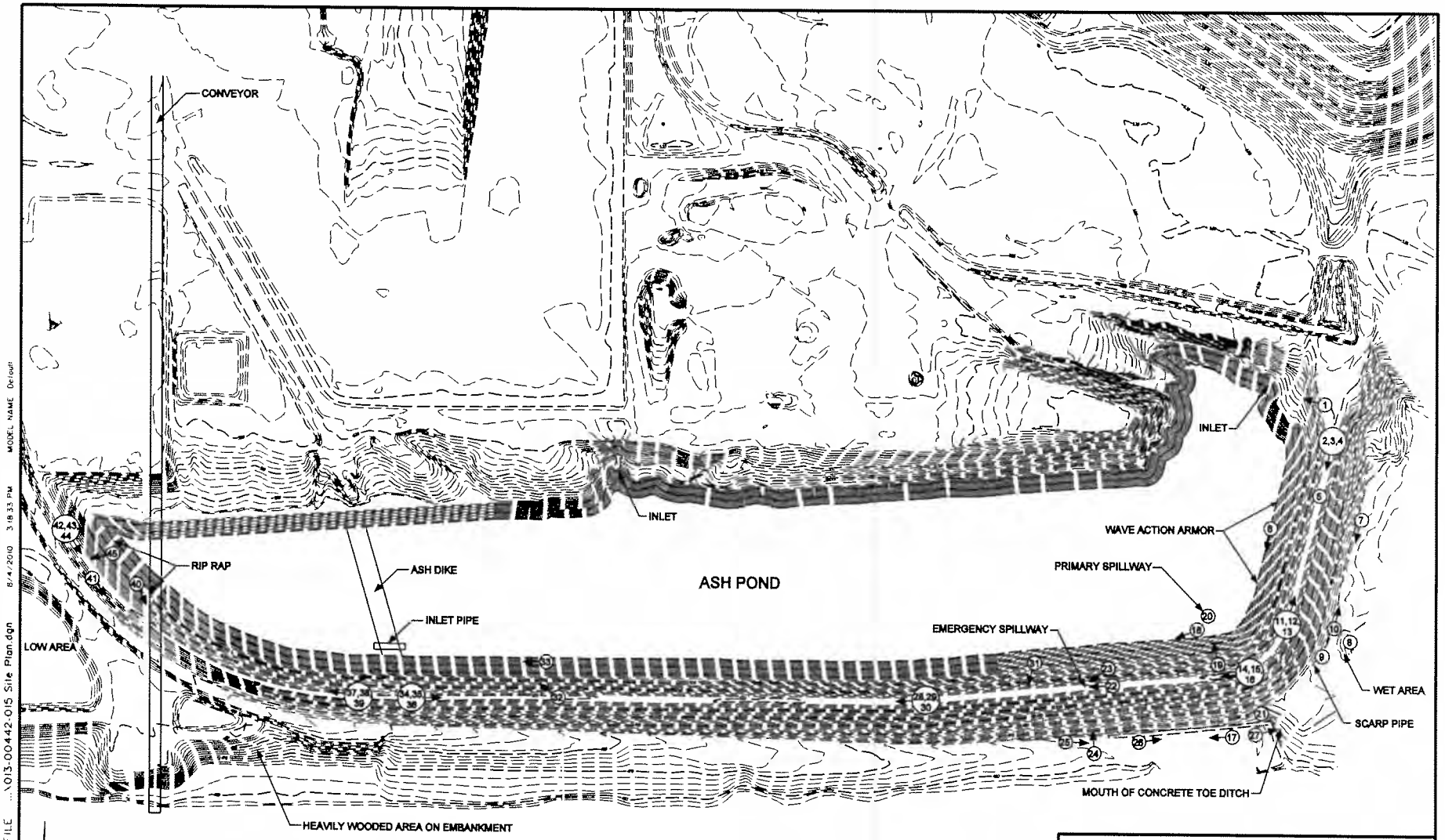
USGS Mapping:
Rising Sun Quad

Project: 013-00442-015	Drawn By: TJM	
Drawing Date: 7-26-2010	Approved By: BCD	
Last Updated: 7-26-2010	Scale: 1" = 2000'	1:1

BBCM
SOLUTIONS TO BUILD ON
Columbus (614) 793-2226
Cleveland (216) 901-1000
Cincinnati (513) 771-8471
Dayton (937) 424-1011

PLATE 1

Images: ~TOPOImap.JPG ~TOPOImap.JPG
Xrefs:
File Last Updated: Jul 26, 2010
Plot Info: 7-26-2010 @ 4:27pm By: lmckelvey
BBC&M Filename: I:\DEPTS\CADD\Drawings\Projects\013-00442\013-00442-015\013-00442-015 Site Map.dwg Layout: Site Map



BBC&M DRAWING FILE ...\013-00442-015 Site Plan.dgn 8/4/2010 3:18:33 PM MODEL NAME Default

SITE PLAN

East Bend Ash Pond
Boone County, Kentucky

Project: 013-00442-015	Drawn By: TJM
Drawing Date: 8-3-2010	Approved By: BCD
Revision Date:	Scale: 1" = 250'

BBCM
SOLUTIONS TO BUILD ON
Columbus (614) 766-2226
Cleveland (216) 801-1000
Cincinnati (513) 771-8471
Dayton (937) 434-1011

PLATE 2

East Bend Ash Pond - Weather Data
June 21 through July 21, 2010

Month	Day	Temperature (°F)		Precipitation (in.)
		Max.	Min.	
June	21	89	71	0.99
	22	86	72	0
	23	91	78	0
	24	85	72	0
	25	85	68	0
	26	88	69	0
	27	89	74	0.02
	28	84	73	0.01
	29	81	65	0
	30	77	60	0
July	1	78	62	0
	2	80	57	0
	3	86	59	0
	4	88	71	0
	5	88	73	0
	6	91	72	0
	7	93	72	0
	8	90	73	0
	9	84	74	0
	10	87	71	0
	11	87	65	0
	12	85	74	0
	13	82	73	0.01
	14	88	72	0
	15	90	74	0
	16	90	77	0
	17	88	73	0.01
	18	88	73	0
	19	90	74	0
	20	85	73	0.48
	21	88	81	0

Source: http://www.wunderground.com

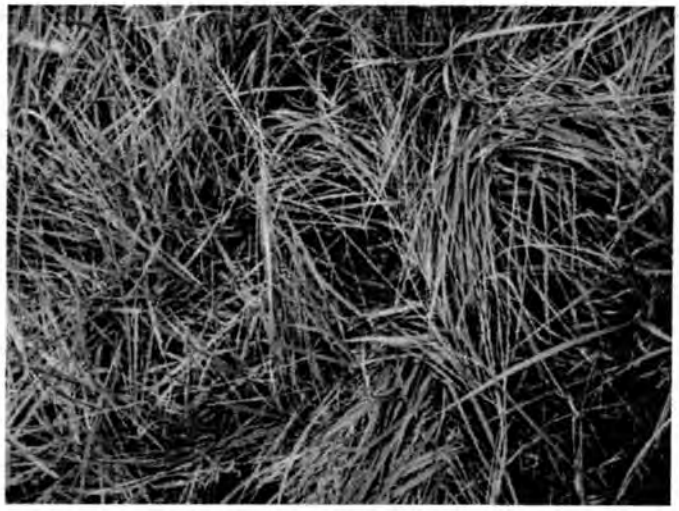
Ash Pond Photographs
July 21, 2010

Photo 1 South slope of north abutment with landfill runoff inlet structure, photo facing west.	
Photo 2 Downstream slope of east embankment, photo facing south.	
Photo 3 Crest of east embankment, photo facing south.	

Ash Pond Photographs
July 21, 2010

Photo 4 Inboard slope of east embankment, photo facing south.	
Photo 5 Low area along crest of east embankment.	
Photo 6 Rip rap placed to remediate wave action erosion on the inboard slope of the east embankment, photo facing south.	

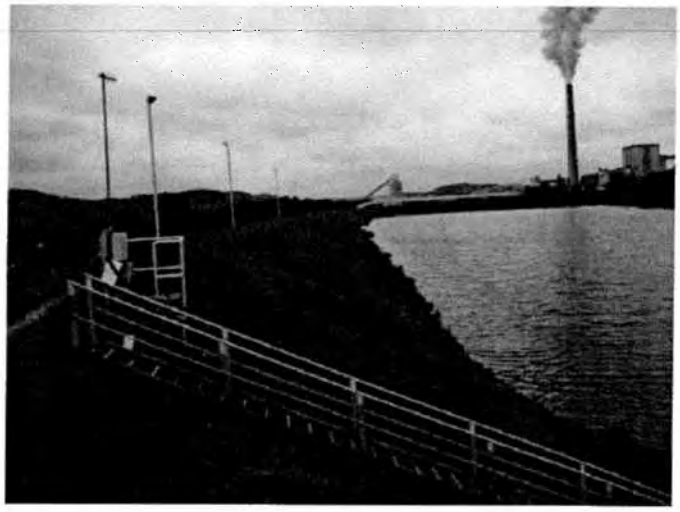
Ash Pond Photographs
July 21, 2010

Photo 7 Toe of east embankment, photo facing south.	
Photo 8 Standing water east of downstream slope of east embankment.	
Photo 9 Existing scrap pipe located near toe of the east embankment.	

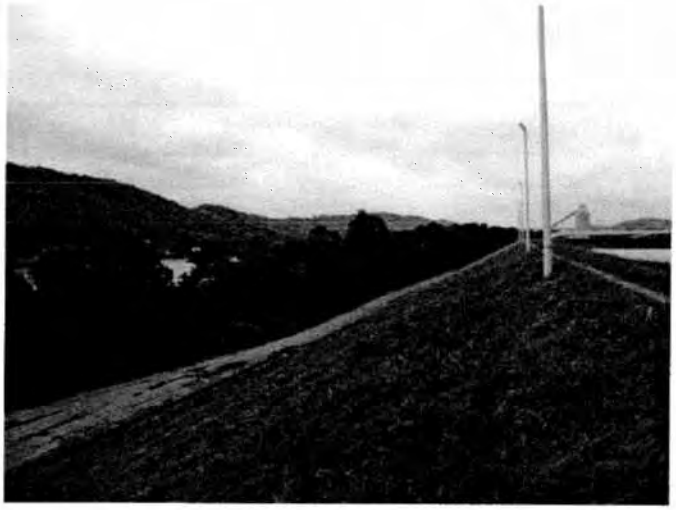
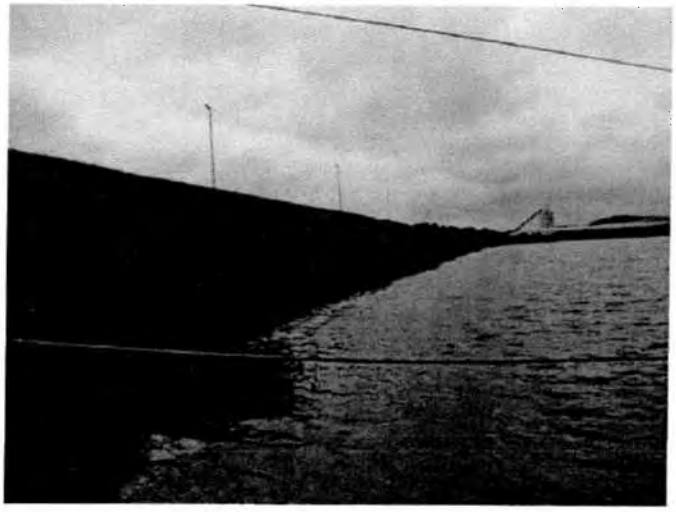
Ash Pond Photographs
July 21, 2010

Photo 10 Toe of east embankment, photo facing north.	
Photo 11 Downstream slope of east embankment, photo facing north.	
Photo 12 Crest of south embankment, photo facing east.	

Ash Pond Photographs
July 21, 2010

Photo 13 Upstream slope of east embankment, photo facing north.	
Photo 14 Upstream slope of south embankment, photo facing west.	
Photo 15 Crest of south embankment, photo facing west.	

