HALEY & ALDRICH, INC.
6500 Rockside Road
Suite 200
Cleveland, OH 44131
216.739.0555

MEMORANDUM

16 October 2016
File No. 128064-003

SUBJECT: History of Construction – Cell 003
Associated Electric Cooperative, Inc.
Thomas Hill Energy Center
Clifton Hill, MO

Haley & Aldrich, Inc. (Haley & Aldrich) has assisted Associated Electric Cooperative, Inc. (AECI). with compiling the history of construction in accordance with §257.73(c)(1) for the existing coal combustion residuals (CCR) surface impoundment known as Slag Pond 001 - Cell 003 (Cell 003) at the Thomas Hill Energy Center (THEC). This document addresses the requirements of the US Environmental Protection Agency's (EPA's) Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities, 40 CFR Part 257 (CCR Rule) effective 19 October 2015. To the extent feasible, AECI has provided documentation supporting the history of construction. Information on the history of construction of Cell 003 is presented in the following sections.

§257.73(c)(1)(i): The name and address of the person(s) owning or operating the CCR unit; the name associated with the CCR unit; and the identification number of the CCR unit if one has been assigned by the state.

Owner:	Associated Electric Cooperative, Inc. 2814 South Golden Avenue P.O. Box 754 Springfield, Missouri 65807
Name of CCR Unit:	Cell 003 (current naming convention, historically referred to as Pond 2, Cell No. 2, and/or Cell 2)

§257.73(c)(1)(ii): The location of the CCR unit identified on the most recent U.S. Geological Survey (USGS) 7 ½ minute or 15 minute topographic quadrangle map, or a topographic map of equivalent scale if a USGS map is not available.

Latitude: 39°32'34"
Longitude: 92°38'17"
The general location of the facility is provided in Appendix A.

§257.73(c)(1)(iii): A statement of the purpose for which the CCR unit is being used.

This impoundment currently receives flows from coal pile runoff, plant process water, and decant water from Cell 001 and Cells 002-East and 002-West. Historically, this impoundment has received CCRs as well.

§257.73(c)(1)(iv): The name and size in acres of the watershed within which the CCR unit is located.

USGS Watershed Name: Little Chariton Watershed 10280203
Watershed Area: 148 acres

The watershed area was referenced from page 11 of "Specific Site Assessment for Coal Combustion Waste Impoundments at Thomas Hill Energy Center" by GEI Consultants, Inc. dated June 2011, and the excerpt is provided in Appendix B-2. It should be noted that updated drainage area is being revised and determined as part of the Inflow Flood Control System Plan required by §257.83 of the CCR Rule which will be provided under separate cover.

§257.73(c)(1)(v): A description of the physical and engineering properties of the foundation and abutment materials on which the CCR unit is constructed.

The description of the physical and engineering properties of the foundation and abutment materials on which Pond 3 was constructed was discussed on pages 3-4, of "Global Stability Evaluation Mine Waste and Ash Pond Embankments" by Geotechnology, Inc. dated 22 April 2010, and the excerpt is provided as Appendix C. AECI was not able to locate other original construction design documents related to this criterion.

§257.73(c)(1)(vi): A statement of the type, size, range, and physical and engineering properties of the materials used in constructing each zone or stage of the CCR unit; the method of site preparation and construction of each zone of the CCR unit; and the approximate dates of construction of each successive stage of construction of the CCR unit.

The type, size, range, and physical engineering properties of the materials of each zone of the Cell 003 were discussed on page 5 to 6 of "Global Stability Evaluation Mine Waste and Ash Pond Embankments" by Geotechnology, Inc. dated 22 April 2010, and the excerpt is provided as Appendix C. AECI was not able to locate other original construction design documents related to this criterion.

Information on the method of site preparation and construction of Cell 003 is included on the drawing Y3 "Grading Plan Area 2" by Burns and McDonnell dated June 4, 1984 and is included in Appendix D.

Cell 003 had modifications made circa 1984. Original construction date is not documented.

§257.73(c)(1)(vii): At a scale that details engineering structures and appurtenances relevant to the design, construction, operation and maintenance of the CCR unit, detailed dimensional drawings of the CCR unit, including a plan view and cross sections of the length and width of the CCR unit, showing all zones, foundation improvements, drainage provisions, spillways, diversion ditches, outlets, instrument locations, and slope protection, in addition to the normal operating pool surface elevation and the maximum pool surface elevation following peak discharge from the inflow design flood, the expected maximum depth of CCR within the CCR surface impoundment, and any identifiable natural or manmade features that could adversely affect operation of the CCR unit due to malfunction or mis-operation.

Drawings providing information listed above, as available have been provided in Appendix D.

§257.73(c)(1)(viii): a description of the type, purpose, and location of existing instrumentation.

No instrumentation exists for Cell 003 as discussed on page 14 of "Specific Site Assessment for Coal Combustion Waste Impoundments at Thomas Hill Energy Center" by GEI Consultants dated June 2011 and is included in Appendix B-3.

§257.73(c)(1)(ix): area-capacity curves for the CCR unit.

Original design area-capacity curves for Cell 003 are not available. It should be noted that updated area-capacity curves for the impoundment are being developed as part of the Inflow Flood Control System Plan required by §257.83 of the CCR Rule which will be provided under separate cover.

§257.73(c)(1)(x): a description of each spillway and diversion design features and capacities and calculations used in their determination.

Decant water discharges through a concrete outlet structure. Spillway and diversion structures for Cell 003 are discussed on pages 4-5 and page 11 of "Specific Site Assessment for Coal Combustion Waste Impoundments at Thomas Hill Energy Center" by GEI Consultants, Inc. dated June 2011, and the excerpts are provided as Appendix B-1 and B-2.

<u>§257.73(c)(1)(xi)</u>: The construction specifications and provisions for surveillance, maintenance, and repair of the CCR unit.

