REPORT

Dam Safety Assessment of CCW Impoundments

Joppa Plant

United States Environmental Protection Agency
Washington, DC

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Washington, DC

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1. INTRODUCTION

1.1. GENERAL

In response to the coal combustion waste (CCW) impoundment failure at the TVA/Kingston coal-fired electric generating station in December of 2008, the U. S. Environmental Protection Agency has initiated a nationwide program of structural integrity and safety assessments of coal combustion waste impoundments or "management units". A CCW management unit is defined as a surface impoundment or similar diked or bermed management unit or management units designated as landfills that receive liquid-borne material and are 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. Management units also include inactive impoundments that have not been formally closed in compliance with applicable federal or state closure/reclamation regulations. This project is being conducted in accordance with the terms of O'Brien & Gere's Order EP10W001240 to Contract BPA# EP10W000673 with the US EPA, dated April 8, 2010.

1.2. PROJECT PURPOSE AND SCOPE

The purpose of this work is to provide dam safety assessment of CCW management units, including the following:

- Identify conditions that may adversely affect the structural stability and functionality of a management unit and its appurtenant structures
- Note the extent of deterioration, status of maintenance, and/or need for immediate repair
- Evaluate conformity with current design and construction practices
- Determine the hazard potential classification for units not currently classified by the management unit owner or by state or federal agencies

O'Brien & Gere's scope of services for this project includes performing a site specific dam safety assessment of all CCW management units at the subject facility. Specifically, the scope includes the following tasks:

- Perform a review of pertinent records (prior inspections, engineering reports, drawings, etc.) made available at the time of the site visit to review previously documented conditions and safety issues and gain an understanding of the original design and modifications of the facility.
- Perform a site visit and visual inspection of each CCW management unit and complete the visual inspection checklist to document conditions observed.
- Perform an evaluation of the adequacy of the outlet works, structural stability, quality and adequacy of the management unit's inspection, maintenance, and operations procedures.
- Identify critical infrastructure within 5 miles downstream of management units.
- Evaluate the risks and effects of potential overtopping and evaluate effects of flood loading on the management units.
- Immediate notification of conditions requiring emergency or urgent corrective action.
- Identify all environmental permits issued for the management units.
- Identify all leaks, spills, or releases of any kind from the management units within the last 5 years.
- Prepare a report summarizing the findings of the assessment, conclusions regarding the safety and structural integrity, recommendations for maintenance and corrective action, and other action items as appropriate.

This report addresses the above issues for the Ash Pond at the Electric Energy, Inc. (EEI) Joppa Station in Joppa, Illinois. The above impoundment is owned and operated by EEI. In the course of this assessment, we obtained information through interviews with representatives of EEI and Ameren Corporation, which owns 80% of EEI.

2. PROJECT/FACILITY DESCRIPTION

2.1. GENERAL

The Joppa Plant is located at 2100 Portland Road in Joppa, Illinois. A Site Location Map is included as Figure 1. The generating station was commissioned in 1953 and includes a coal-fired electrical power generating facility with an approximate capacity of 1,086 megawatts (MW) gross generation capacity from its six coal-fired electric generating units, as well as 76 MW from its two natural gas units, owned by an EEI subsidiary. Coal combustion waste that is produced during power generation is managed on-site with a CCW impoundment.

The facility utilizes one impoundment known as the Ash Pond, separated by a dividing dike (Central Dike) into two sections, referred to as the Northern and Southern Ponds, for CCW management. The Ash Pond is located on the north side of the site. This safety assessment report summarizes the April 2010 inspection of the CCW management pond at the Joppa Plant. Please note that certain sections of this report describe the Northern and Southern Ponds separately; however, the Ash Pond was reported as a single unit to the USEPA, therefore, a single checklist was submitted and the Conclusions and Recommendations presented at the end of this report are provided for the Ash Pond as a whole, not the separate Northern and Southern Ponds. The two sections of the CCW management unit inspected during this safety assessment are identified on Figure 2 – Facility Layout Plan. The Northern Pond was constructed "pre-rules" for dams in the state of Illinois and as a Class III structure only requires a permit if significant modifications to the structure are made. The Southern Pond appears to have been constructed "post-rules" and may be subject to permit requirements. EEI and Ameren have developed an Emergency Action Plan (EAP) And a Dam Safety Program for the impoundment in accordance with Illinois dam safety guidelines.

2.2. MANAGEMENT UNIT DESCRIPTION

CCW consists of bottom ash and fly ash. Bottom ash generated at the Joppa Plant is hydraulically sluiced to the Southern Pond. Fly ash which is collected using electrostatic precipitators was previously sluiced to the Ash Pond but it is now pneumatically conveyed to storage silos, and finally sold for reuse. The market for the fly ash generated at the Joppa Plant has greatly diminished since the plant started injecting powdered activated carbon upstream of the electrostatic precipitators in response to Illinois mercury removal requirements. Dewatered bottom ash is excavated and sold for reuse. The Plant still reclaims "legacy" ash.

2.2.1. Northern Pond

Construction of the Northern Pond was completed in 1973. The pond embankment has not been raised since, but material has been added in some areas to increase the width. Currently, the Northern Pond is drained and no CCW is sluiced to the Northern Pond. However, overflow from the Southern Pond does enter the Northern Pond through a corrugated metal pipe (CMP) installed in the Central Dike.