Ash Pond Photographs
July 21, 2010

Photo 16 Downstream slope of south embankment, photo facing west.	
Photo 17 Toe of south embankment, photo facing west.	
Photo 18 Wave action erosion on the upstream slope of the south embankment, photo facing west.	

Ash Pond Photographs
July 21, 2010

Photo 19 Outlet structure located near southeast corner of ash pond, photo facing north.	
Photo 20 Outlet structure located near southeast corner of ash pond.	
Photo 21 Vertical riser in the outlet pipe located beyond and downstream of the toe.	

Ash Pond Photographs
July 21, 2010

Photo 22 Emergency spillway on crest of south embankment, photo facing west.	
Photo 23 Emergency spillway on crest of south embankment, photo facing west.	
Photo 24 Emergency spillway channel on south embankment, photo facing north.	

Ash Pond Photographs
July 21, 2010

Photo 25 Emergency spillway channel along toe of south embankment, photo facing east.	
Photo 26 Emergency spillway channel along toe of south embankment, photo facing east.	
Photo 27 Emergency spillway channel mouth and vertical riser for the outlet pipe along toe of south embankment, photo facing east.	

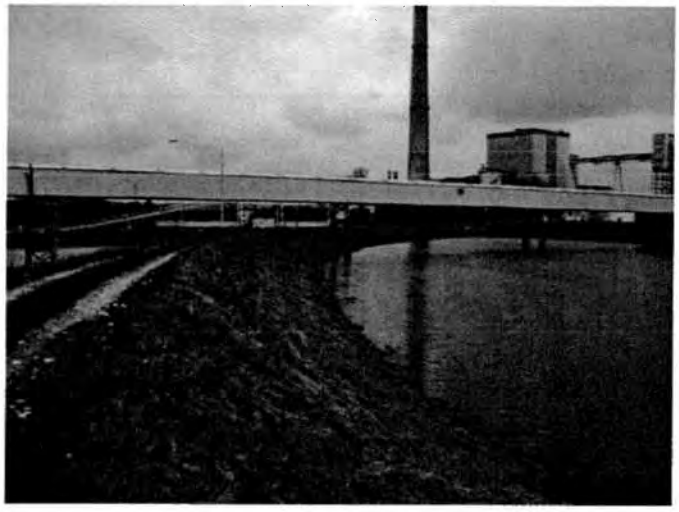
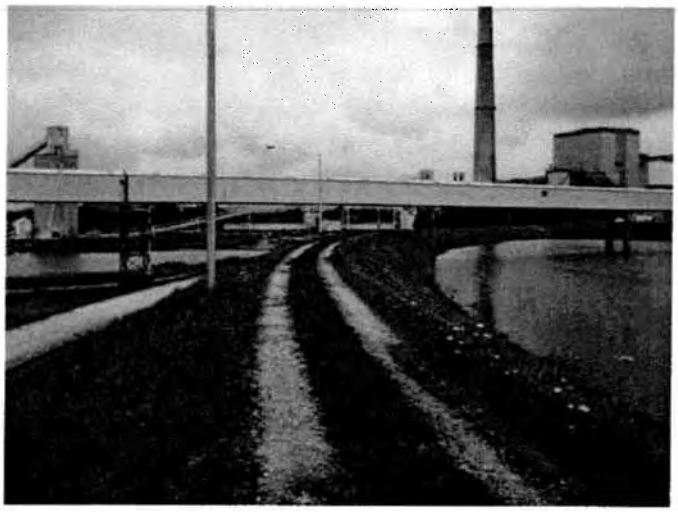
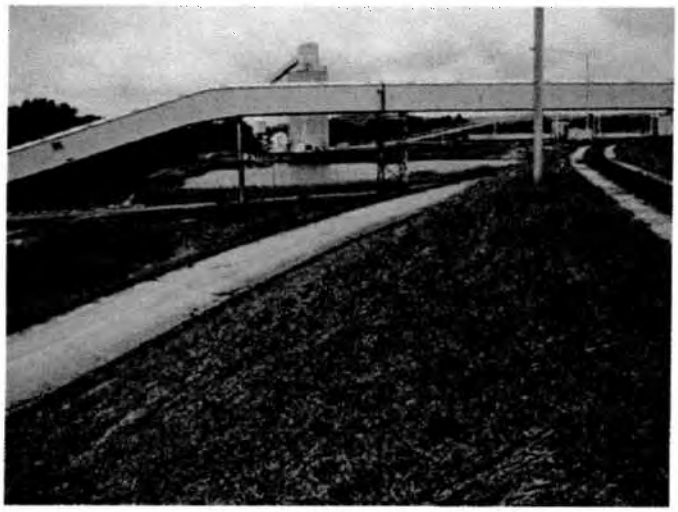
Ash Pond Photographs
July 21, 2010

Photo 31 Erosion channel on the upstream slope of the south embankment, photo facing south.	
Photo 32 Ash divider dike with pipe through the ash dike, photo facing west.	
Photo 33 Inlet channel flowing through the ash along the south embankment, photo facing west.	

Ash Pond Photographs
July 21, 2010

Photo 34 Upstream slope of south embankment, west of ash dike, photo facing east.	
Photo 35 Crest of south embankment, west of ash dike, photo facing east.	
Photo 36 Downstream slope of south embankment, west of ash dike, photo facing east.	

Ash Pond Photographs
July 21, 2010

Photo 37 Upstream slope of west embankment, photo facing west.	
Photo 38 Crest of west embankment, photo facing west.	
Photo 39 Downstream slope of west embankment, photo facing west.	

Ash Pond Photographs
July 21, 2010

Photo 40 Rip rap placed on the upstream slope below the coal conveyor, photo facing southeast.	
Photo 41 Depression on the downstream slope of the west embankment, photo facing southeast.	
Photo 42 Upstream slope of west embankment, photo facing southeast.	

Ash Pond Photographs
July 21, 2010

Photo 43 Crest of west embankment, photo facing southeast.	
Photo 44 Low area on the downstream slope of west embankment, photo facing southeast.	
Photo 45 Rip rap placed on the upstream slope of the west embankment at the inlet from the wastewater structure, photo facing west.	

East Bend Station

Name: Ash Pond Dam County: Boone

Kentucky Inventory Number: 1215

Date: 7/21/10 Inspector(s): JMT, BCD Temp. & Time: 9:00AM, 82°F

Pool Level: Normal

Location:	Condition: Good	Fair	Poor	Comments:
Upstream Slopes:				Approximately 2H:1V
Cracks, slides, or erosion	( )	(X)	( )	Observed several erosion channels
Rodent burrows	(X)	( )	( )	None observed
Condition of Vegetation	( )	(X)	( )	
Slope protection	( )	( )	(X)	Lacking wave action erosion slope protection
Crest:				El. 520
Large cracks, ruts, or erosion	( )	(X)	( )	None observed
Low areas, or potholes	( )	( )	(X)	Observed approximately 12 low areas
Condition of Vegetation	( )	(X)	( )	
Downstream Slopes:				Approximately 2H:1V
Cracks, slides, or erosion	( )	(X)	( )	None observed
Rodent burrows	(X)	( )	( )	None observed
Condition of Vegetation	( )	(X)	( )	Tall grass observed on the southeast corner of embankment
Seepage:				
Downstream slope	( )	(X)	( )	None observed
Saturated or wet areas	( )	(X)	( )	Wet areas observed beyond the toe of east embankment
Low areas or seeps above penetrations?	( )	(X)	( )	Low area observed near crest of west embankment, no seepage observed
Impoundment:				
Pool level	( )	(X)	( )	Normal pool levels observed to be greater than 10 feet below embankment crest(s)
Wave action protection	( )	( )	(X)	Observed toe erosion along east and south embankments
Inlet Structure:				Type: Multiple inlets from the plant and landfill
Structure condition	( )	(X)	( )	
Debris	(X)	( )	( )	None observed
Valves	( )	(X)	( )	Appear to be operating
Outlet Structure:				
Structure condition	( )	( )	( )	Could not observe, structure was below the level of the Ohio River
Debris	( )	(X)	( )	None observed, portions under water
Erosion or slides in the outlet channel	( )	(X)	( )	None observed, portions under water
Armor around outlet	( )	( )	( )	Could not observe
Drains:				No internal drains observed
Condition of drains	( )	( )	( )	
Primary Spillway Structure:				Type: Pipe and riser structure
Spillway condition	( )	(X)	( )	No obstructions observed around inlet pipe. Observed flowing water in downstream riser pipes
Emergency Spillway Structure:				Type: Concrete lined open-channel spillway, crest El. 518.5 approximately
Spillway condition	( )	(X)	( )	

Good – A condition that is generally better than what is minimally expected or required
Fair/Satisfactory – A condition that generally meets what is minimally expected or required
Poor – A condition that is generally below what is minimally expected or required

KPDES

KENTUCKY POLLUTANT DISCHARGE ELIMINATION SYSTEM

PERMIT

PERMIT NO.: KY0040444

AUTHORIZATION TO DISCHARGE UNDER THE KENTUCKY POLLUTANT DISCHARGE ELIMINATION SYSTEM

Pursuant to Authority in KRS 224,

The Cincinnati Gas & Electric Company
P.O. Box 960
Cincinnati, Ohio 45201

is authorized to discharge from a facility located at

The Cincinnati Gas & Electric Company
East Bend Station
Kentucky Route 338
Rabbit Hash, Boone County, Kentucky

to receiving waters named

Outfalls 001, 003, and 014 are to the Ohio River at mile points 469.9, 470.60, and 470.55, respectively.
Outfalls 007, 008, and 010 are internal outfalls to the Ash Pond (Outfall 001).
Outfall 011, the plant intake, is at mile point 470.65 of the Ohio River.

in accordance with effluent limitations, monitoring requirements, and other conditions set forth in PARTS I, II, III, IV, and V hereof. The permit consists of this cover sheet and PART I 8 pages, PART II 1 page, PART III 1 page, PART IV 2 pages, and PART V 3 pages.

This permit shall become effective on APR 1 2004

This permit and the authorization to discharge shall expire at midnight, July 31, 2007.

FEB 5 2004
Date Signed

Jeffrey W. Pratt, Director
Division of Water

Robert W. Logan
Commissioner

DEPARTMENT FOR ENVIRONMENTAL PROTECTION
Division of Water, Frankfort Office Park, 14 Reilly Road, Frankfort, Kentucky 40601

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A1. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on the effective date of this permit and lasting through the term of this permit, the permittee is authorized to discharge from Outfall serial number: [redacted] Significant contributing flows are: direct storm water runoff to ash pond(0.41, 142 MGD), coal pile runoff(0.11, 39 MGD), scrubber sludge landfill runoff(0.51, 176 MGD), bottom ash pyrites and economizer fly ash sluice water(0.27 0.57 MGD), miscellaneous plant drains(1.27, 1.5 MGD), cooling tower overboard(1.43, 143 MGD), sanitary wastewater(0.43, 0.043 MGD), and demineralizer regeneration water(0.33, 0.091 MGD)).

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS		MONITORING REQUIREMENTS	
	Monthly Avg.	Daily Max.	Measurement Frequency	Sample Type
Flow (MGD)	Report	Report	Continuous	Recorder
Total Suspended Solids (mg/l)	30	56	1/Month	Grab
Oil & Grease (mg/l)	8.5	11.5	1/Month	Grab
Hardness (as mg/l) ($CaCO_3$)	Report	Report	1/Month	Grab
Total Recoverable Metals (mg/l)	Report	Report	1/Quarter	Grab
Acute Toxicity (TU_a)	N/A	1.00	1/Quarter	1 Grab

The pH of the effluent shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/Month by grab sample.

There shall be no discharge of floating solids or visible foam or sheen in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location: nearest accessible point after final treatment, but prior to actual discharge to or mixing with the receiving waters or wastestreams from other outfalls.

The abbreviation N/A means Not Applicable.

The effluent characteristic "Total Recoverable Metals" means Antimony, Arsenic, Beryllium, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, Silver, Thallium, and Zinc. To report the results of the analyses for this parameter, the permittee shall total the results of the analyses for each individual parameter, and report that aggregate value on the DMR. The laboratory bench sheets showing the results for each parameter shall be attached to the DMR.