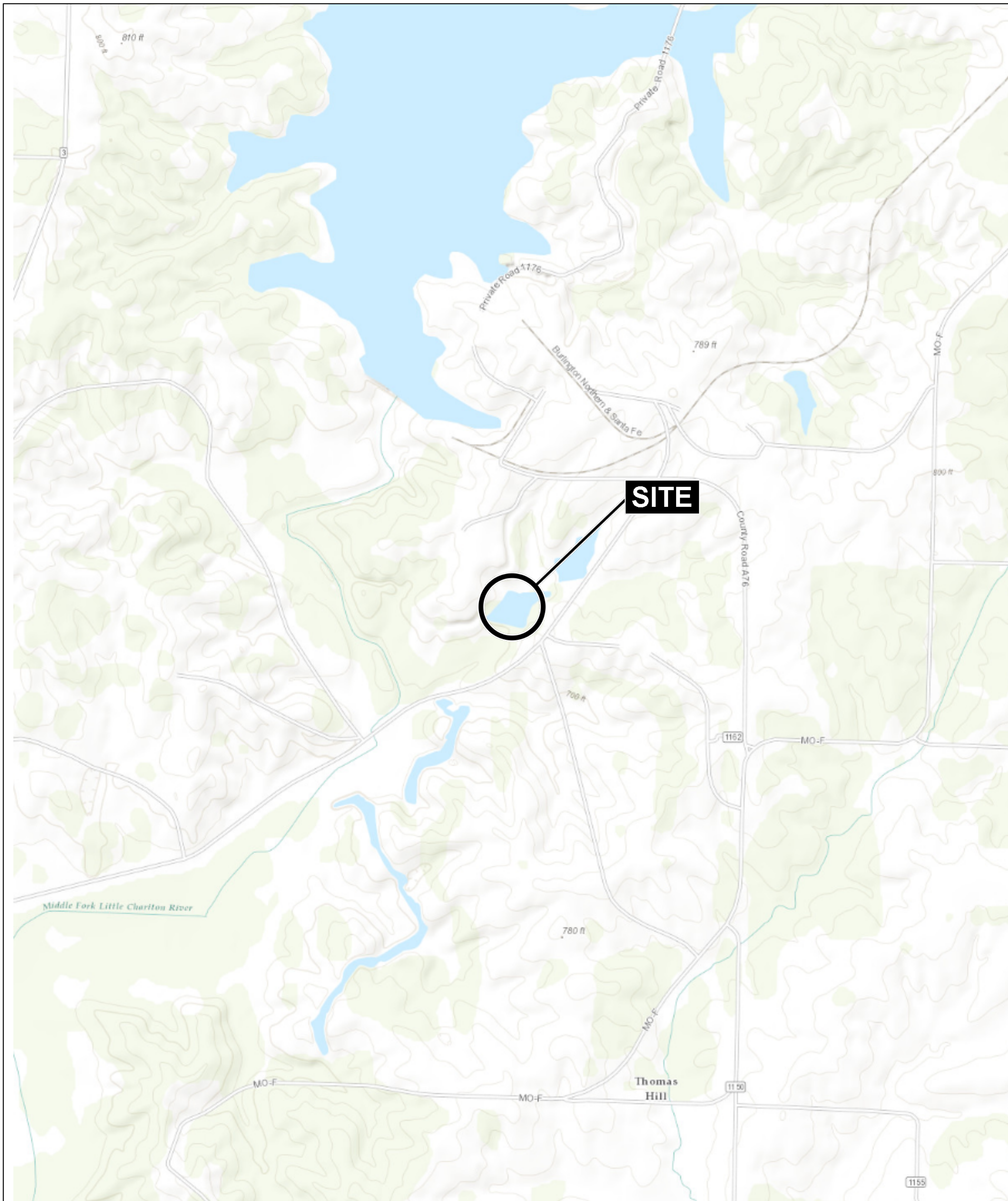
The construction specifications and provisions for surveillance, maintenance, and repair of the Cell 003 are discussed in the "Pond 001, The Ash Pond Series Operating and Management Plan" by AECI dated 3 January 2012 provided as Appendix E.

<u>§257.73(c)(1)(xii)</u>: any record or knowledge of structural instability of the CCR unit.

There are no records or knowledge of structural instability associated with Pond 3.

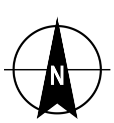
Cc: Kim Dickerson-AECI
Steve Putrich/Jason Pokorny-Haley & Aldrich

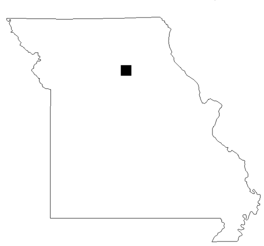
APPENDIX A
Site Locus



MAP SOURCE: ESRI

SITE COORDINATES: 39°32'34"N, 92°38'17"W





HALEY ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
THOMAS HILL ENERGY CENTER- POND 3
CLIFTON HILL, MISSOURI

PROJECT LOCUS

APPROXIMATE SCALE: 1 IN = 2000 FT
SEPTEMBER 2016

FIGURE 1

40616_1_LOCUS.PDF

APPENDIX B

Excerpts from:

Specific Site Assessment for Coal Combustion Waste Impoundments at Thomas Hill Energy Center

By GEI Consultants, Inc., Dated June 2011

APPENDIX B-1

Pg. 4-5 from:

Specific Site Assessment for Coal Combustion Waste Impoundments at Thomas Hill Energy Center

By GEI Consultants, Dated June 2011

Geotechnical
Environmental
Resources
Ecological

Specific Site Assessment for Coal Combustion Waste Impoundments at Thomas Hill Energy Center

Clifton Hill, Missouri

Submitted to:
U.S. Environmental Protection Agency
Office of Resource Conservation and Recovery
5304P
1200 Pennsylvania Avenue NW
Washington, DC 20460

Submitted by:
GEI Consultants, Inc.
4601 DTC Blvd, Suite 900
Denver, CO 80237

June 2011
Project Number: 092884

Steven R. Townsley, P.E.
Senior Project Engineer

The materials stored in each of the CCW impoundment dikes are summarized below:

- Slag Dewatering Basin – This basin is a wet storage area that is used to contain both bottom ash and boiler slag. The ash and slag is continuously dredged and is sold to a private contractor who uses the material as roofing granules.
- Ash Pond – Cell No. 2 – This cell is a wet storage that is used to contain fly ash, bottom ash, boiler slag, and sediments from the coal pile runoff. The fly ash is collected and used as part of the mine reclamation activities on the power plant property.

Based on our observation and the soil boring information presented in the Global Stability Evaluation report prepared by Geotechnology, Inc. in May of 2010, the CCW impoundment dikes appear to have homogeneous construction using silty clayey fill soils. The dikes were designed without internal drains from the collection of seepage.

The dike for the Slag Dewatering Basin has an approximate crest width of 10 feet and design upstream and downstream side slopes of 3H:1V and 2H:1V, respectively. The perimeter dike for Ash Pond – Cell No. 2 has an approximate crest width of 18 feet and design upstream and downstream side slopes of 3H:1V.

The basic dimensions and geometry of each impoundment is summarized in Table 2-1.

Table 2-1: Summary Information for Impoundment Dike Parameters

Parameter	Value	
Dam	Slag Dewatering Basin	Ash Pond – Cell No. 2
Maximum Height (ft)	Approximately 10	25
Approximate Length (ft)	1,500	830
Approximate Crest Width (ft)	15	18
Lowest Crest Elevation (ft)	735	717
Design Side Slopes (H:V)	3:1 US/2:1 DS	3:1 US/3:1 DS
Estimated Freeboard (ft) at time of site visit	2.7	4
Total Storage Capacity (cubic yards)*	16,000	50,000
Approximate Surface Area (acres)*	3	12

*Storage capacity and area values provided by Associated Electric Cooperative, Inc.

2.3 Spillways

The Ash Pond – Cell No. 2 Impoundment has an emergency spillway (Photo 16) which, if utilized, would flow into Ash Pond – Cell No. 3. The emergency spillway is an Open Channel Spillway, trapezoidal in shape, with a top width of approximately 18 feet, an average bottom width of 12 feet, and a depth of 2 feet below the top of the dike crest. The emergency spillway crest is lined with 3- to 6-inch crushed rock.

The Slag Dewatering Pond does not have a spillway associated with the impoundment.

2.4 Intakes and Outlet Works

2.4.1 Slag Dewatering Basin

The coal ash slurry line at the Slag Dewatering Basin consists of an 18-inch steel pipe from the power plant. Photos 1 and 2 in Appendix B show the inlet structure to the Slag Dewatering Basin.