2.2.2. Southern Pond

The Southern Pond was formed by construction of an additional dike south of the existing Northern Pond. This construction was completed in 1985. After construction of the Southern Pond, the former south embankment of the Northern Pond became known as the Central Dike. The Southern Pond is currently used for CCW storage. Sluiced CCW enters the pond in the southwestern corner. Sluice water that is routed through the pond is discharged into an outlet structure located near the northeast corner of the pond, near the Central Dike. The discharge flows through an underground pipe to a concrete structure located near the northernmost point of the Northern Pond (outside the impoundment), where it mixes with any discharge from the Northern Pond, is

treated with acid if necessary to reduce the effluent pH to comply with the Plant NPDES permit, and finally discharged south through open channels and underground pipes to the Ohio River.

2.2.3. Other Impoundments

The Facility Layout Map provided as Figure 2 shows the location of the various impoundments on the site. There are three additional impoundments at the Joppa Station, identified as follows:

1) Capped Ash Pond – The Capped Ash Pond is located on the west side of the Joppa Station. CCW is currently not sluiced to the Capped Ash Pond. The Capped Ash Pond was the original CCW management unit constructed at the site, but it has been decommissioned since the Northern Pond came on-line in 1973. The decommissioning included grading the pond to prevent storage of water.

2) Settlement Pond – The Settlement Pond is located to the south of the Joppa Plant's coal stockpile, between the stockpile and the Ohio River. This pond was constructed at the same time as the Northern Pond. The purpose of the pond is to collect stormwater runoff from the coal stockpile.

3) Sewage Lagoon – The Sewage Lagoon is located to the west of the Capped Ash Pond (see Figure 2). It was constructed in 1995.

2.3. HAZARD POTENTIAL CLASSIFICATION

The Illinois dam safety law is contained in Illinois Compiled Statutes (615ILCS5), originally enacted June 10, 1911, and last amended February 7, 1996. The rules pertaining to the dam safety program are contained in the Illinois Administrative Code, Title 17 (Conservation), Chapter I (Dept. of Natural Resources), Subchapter h (Water Resources). These rules were originally adopted September 2, 1980, and last revised April 10, 1998. The regulations are administered by the Illinois Department of Natural Resources (IDNR). The IDNR defines a dam as "all obstructions, walls, embankments, or barriers, together with their abutments and appurtenant works, if any, constructed for the purpose of storing or diverting water or creating a pool. Not included are underground or elevated tanks to store water." (Section 3702.20)

Dams are categorized according to the degree of threat to life and property in case of failure. *Class I* dams are those for which failure has a high probability of causing loss of life or substantial economic loss, similar to that of US Army Corps of Engineers High Hazard Potential or USDA Natural Resources Conservation Service Class (c) dams. *Class II* dams are those for which failure has a moderate probability for causing loss of life or substantial economic loss, similar to USACE Significant Hazard Potential or USDA/NRCS Class (b) dams. *Class III* dams are those for which failure has a low probability for causing loss of life or substantial economic loss, similar to the USACE Low Hazard Potential or USDA/NRCS Class (a) dams.

As stated previously, the Southern Pond may meet the requirements for a regulated structure by the State of Illinois. EEI has complied with some IDNR requirements and have developed an Emergency Action Plan and a Dam Safety Program for the impoundment**.**

The definitions for the four hazard potentials (Less than Low, Low, Significant and High) to be used in this assessment are included in the EPA CCW checklist found in Appendix A. Based on the checklist definitions and as a result of this assessment, the hazard potential rating recommended for the Ash Pond is **LOW,** which would generally be synonymous with the State of Illinois *Class III*. Failure is not likely to cause loss of life because the nearest residences appear to lie at an elevation near the normal pool elevation and the area between the Ash Pond and the residences forms a natural drainage swale which would convey the CCW and water to the Ohio

River. Additionally, EEI owns the land that would likely be inundated with CCW and sluice water should the Ash Pond embankments fail. While the Ohio River is located downstream from the Southern Pond, environmental and economic damage appears to be limited to EEI property due to the distance to the Ohio River and the railroad embankment located near the pond would limit the release of CCW downstream.

2.4. IMPOUNDING STRUCTURE DETAILS

Prior to construction of the Southern Pond, the Ash Pond consisted solely of what is now referred to as the Northern Pond. At that time, the southern dike of the pond became known as the Central Dike. The following sections summarize the structural components and basic operations of the Northern Pond, the Southern Pond and the Central Dike. The locations of these features at the Joppa Plant are shown on Figure 2. A smaller scale plan of the Ash Pond and photo location identifiers is provided as Figure 3. Additionally, photos taken during the visual inspection are incorporated in a Photographic Log provided as Appendix B.

2.4.1. Embankment Configuration

Northern Pond

The Northern Pond is a diked earthen embankment impoundment with a total surface area of approximately 49, acres based on a survey dated January 5, 2005 provided by EEI during the inspection. The area currently impounding water, however, is less than 6 acres based on the survey; the remaining storage area is filled with CCW. The Northern Pond is diked over the length of its perimeter and the height of the dike varies from approximately 15 to 45 feet above the outboard toe of slope. The crest is at approximately elevation (EL) 380 feet above mean sea level. The inboard and outboard embankment slopes were designed at an inclination of 1.5H:1V. A 24-inch CMP through the Central Dike connects the Northern and Southern Ponds. The pipe was not constructed with a control system (gate, valve, stoplogs, etc.) to manage flow between the ponds.