A2. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on the effective date of this permit and lasting through the term of this permit, the permittee is authorized to discharge from Outfall serial number: [redacted] heat exchanger by-pass water.

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS		MONITORING REQUIREMENTS	
	Monthly Avg.	Daily Max.	Measurement Frequency	Sample Type
Flow (MGD)	Report	Report	Continuous	Recorder
Temperature (°F)		105	Continuous	Recorder

There shall be no discharge of floating solids or visible foam or sheen in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location: nearest accessible point after final treatment, but prior to actual discharge to or mixing with the receiving waters or wastestreams from other outfalls.

A3. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on the effective date of this permit and lasting through the term of this permit, the permittee is authorized to discharge from Outfall serial number: [redacted] Outfall 007 is an internal outfall to the ash pond (Outfall 001).

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS		MONITORING REQUIREMENTS	
	Monthly Avg.	Daily Max.	Measurement Frequency	Sample Type
Flow (MGD)	Report	Report	1/Month	Instantaneous
Biochemical Oxygen Demand, 5-day (mg/l)	30	45	1/Month	Grab
Total Suspended Solids (mg/l)	30	45	1/Month	Grab
Total Residual Chlorine (mg/l)(minimum)	0.5	Report	1/Month	Grab

There shall be no discharge of floating solids or visible foam or sheen in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location: nearest accessible point after final treatment, but prior to actual discharge to or mixing with the receiving waters or wastestreams from other outfalls.

Pursuant to 401 KAR 5:010, Sections 2 and 8, the operation of this wastewater treatment plant requires a Class One certified operator, who must maintain appropriate records to assure compliance with the proper operation and maintenance requirements of 401 KAR 5:065, Section 1(5).

A4. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on the effective date of this permit and lasting through the term of this permit, the permittee is authorized to discharge from Outfall serial number: [redacted] Outfall 008 is an internal outfall to the ash pond (Outfall 001).

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS		MONITORING REQUIREMENTS	
	Monthly Avg.	Daily Max.	Measurement Frequency	Sample Type
Flow (MGD)	Report	Report	1/Batch	Calculated
Total Iron (mg/l)	1.0	1.0	1/Batch	Grab
Total Copper (mg/l)	1.0	1.0	1/Batch	Grab
pH (Standard Units)	Report	Report	1/Batch	Grab

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location: nearest accessible point after final treatment, but prior to actual discharge to or mixing with the receiving waters or wastestreams from other outfalls.

A5. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on the effective date of this permit and lasting through the term of this permit, the permittee is authorized to discharge from Outfall serial number: [redacted] Outfall 010 is an internal outfall that discharges to the Ash Pond (Outfall 001).

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS		MONITORING REQUIREMENTS	
	Monthly Avg.	Daily Max.	Measurement Frequency	Sample Type
Flow (MGD)	Report	Report	1/Month	Instantaneous
Free Available Chlorine (mg/l)	0.2	0.5	Occurrence	Multiple Grab
Total Residual Chlorine (mg/l)	0.2	0.2	Occurrence	Multiple Grab
Total Residual Oxidants (mg/l)	Report	0.2	Occurrence	Multiple Grab
Time of Oxidant Addition (Minutes/unit/day)	N/A	120	Occurrence	Log
Total Chromium (mg/l)	0.2	0.2	Annually	Grab
Total Zinc (mg/l)	1.0	1.0	Annually	Grab
Priority Pollutants (mg/l)	Report	NDA	Annually	Grab

There shall be no discharge of floating solids or visible foam or sheen in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location: nearest accessible point after final treatment, but prior to actual discharge to or mixing with the receiving waters or mixing with the waters of the ash pond.

Priority Pollutants shall be monitored annually by grab sample or by engineering calculations. The results of the analyses/engineering calculations shall be totaled and reported as a single concentration on the DMR. The laboratory bench sheets/engineering calculations showing the results for each pollutant shall be attached to the DMR. The term Priority Pollutants means the 126 priority pollutants listed in 40 CFR Part 423 Appendix A. See Attachment A - Fact Sheet Addendum for Steam Electric Power Generating Plants.

The term Total Residual Oxidants (TRO) means the value obtained using the amperometric titration or DPD methods for total residual chlorine described in 40 CFR Part 136. In the event of addition of an oxidant other than chlorine, the permittee shall receive prior approval from the Division of Water permitting staff before the initial use.

The measurement frequency "Occurrence" means during periods of chlorination or oxidant addition, but no more frequent than once per week.

The sample type "Multiple Grab" means grab samples collected at the approximate beginning of oxidant discharge and once every fifteen minutes thereafter until the end of oxidant discharge.

The abbreviation N/A means Not Applicable.

The abbreviation NDA means No Detectable Amount.

A6. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on the effective date of this permit and lasting through the term of this permit, the permittee is authorized to discharge from Outfall serial number: [redacted]

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS		MONITORING REQUIREMENTS	
	Monthly Avg.	Daily Max.	Measurement Frequency	Sample Type
Flow (MGD)	Report	Report	Continuous	Recorder
Temperature (°F)	Report	Report	Continuous	Recorder
Total Suspended Solids (mg/l)	Report	Report	1/Month	Grab
Hardness (as mg/l)($CaCO_3$)	Report	Report	1/Month	Grab
pH (Standard Units)	Report	Report	1/Month	Grab
Total Recoverable Metals	N/A	Report	1/Quarter	Grab

There shall be no discharge of floating solids or visible foam or sheen in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location: plant intake, except that temperature may be monitored at the river pumps.

The effluent characteristic "Total Recoverable Metals" means Antimony, Arsenic, Beryllium, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, Silver, Thallium, and Zinc. To report the results of the analyses for this parameter, the permittee shall total the results of the analyses for each individual parameter and report that aggregate value on the DMR. The laboratory bench sheets showing the results for each parameter shall be attached to the DMR.

A7. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on the effective date of this permit and lasting through the term of this permit, the permittee is authorized to discharge from Outfall serial number: [redacted] from the main plant area.

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS		MONITORING REQUIREMENTS	
	Monthly Avg.	Daily Max.	Measurement Frequency	Sample Type
Flow (MGD)	Report	Report	1/Quarter	Instantaneous
Precipitation (inches)	Report	Report	1/Quarter	Grab
Total Suspended Solids (mg/l)	Report	Report	1/Quarter	Grab
Oil & Grease (mg/l)	Report	Report	1/Quarter	Grab
Hardness (as mg/l)($CaCO_3$)	Report	Report	1/Quarter	Grab
pH (Standard Units)	Report	Report	1/Quarter	Grab
Total Recoverable Metals	N/A	Report	1/Quarter	Grab

There shall be no discharge of floating solids or visible foam or sheen in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location: but prior to actual discharge to or missing with the receiving waters or other wastestreams from other outfalls.

The effluent characteristic "Total Recoverable Metals" means Antimony, Arsenic, Beryllium, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, Silver, Thallium, and Zinc. To report the results of the analyses for this parameter, the permittee shall total the results of the analyses for each individual parameter and report that aggregate value on the DMR. The laboratory bench sheets showing the results for each parameter shall be attached to the DMR.

B. Schedule of Compliance

The permittee shall achieve compliance with all requirements on the effective date of this permit.

C. Cooling Water Additives, FIFRA, and Mollusk Control

The discharge of any product registered under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) in cooling water which ultimately may be released to the waters of the Commonwealth is prohibited, except Herbicides, unless specifically identified and authorized by the KPDES permit. In the event the permittee needs to use a biocide or chemical not previously reported for mollusk control or other purpose the permittee shall submit sufficient information, a minimum of thirty (30) days prior to the commencement of use of said biocides or chemicals, to the Division of Water for review and establishment of appropriate control parameters. Such information requirements shall include:

1. Name and general composition of biocide or chemical,
2. Any and all aquatic organism toxicity data,
3. Quantities to be used,
4. Frequencies of use,
5. Proposed discharge concentrations, and
6. EPA registration number, if applicable.

D. Polychlorinated Biphenyls

Pursuant to the requirements of 401 KAR 5:065, Section 4(4) (40 CFR Parts 423.12(b)(2) and 423.13(a)), there shall be no discharge from any point source of polychlorinated biphenyl compounds such as those commonly used in transformer fluids. The permittee shall implement this requirement as a specific section of the BMP plan developed for this station.

E. Selective Catalytic Reduction Devices or Systems (SCRs) and Nonselective Catalytic Reduction Devices or Systems (NSCRs)

In response to recent Clean Air Act amendments, the installation of these devices for NOx reduction may become necessary. Associated with the installation and operation of these units, an "ammonia slip" may occur resulting in the discharge of ammonia to the ash pond. The impact of such an occurrence on the performance of the ash pond and any eventual impact on the environment are not known. Therefore, should it become necessary to install these devices, the permittee shall develop and implement an Ammonia Monitoring Plan. The plan shall be submitted to the Division of Water within ninety (90) days of the determination that these devices will be installed, and shall include at a minimum influent and effluent monitoring of each unit on a monthly basis with submission of the data as a quarterly report.

F. Section 311, Clean Water Act Exclusion

The permittee is relieved of the reporting and liability requirements under Section 311 of the Clean Water Act for the following substances, consistent with Exclusion 2, authorized by Section 311(a)(a)(B) and 40 CFR Part 117.12 for: Ammonium Hydroxide, Sodium Hypochlorite, Ethylene Diaminetetracetic Acid (EDTA), Sodium Hydroxide, Sodium Nitrite, Sodium Phosphate (Dibasic), and Sulfuric Acid.

STANDARD CONDITIONS FOR KPDES PERMIT

The permittee is also advised that all KPDES permit conditions in KPDES Regulation 401 KAR 5:065, Section 1 will apply to all discharges authorized by this permit.

This permit has been issued under the provisions of KRS Chapter 224 and regulations promulgated pursuant thereto. Issuance of this permit does not relieve the permittee from the responsibility of obtaining any other permits or licenses required by this Cabinet and other state, federal, and local agencies.

It is the responsibility of the permittee to demonstrate compliance with permit parameter limitations by utilization of sufficiently sensitive analytical methods.

PART III

OTHER REQUIREMENTS

A. Reporting of Monitoring Results

Monitoring results obtained during each month must be reported on a preprinted Discharge Monitoring Report (DMR) Form, which will be mailed to you. Each month's completed DMR must be sent to the Division of Water at the address listed below (with a copy to the appropriate Regional Office) postmarked no later than the 28th day of the month following the month for which monitoring results were obtained.

Division of Water
Florence Regional Office
8020 Veterans Memorial Drive
Suite 110
Florence, Kentucky 41042
ATTN: Supervisor

Kentucky Natural Resources and
Environmental Protection Cabinet
Dept. for Environmental Protection
Division of Water/KPDES Branch
14 Reilly Road, Frankfort Office Park
Frankfort, Kentucky 40601

B. Reopener Clause

This permit shall be modified, or alternatively revoked and reissued, to comply with any applicable effluent standard or limitation issued or approved under 401 KAR 5:050 through 5:080, if the effluent standard or limitation so issued or approved:

1. Contains different conditions or is otherwise more stringent than any effluent limitation in the permit; or

2. Controls any pollutant not limited in the permit.

The permit as modified or reissued under this paragraph shall also contain any other requirements of KRS Chapter 224 when applicable.

PART IV
ACUTE CONCERNS
Biomonitoring

In accordance with Part I of this permit, the permittee shall initiate the series of tests described below within 30 days of the effective date of this permit to evaluate wastewater toxicity of the discharge from Outfall 001. If the permittee is using a more sensitive species, the initial four (4) tests shall be conducted using both test species as indicated below to provide confirmation of previously identified most sensitive test organism.