The outlet structure (Photos 3 and 7) consists of a 30-inch diameter concrete outlet pipe from the concrete decant tower with 60-inch wide, 6-inch square concrete stop logs. The outlet structure releases the decant water into a bypass channel (Photo 4) which bypasses Ash Pond – Cell No. 1 and discharges into the Ash Pond – Cell No. 2 (Photos 8 and 9). At the time of our visit to the site, there was active flow through the outlet structure.

2.4.2 Ash Pond – Cell No. 2

Decant water is received from the Slag Dewatering Basin through a bypass channel (Photos 8 and 9) and from a concrete decant tower with 60-inch wide, 6-inch square concrete stop logs in the Ash Pond – Cell No. 1. This decant water is collected from natural runoff around Ash Pond – Cell No. 1.

The outlet structure (Photo 12) consists of a 36-inch diameter concrete outlet pipe from the concrete decant tower with 72-inch wide, 6-inch square concrete stop logs. At the time of our visit to the site, there was active flow through the outlet structure into Ash Pond – Cell No. 3. Ash Pond – Cell No. 3 contains only decant water prior to its release to the Middle Fork of the Little Chariton River.

2.5 Vicinity Map

Thomas Hill Energy Center is located in the town of Clifton Hill in Randolph County, Missouri, as shown on Figure 1. The specific latitude and longitude of the ponds is provided below:

Longitude: 92 Degrees, 38 Minutes, 17 Seconds
Latitude: 39 Degrees, 32 Minutes, 34 Seconds

2.6 Plan and Sectional Drawings

GEI was provided with two partial sets of design documents for this project and a geotechnical engineering report. These documents included:

- Engineering drawings for the "Ash Pond Facilities" project in 1978-79. These plans were prepared by Burns and McDonnell dated December 1, 1978 and March 23, 1979.

APPENDIX B-2
Pg. 11 from:
Specific Site Assessment for Coal Combustion Waste Impoundments at Thomas Hill Energy Center
By GEI Consultants, Dated June 2011

GEI Consultants

Geotechnical
Environmental
Resources
Ecological

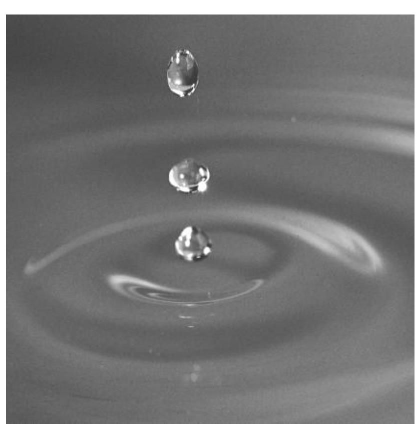
Specific Site Assessment for Coal Combustion Waste Impoundments at Thomas Hill Energy Center

Clifton Hill, Missouri

Submitted to:
U.S. Environmental Protection Agency
Office of Resource Conservation and Recovery
5304P
1200 Pennsylvania Avenue NW
Washington, DC 20460

Submitted by:
GEI Consultants, Inc.
4601 DTC Blvd, Suite 900
Denver, CO 80237

June 2011
Project Number: 092884



Steven R. Townsley, P.E.
Senior Project Engineer

invert elevation is at about El. 731 feet. Based on the 24-hour 100-year precipitation event of 7.2 inches, the Slag Dewatering Basin would receive about 8.4 acre-feet of storm water. Without detailed hydraulic routing simulations, it is difficult to determine the resulting water surface elevation in Slag Dewatering Basin, however the available storage volume and discharge capacity of the decant structure is likely enough to maintain at least 1 foot of residual freeboard during the design event. Based on these results, the Slag Dewatering Basin meets the regulatory requirements for storing and passing the 24-hour 100-year inflow design flood without overtopping the dam.

5.2.2 Ash Pond – Cell No. 2

The contributing drainage area to the Ash Pond – Cell No. 2 includes the impoundment's surface area (Table 2-1) and a considerable amount of surrounding surface drainage. Additionally, decant water from the Slag Dewatering Basin and Ash Pond – Cell No. 1 can be routed to Ash Pond – Cell No. 2 through the decant structures, producing a total contributing drainage area of about 148 acres. However, currently Ash Pond – Cell No. 1 does not store any water and has considerable available storage capacity to store the design storm precipitation that falls over the reservoir surface. Therefore, based on the current configuration, Ash Pond – Cell No. 1 does not contribute storm water runoff to Ash Pond – Cell No. 2, resulting in a total contributing drainage area to Ash Pond – Cell No. 2 of about 136 acres.

The water surface in Ash Pond – Cell No. 2 is regulated by a decant structure located through the south dike that discharges water into Ash Pond – Cell No. 3. Additionally, Ash Pond – Cell No. 2 has an 18-foot wide by 2-foot deep emergency spillway located over the south dike that can also discharge water into Ash Pond – Cell No. 3. Currently, the Ash Pond – Cell No. 2 water level is maintained at about El. 713 feet, providing about 4.0 feet of freeboard. Based on the current configuration and the 24-hour 100-year precipitation event of 7.2 inches, the Ash Pond – Cell No. 2 would receive about 83 acre-feet of storm water. Without detailed hydraulic routing simulations, it is difficult to determine the resulting water surface elevation in Ash Pond – Cell No. 2, however the combined discharge capacity of the decant structure and emergency spillway is likely enough to maintain at least 1 foot of residual freeboard during the design event. Based on these results, the Ash Pond – Cell No. 2 will likely meet the regulatory requirements for storing and passing the 24-hour 100-year inflow design flood without overtopping the dam.

5.2.3 Determination of the PMF

Not applicable.

5.2.4 Freeboard Adequacy

Based on the data obtained, the freeboard is adequate at each of the two CCW impoundments at the Thomas Hill Energy Center.

5.2.5 Dam Break Analysis

It is our understanding that there have been no dam break analyses performed for the impoundments at the Thomas Hill Energy Center.

5.3 Spillway Rating Curves

The spillway rating curve for Ash Pond – Cell No. 2 was not provided.

5.4 Evaluation

Based on the current facility operations and inflow design floods documents, the impoundments at the Thomas Hill Energy Center appear to have adequate capacity to store or pass the regulatory design floods without overtopping the dams based on the recommended hazard classifications for the dams. However, these results should be confirmed with detailed hydrologic and hydraulic studies of the CCW impoundments. Additionally, if the current operations or facility configurations change in the future these flood studies should be re-evaluated.

APPENDIX B-3

Pg. 14 from:

Specific Site Assessment for Coal Combustion Waste Impoundments at Thomas Hill Energy Center

By GEI Consultants, Dated June 2011

Geotechnical
Environmental
Resources
Ecological

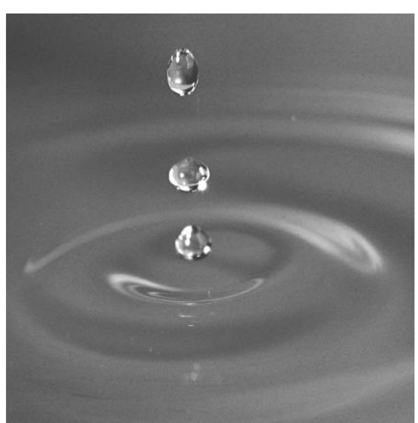
Specific Site Assessment for Coal Combustion Waste Impoundments at Thomas Hill Energy Center

Clifton Hill, Missouri

Submitted to:
U.S. Environmental Protection Agency
Office of Resource Conservation and Recovery
5304P
1200 Pennsylvania Avenue NW
Washington, DC 20460

Submitted by:
GEI Consultants, Inc.
4601 DTC Blvd, Suite 900
Denver, CO 80237

June 2011
Project Number: 092884



Steven R. Townsley, P.E.
Senior Project Engineer

7.0 Instrumentation

7.1 Location and Type

We are not aware of any instrumentation associated with the Slag Dewatering Basin and Ash Pond – Cell No. 2 impoundments at the Thomas Hill Energy Center.