Southern Pond

The Southern Pond is also a diked earthen embankment structure with a height that varies from approximately 15 to 45 feet above its outboard toe. The Southern Pond total surface area is approximately 54 acres, based on the 2005 survey provided by EEI. The area currently impounding water, however, is approximately 26 acres based on the survey; the remaining storage area is filled with CCW. As with the Northern Pond, the crest is at approximately elevation (EL) 380 feet above mean sea level. Power lines cross the Southern Pond; these lines were constructed before the Ash Pond was expanded into the Northern and Southern Ponds, thus the Southern Pond was built around the lines. The lines have sagged, and, currently vehicular traffic is prohibited along the eastern portion of the Southern Pond embankment as a precaution against contact with the power line.

In addition to the impoundments described above, there are three ponds located on the Joppa Site. These impoundments were described in Section 2.2.3 of this report. These ponds were not assessed as part of this CCW impoundment assessment since their purpose is not to store actively sluiced CCW.

2.4.2. Type of Materials Impounded

Currently, influent into the Ash Pond includes water with solids consisting of primarily bottom ash with lesser quantities of miscellaneous fines such as coal fines and fly ash.

2.4.3. Outlet Works

The Northern and Southern Ponds are diked impoundments that have been designed to receive sluice flows and direct precipitation. The Southern Pond's primary outlet structure is located near the northeastern corner of the impoundment and consists of a 24-inch steel "T" structure connected to a 24-inch pipe that passes through the eastern embankment. Additionally, the Southern Pond can discharge directly into the Northern Pond through a 24-inch CMP pipe installed in the Central Dike, this pipe is referred to as the Culvert through the Central Dike. The 24-inch outlet pipe turns north at some point underground and discharges into a concrete structure located near the northeastern corner of the Northern Pond. Discharge from the Northern Pond exits through a 30-inch pipe located at its northernmost corner. The flow from the Southern Pond mixes with any outflow from the Northern Pond in the concrete structure, where the combined effluent is stabilized with acid when its pH exceeds permitted levels (pH of 9.0). The discharge flows in an open channel along the outboard toe of the Northern Pond eastern embankment for approximately 300 feet. At this point, the flow enters an underground culvert via a concrete headwall. The flow travels approximately 1,700 feet underground before exiting into an open channel located east of the impoundment. The channel passes below the Joppa Plant's coal-delivery railroad siding through a concrete culvert and terminates approximately 2,400 feet downstream at the Ohio River. The Ash Pond discharge to the Ohio River is permitted under IEPA permit # IL-0004171.

3. RECORDS REVIEW

A review of the available records related to design, construction, operation and inspection of the Joppa Plant CCW impoundment was performed as part of this assessment. The documents provided by EEI and Ameren are listed below:

Table 3.1 *Summary of Documents Reviewed*

Document	Dates	By	Description
East Ash Pond Soil Survey Profile Cross Section, Shts. 1 & 2	Unknown	Unknown	Boring Logs
Dwg. AP-102	07/19/71	EEI	East Ash Pond Canal Profile
Ash Pond Soil Survey	03/12/73	SO-BI-CO	Subsurface investigation in preparation of Ash Pond design/construction
Detail Process for Design Specifications for Ash Pond	03/21/73	WAPORA, Inc.	Preliminary design document for Ash Pond construction
Dwg. 4229-8200	03/29/73	WAPORA, Inc.	Plan View – Proposed (East) Ash Pond
Aerial Photo	11/17/73	Unknown	Pre-construction Aerial Photo of NE corner of Ash Pond
Dwg. 4229-8218	09/11/77	WAPORA, Inc.	Plans and Sections, Ash [Northern] Pond
Dwg. AP-109, Shts. 1 – 6	07/13/82	EEI	East Ash Pond – Sections, Proposed Levee
Aerial Photo	09/20/85	Unknown	Aerial Photo of Ash Pond
Dwg. 4229-8211, Shts. 1, 2 & 5	06/13/86	EEI	As-Built Plan and Sections, Southern Pond
Dwg. AP-112	04/29/92	EEI	Proposed Modifications to Ash Pond – New Outlet from Southern Pond
Memorandum	06/10/92	EEI	EEI Memo to IEPA regarding proposed discharge line
Letter to IEPA	09/18/92	EEI	Letter to IEPA requesting permit for construction of new discharge line from Southern Ash Pond
Memorandum	04/20/93	EEI	Brief memorandum on Ash Pond construction history
Ash Pond Topo Survey Report	12/29/04	Mikon Corp.	Memorandum summarizing results of bathymetric survey of the Ash Pond
Dwg. 00032854	01/05/05	Mikon, Inc.	Plan - Bathymetric Survey of Ash Pond
Water Detention Facilities Inspection Letter Report	03/17/09	Hanson Professional Services, Inc.	Letter Report detailing results of visual inspection of Joppa Plant ponds
Dam Safety Program	06/17/09	EEI	Dam Safety Program for Ash Pond dikes
Ash Pond Dike Emergency Action Plan	07/08/09	EEI	Emergency Action Plan for the Ash Pond
IEPA NPDES Permit	08/07/09	IEPA	NPDES Permit IL0004171
ICR Response	01/26/10	EEI and Ameren	Response to EPA inquiry
Weekly Inspection Log	02/23-/09 – 04/23/10	EEI	Weekly Inspection Logs for the Ash Pond

3.1. ENGINEERING DOCUMENTS

Review of the documents and drawings revealed information on the design details for the Northern and Southern Ponds which is summarized below:

- The Northern Pond was constructed in 1973 by Barter Construction. At the time, it was known as the (East) Ash Pond. It replaced the existing (West) Ash Pond that had been used for CCW management since the Plant was commissioned.
- The soils at the Joppa Plant are generally classified as Clayey-Silts (CL) in accordance with the Unified Soil Classification procedure. Recorded permeabilities ranged from $5.2x10^{-4}$ to $4.6x10^{-7}$ cm/sec. Due to the low permeability of the native soils, the embankments were designed without a liner.
- The inboard and outboard slopes of the embankments were designed and constructed at 1.5H:1V, which is steeper than generally recommended for dam and dike construction.
- Construction of the Southern Pond began in 1977 and was completed in 1985. The design drawings for the expansion indicate that the portions of the embankment that was to be constructed over an underlying foundation identified as "Fly Ash" would have a cutoff trench through the ash into native soils. Sections of the embankment that were constructed directly on native soils were designed without a cutoff trench. The embankments were to be "Compacted to 95%" (Standard or Modified Proctor was not identified).
- The Northern and Southern Ponds were constructed to a crest elevation of 380 feet above mean sea level (msl). The crests have not been raised since their completion.
- The 24-inch discharge pipe system for the Southern Pond was constructed in 1992. Prior to its construction, all flow from the Southern Pond passed into the Northern Pond through the 24-inch CMP ("Culvert") in the Central Dike before discharging from the impoundment through the outlet structure located at the northern end of the Northern Pond. The original HDPE structure was replaced by a steel "T" in 1998.
- Slope stability analyses for the design of the embankments were not found.

3.1.1. Stormwater Inflows

Stormwater inflows to both the Northern and the Southern Ponds are minimal. The impounding structures are comprised of diked embankments on four sides which direct storm water away from the impoundment and limit runoff to that which falls directly on the water surface and crest of the embankments.

3.1.2. Stability Analyses

As stated above, no slope stability analyses were included in the records made available by EEI and Ameren. A subsurface investigation program of the Northern and Southern Pond embankments is scheduled for the summer of 2010, with stability analyses based on the results of the investigation to follow.

3.1.3. Instrumentation

No instrumentation is present at either pond.

3.2. PREVIOUS INSPECTIONS

EEI personnel perform weekly inspections of the ponds and record the results in a log. EEI retained the services of Hanson Professional Services, Inc. to perform visual inspections of the Plant impoundments. The results of the inspections are presented in a letter report dated March 17, 2009. The report stated that the embankments appeared to be in Fair condition with some deleterious vegetative growth and minor erosion observed.

3.3. OPERATOR INTERVIEWS

Numerous plant and corporate personnel took part in the inspection proceedings. The following is a list of participants for the inspection of the Ash Pond.

Table 3.2 *List of Participants*

Name	Affiliation	Title
Bruce Parker	EEI	Senior Engineer
Michael Mercer	EEI	Senior Chemical and Environmental Specialist
Chris Skates	EEI	Plant Chemistry Supervisor
Terry Larbes	EEI	Manager, Technical Services
Steve Bluemner	Ameren	Supervising Engineer
Johan Anestad	O'Brien & Gere	Technical Associate
Rob Ganley	O'Brien & Gere	Vice President

The EEI and Ameren personnel provided a good working knowledge of the Ash Pond, provided general plant operation background as well as available historical documentation.

4. VISUAL INSPECTION

The following sections summarize the inspection of the Joppa Plant Ash Pond (Northern and Southern Ponds), which occurred on April 27, 2010. Following the inspection, O'Brien & Gere completed an EPA inspection checklist that briefly summarizes the results of the inspection. The checklist was submitted electronically to EPA on May 4, 2010. A copy of the completed inspection checklist is included as Appendix A.

4.1. GENERAL

The weather on the date of the inspection included some rain showers, wind and mostly cloudy conditions; the temperature was approximately 55 - 65 degrees. The visual inspection consisted of a thorough site walk along the crest, outboard slope, and toe of the embankments, and along exposed portions of the inboard slopes. The team also inspected the inlet/outlet structures.

Photos of relevant features and conditions observed during the inspection were taken by O'Brien & Gere and are provided in Appendix B. A Site Plan of the Northern and Southern Ponds is presented as Figure 3, which also provides photograph locations and directions.

4.2. SUMMARY OF FINDINGS

Northern Pond

The following observations were made during the inspection:

- Sluiced CCW by-product discharge does not currently enter the Northern Pond on a regular basis. Overflow from the Southern Pond may discharge to the Northern Pond through a 24-inch CMP (the "Culvert") installed in the Central Dike.
- The 24-inch connecting pipe does not have a control structure (gate, valve, stoplogs, etc.) to regulate the amount of flow between the impoundments. Riprap has been placed, or fallen into, the opening of the pipe and was observed within the pipe, near its midpoint. The riprap limits the capacity of the pipe and may have slightly raised the water surface elevation in the Southern Pond (Photos 2 & 3).
- CCW has accumulated above the normal pool level over an estimated 90 percent of the pond area. Water in the pond is isolated to primarily the northeastern corner (Figures 2 & 3, Photos 4 & 5).
- Portions of the outboard slopes of the embankments are covered with rock fill and small riprap. The majority of the outboard slopes are overgrown with vegetation such as grasses, and small shrubs (Photos 6 – 8).
- The outboard slope is steeper than generally recommended for dam and dike construction, and surface erosion has occurred. EEI procedure is to dump rockfill over the eroded areas to prevent the deterioration from spreading.
- An access road runs along the toe of the western embankment. A section of the western embankment was modified to more safely accommodate truck traffic by reconstructing the embankment, effectively moving it to the east. The finished slope of the modified section matches the 1.5H:1V of the remainder of the outboard slope.
- The outboard toe area was generally well drained, although some standing water was observed in the area of the Central Dike and further north near the drainage channel culvert entrance.
- In addition to the Ash Pond effluent, discharge from a drainage area east of the EEI railroad siding enters the outlet drainage channel (Photo 10).
- The inboard slope was also constructed at a slope of 1.5H:1V, originally with a riprap layer to protect the embankment against erosion. The riprap is now generally buried below bottom ash that has been dredged