1. Test Requirements

   A. The permittee shall perform a 48-hour static toxicity test with Ceriodaphnia sp. Tests shall be conducted on one (1) grab. Tests shall be conducted with appropriate replicates of 100% effluent, a control and a minimum of four (4) evenly spaced effluent concentrations. If the permit limit is less than 100% effluent and greater than or equal to 75% effluent, then one (1) concentration should be 100%. If the permit limit is less than 75% effluent, the permit limit concentration shall be bracketed with two (2) concentrations above and two (2) concentrations below. The selection of the effluent concentrations is subject to revision by the Division. Testing of the effluent shall be initiated within 36 hours of each sample collection. Controls shall be conducted concurrently with effluent testing using a synthetic water. The analysis will be deemed reasonable and good only if control survival is 90% or greater in test organisms held in synthetic water. Any test that does not meet the control acceptability criteria shall be repeated as soon as practicable within the monitoring period (i.e. monthly or quarterly). Noncompliance with the toxicity limit will be demonstrated if the LC_{50} is less than 100% effluent.

   B. Tests shall be conducted quarterly or at a frequency to be determined by the permitting authority.

2. Reporting Requirements

   Results of all tests conducted with any organism shall be reported according to the most recent format provided by the Division of Water. Test results shall be submitted to the Division of Water with the next regularly scheduled discharge monitoring report.

   Due to administrative and regulatory constraints regarding the requirements of Section 3 of this Part, monthly DMRs shall be submitted. Those required to conduct tests on a frequency other than monthly shall submit DMRs with "Not required this monitoring period" typed or written in the parameter row in addition to the DMR reporting the results of the test. All DMRs for biomonitoring shall be submitted monthly regardless of required monitoring frequency.

3. Acute Toxicity

A. If noncompliance with the toxicity limit occurs (the LC_{50} is less than 100% effluent), the permittee must conduct a second test within 10 days of the first failure. This test will be used in evaluating the persistence of the toxic event and the possible need for a toxics reduction evaluation (TRE).

If the second test demonstrates noncompliance with the toxicity limit, the permittee will be required to perform either of the options listed below. The Division must be notified of the option selected within five (5) days of the failure of this second test.

1) Accelerated Testing

Complete four (4) tests within 60 days of selection of this option to evaluate the frequency and degree of toxicity. The results of the two (2) tests specified in Section 3.A and of the four (4) additional tests will be used for purposes of this evaluation.

If results from two (2) of any six (6) tests show a significant noncompliance with the acute limit ($\geq$1.2 times the TU_a), or results from four (4) of any six (6) tests show acute toxicity (as defined in 1.A), a Toxicity Reduction Evaluation (TRE) will be required. The Division reserves the right to require a TRE in situations of recurring toxicity.

2) Toxicity Reduction Evaluation (TRE)

If it is determined that a TRE is required, a plan and implementation schedule must be submitted to the Division within 30 days of notification. The TRE shall include appropriate measures such as in-plant controls, additional treatment, or changes in the operation of the wastewater discharge to meet permit conditions. The TRE protocol shall follow that outlined in the most recent edition of EPA's guidance manual for conducting TREs.

B. If a violation of the toxicity limit occurs, different or more stringent monitoring requirements may be imposed in lieu of the normal requirements of this permit for whatever period of time is specified by the Division of Water. The Division reserves the right to require additional testing or a TRE in situations of recurring toxicity.

4. Test Methods

All test organisms, procedures, and quality assurance criteria used shall be in accordance with Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms, EPA/600/4-90/027F (4th edition) or the most recently published edition of this publication.

PART V

BEST MANAGEMENT PRACTICES

SECTION A. GENERAL CONDITIONS

1. Applicability

These conditions apply to all permittees who use, manufacture, store, handle, or discharge any pollutant listed as: (1) toxic under Section 307(a)(1) of the Clean Water Act; (2) oil, as defined in Section 311(a)(1) of the Act; (3) any pollutant listed as hazardous under Section 311 of the Act; or (4) is defined as a pollutant pursuant to KRS 224.01-010(35) and who have ancillary manufacturing operations which could result in (1) the release of a hazardous substance, pollutant, or contaminant, or (2) an environmental emergency, as defined in KRS 224.01-400, as amended, or any regulation promulgated pursuant thereto (hereinafter, the "BMP pollutants"). These operations include material storage areas; plant site runoff; in-plant transfer, process and material handling areas; loading and unloading operations, and sludge and waste disposal areas.

2. BMP Plan

The permittee shall develop and implement a Best Management Practices (BMP) plan consistent with 401 KAR 5:065, Section 2(10) pursuant to KRS 224.70-110, which prevents or minimizes the potential for the release of "BMP pollutants" from ancillary activities through plant site runoff; spillage or leaks, sludge or waste disposal; or drainage from raw material storage. A Best Management Practices (BMP) plan will be prepared by the permittee unless the permittee can demonstrate through the submission of a BMP outline that the elements and intent of the BMP have been fulfilled through the use of existing plans such as the Spill Prevention Control and Countermeasure (SPCC) plans, contingency plans, and other applicable documents.

3. Implementation

If this is the first time for the BMP requirement, then the plan shall be developed and submitted to the Division of Water within 90 days of the effective date of the permit. Implementation shall be within 180 days of that submission. For permit renewals the plan in effect at the time of permit reissuance shall remain in effect. Modifications to the plan as a result of ineffectiveness or plan changes to the facility shall be submitted to the Division of Water and implemented as soon as possible.

4. General Requirements

The BMP plan shall:

a. Be documented in narrative form, and shall include any necessary plot plans, drawings, or maps.

b. Establish specific objectives for the control of toxic and hazardous pollutants.

(1) Each facility component or system shall be examined for its potential for causing a release of "BMP pollutants" due to equipment failure, improper operation, natural phenomena such as rain or snowfall, etc.

(2) Where experience indicates a reasonable potential for equipment failure (e.g., a tank overflow or leakage), natural condition (e.g., precipitation), or other circumstances which could result in a release of "BMP pollutants," the plan should include a prediction of the direction, rate of flow, and total quantity of the pollutants which could be released from the facility as result of each condition or circumstance.

c. Establish specific Best Management Practices to meet the objectives identified under paragraph b of this section, addressing each component or system capable of causing a release of "BMP pollutants."

d. Include any special conditions established in part b of this section.

e. Be reviewed by plant engineering staff and the plant manager.

5. Specific Requirements

The plan shall be consistent with the general guidance contained in the publication entitled "NPDES Best Management Practices Guidance Document," and shall include the following baseline BMPs as a minimum.

a. BMP Committee
b. Reporting of BMP Incidents
c. Risk Identification and Assessment
d. Employee Training
e. Inspections and Records
f. Preventive Maintenance
g. Good Housekeeping
h. Materials Compatibility
i. Security
j. Materials Inventory

6. SPCC Plans

The BMP plan may reflect requirements for Spill Prevention Control and Countermeasure (SPCC) plans under Section 311 of the Act and 40 CFR Part 151, and may incorporate any part of such plans into the BMP plan by reference.

7. Hazardous Waste Management

The permittee shall assure the proper management of solid and hazardous waste in accordance with the regulations promulgated under the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1978 (RCRA) (40 U.S.C. 6901 et seq.) Management practices required under RCRA regulations shall be referenced in the BMP plan.

8. Documentation

The permittee shall maintain a description of the BMP plan at the facility and shall make the plan available upon request to NREPC personnel. Initial copies and modifications thereof shall be sent to the following addresses when required by Section 3:

Division of Water
Florence Regional Office
8020 Veterans Memorial Drive
Suite 110
Florence, Kentucky 41042
ATTN: Supervisor

Kentucky Natural Resources and
Environmental Protection Cabinet
Dept. for Environmental Protection
Division of Water/KPDES Branch
14 Reilly Road, Frankfort Office Park
Frankfort, Kentucky 40601

9. BMP Plan Modification

The permittee shall amend the BMP plan whenever there is a change in the facility or change in the operation of the facility which materially increases the potential for the ancillary activities to result in the release of "BMP pollutants."

10. Modification for Ineffectiveness

If the BMP plan proves to be ineffective in achieving the general objective of preventing the release of "BMP pollutants," then the specific objectives and requirements under paragraphs b and c of Section 4, the permit, and/or the BMP plan shall be subject to modification to incorporate revised BMP requirements. If at any time following the issuance of this permit the BMP plan is found to be inadequate pursuant to a state or federal site inspection or plan review, the plan shall be modified to incorporate such changes necessary to resolve the concerns.

SECTION B. SPECIFIC CONDITIONS

Periodically Discharged Wastewaters Not Specifically Covered By Effluent Conditions
The permittee shall include in this BMP plan procedures and controls necessary for the handling of periodically discharged wastewaters such as intake screen backwash, meter calibration, fire protection, hydrostatic testing water, water associated with demolition projects, etc.

CONFIDENTIAL

EAST BEND ASH POND

OPERATION MAINTENANCE MANUAL AND EMERGENCY ACTION PLAN

(PURSUANT TO 401 KAR 4:030)

(A) Operation Plan

The Ash Pond is used as a settling pond for coal ash (bottom ash).

(B) Scheduled Maintenance Program

A regular vegetation management program is followed to ensure that visual inspections can be completed without hindrance. Repairs are completed as needed as part of a regular maintenance program.

(C) Inspection and Monitoring Program

The Ash Pond is visited (drive by) daily by lab personnel and visually inspected monthly by Ash Management personnel and records are made of those drive by/inspections. Attached are copies of the inspection forms. Any concerns and remedial actions are also noted on the inspection forms. Inspection forms are kept on file by Ash Management site representatives.

(D) Safe-rate Drawdown Procedure for the Reservoir

Not applicable

(E) Provisions for Periodic Inspection by a Qualified Engineer

Once a year a qualified engineer from the Station and/or Program Engineering will inspect the Ash Pond

(F) Emergency Action Plan

PURPOSE OF PLAN

The purpose of the Emergency Action Plan is to provide a written plan that personnel at East Bend Station can readily utilize to aid them in determining an appropriate course of action if some degree of a slope failure is visually observed. This document is designed as a guideline for these personnel to use. Immediate decisions for any particular course of actions will be required by personnel based on their observations, experience and knowledge of the site conditions.

OBSERVATION OF CONDITIONS

LEVEL 1 - Tension cracks observed on the dike roadway or slope which were not present during the previous inspection.

LEVEL 2 - Tension cracks in excess of three inches wide observed on the dike roadway or slope which were not present during the previous inspection.

LEVEL 3 - Downward slope movement visually observed on the dike roadway or slope which was not present during the previous inspection.

LEVEL 4 - Volumes of water/material are in transport. Visual observations indicate that slope failure may be imminent.

COURSE OF ACTION

LEVEL 1 -

1. Notify Ash Management site representative

LEVEL 2 -

1. Notify Ash Management site representative as soon as possible
2. The tension cracks should be clearly marked with spray paint and/or staked and the slope should be monitored at least once a day for any further movement.

LEVEL 3 -

1. Notify Ash Management site representative as soon as possible
2. The downward movement of the slope should be clearly marked with spray paint and/or staked
3. Markers should be installed and surveyed as soon as possible. The slope should be monitored at least twice a day for any further movement.

LEVEL 4 -

1. Notify the Production Supervisor immediately that a slope failure may be imminent and request immediate evacuation of all personnel from the affected area as well as any adjacent areas that may be affected by a dam breach. No personnel shall enter the embankment area until visual observations indicate slope failure will not occur in the near future, the downward slope movement has ceased and the area appears secured.
2. Notify Ash Management site representative.
3. Notify Environmental, Health and Safety representative.

LEVEL 4 NOTIFICATION

CONTACT THE GENERAL Production Supervisor
IMMEDIATELY AT 513-467-4733

PRODUCTION SUPERVISOR SHALL CONTACT ALL THE FOLLOWING PEOPLE

Production Supervisor

Station Manager

Station Manager
Notifies One of the
Following people in EHS:

(See attached Call List)

Environmental Services Notifies:

Kentucky Department of Environmental Protection
Division of Water
Dam Safety and Flood Compliance
502-564-3410

Ash Management
Site Representative

Director By-Products
Management

DUKE ENERGY SPILL/RELEASE CONTACTS – OHIO & KENTUCKY
8/4/2010

1. Environmental Staff

The following contact list should be used by Duke Midwest facilities in Ohio and Kentucky to notify corporate Environmental staff in the event of a reportable oil or chemical release to the environment.