7.2 Readings

7.2.1 Flow Rates

It is our understanding that flow rates are not monitored within the inlet or outlet structures within the Slag Dewatering Basin and Ash Pond – Cell No. 2 impoundments at the Thomas Hill Energy Center. The outflow from Ash Pond – Cell No. 3 is monitored as part of the NPDES permit requirements.

7.2.2 Staff Gauges

There was no staff gauge observed at either the Slag Dewatering Basin and Ash Pond – Cell No. 2 impoundments.

7.3 Evaluation

At this time, there is no geotechnical instrumentation in-place at either pond. The decision to install instrumentation at either dike should be based on the recommendations of project geotechnical engineer.

APPENDIX C
Excerpt from:
Global Stability Evaluation – Mine Waste and Ash Pond Embankments, AECI Facilities
By Geotechnology, Inc., dated April 22, 2010
Pgs. 3-6

GLOBAL STABILITY EVALUATION
MINE WASTE AND ASH POND EMBANKMENTS
AECI FACILITIES
BEE VEER AND THOMAS HILL, MISSOURI

Prepared for:

ASSOCIATED ELECTRIC COOPERATIVE, INC.
Springfield, Missouri

Prepared by:

GEOTECHNOLOGY, INC.
St. Louis, Missouri

Geotechnology Project No. J011309.01

April 22, 2010

Unless noted on the logs, the lines designating the changes between various strata represent approximate boundaries. The transition between materials may be gradual or may occur between recovered samples. The stratification given on the logs, or described herein, is for use by Geotechnology in its analyses and should not be used as the basis of design or construction cost estimates without realizing that there can be variation from that shown or described.

The logs and related information depict subsurface conditions only at the specific locations and times where sampling was conducted. The passage of time may result in changes in conditions, interpreted to exist, at or between the locations where sampling was conducted.

LABORATORY TESTING

Laboratory testing was performed to estimate pertinent engineering and index properties of the soil. Moisture contents were determined for cohesive soil samples, and Atterberg limits tests were accomplished on selected samples. Unconfined compression tests were performed on selected Shelby tube samples. Consolidated-undrained triaxial compression tests were performed on representative samples. Laboratory test results are presented in Appendices B and D.

SECTION III - SUBSURFACE CONDITIONS

STRATIGRAPHY

Bee Veer Facility. Borings D-1 and -2 were drilled at the Bee Veer site. The borings were located at the top and toe of the embankment, respectively. The overburden in Boring-D-1, drilled on the embankment, consists of fill underlain by silty clay. The fill is comprised of 39 feet of silty clay mixed with sand, gravel and coal debris. The percentage of coal debris in the fill varies widely. Representative samples in the fill had unit dry densities from 88 to 107 pounds per cubic foot (pcf). Moisture content percentages ranged from the upper-teens to the low thirties. SPT N-values in the embankment fill varied from 8 to 15 blows per foot (bpf). The natural soil encountered beneath the fill consists of medium stiff, brown and gray, silty clay with sand. The silty clay extends to a depth of approximately 67 feet. In Boring D-2 the surface stratum consists of gray and brown clay, which extends to a depth of 8 feet. Below the clay, approximately 3.5 feet of weathered limestone is present. The limestone is underlain by hard, brown and gray, silty clay to a depth of approximately 16 feet. In both borings the silty clay is underlain by moderately hard, gray shale. Auger refusal occurred in Boring D-1 at a depth of 72 feet, and at a depth of 20.5 feet in Boring D-2.

CPT soundings DC-1 through -3, which were performed along the top of the embankment, indicate the presence of 40 to 43 feet of interlayered silty clay, clay, sandy silt and sandy clay with gravel, which probably is the embankment fill. Below the fill stiff to very stiff, occasionally soft, silty clay to clay is present. CPT soundings DC-4 and -5, which were performed behind the embankment in the mine waste storage area, indicate the presence of 45 to 60 feet of very soft to soft, occasionally stiff, fine-grained soil. Below the mine waste, natural soil comprised of silty clay, clay and silt are present. The natural soil strata in all CPT soundings extended to the cone refusal depths of 66 to 101 feet.

Thomas Hill Facility. Borings C-1 and -2 were drilled at the north and south embankments, respectively. At the north embankment, clay fill with silt and sand is present to a depth of 11 feet. Moisture content of the fill varied between low to mid twenties. SPT N-values ranged from 8 to 11 bpf. Below the fill, interlayered, medium stiff to very stiff, brown and gray clay and silty clay are present. The fine-grained soil extends to the depth of exploration (50feet). The south embankment includes 20 feet of fill. The fill consists of interlayered silty clay and clay. A representative sample in the fill had a unit dry density of 100 pcf. Moisture content ranged from upper teens to mid twenties. The fill is underlain by stiff, brown and gray clay. The clay extends to the top of limestone at a depth of 37 feet. Auger refusal was encountered at 37.2 feet.

The CPT soundings indicate the presence of 37 to 42 feet of stiff to very stiff, silty clay to clay, which is underlain by stiff, clayey to sandy silt. The silt stratum extends to the depth of termination or refusal. The sounding on the south embankment encountered refusal at a depth of 52.6 feet.

GROUNDWATER

Groundwater was not observed in the borings during the subsurface exploration program. Also, the possible groundwater level in two of the borings (i.e. Borings C-1 and D-1) could not be recorded due to the rotary wash technique used in drilling the borings. Rotary wash drilling technique includes the introduction of water into the borehole which masks the presence of groundwater. However, based on the CPT soundings, groundwater at Bee Veer and Thomas Hill appear to be at depths of 46 to 53 feet and 33 to 40 feet, respectively. Groundwater levels shown on the logs may not have stabilized before backfilling, which is typical in less permeable cohesive soil. Consequently, the indicated/lack of observed groundwater levels may not represent present or future levels. Groundwater levels may vary significantly over time due to the effects of seasonal variation in precipitation, recharge, presence of creeks or lakes nearby, or other factors not evident at the time of exploration.

SECTION IV – EMBANKMENT INSPECTIONS AND GLOBAL STABILITY EVALUATION

As part of the embankment evaluation, slope stability analyses were performed. Current topographic plans were not provided. Our analyses are based on topographic plans dated 1998 (Bee Veer) and 2005 (Thomas Hill). Results of the analysis are discussed in subsequent sections.