from inside the impoundment and placed on the inboard slope. The inboard slope was also generally overgrown with reedy grasses (Photo 5).

- A crushed-stone access road was constructed over the length of the crest. The road appears to be in good condition with no rutting, erosion or standing water observed.
- The outlet structure was covered with dried reeds but appeared to be in good condition and functioning normally (Photo 12).

Southern Pond

The following observations were made during the visual inspection:

- Sluiced CCW by-product discharge enters the pond in the southwestern corner (Photo 13) and flows along the southern embankment in a channel dredged into dried CCW (Photo 14). Sluice water exits the pond through a 24-inch steel "T" structure located near the northeast corner of the impoundment (Photos 15 & 16).
- Water can also flow from the Southern Pond into the Northern Pond through a 24-inch CMP installed in the Central Dike. The condition of the pipe was described above.
- CCW has accumulated above the normal pool level over an estimated 50 percent of the pond area. Water in the pond is isolated to primarily the eastern half of the pond (Figures 2 & 3, Photo 17).
- Portions of the outboard slope are covered with rock fill and small riprap. The rock was reportedly dumped from the crest to protect areas that had experienced erosion (Photos 18 - 20).
- The majority of the outboard slope is overgrown with vegetation such as grasses, and small shrubs. Large trees were not observed growing on the embankment, although evidence of past tree growth was evident.
- The outboard slope is steeper than generally recommended for dam and dike construction. The design drawings (See attached EEI Drawing AP-109) indicate the slope should be 2H:1V, but the observed slope appeared to be steeper and matched the 1.5H:1V slope of the Northern Pond.
- Surface erosion, sloughs and slides were observed along the outboard slope. The most significant erosion was observed in the area below the power lines that cross the Southern Pond (Photos 20 - 22).
- Erosion gullies were also observed in the lower portion of the embankment near the southeastern corner of the impoundment. The extent of the gullies could not be investigated due to heavy vegetative growth.
- Seepage was observed in multiple locations along the outboard toe of the embankment. The most significant area of seepage is located approximately 500 feet north of the power lines (Photos 23 & 24). Other areas where seepage was observed include an area approximately 200 feet south of the power lines and along the southern embankment of the Southern Pond. The approximate locations of seepage are identified on Figure 3.
- Based on Drawing AP-109, Sht. 1 (attached), the Southern Pond embankment was keyed into a suitable foundation through a layer of fly ash for a portion of the embankment. Section A-A, which is indicative of construction in the area near the power lines (Dwg. 4229-8211, Sht. 1), indicates that this section of the embankment was not keyed into the underlying foundation.
- EEI is in the process of constructing an access road along the outboard toe of the embankment. Wet conditions and vegetation have prevented the project from being completed.
- A crushed-stone access road was constructed over the length of the crest. The road appears to be in good condition with no rutting, erosion or standing water observed. Jersey barriers prevent vehicular traffic from using the access road along the eastern half of the southern embankment and along the eastern embankment south of the Central Dike. The barriers were installed as a safety precaution to prevent vehicular traffic from crossing below the power lines when they started to sag.
- The inboard slope was also constructed at a slope of 1.5H:1V, originally with a riprap layer to protect the embankment against erosion. The riprap is now generally buried below bottom ash that has been dredged from inside the impoundment and placed on the inboard slope. The inboard slope was also generally

overgrown with reedy grasses.

Based on conversations with plant personnel, no releases have occurred from the Ash Pond. Some patchwork repairs and regrading of the embankment are known to have been performed.

5. CONCLUSIONS

Based on the ratings defined in the RFP (Satisfactory, Fair, Poor and Unsatisfactory), the information reviewed and the visual inspection, the overall condition of the Ash Pond is considered to be **FAIR**. Acceptable performance is expected under all loading conditions; however, some deficiencies exist that require repair and/or additional studies or investigations. The deficiencies include the following:

- Sloughs, slides and erosion of the Southern Pond embankment.
- Deleterious vegetation growing along the length of the inboard and outboard slopes of the embankment.
- Riprap in the 24-inch culvert through the Central Dike limiting the pipe capacity.
- Seepage in multiple locations along the outboard toe of the Southern Pond embankment.
- Portions of the Southern Pond embankment constructed on "Fly Ash" foundation, other portions on native soils without a cutoff trench.

Other than the conditions cited above, the owner has conducted regular inspections and maintenance which enable the impoundment to be kept in reasonably good working order.