If a reportable release occurs, please contact a member of the Environmental staff, regardless of the time of day, using the following call list. Start at the top of the list and continue calling until you have reached one of the people listed below. DO NOT leave a message. If there has been no response to your page within two (2) minutes, continue down the list.

	Office	Home	Cell Phone/Pager
Pat Coyle	513-287-2268	513-877-2122	513-509-0040 (cell)
Randy Born	513-287-3234	859-261-1678	513-260-1679 (cell)
Tammy Jett	513-287-2208	513-738-0203	513-659-9198 (cell)
Jim Stieritz	513-287-2269	859-635-1595	513-260-3298 (cell)
Kerri Buhrlage	513-287-2414	513-385-1235	513-673-4738 (cell)
John Funke	513-287-3821	513-574-6230	513-219-3247 (pager)
John Pike	317-838-6218	317-539-7529	317-431-5488 (cell)
Bill Taylor	317-838-1711	317-796-6572 (cell)	317-796-6572 (cell)
Mike Judd	317-838-1729	317-272-0803	317-670-5038 (cell)
Pat McKee	317-838-1194	317-745-4428	317-430-2764 (cell)
Debbie Nispel	317-838-1957	765-653-6542	765-720-2077 (cell)

2. Duke Energy Ohio and Duke Energy Kentucky Regional Communications

If the release could cause concern to the public or involve the news media, Duke Energy's local media relations staff should be contacted as soon as possible, regardless of the time of day. Start at the top of the list and continue calling until you have reached one of the people listed below.

	Office	Home	Cell Phone/Pager
Johnna Reeder	513-419-5760	859-360-0787	513-256-8411 (cell)
Angeline Protogere	317-838-1338	317-298-3090	317-367-3306 (pager)
Lew Middleton	317-838-1505	317-773-0417	317-474-7448 (cell)

DUKE ENERGY

MONTHLY DAM INSPECTION CHECKLIST

NAME OF STATION:
INSPECTOR:
WEATHER:

COUNTY, ST:
INSPECTION DATE:
AMT OF RAINFALL IN LAST 24 HOURS:

Pool Level
Primary Pond Level:

Interior Slope	**Yes**	**No**	**N/A**	**Monitor**	**Repair**	**Evaluate**
Are there any cracks, slides or erosion?	☐	☐	☐	☐	☐	☐
Are there any rodent burrows or depressions?	☐	☐	☐	☐	☐	☐
Is there vegetation or sediment in the riprap?	☐	☐	☐	☐	☐	☐
Is there vegetation greater than 2 inch diameter?	☐	☐	☐	☐	☐	☐
Comments:						
Crest	**Yes**	**No**	**N/A**	**Monitor**	**Repair**	**Evaluate**
Are there large cracks?	☐	☐	☐	☐	☐	☐
Are there low areas or potholes?	☐	☐	☐	☐	☐	☐
Is there vegetation greater than 2 inch diameter?	☐	☐	☐	☐	☐	☐
Comments:						
Exterior Slope	**Yes**	**No**	**N/A**	**Monitor**	**Repair**	**Evaluate**
Are there cracks, slides or erosion?	☐	☐	☐	☐	☐	☐
Are there rodent burrows or depressions?	☐	☐	☐	☐	☐	☐
Is the grass cover in good condition?	☐	☐	☐	☐	☐	☐
Are there areas of seepage?	☐	☐	☐	☐	☐	☐
Is there vegetation greater than 2 inch diameter?	☐	☐	☐	☐	☐	☐
Comments:						
Outlet Structure (Discharge Tower)	**Yes**	**No**	**N/A**	**Monitor**	**Repair**	**Evaluate**
Are the valves and operators in good condition?	☐	☐	☐	☐	☐	☐
Is the system operable?	☐	☐	☐	☐	☐	☐
Is the outlet structural material in good condition?	☐	☐	☐	☐	☐	☐
Is the walkway to the outlet in good condition?	☐	☐	☐	☐	☐	☐
Comments:						
Emergency Spillway (If applicable)	**Yes**	**No**	**N/A**	**Monitor**	**Repair**	**Evaluate**
Are there cracks or slides in the spillway?	☐	☐	☐	☐	☐	☐
Are there any points of erosion around or along the spillway?	☐	☐	☐	☐	☐	☐
Piezometers	**Yes**	**No**	**N/A**	Monitor		
Are all Piezometers working properly?	☐	☐	☐	☒		
Comments:						

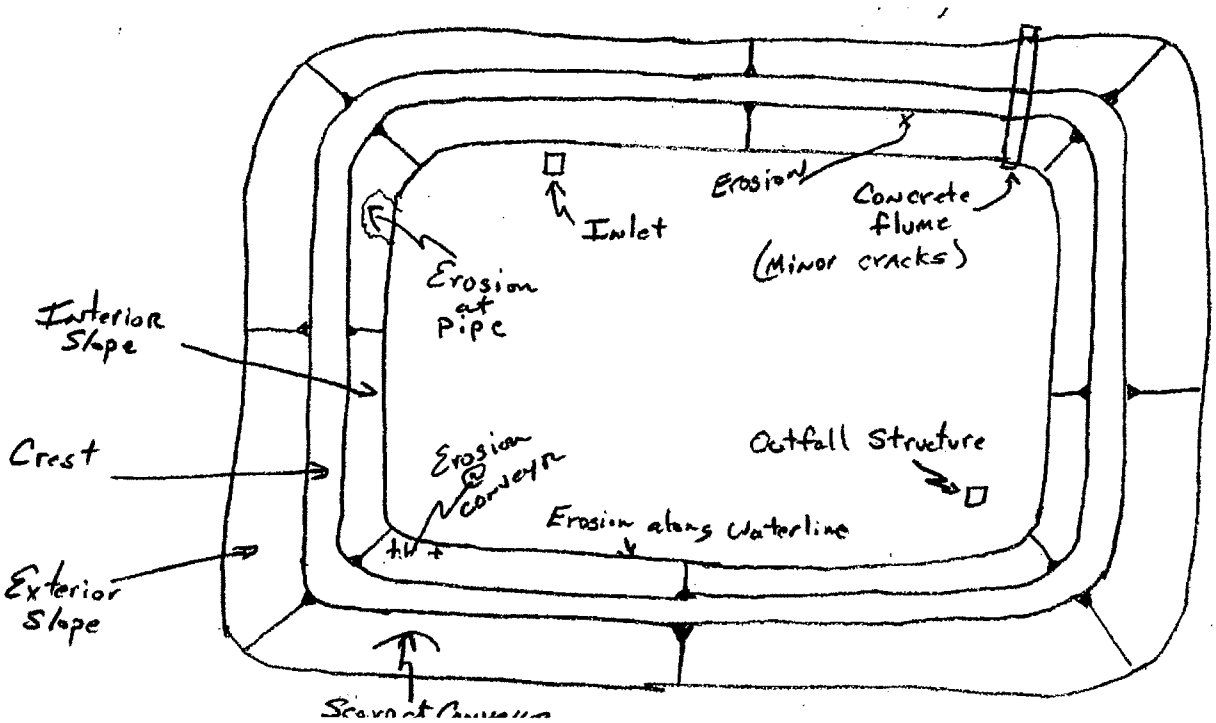
Monitoring Wells	Yes	No	N/A	Monitor
Are all monitoring wells working properly?	☐	☐	☐	☒
Comments:				

Drains	Yes	No	N/A	Monitor
Are all drains working properly?	☐	☐	☐	☒
Comments:				

Survey Monuments	Yes	No	N/A	Monitor
Are all survey monuments in place?	☐	☐	☐	☒
Comments:				

2" Rainfall Inspection	Yes/No	Date(s)	Comments
Has a 2" rain event occurred during the month			

Post Pictures Here:



SIGNATURE _____
DATE _____

I hereby certify that I have reviewed the following checklist and have taken the appropriate action(s) to remediate any areas that may cause harm to the structural integrity of the dam.

REVIEWED BY _____
DATE _____

ANNUAL DAM INSPECTION CHECKLIST
Duke Energy
Program Engineering

NAME OF FACILITY:
LOCATION: **Municipality:** **County:**
CLASSIFICATION DATA: **Size:** **Hazard:**

PHYSICAL DATA:
Type of Dam: _____ **Height of Dam:** _____ **Normal Pool Storage Capacity:** _____

OPERATOR: _____
ADDRESS: _____ _____
PHONE: (___)-___-_____ **FAX NO.:** (___)-___-_____ **E-MAIL ADDRESS:** _____

PERSONS PRESENT AT INSPECTION:

Name	Title/Position	Representing

DATE OF INSPECTION: ____/____/____

WEATHER: _____

TEMPERATURE: _____

This is to certify that the above dam has been inspected and the following are the results of this inspection.

_____ _____
Date

NAME OF DAM:		DATE:

ITEM	CONDITION	COMMENTS	MONITOR	REPAIR	EVALUATE
EMBANKMENT: CREST					
1	Surface Cracking		☐	☐	☐
2	Sinkhole, Animal Burrow		☐	☐	☐
3	Low Area(s)		☐	☐	☐
4	Horizontal Alignment		☐	☐	☐
5	Ruts and/or Puddles		☐	☐	☐
6	Vegetation Condition		☐	☐	☐
7	Warning Signs		☐	☐	☐
8			☐	☐	☐
Additional Comments (Refer to item number if applicable):					
EMBANKMENT: UPSTREAM FACE					
10	Slide, Slough, Scarp		☐	☐	☐
11	Slope Protection		☐	☐	☐
12	Sinkhole, Animal Burrow		☐	☐	☐
13	Emb.-Abut. Contact		☐	☐	☐
14	Erosion		☐	☐	☐
15	Vegetation Condition		☐	☐	☐
17			☐	☐	☐
Additional Comments (Refer to item number if applicable):					
EMBANKMENT: DOWNSTREAM FACE					
18	Wet Area(s) (No Flow)		☐	☐	☐
19	Seepage		☐	☐	☐
20	Slide, Slough, Scarp		☐	☐	☐
21	Emb. - Abut. Contact		☐	☐	☐
22	Sinkhole, Animal Burrow		☐	☐	☐
23	Erosion		☐	☐	☐
24	Unusual Movement		☐	☐	☐
25	Vegetation Control		☐	☐	☐
26			☐	☐	☐
27			☐	☐	☐
Additional Comments (Refer to item number if applicable):					

NAME OF DAM:		DATE:

ITEM	CONDITION	COMMENTS	MONITOR	REPAIR	EVALUATE
EMBANKMENT: INSTRUMENTATION					
28	Piezometers/Observ. Wells		☐	☐	☐
29	Staff Gauge and Recorder		☐	☐	☐
30	Weirs		☐	☐	☐
31	Survey Monuments		☐	☐	☐
32	Drains		☐	☐	☐
33	Low Flow Release		☐	☐	☐
34	Frequency of Readings		☐	☐	☐
35	Location of Records		☐	☐	☐
36			☐	☐	☐
37			☐	☐	☐
Additional Comments (Refer to item number if applicable):					
DOWNSTREAM AREA					
38	Abutment Leakage		☐	☐	☐
39	Foundation Seepage		☐	☐	☐
40	Slide, Slough, Scarp		☐	☐	☐
41	Drainage System		☐	☐	☐
42	Boils		☐	☐	☐
43	Wet Areas		☐	☐	☐
44	Reservoir Slopes		☐	☐	☐
45	Access Roads		☐	☐	☐
46	Security Devices		☐	☐	☐
47	Signs and Buoys		☐	☐	☐
48			☐	☐	☐
49			☐	☐	☐
Additional Comments (Refer to item number if applicable):					
SPILLWAYS: ERODABLE CHANNEL					
50	Slide, Slough, Scarp		☐	☐	☐
51	Erosion		☐	☐	☐
52	Vegetation Condition		☐	☐	☐
53	Debris		☐	☐	☐
54			☐	☐	☐
55			☐	☐	☐
Additional Comments (Refer to item number if applicable):					

NAME OF DAM:		DATE:

ITEM	CONDITION	COMMENTS	MONITOR	REPAIR	EVALUATE
SPILLWAYS: NON-ERODABLE CHANNEL					
56	Sidewalls		☐	☐	☐
57	Channel Floor		☐	☐	☐
58	Unusual Movement		☐	☐	☐
59	Approach Area		☐	☐	☐
60	Weir or Control		☐	☐	☐
61	Discharge Channel		☐	☐	☐
62	Boils or Bimps		☐	☐	☐
63			☐	☐	☐
64			☐	☐	☐
Additional Comments (Refer to item number if applicable):					
SPILLWAYS: DROP INLET					
65	Intake Structure		☐	☐	☐
66	Trashrack		☐	☐	☐
67	Stilling Basin		☐	☐	☐
68			☐	☐	☐
69			☐	☐	☐
Additional Comments (Refer to item number if applicable):					
OUTLET					
70	Intake Structure		☐	☐	☐
71	Trash rack		☐	☐	☐
72	Stilling Basin		☐	☐	☐
73	Primary Closure		☐	☐	☐
74	Secondary Closure		☐	☐	☐
75	Control Mechanism		☐	☐	☐
76	Outlet Pipe		☐	☐	☐
77	Outlet Tower		☐	☐	☐
78	Outlet Structure		☐	☐	☐
79	Seepage		☐	☐	☐
80	Unusual Movement		☐	☐	☐
Additional Comments (Refer to item number if applicable):					

NAME OF DAM:		DATE:

ITEM	CONDITION	COMMENTS	MONITOR	REPAIR	EVALUATE
RESERVOIR AREA					
81	Sedimentation		☐	☐	☐
82	Slope Stability		☐	☐	☐
83	Sinkholes		☐	☐	☐
84	Fractures		☐	☐	☐
85	Unwanted Growth		☐	☐	☐
86	Storage Gage		☐	☐	☐

Additional Comments (Refer to item number if applicable):

Final Comments:

DAM Inspection CHECKLIST
Duke Energy
Program Engineering

NAME OF DAM:

This is to certify that both the Downstream Hazard Description is accurate and the Posted Notice locations listed below have been inspected and the following are the results of these inspections.

Name of Dam Owner | Signature of Dam Owner | Date

This Dam Owners Notice Checklist is to accompany the Inspection Checklist filed by the Engineer.

EMERGENCY ACTION PLAN

Date of Last Update of Emergency Plan:

Downstream Hazard Description, additionally, specify any new developments, structures, etc. downstream within the inundation area:

Action Items

ITEM #	DATE INSPECTED	LOCATION	COMMENTS	EXISTING	MISSING	REPLACED
				☐	☐	☐
				☐	☐	☐
				☐	☐	☐
				☐	☐	☐
				☐	☐	☐
				☐	☐	☐
				☐	☐	☐
				☐	☐	☐

Additional Comments (Refer to item number if applicable):

DUKE ENERGY FOSSIL HYDRO GENERATION

PROGRAM ENGINEERING PROCEDURE

FHGP-112 Fossil Impoundment Dam Inspection Program

Process/Program Owner: Program Engineering

REVISION NUMBER	**ISSUE DATE**
000	06/30/2010

Fossil-Hydro Generation

Approved By/Date

Dave Waugh/07/01/2010

Senior Project Director, Program Engineering, Fossil-Hydro Generation

Effective Date:

07/01/2010

Issued By:

David W Arndt / Manager, Process & Sys Integration

Effective Date:

07/01/2010

VERIFICATION OF PROCEDURE

Procedure Title: **Fossil Impoundment Dam Inspection Program**

Procedure Number: FHGP- 112 Revision: 000

The quality of this Procedure has been assured. Signatures certify that the above Procedure was originated and approved as noted below:

Prepared By: _____ Date: 6/30/2010

Checked By: B. H. Tyler Date: 6/30/10

Approved By: _____ Date: 6/30/2010

CONTENTS:

PURPOSE:

This procedure establishes the guidelines and objectives for the planning, conducting and reporting of Fossil Impoundment Dam and Dike Inspections and planning for maintenance and repairs.

INTRODUCTION:

The past decade has brought an ever increasing amount of attention and environmental awareness to how we as a utility manage our waste streams. Program Engineering has developed this detailed procedure to ensure safety and regulatory compliance of the stations' combustion byproduct and cooling water impoundments.

The program is based upon a three-tiered approach, relying on an examination of existing conditions, third party inspections and periodic reviews. The first level of the program is the Monthly Inspection; this inspection will be conducted by the Station Dam Equipment Owners (plant personnel). The second level is an Annual Inspection; this inspection will be performed by representatives from Program Engineering, Environmental Health and Safety (EH&S), and the Dam Equipment Owners. The third level is an inspection performed every 2 to 5 years by a Federal/State Agency or 3rd party engineering firm; this inspection can be substituted for the Annual Inspection.

The use of the three-tiered program of fossil impoundment dam inspections reinforces the company's commitment to environmental compliance and to conducting its operations with appropriate concern for the structural integrity of its dams.

DEFINITIONS:

Berm - a mound of earth, often linear, to form a boundary, designed to keep flood flows from entering an adjacent area.

Coal Combustion ByProducts (CCP) - generated from burning coal in coal-fired power plants. These byproducts include fly ash, bottom ash, boiler slag, and flue gas desulfurization gypsum.

Dam* - A constructed wall that crosses a stream bed to hold back a body of water.

Dike* – A constructed wall that forms a boundary for a body of water without crossing the main stream bed.

Divider Dike – An intermediate Dike within an ash pond that may be constructed on top of Ash, or constructed largely out of compacted Ash. A Divider Dike failure would in no way jeopardize public safety or result in a release of coal combustion byproducts.

Impoundment – A Body of water created by a dam or dike.

* For the purposes of this procedure, Dam will mean both *Dam* and *Dike*.

AUTHORIZATION:

Program Engineering has the responsibility for the development and implementation and management of a companywide Fossil Impoundment Dam Inspection Program and Procedure.

OBJECTIVES:

- To effectively manage, inspect, and maintain the fossil impoundment dams.
- To resolve any potential problems with the existing dams and to ensure compliance with the federal, state and local regulations that govern them.
- To establish a consistent and reliable inspection program throughout the entire Duke Energy Company.

SCOPE:

This procedure applies to any Duke Energy Fossil Impoundment Dams that are not licensed by the Federal Energy Regulatory Commission (FERC). These impoundments include those that contain water or coal combustion byproducts including gypsum, fly ash, bottom ash and boiler slag.

STATE REQUIREMENTS:

Duke Energy has dams in the Midwest and Carolinas regions. The Midwest region includes the states of Indiana, Ohio and Kentucky. The Carolinas region includes North and South Carolina. These five states have separate agencies that regulate dams. Every agency has a different classification system, inspection duration and overall inspection program. It is important that Duke Energy comply with each state's dam regulations. On the following page is the breakdown of the five states and their corresponding regulatory agency.

State Jurisdiction Table

State	Primary Jurisdictional Agency	Division	Program	Classification			General Requirements	Frequency
				High	Moderate	Low		
Indiana	Department of Natural Resources	Division of water	Dam Safety	High hazard (1): A structure the failure of which may cause the loss of life and serious damage to homes, industrial and commercial buildings, public utilities, major highways, or railroads.	Significant hazard (2): A structure the failure of which may damage isolated homes and highways, or cause the temporary interruption of public utility services.	Low Hazard (3): A structure the failure of which may damage farm buildings, agricultural land or local roads.	• Dam Safety Inspection • Emergency Action Plans •Operations, Maintenacnce and Inspection Manuals (OM&I)	• Owner - Periodically • Spillway - minimum once per year • High Hazard - professionally every 2 years
Kentucky	Department of Natural Resources and Environmental Protection	Division of water	Dam Safety	High Hazard (C): Structures located such that failure may cause loss of life or serious damage to houses, industrial or commercial buildings, important public utilities, main highways or major railroads	Moderate Hazard (B): Structures located such that failure may cause significant damage to property and project operation, but loss of human life is not envisioned.	Low Hazard (A): Structures located such that failure would cause loss of the structure itself but little or no additional damage to other property	• Dam Safety Inspection • Emergency Action Plans •Operations, Maintenacnce and Inspection Manuals (OM&I)	• Owner - Periodically • High and Moderatre-hazard dams every 2 years • Low Hazard dams - every 5 years
Ohio	Department of Natural Resources	Division of water	Dam Safety	Class I: Dams >5,000 acre-feet max storage volume or >60 feet high. A dam shall be placed in class I when sudden failure of the dam would result in one of the following conditions. (a) Probable loss of human life. (b) Structural collapse of at least one residence or one commercial or industrial business.	Class II: Dams . 500 acre-feet max storage volume or > 40 feet high. A dam shall be placed in class II when sudden failure of the dam would result in significant property damage, but loss of human life is not probable.	Class III: Dams >50 acre-feet max storage volume or >25 feet high. A dam shall be placed in class III when sudden failure of the dam would result in significant property damage, but loss of human life is not probable. not probable. Class IV: Dams ≤ 50 acre-feet max storge volume or ≤ 25 feet high. When sudden failure of the dam would result in property losses restricted mainly to the dam and rural lands, and loss of human life is not probable. Class IV: Dams ≤ 50 acre-feet max storge volume or ≤ 25 feet high. When sudden failure of the dam would result in property losses restricted mainly to the dam and rural lands, and loss of human life is not probable.	• Dam Safety Inspection • Emergency Action Plans •Operations, Maintenacnce and Inspection Manuals (OM&I)	• Owner - Periodically • Yearly-Engineer/Owner • ODNR - Engineer's Safety Inspection 3 to 5 years
North Carolina	Department of Environmental and Nautral Resources	Division of Land Resources	Dam Safety	High (C): Loss of human life - Probable loss of 1 or more human lives, Probable loss of human life due to breached roadway or bridge on or below the dam - 250 or more vehicles per day, Economic damage - More than $200,000	Intermediate (B): Damage to highways, Interruption of service - 25 to less than 250 vehicles per day, Economic damage - $30,000 to less than $200,000	Low (A): Interruption of road service, low volume roads - Less than 25 vehicles per day, Economic damage - Less than $30,000.	• Dam Safety Inspection • Emergency Action Plans •Operations, Maintenacnce and Inspection Manuals (OM&I)	• Class A and B dams once every 5 years • Class C dams once every 2 years
South Carolina	Department of Heath and Environmental Control	Division of water	Dam and Reservoirs Safety Programs	High Hazard (Class I): Dams located where failure will likely cause loss of life or serious damage to homes(s), industrial and commercial facilities, important public utilities, main highway(s) or railroads.	Significant Hazard (Class II): Dams located where failure will not likely cause loss of life but may damage home(s), industrial and commercial facilities, secondary highway(s) or railroad(s) or cause interruption of use or service of relatively important public utilities	Low Hazard (Class III): Dams located where failure may cause minimal property damage to others. Loss of life is not expected.	• Dam Safety Inspection • Emergency Action Plans •Operations, Maintenacnce and Inspection Manuals (OM&I)	• Class I - each 2 years • Class II - each 3 years • Class III - each 6 years upon renewal of certificate

Indiana

Under the Indiana Department of Natural Resources.

Information Maintained by the Office of Code Revision Indiana Legislative Services Agency -

Frequency of inspection:

- Owner – Periodically
- Spillway – minimum of one per year
- High Hazard – professionally every two (2) years

Kentucky

- Under the Kentucky Department of Natural Resources and Environmental Protection.
- KRS 151293, Section 6, authorizes the Energy and Environment Cabinet to inspect existing structures that meet the definition of a dam. The Dam Safety and Floodplain Compliance Section of the Water Infrastructure Branch maintain a list of these structures in an inventory database.
- High and moderate hazard dams are inspected every two years. Low hazard dams are inspected at least every five years.
- Items of general maintenance of a dam shall include provisions for at least the following: dams shall be mowed regularly; dams shall be free of trees and brush; animal burrows shall not be allowed on dams; slides, erosion and cracks that could pose problems to dams shall be properly repaired; action shall be taken to alleviate excessive wetness and abnormal seepage; appurtenances that are necessary for the proper operation and maintenance of the dam shall be kept in proper working condition.