EMBANKMENT INSPECTIONS

An engineer from Geotechnology visually inspected the existing embankments. Inspection check lists and the photographs of the embankments are included in Appendix E. The photograph locations and viewing directions are shown on Plates 2 and 3. Based on our inspection it appears that the embankments are in stable condition

SLOPE STABILITY ANALYSIS

Slope stability analysis consists of comparing the driving forces within a slope to the resisting forces and determining the factor of safety. Gravity forces tend to move the slope downwards (driving force), while resisting forces derived from the soil shear strength tend to keep the slope in place. When the driving force acting on the slope is greater than the resisting force, sliding can occur. The factor of safety of the slope is the ratio of the restraining force divided by the driving force. Generally, when the factor of safety is 1 or less, the slope is considered to be unstable. The accepted standard in local practice is to have a factor of safety of 1.5 for long-term static stability of a slope, and 1.0 for pseudo-static (seismic loading) and rapid drawdown conditions.

Slope stability analyses were performed for the embankment at Bee Veer and the north and south embankments at Thomas Hill. The locations of typical cross-sections of the embankments are represented by Sections A-A through C-C, and are shown on Plates 2 and 3. Soil properties used in the stability analysis were selected based on laboratory test results, CPT data interpretation and Geotechnology's experience with similar materials. The soil properties used in the models are summarized in the following table:

BEE VEER SOIL PROPERTIES			
Soil Type	**Density (pcf)**	**Cohesion (psf)**	**Friction Angle (°)**
Embankment Fill	120	100	28
Silty Clay (CL)	118	50	31
Clay (CH)	120	50	25

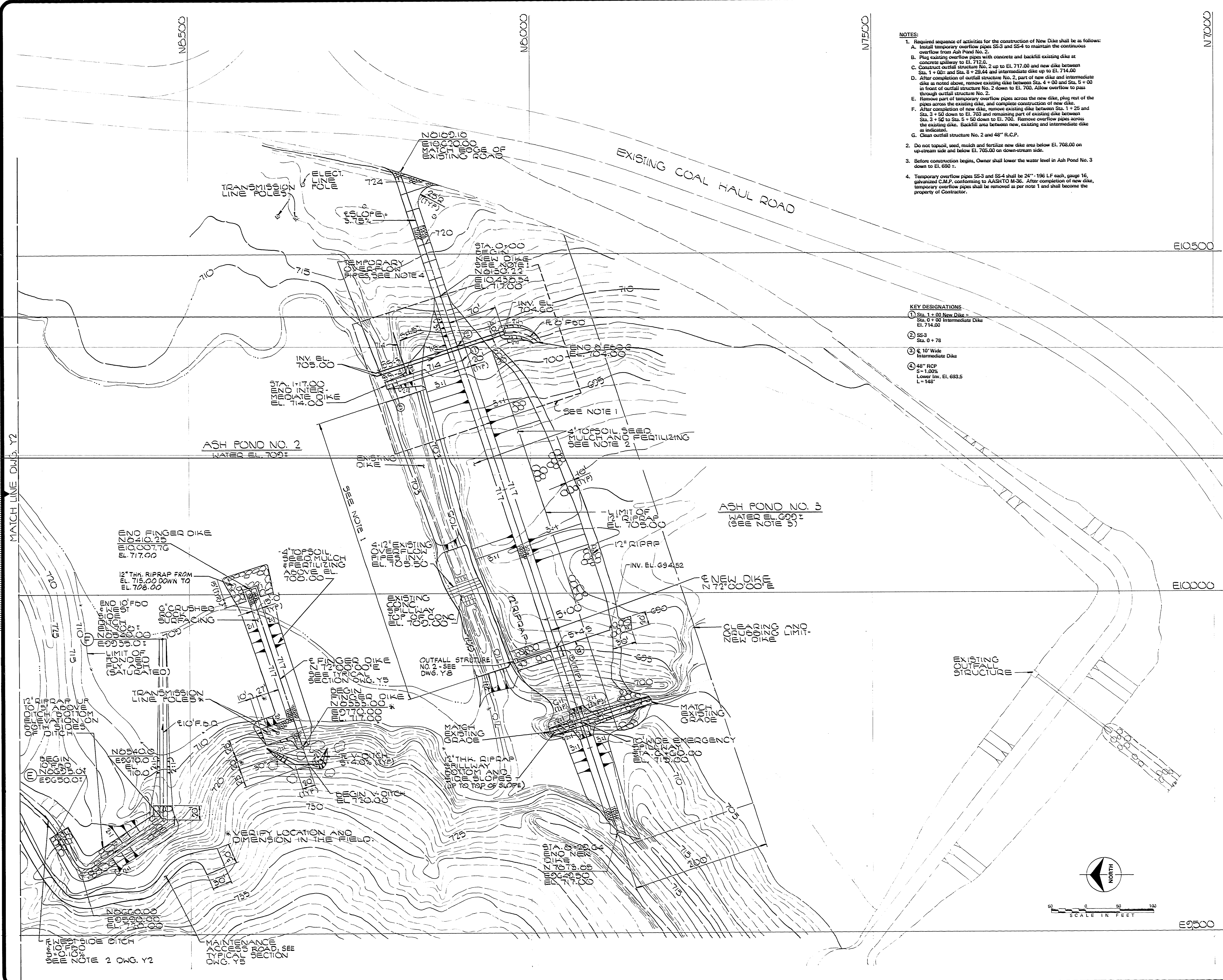
THOMAS HILL SOIL PROPERTIES			
Soil Type	**Density (pcf)**	**Cohesion (psf)**	**Friction Angle (°)**
Embankment Fill	120	100	28
Silty Clay (CL)	120	50	27
North Embankment Clay (CH)	120	50	26
South Embankment Clay (CH)	120	50	27

Geotechnology performed stability analysis for deep seated, global failure of the embankments. Representative cross-sections of the embankments are shown on the attached Plates 4 through 15. Since the embankments have been in place for several years, long-term stability of the embankments was analyzed (i.e. effective stress conditions). Based on field observations and CPT data interpretation, groundwater at the Bee Veer embankment was assumed to vary from El 746 at the embankment toe to El 763 behind the embankment. The normal pool levels at the south and north ponds at Thomas Hill were considered to be at El 710 and 724, respectively. A pseudo-static seismic analysis was performed on the typical embankment sections using horizontal and vertical accelerations of 0.04g and 0.02g, respectively, which corresponds to a seismic event with a 90 percent probability of not being exceeded in 50 years (i.e. 1 in every 500 years). The Morgenstern-Price procedure was used to compute factors of safety. The computer program SLOPE/W was used to perform the computations. The calculated factors of safety are given in the following table.