In addition to the physical deficiencies, it was noted that no geotechnical evaluations or slope stability analyses are on record for the Ash Pond embankments. According to EEI and Ameren, a subsurface investigation and slope stability analyses should be completed by the end of the year. Completion of these additional studies for critical slopes (highest and steepest) will formally document the stability of the earth structure in accordance with applicable safety criteria for earth dams. During the course of the meetings and inspection, the owners stated that only two lines of borings, taken at the critical sections (highest/steepest) of the Northern and Southern Pond embankments, were planned. It was recommended that additional borings be considered due to the length of the perimeter embankment and the seepage observed at the toe of the eastern and southern embankments of the Southern Pond. Additionally, O'Brien & Gere recommended that open-well PVC piezometers be installed in the borings to allow EEI to monitor phreatic conditions within the embankment. EEI and Ameren indicated that they were agreeable to the idea of installing the piezometers, but noted that the Ash Pond is scheduled to be taken out of service, and all CCW landfilled or sold for beneficial reuse in a 10-15 year timeframe, therefore, a much more extensive subsurface investigation program may not be undertaken.

The plant staff maintains available documents in a well organized manner, performs regular inspections and maintenance, has developed an Emergency Action Plan and a Dam Safety Program in accordance with IDNR guidelines, and plans to conduct additional investigations/analyses to supplement the existing data. Based on these findings, O'Brien & Gere is of the opinion that the operations and maintenance procedures being practiced at the Ash Pond are adequate, although some additional maintenance/improvement actions are recommended to correct some of the conditions observed.

6. RECOMMENDATIONS

Based on the findings of our visual inspection and review of the available records for the Ash Pond, O'Brien & Gere recommends that additional investigations/analyses and maintenance of the embankments be performed to correct the deficiencies cited above.

6.1. URGENT ACTION ITEMS

None of the recommendations are considered to be urgent, since the issues noted above do not appear to threaten the structural integrity of the impoundment in the near term.

6.2. LONG TERM IMPROVEMENT

The deficient conditions observed during the inspection do not require immediate attention, but should be corrected in the near future as part of a regular maintenance plan. The recommended maintenance/improvement actions are described below:

- Outboard slopes – remove deleterious vegetation and continue regular maintenance of the slopes; repair any areas of sloughs, slides and erosion.
- Outboard toe – investigate the extent of seepage, monitor the seepage on a regular basis, and develop alternatives for treating the deteriorated sections of the embankment.
- Inboard slopes – keep vegetation under control to allow for visual inspection of the exposed portion of the slope above the waterline.
- Additional studies – perform geotechnical investigation, cross-sectional topographic survey, and slope stability analyses of critical sections. Install piezometers to check phreatic levels within the embankment. Analyze for normal pool with steady state seepage, maximum surcharge pool, and seismic loading conditions and, depending on the results of the analyses, consider alternatives for stabilizing the embankments and control the seepage.

6.3. MONITORING AND FUTURE INSPECTION

Consideration should be given to inspections by licensed dam safety engineers on a regular basis to document the continued proper maintenance and operation of the Ash Pond. This is especially critical for the portion of the Southern Pond embankment where seepage was observed.

6.4. TIME FRAME FOR COMPLETION OF REPAIRS/IMPROVEMENTS

Based on conversations with representatives of EEI and Ameren, the subsurface investigation and stability analysis is scheduled to be performed by the end of 2010. It is O'Brien & Gere's recommendation that the owner continue toward this schedule as planned, to consider installing piezometers in the sample locations and to expand the scope of the investigation. It is recommended that the other improvements and analyses recommended above be completed in a timely manner.

6.5. CERTIFICATION STATEMENT

I acknowledge that the Ash Pond (Northern and Southern Ponds) CCW management unit referenced herein were personally inspected by me on April 27, 2010 and was found to be in the following condition:

~~SATISFACTORY~~
FAIR
~~POOR~~
~~UNSATISFACTORY~~

Signature: _____ Date: September 24, 2010

Robert C. Ganley, PE
IL PE # 062-045829

FIGURES

FIGURE 1

ADAPTED FROM: JOPPA, ILLINOIS QUADRANGLE, U.S.G.S. 7.5 MIN. QUAD 2010

QUADRANGLE LOCATION

US EPA
DAM SAFETY ASSESSMENT
OF CCW IMPOUNDMENTS

JOPPA PLANT
JOPPA, ILLINOIS

SITE LOCATION MAP

1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

SCALE: 1:24000

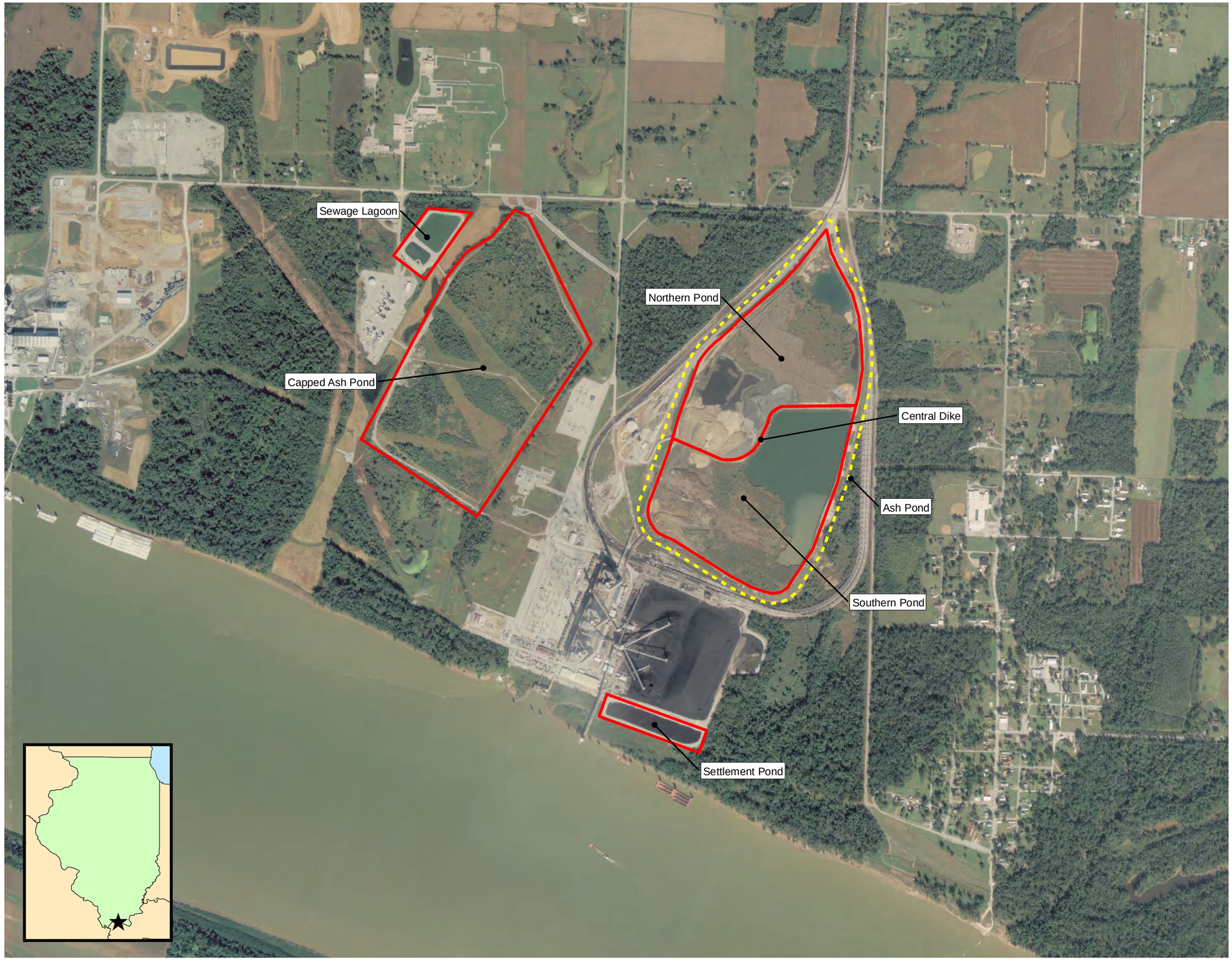
46122–JOPPA–F01
SEPTEMBER 2010

O'BRIEN & GERE

2010 © O'Brien & Gere Engineers, Inc.

I:\US-EPA.13498\46122.ASSESS-OF-DAM-S\DOCS\DWG\SHEETS\46122-JOPPA-F01.DWG, 09/22/2010 11:03AM

FIGURE 2



N

NOTE
Aerial imagery provided by National Agriculture Imagery Program (USDA), 2009.

ELECTRIC ENERGY, INC.
JOPPA PLANT
JOPPA, ILLINOIS

SITE LAYOUT MAP

0 500 1,000 2,000
Feet

SEPTEMBER 2010
13498/46122

O'BRIEN & GERE
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NAME: KaufmaDR
DATE: 9/1/2010 10:48:38 AM

FIGURE 3

This document was developed in color. Reproduction in B/W may not represent the data as intended.

N

LEGEND

(1) Photograph Direction/Location

NOTE
Aerial imagery provided by National Agriculture Imagery Program (USDA), 2009.