North Carolina

- Under North Carolina Department of Environmental and Natural Resources (NCDENR) effective January 1, 2010.
- The rules and regulations contained in the Dam Safety Law of 1967, as expressed in G.S. 143-215.24 authorizes the implementation of a dam inspection and certification program in the interest of public health, safety and welfare.
- The NC Dam Safety Law of 1967 states that the Department may at any time inspect any dam, including a dam that is otherwise exempt from this Law, upon receipt of a written request of any affected person or agency, or upon a motion of the Environmental Management Commission. Within the limits of available funds the Department shall endeavor to provide for inspection of all dams at intervals of approximately five years.

- All class A (Low) and B (Intermediate) dams shall be inspected at least once every five years.
- Class C (High) dams shall be inspected at least once every two years.
- At any time an inspection indicates that a dam may not perform satisfactorily or that the hazard classification has changed, the Director of Dam Safety may require a detailed investigation at the owner's expense to determine the required remedial action, if any.

Ohio

- Under the Ohio Department of Natural Resources (ODNR)
- All dams should be inspected periodically by the chief engineer, except for classes of dams that are required to be inspected by a Professional Engineer (PE) approved by the chief engineer. Inspection shall ensure that continued operation does not constitute a hazard to life, health, or property.
- Exempted dams don't require inspections by the chief engineer.
- Inspection intervals are determined by the chief engineer (not exceeding 5 years).
- The owner shall maintain and operate the structure in accordance with rules, permit conditions, and requirements under 1521.06.
- Before repair or improvements can be made approval from the division is required. Emergency repairs are exempt from approval.

South Carolina

Under the South Carolina Department of Health and Environmental Control (SCDHEC).

Lee Station NPDES Permit- certify that the ash pond(s) provide(s) the necessary minimum wet weather detention volume, and annually survey all ash pond dikes and toe areas to determine if the structural integrity has been compromised. The permittee shall notify SCDHEC within five (5) days of becoming aware of any abnormalities and provide a proposed course corrective action and implementation schedule.

DAM INSPECTIONS:

Monthly Internal Inspection:

A Monthly Internal Inspection provides a method by which the Station will survey existing conditions on their impoundment dams and assess compliance activities with respect to applicable permits, environmental and dam regulations.

The Internal Inspection will be performed monthly on all of the fossil impoundment dams.

Each facility is responsible for implementing and carrying out the internal Inspections.

The Internal Inspections shall be performed by the Station Dam Equipment Owner and/or the site's Environmental Coordinator.

In the event that a Regulatory/Third Party inspection takes place during the month when the monthly inspection has yet to be performed, then the monthly inspection can be performed during the third party's inspection.

Checklists used to perform the Monthly Internal Inspection will be furnished by Program Engineering. The checklist will be station specific and will include monthly monitoring programs and may also include federal/state agencies and/or third party recommendations.

A copy of the completed checklists, sketches, notes, areas of concern and action items shall be forwarded to the Program Engineering Group. In the Midwest, the completed checklists will be sent to Adam Deller. In the Carolinas, the completed checklists shall be sent to Henry Taylor. After Program Engineering receives the completed checklists, an engineering review will be performed, copies will be distributed and any necessary action will be determined.

A visual inspection will be performed after a rain event of 2 inch or greater in 24 hours or less. The monthly checklists can be used for this inspection if needed.

The Station Dam Equipment Owner shall ensure that these actions are taken in a timely manner. If immediate concerns are found, Program Engineering will be notified and respond immediately. The following are those who should be contacted in case of an immediate issue:

Midwest

Ron Ehlers
(513)287-2759 O
(513)312-4351 M

Adam Deller
(513)287-1239 O
(513)309-2108 M

Carolinas

Henry Taylor, P.E.
(704)382-4913 O
(704)458-0360 M

Alex Papp
(704)382-1196 O
(704)996-2768 M

Annual Inspection:

An Annual Internal Inspection provides for a method by which the Station and Program Engineering will survey existing conditions on the impoundment dams and assess compliance activities with respect to applicable permits, environmental and dam regulations.

The Annual Internal Inspection will be performed at least once a year on all of the impoundment dams. Inspections shall be coordinated with the station mowing schedule to occur soon after a mowing.

Program Engineering is responsible for scheduling and performing the Annual Internal Inspection.

The Annual Internal Inspection will typically be performed by representatives of Program Engineering, the Dam Equipment Owner, and the site's environmental coordinator.

Checklists used to perform the Annual Internal Inspection will be furnished by Program Engineering. The checklist will be station specific and will include monthly annual monitoring programs and may also include federal/state agency and/or third party recommendations. The checklist will include GPS locations of any items or issues noted to help better identify their locations.

In the event that a Regulatory/Third Party Inspection is performed before the annual inspection is performed internally then the annual inspection will not have be performed for the calendar year. Program Engineering will follow up with the station at various intervals to determine the status of any action items, necessary work and/or monitoring programs that may have been recommended by the Third Party Inspection.

Program Engineering will collect the completed checklists, perform an engineering review, distribute copies and determine if any action is necessary.

Action plans will be developed by Program Engineering and the Station Dam Equipment Owner. Action plans will be reviewed by Station Management. Station Management will also make budgetary arrangements from station O&M as required for maintenance and repairs. Program Engineering manages all recommendations by providing engineering support, addressing any potential compliance issues identified in the checklists, monitoring progress to resolve the issues, documenting the completion of the corrective action, and verifying the maintenance or repair is successful.

Program Engineering shall assure that these actions are taken in a timely manner. If immediate concerns are found during the inspection, Program Engineering will respond immediately.

Regulatory and Third Party Inspection:

A two to five year Inspection provides for an official regulatory inspection method by which the Station, Program Engineering, EHS representative, third party geotechnical consultants and Agency officials will survey existing conditions on the pond dams and assess compliance activities with respect to applicable permits, and environmental and dam regulations.

The Inspection will be performed at intervals as required by local dam governing agencies, in which the interval between inspections will be no longer than five (5) years. Efforts will be made to coordinate with state regulatory officials to setup and perform the inspection.

Program Engineering is responsible for scheduling and assisting government agencies with the Regulatory or Third Party Inspection.

The final product of the Regulatory or Third Party Inspection will be a geotechnical consultant report utilizing GPS locations of items noted. The report shall itemize all recommendations. The recommendations must be clear, specific, and concise.

Action plans will be developed by Program Engineering and Station Pond Equipment Owner. Action plans will be reviewed by Station Management. Station Management will also make budgetary arrangements from station O&M as required for maintenance and repairs. Program Engineering manages all recommendations by providing engineering support, addressing any potential compliance issues identified in the checklists, monitoring progress to resolve the issues, documenting the completion of the corrective action, and verifying the maintenance or repair is successful.

Program Engineering shall assure that these actions are taken in a timely manner. If immediate concerns are found during the inspection, Program Engineering will respond immediately without waiting for the final inspection report.

Maintenance and Repairs

The station is responsible for all routine maintenance and repairs. The Station Equipment Owner will be responsible for O&M budgets, as well as the budgeting of annual and monthly inspections. Generation Engineering will prepare budgets for capital items.

Program Engineering will work with the plant representatives and Generation Engineering in the design of significant repairs and potential capital items. Implementation of repairs will be handled by Generation Engineering. Program Engineering will ensure that all fixes, repairs and upgrades comply with state requirements.

Record Retention

The Program Engineering Group will utilize the EH&S eTRAC management software via the Duke Energy Portal to coordinate and track checklists for all inspections.

All documents, reports, and information prepared relating to the inspection and corrective actions shall be collected and maintained by the Program Engineering Group.

Data Collection

The following list contains the types of data collected and the responsible party:

1. Monthly Piezometers and Monitoring Well readings associated with Dam integrity *(Performed Monthly)* – Station EH&S Professional and Plant Chemistry Dept.
2. Settlement Monument Survey *(Performed Annually)* – Surveyors - Arranged by Program Engineering for Belews Creek, Buck, Dan River, Lincoln CT, and Riverbend in the Carolinas.
3. Inclinometer readings (Midwest only) – Station Ash Pond Dam Equipment Owner
4. Required Monitoring from Inspection Commitments *(i.e., Seepage, etc.)* – Station Ash Pond Dam Equipment Owner or EH&S Professional

Below are the responsible parties at the stations in the Carolinas and Midwest.

Carolinas			
Plant	**Environmental Contact**	**Engineering Contact**	**Equipment Owner**
Allen	Don Scruggs	Gary Blevins	Don Scruggs
Belews Creek	Melonie Martin	Tom Wiest	Tom Wiest
Buck	Nob Zalme	Elena Massimini	Bill Wilson
Cliffside	Steve Hodges	Kelley Allison	Steve Hodges
Dan River	George Tolbert	Tom Wiest	George Tolbert
Lee	Marcus Pitts	Kelley Allison	Marcus Pitts
Lincoln CT	David Brooks	Paul Beatty	Kristi McCall
Marshall	Donna Burrell	Elena Massimini	Carlton Allred
Riverbend	Steve Jones	Gary Blevins	Steve Jones
Midwest			
Plant	**Environmental Contact**	**Engineering Contact**	**Equipment Owner**
Beckjord	Micheal L Byrd	Greg Mumford	Ron Frey
Cayuga	Tom Knapke	Pete Massa	Tom Knapke
East Bend	JR Wood	Michael Brissie	Andy Buckley
Edwardsport	Shawn Flaningam	-	-
Gallagher	Jeff Kling	Kristie Beaven	Bill Chanley
Gibson	Becky Sparks	Kevin Olivey	Becky Sparks
Miami Fort	Tara Thomas	Kendall McCall	Ron Frey
Wasbash River	Sheryl Fisher	Pete Massa	Sheryl Fisher
Zimmer	Tom Patt	Al Schmitt	Tom Patt

After the data is collected, the responsible party forwards it to the respectful Program Engineering contacts referenced on page 8 of this procedure. These contacts are the responsible party that will load it onto the shared server. Data analysis is a function of Program Engineering. Maximo will be used to schedule station based activities. In particular, this will ensure the monthly and annual monitoring data is collected.

Exhibits

1. Monthly Internal Inspection Checklist
2. Annual Inspection Checklists
3. Example of completed checklist

APPENDIX B

SITE PHOTOGRAPHS

Photograph 1: Embankment Crest @ Northwest Abutment

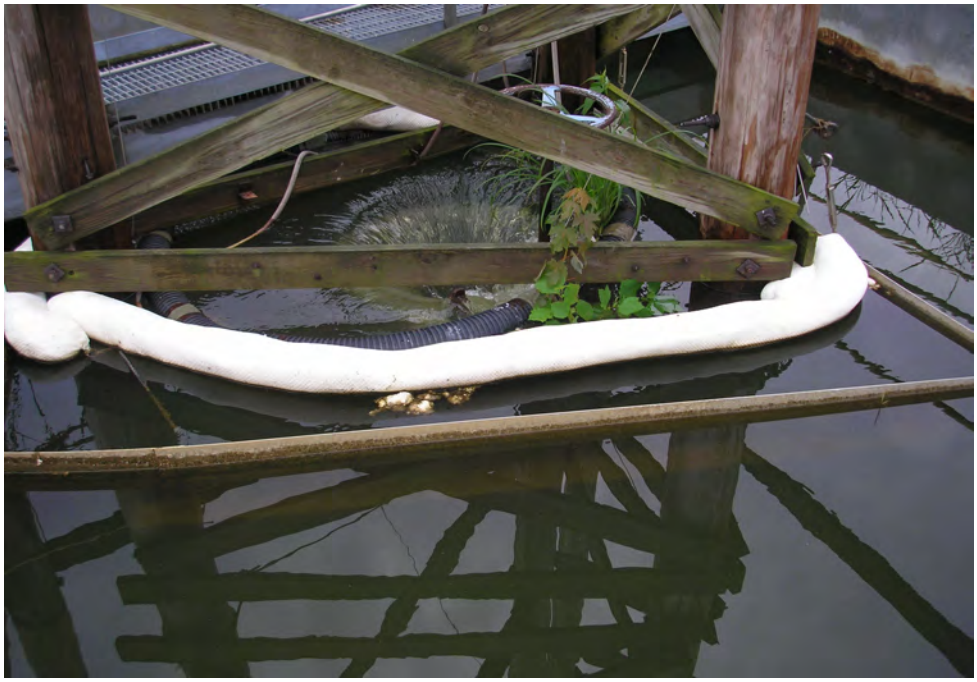
Photograph 2: Embankment Crest @ Northeast Abutment

Photograph 3: Toe Rip Rap Armoring – East Section Down Gradient Slope

Photograph 4: Down Gradient Slope @ Northeast Abutment

Photograph 5: Down Gradient Slope @ Southwest Groin

Photograph 6: Primary Spillway Riser Structure



Photograph 7: Skimmer Boom at Primary Riser Spillway

Photograph 8: Emergency Spillway View from Down Gradient Toe

APPENDIX C

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name: East Bend Station | Date: 5 August 2010

Unit Name: East Bend station Unit 1 | Operator's Name: Duke - Energy

Unit I.D.: KY 1215 | Hazard Potential Classification: High (Significant) Low

Inspector's Name: Hugh Ward, P.E. Joseph P. Klein III P.E.