Location	Cross Section	Condition	Calculated F.O.S.	Plate
Bee Veer	A-A’	Static Seismic	1.6 and 1.5 1.4 and 1.3	4 and 5 6 and 7
Thomas Hill	B-B’ (South Embankment) Downstream slope	Static Rapid Drawdown Seismic	1.5 1.3 1.3	8 9 10
	B-B’ (South Embankment Upstream slope)	Static Rapid Drawdown Seismic	2.6 2.0 2.1	11 12 13
	C-C’ (North Embankment)	Static Seismic	2.1 1.9	14 15

We recommend a minimum factor of safety of 1.5 for long-term stability. Based on the analyses, the embankments have factors of safety greater than 1.5. During an extreme event, such as an earthquake or the rapid drawdown of the downstream pond due to a dam breach, a factor of safety of 1.0 or more is recommended and it appears that the embankments satisfy the minimum requirements. Geotechnology’s zone of investigation only considered analytical surfaces that intersected the crest of the embankment as failure in this zone would result in a breach of the

APPENDIX D
Drawings Y3 and Y8:
Ash Pond Modifications
By Burns and McDonnell, Dated June 4, 1984



NOTES:

1. Required sequence of activities for the construction of New Dike shall be as follows:
   A. Install temporary overflow pipes SS-3 and SS-4 to maintain the continuous overflow from Ash Pond No. 2.
   B. Plug existing overflow pipes with concrete and backfill existing dike at concrete spillway to El. 712.0.
   C. Construct outfall structure No. 2 up to El. 717.00 and new dike between Sta. 1 + 00± and Sta. 8 + 29.44 and intermediate dike up to El. 714.00
   D. After completion of outfall structure No. 2, part of new dike and intermediate dike as noted above, remove existing dike between Sta. 4 + 00 and Sta. 5 + 00 in front of outfall structure No. 2 down to El. 700. Allow overflow to pass through outfall structure No. 2.
   E. Remove part of temporary overflow pipes across the new dike, plug rest of the pipes across the existing dike, and complete construction of new dike.
   F. After completion of new dike, remove existing dike between Sta. 1 + 25 and Sta. 3 + 50 down to El. 703 and remaining part of existing dike between Sta. 3 + 50 to Sta. 5 + 50 down to El. 700. Remove overflow pipes across the existing dike. Backfill area between new, existing and intermediate dike as indicated.
   G. Clean outfall structure No. 2 and 48" R.C.P.
2. Do not topsoil, seed, mulch and fertilize new dike area below El. 708.00 on up-stream side and below El. 705.00 on down-stream side.
3. Before construction begins, Owner shall lower the water level in Ash Pond No. 3 down to El. 690 ±.
4. Temporary overflow pipes SS-3 and SS-4 shall be 24" - 196 LF each, gauge 16, galvanized C.M.P. conforming to AASHTO M-36. After completion of new dike, temporary overflow pipes shall be removed as per note 1 and shall become the property of Contractor.

KEY DESIGNATIONS

1. Sta. 1 + 00 New Dike = Sta. 0 + 00 Intermediate Dike El. 714.00
2. SS-3 Sta. 0 + 78
3. ℄ 10' Wide Intermediate Dike
4. 48" RCP S = 1.00% Lower Inv. El. 693.5 L = 148'

no.	date	by	revision
	8-6-84	UAK	ISSUED FOR CONSTRUCTION
1	10-17-85	DLM	CONFORMING TO CONSTRUCTION RECORDS

STATE OF MISSOURI H. L. WONDERLY NUMBER E-20896 REGISTERED PROFESSIONAL ENGINEER

date JUNE 4, 1984
designed KUMTHEKAR
detailed MADDOCK
checked

Burns & McDonnell
Engineers • Architects • Consultants
Kansas City, Missouri

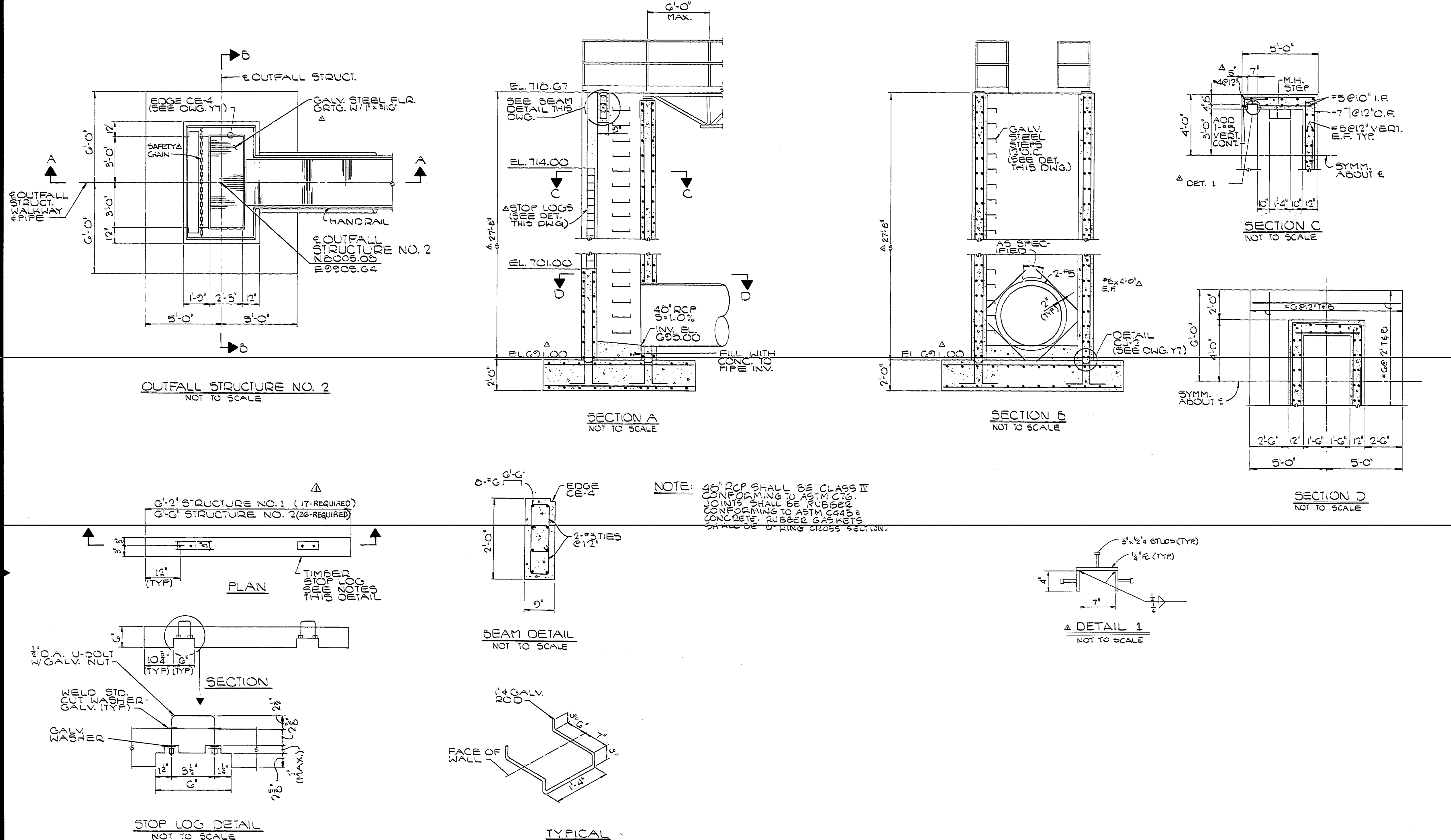
THOMAS HILL POWER PLANT
ASSOCIATED ELECTRIC COOPERATIVE
MISSOURI 73

ASH POND MODIFICATIONS

GRADING PLAN
AREA NO. 2

project 83-210-1 | contract EP. TO. 8301
drawing Y3 | rev. - 1

EP. TO. 8301



NOTE: 48" RCP SHALL BE CLASS IV CONFORMING TO ASTM C76. JOINTS SHALL BE RUBBER CONFORMING TO ASTM C443 & CONCRETE. RUBBER GASKETS SHALL BE O-RING CROSS SECTION.

NOTES:

1. STOP LOGS SHALL BE DENSE STRUCTURAL SOUTHERN PINE OR DENSE SELECT DOUGLAS FIR TIMBER WITHOUT ANY DEFECTS.
2. TREAT ALL STOP LOGS W/60/40 CREOSOTE-COAL TAR SOLUTION IN ACCORDANCE WITH AWPA STANDARD C-6.
3. ALLOWABLE UNIT STRESS FOR TIMBER STOP LOG SHALL BE MINIMUM 2000 PSI. BENDING, 135 P.S.I. SHEAR
4. SUBMIT TIMBER TREATMENT & PRESERVATION RECORDS

no.	date	by	revision
1	6-26-84	AFF	REVISED PER ADDENDUM NO. 1
	6-29-84	UAK	ISSUED W/ADD NO. 1
	8-6-84	UAK	ISSUED FOR CONSTRUCTION
2	10-17-85	DLM	CONFORMING TO CONSTRUCTION RECORDS

date JUNE 4, 1984
designed SEYS
detailed MADDOCK
checked

Burns & McDonnell
Engineers • Architects • Consultants
Kansas City, Missouri

THOMAS HILL POWER PLANT
ASSOCIATED ELECTRIC COOPERATIVE
MISSOURI 73

ASH POND MODIFICATIONS

OUTFALL STRUCTURE NO. 2

project 83-210-1
contract EP. TO. 8301
drawing Y8
rev. 2

EP. TO 8301

APPENDIX E
Pond #001,The Ash Pond Series
Operating Management Plan
Dated January 3, 2012

Pond #001, the Ash Pond Series

Operating and Management Plan

1/3/2012 (Revised 12/14/2012)

Overview -

The ash pond series consists of 4 cells, each of which performs a vital function in separating ash and sediment from the clean discharge water.

At the head of the series are Cells 1 and 2. Cell 1 sits inside Cell 2 and collects the pipe-discharged, slag slurry sluiced from the power plant. Cell 2 receives some runoff from the plant's coal yard as well as the slag solids, which are mechanically moved with heavy machinery from Cell 1 to Cell 2.

The purpose of Cell 2 is to collect the slag generated by the power plant. As such, an ash recycling contractor stages a slag recovery and sizing operation on this cell. The waste solids are removed to the plant's permitted utility waste landfill. The water discharge from Cell 2 flows into Cell 3 through the principal spillway discharge weir located on the eastern side of the Cell 2 dam. Similarly, the water discharge from Cell 1 flows to Cell 3. The path differs, however, with flow entering Cell 3 from the western side, through a stream-like channel that also carries the majority of the coal yard runoff, be it storm water, wash water, or pumped discharges.

The sediments carried into Cell 3 drop out in this pool. Cell 3 is managed to capture the particles separating the water through gravitational settling. The water then discharges through the principal spillway weir in the Cell 3 dam into the pool of Cell 4.

Cell 4 is a polishing pond, collecting the finest of sediments before allowing flow from the plant's NPDES permitted discharge point, #001, located at the outlet of the Cell 4 principal spillway weir. The final discharge water joins the Middle Fork of the Little Chariton River after flowing overland for about one quarter mile. Please see the diagram below for a visual depiction:

Operation –

Water pumped from the Thomas Hill Reservoir transports the slag, primarily from Thomas Hill Units 1 and 2, through an abrasion resistant, ceramic lined (Abersist) pipeline to Cell 1 of the Ash Pond Series. A small flow from the Thomas Hill Unit 3 economizer screens also joins the pipeline discharge. Slurry flow usually is continuous, but a water conservation mode can be implemented, if needed, to help reduce the amount of water removed from the Thomas Hill Reservoir, or to support low flow needs within the pond system for maintenance work or for water quality consideration. (The Operations Department manages sluice line operation when low flow conditions warrant.)

Sluice Pumps * -			Continuously Pumped	+	Sluiced	=	Total from Sluice Pumps
	(GPM)		(gallons / year)		(gallons / year)		(gallons / year)
Unit 1	1,500		721,440,000		90,180,000		811,620,000
Unit 2	2,700		1,318,032,000		164,754,000		1,482,786,000
Unit 3	20		10,512,000		0		10,512,000
Total							2,304,918,000
* Calculation basis: Unit 1&2 - One pump on each unit runs continuously. Sluice every 4 hours, 30 minutes per unit. Sluicing requires 2 pumps.							
	2011 - No water conservation measures were in place.						
	Unit 3 - A continuous flow, measured by Operations as 5 gallons every 15 seconds, is pumped from U3 and joins U2 sluice line discharge.						
	Unit 3 source of flow - spray nozzles in the economizer ash tanks on the 6th floor.						
	Water source is circulating water pumps at the intakes and the discharge follows the sluice lines to discharge through #001 into the Middle Fork of the Little Chariton River.						

During periods when the Thomas Hill Reservoir water levels are below the permanent pool elevation of 712 feet, the ash pond discharge provides the primary flow to the Middle Fork of the Little Chariton River. In an agreement with the Missouri Department of Conservation (MDC), the plant is obligated to provide a 5 cubic feet per second (cfs) flow to the river, either through the hole in the reservoir principal spillway, or through the ash pond. During non-drought conditions, discharge flow is more than sufficient to support the MDC obligation. Ash pond discharges average 15 cubic feet per second, continuously (NPDES weekly monitoring records).

Maintenance –

<u>Cell 1</u> - The pipeline, which receives a daily visual inspection for leaks (Operations Department, Daily Environmental Report) discharges into Cell 1. Solids build up and are pushed out with heavy equipment. The Materials Handling Department moves the slag from Cell 1 to Cell 2 as needed, but usually on a weekly or bi-weekly (every other week) basis.

Water flows around the horse shoe shaped pond, maximizing retention time to allow the majority of the slag particles to settle within the pond. Water discharge typically is not controlled or manipulated, but simply is allowed to discharge through the principal spillway weir.

<u>Cell 2</u> – The recycling contractor, currently the Harsco Company operates on Cell 2, under their own direction. Routinely the plant Environmental staff, Material Handling Department, and Harsco discuss operations and sediment control techniques on the cell. Material Handling supervisors observe the

operation daily and coordinate waste removal with the Harsco crew. Quarterly, the Environmental staff inspects the operation regarding spill prevention, control and countermeasures.

The Materials Handling Department manages the principal spillway weir. Pool is maintained at the agreed upon level. After consultation with the Environmental staff and Harsco, if affected, weir boards are removed or added as needed. The weir stop logs allow water level adjustments in 6-inch increments and may be used to facilitate the operation, such as lowering water level during annual channel cleanout. A channel without ash is maintained adjacent to the dam. Sediments are removed annually. Water level is dropped to allow settling before discharging.