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	Monthly		18. Sloughing or bulging on slopes?		✓
2. Pool elevation (operator records)?	490.1		19. Major erosion or slope deterioration?		✓
3. Decant inlet elevation (operator records)?	485.5		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	518.5		Is water entering inlet, but not exiting outlet?		✓
5. Lowest dam crest elevation (operator records)?	520.0		Is water exiting outlet, but not entering inlet?		✓
6. If instrumentation is present, are readings recorded (operator records)?		NA	Is water exiting outlet flowing clear?		N/A
7. Is the embankment currently under construction?		✓	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation,stumps, topsoil in area where embankment fill will be placed)?	✓		From underdrain?		
9. Trees growing on embankment? (If so, indicate largest diameter below)		✓	At isolated points on embankment slopes?		
10. Cracks or scarps on crest?		✓	At natural hillside in the embankment area?		
11. Is there significant settlement along the crest?		✓	Over widespread areas?		
12. Are decant trashracks clear and in place?		NA	From downstream foundation area?		
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		✓	"Boils" beneath stream or ponded water?		
14. Clogged spillways, groin or diversion ditches?		✓	Around the outside of the decant pipe?		
15. Are spillway or ditch linings deteriorated?		✓	22. Surface movements in valley bottom or on hillside?		
16. Are outlets of decant or underdrains blocked?		✓	23. Water against downstream toe?		
17. Cracks or scarps on slopes?		✓	24. Were Photos taken during the dam inspection?		

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Inspection Issue # Comments

1 - Monthly inspections by Station environmental staff. Annual inspection by Duke Energy Program Engineering / Third Party or State inspectors

6 - The dam is not instrumented

8 - Construction drawings show existing ground undercut 2 to 5 feet to provide embankment subgrade

12 - Decant riser does not have a trashrack. Floating skimmer in place.

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name: East Bend Station Date: 5 August 2010

Unit Name: East Bend Sta. Unit 1 Operator's Name: Duke - Energy

Unit I.D.: KY 1215 Hazard Potential Classification: High (Significant) Low

Inspector's Name: Hugh Ward, P.E. Joseph P. Klein III, P.E.

Inspection Issue #	Comments
18	Minor erosion rils and scattered rodent burrows observed. Some wave erosion observed near southeast corner of impoundment
20	Primary spillway pipe discharge is located in the Ohio River, below normal pool elevation. Observations made in discharge pipe vents. Water flow was clear and unobstructed.

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW) Impoundment Inspection

Impoundment NPDES Permit # KY0040444 INSPECTOR Hugh Ward, P.E.
Date 5 August 2010 Joseph P. Klein, III P.E.

Impoundment Name East Bend Station
Impoundment Company Duke Energy
EPA Region 4
State Agency (Field Office) Addresss Division of Water
8020 Veterans Memorial Dr., Florence, KY 41042
Name of Impoundment East Bend Station
(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New _____ Update ✓

	Yes	No
Is impoundment currently under construction?		✓
Is water or ccw currently being pumped into the impoundment?	✓	

IMPOUNDMENT FUNCTION: Store fly ash sluice, bottom ash, scrubber sludge, direct storm water runoff, coal pile stormwater runoff, landfill runoff, cooling tower overboard and misc. plant drains.

Nearest Downstream Town : Name Patriot, IN.
Distance from the impoundment 4.5 miles (straight line across river)
Impoundment 7.5 miles (down river).
Location: Longitude -84 Degrees 50 Minutes 28 Seconds
Latitude 38 Degrees 54 Minutes 07 Seconds
State KY County Boone

Does a state agency regulate this impoundment? YES ✓ NO _____

If So Which State Agency? KY Dept. for Env. Protection, Div. of Water

HAZARD POTENTIAL (In the event the impoundment should fail, the following would occur):

_____ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

_____ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

__✓__ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

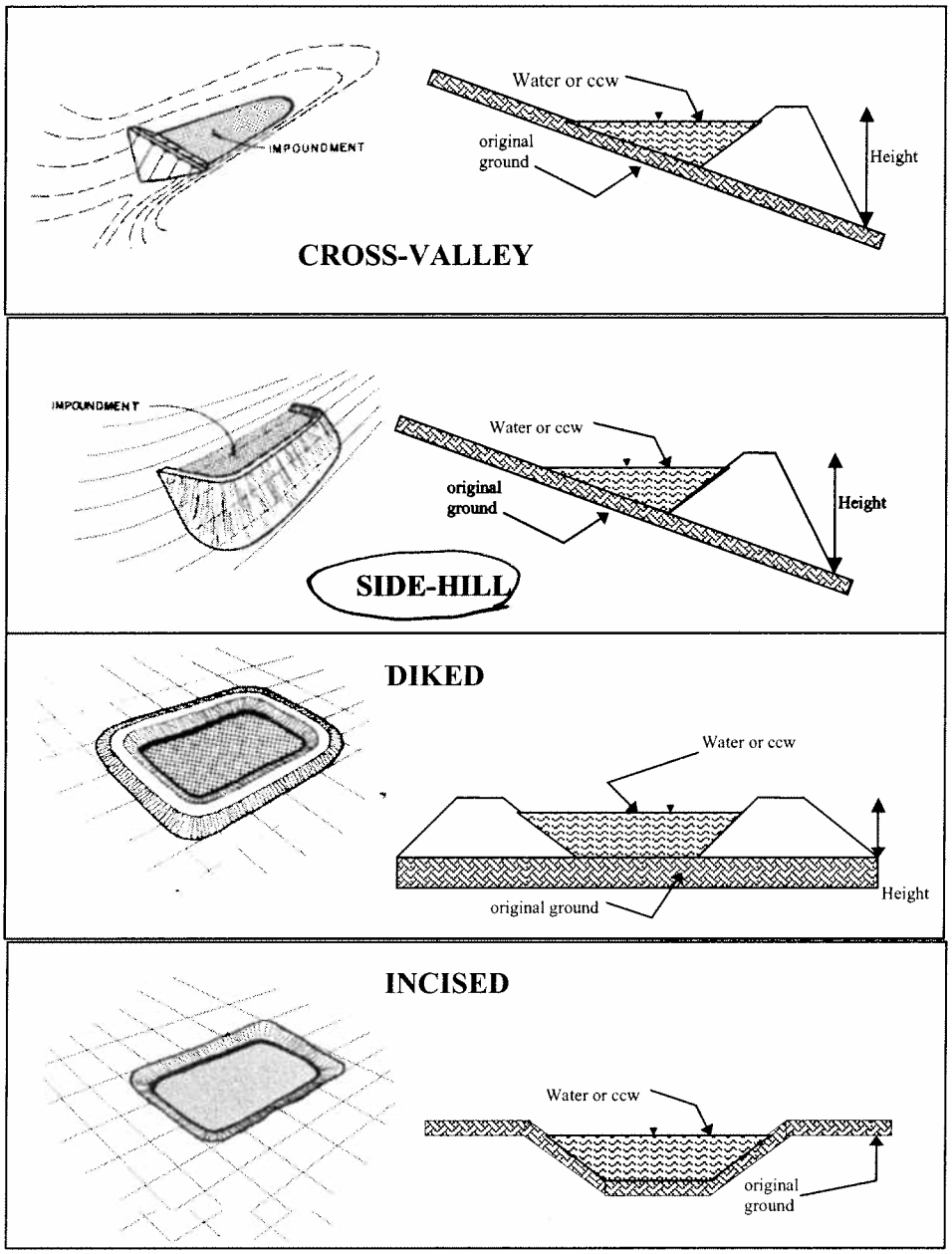
_____ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

The Significant Hazard Potential rating is based on the probable economic loss and environmental damage in the event of a dam failure or misoperation.

A dam failure would likely result in a release of ash sludge into the Ohio River which would have a damaging environmental impact and likely require extensive clean-up and long term monitoring. Additionally a release might impact the fish hatchery and Bald Eagle nesting site adjacent to the impoundment.

CONFIGURATION:

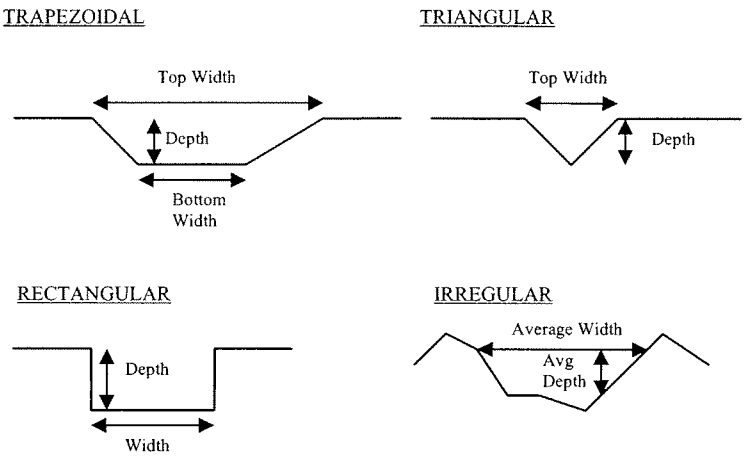


_____ Cross-Valley
__✓__ Side-Hill
_____ Diked
_____ Incised (form completion optional)
_____ Combination Incised/Diked

Embankment Height __60__ feet Embankment Material __Compacted fill w/ clay core__
Pool Area __53.4__ acres Liner __None__
Current Freeboard __29.9__ feet Liner Permeability __Not Applicable__

TYPE OF OUTLET (Mark all that apply)

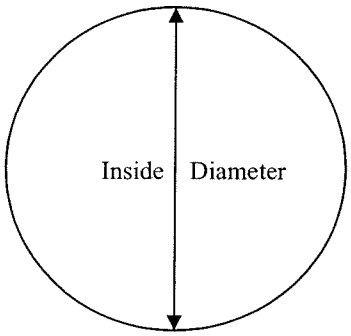
_____ **Open Channel** Emergency **Spillway**
_____ Trapezoidal
_____ Triangular
✓ Rectangular
_____ Irregular



1.5 ft depth
12 ft bottom (or average) width
_____ top width
_____

✓ **Outlet**

48"/40" inside diameter riser
36"/28" inside diameter - outfall pipe
Note: 48" & 36" - original construction
40" & 28" - pipe liners reportedly installed in 1991.



Material
✓ corrugated metal
_____ welded steel
_____ concrete
_____ plastic (hdpe, pvc, etc.)
_____ other (specify) _____

_____

Is water flowing through the outlet? YES ✓ NO _____

_____ **No Outlet**

_____

_____ **Other Type of Outlet** (specify) _____

The Impoundment was Designed By Sargent & Lundy Engineers

Has there ever been a failure at this site? YES _____ NO ___✓___

If So When? _____

If So Please Describe : _____

Has there ever been significant seepages at this site? YES _____ NO ✓

If So When? _____

IF So Please Describe: _____

Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site? YES _____ NO ✓

If so, which method (e.g., piezometers, gw pumping,...)? _____

If so Please Describe : _____