<u>Cell 3</u> – The pond is the workhorse of the system, treating sediment laden water by promoting settling. A baffle (dike) extends out from the western shore, downstream from the overland flow channel that brings water into the pond from Cell 1 and from the Coal Yard. Similarly, on the eastern side, the principal spillway weir discharges flow from Cell 2 that travels toward the west before entering the main body of the pond. Both arrangements ensure that the flow slows, since it takes a longer distance to travel through the pond before discharging, thus prompting the sediment load to drop out. Accumulation is heavy on the north end, along the toe of the Cell 2 embankment, which is one of the pond's challenges.

The Cell 2 embankment toe is inundated with the pool water of Cell 3, and subsequently with the sediment as well. Care must be taken when removing sediment, to insure the integrity of the upstream dam. Also complicating management of the cell are two large transmission power lines that bisect the pond, a 161Kv and a 345Kv line. A 20 foot buffer zone must be maintained around the lines to avoid arcing, and the lines sag with increasing weather temperatures, limiting the use of equipment under the lines. The third challenge in Cell 3 is an underwater embankment that parallels the controlling structure. It can be seen on the design drawings. The ash pond capacity was increased in the early 1980s, with construction of an independent dam downstream, flooding the old dam in place. When the water level is lowered in Cell 3, the old dam can become exposed, allowing an increased sediment load as water cuts into the old clay dam surface. Sediment loading must be watched when 2 or more stop logs are removed below permanent pool.

Management of the pond centers on making it function as a sediment collection basin, maximizing its shape to support sedimentation, and working through the challenges. Cleaning the pond is essential to assuring adequate capacity, thus the need for a distinct dredging plan to insure timely removal of the sediment.

<u>Dredging Plan</u> – A contracted dredge is used routinely to clean Cell 3 of the Ash Pond. The waste is pumped through a semi-permanent pipeline to the AECI-owned, Utility Waste Landfill # 717502. Past dredging has occurred roughly every seven years, but with the 2011 completion of the pipeline construction, more frequent dredging becomes economical. The pipeline is a 12-inch, high density polyethylene, welded pipe. It follows the terrain, so increasing elevation toward the landfill cell prompts the need for a booster pump. The pipe is flanged at the low point in the line, with the site being located at a point where a concrete pad sits inside a spill containment area. The contractor is able to set his booster pump on the pad and quickly hook up to the pipeline. The slurry discharges into the western end of Ash Cell #3 in the landfill.

About 18,000 cubic yards were dredged from the southern half of Ash Pond Cell 3 in 2011. Removal is needed in the northern half and is planned for 2013. Since this area is full above current pool elevation, dry removal is being discussed for 2013. Operational support would involve lowering, rather than raising the water level to accommodate the operation. Once capacity is reestablished, dredging will proceed at two year intervals, as follows: Dredge southern half of pond in 2015. Dredge northern half of pond in 2017. Dredge southern half in 2019, northern in 2021, with this recurrence interval continuing into the future.

Operationally, the plant will support the contracted dredging projects, primarily through water level fluctuation. The Materials Handling Department will add water depth as needed to float the dredge. Depth requirements may vary with the type of dredge deployed. Weir boards, or stop logs are added for short durations to increase pool depth in 6-inch intervals. When 3 boards have been added, it becomes necessary to seal the emergency spillway (ES). Clay is placed over the rock surface of the ES. One more stop log may be added to achieve maximum pool depth. At this level, the dam still has 2 feet of freeboard. Weather conditions are monitored to assure removal of the clay ES plug should a potential arise for a storm flow level increase. The Environmental staff and the Materials Handling Department coordinate to remove the boards if storm flow warrants. Operational measures also can help to influence water level, such as implementing water conservation measures to decrease inflow, or by doing the reverse. Wash water in the coal yard also can be managed to help establish the desired pool elevation. Significantly slowing Cell 3 discharge or raising the pool above the old submerged dam are the best ways to control sediment load leaving the pond.

Cell 4 – The final discharge point from the Ash Pond Series, Cell 4 functions as a settling basin. Permanent pool, design elevation is maintained in this pond. If a change is needed to facilitate a non-routine maintenance activity, the departments coordinate to assess risks and to develop an individual plan for the specific task.

Plant chemical lab technicians check water quality weekly at the discharge from Cell 4. The location is marked with a labeled, red post. If trouble shooting, control points (identified with white stakes) may be used for sampling. Though rare, quality problems are reported to the assistant plant chemists and to the environmental staff. Appropriate responses are coordinated with the Materials Handling Department.

Parameters of concern include total suspended solids and oil and grease. For instance, if an increasing suspended solids trend is developing, upstream sediment sources are evaluated and cleaned up if possible. If not possible, control alternatives within the cells exist: Incoming water flow can be reduced, a weir board may be added to the Cell 3 principal spillway, or to the Cell 2 principal spillway if the source is in that cell, thus allowing additional settling time. The pool area of each cell is observed daily for the presence of an oil sheen. Oil absorbent booms are in place at each discharge structure. The Materials Handling Department responds to an oil sighting, using spill control and clean up products to contain and remove the sheen. If discharge manipulation is needed, it is coordinated between the departments, again with the options of reducing incoming water flow from plant operations, a weir board may be added to the Cell 3 principal spillway, or to the Cell 2 principal spillway if the source is in that cell. A portable pump also may be placed to run pump-back operations geared at reducing or stopping flow while cleanup is started.

Documents -

Structural stability reports are available for each cell, and design drawings are available for Cells 1, 3 and 4. They are accessible in plant environmental files or in RX Index.

Ash Pond #001 Specs -

Cell Description	Cell Number	Top of Dam (TOD)	Down stream Toe	Normal Pool	Emergency Spillway (ES) Dimensions			Principal spillway (PS) Dimensions (elev. Ft.)			
		Elevation (ft)	Elevation (ft)	Elevation (ft)	Crest Elevation (ft)	Control Section	Side Slopes (perpendicular to flow)	crest (normal pool)	Stop log extent	pipe invert elevation	Stop log height (in)
Dewater pond	1	740		731	na			731			6
Slag Pond, supporting slag recycling operation	2	726.5	692-695 *	723.4	724						6
(Submerged Dam in pool of Cell 3)		710.3	692	-	702.5						
Coal Yard Sediment Control Basin	3	717	690	713 **	715	10'x10'	6:1				6
Polishing Pond; final discharge water	4	705.2 - 705.7	681	700	703	10'x10'	6:1	700	682.2	680.6	6

* Underwater and covered with sediment

** Estimated relative to TOD and ES. (2005 elevation discrepancy should be resolved the next time a land survey crew performs work on the Ash Pond Series)

Actions Upcoming:

Project # 1301020 is planned for execution in 2013: Removal of Waste Ash From Cell 2. The project involves removal of 352,000 cubic yards of waste fly ash, and slag from the eastern side of Cell 2. The waste will be hauled to Landfill Cells 2 and 3 for final disposal, leaving the ash pond cell as solely a slag recycling operation.

Survey drop log spillway structures to determine heights, and confirm structure elevations to establish relationship between PS, ES and TOD and to resolve discrepancy with 2005 flown topography. *(complete when surveying for waste ash removal project, Spring 2013)*

Project # 1300380 is planned for execution in 2013: Dredging of sediments from Cell 3. Discussed in the dredging plan, this effort needs to focus on removal of the sediments deposited in the northern part of the cell.

Tentative, possibly in the future: Draft NPDES permit, under negotiation discusses a ground water monitoring program around the Ash Pond Series.