ELECTRIC ENERGY, INC.
JOPPA PLANT
JOPPA, ILLINOIS

PHOTO LOCATIONS AND SITE FEATURES

0 200 400 800
Feet

SEPTEMBER 2010
13498/46122

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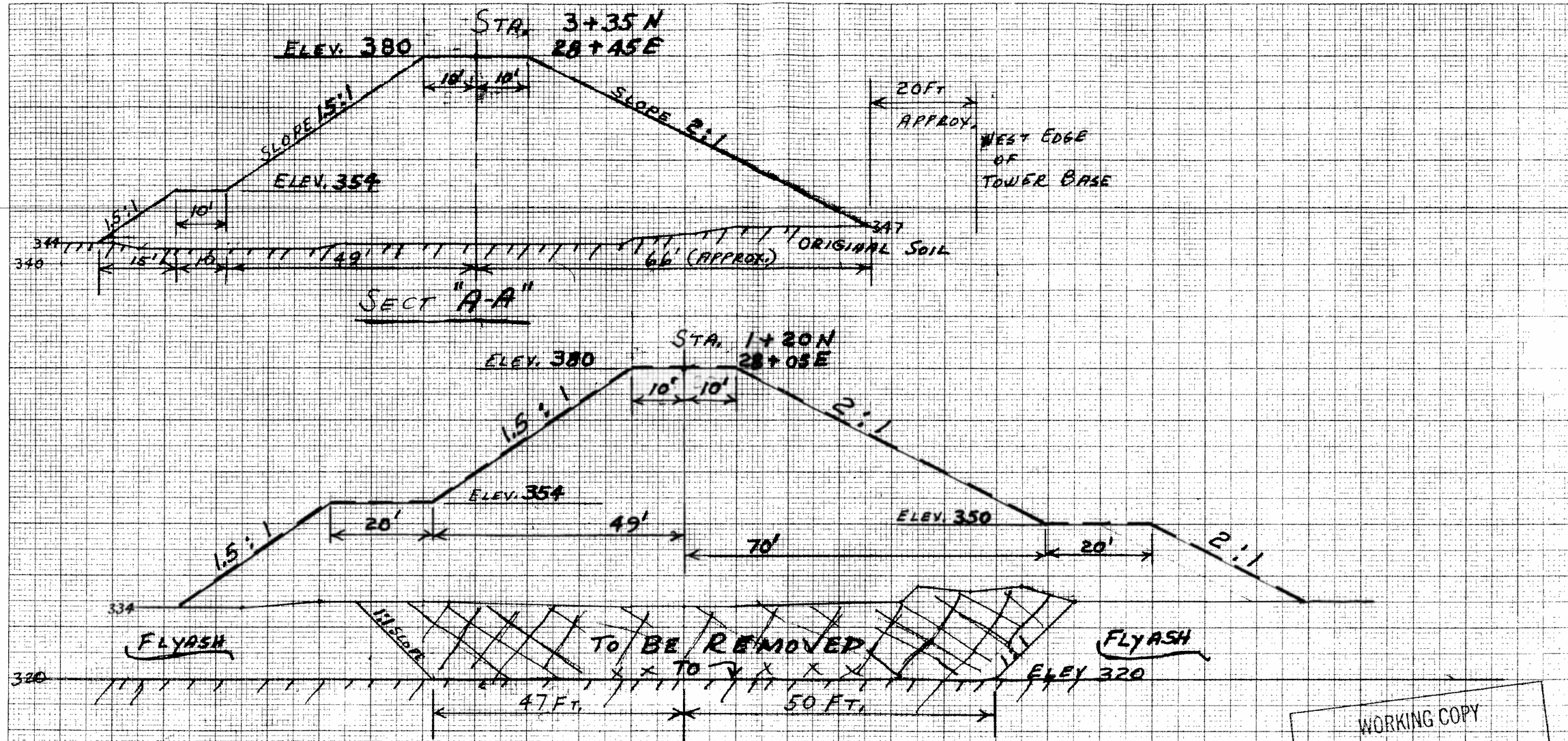


WORKING COPY
COPIED BY: acb
DATE: 4/23/10

95% COMPACTION DESIRED

TO BE CONSTRUCTED WITH 6" COMPACTED LAYERS

EAST ASH POND

PROPOSED LEVEE - SECTIONS

REF: 4229-8211 FOR LAYOUT

5-27-82 H.M^c
7-13-82

AP-109 SH. 1

47 1322
10 X 10 TO ½ INCH • 10 X 15 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.

APPENDIX A

Visual Inspection Checklist

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name:	Joppa Plant	Date:	04/27/10
Unit Name:	Ash Pond	Operator's Name:	Electric Energy, Inc.
Unit I.D.:		Hazard Potential Classification:	High Significant Low ✓
Inspector's Name:	Robert C. Ganley, P.E. and NJ Anestad, 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?	Weekly		18. Sloughing or bulging on slopes?	✓	
2. Pool elevation (operator records)?	374.0		19. Major erosion or slope deterioration?		✓
3. Decant inlet elevation (operator records)?	NA		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	NA		Is water entering inlet, but not exiting outlet?		✓
5. Lowest dam crest elevation (operator records)?	380.0		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?	✓	
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)?	NA		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?	✓		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?	NA		Around the outside of the decant pipe?		✓
15. Are spillway or ditch linings deteriorated?	NA		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
9	Trees <4"dia (Eastern Embankment of Southern Pond)
17, 18, 19	Scarps and sloughing of embankment observed in area below power lines that cross the South Pond (Eastern embankment of South Pond). Erosion of lower portion of berm observed approximately 100' south of power lines.
21	Seepage observed at various locations along the toe of the eastern embankment on South Ponds. Seepage area extends approximately 100', starting approximately 500' North of power lines. Seepage was also observed on the Southern embankment of the South Pond in the area facing the coal piles. Evidence of seepage on the embankment slope was observed in this location, but seepage was not.
23	Discharge from ponds travels in open channel at the toe of the East embankment of the North Pond before entering a 48" dia CMP culvert.

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit #: IL0004171__ INSPECTOR: RC Ganley, P.E., NJ Anestad, P.E.
Date: April 27, 2010_____

Impoundment Name: Ash Pond_____
Impoundment Company: Electric Energy, Inc._____
EPA Region: ____5_____
State Agency (Field Office) Address: Illinois EPA - 2309 W. Main Street, Marion, IL 62959

Name of Impoundment: _____
(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New ____X____ Update _____

	Yes	No
Is impoundment currently under construction?	_____	__X_
Is water or ccw currently being pumped into the impoundment?	__X____	_____

IMPOUNDMENT FUNCTION: Storage of bottom ash, settling pond_____

Nearest Downstream Town: Name Joppa_____
Distance from the impoundment __Approximately 0.5 miles_____
Impoundment
Location: Longitude _81_____ Degrees _51_____ Minutes __00____ Seconds
Latitude _37_____ Degrees __12____ Minutes ___55___ Seconds
State ____IL_____ County ___Massac_____

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

If So Which State Agency?_____

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.

__X__ **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.

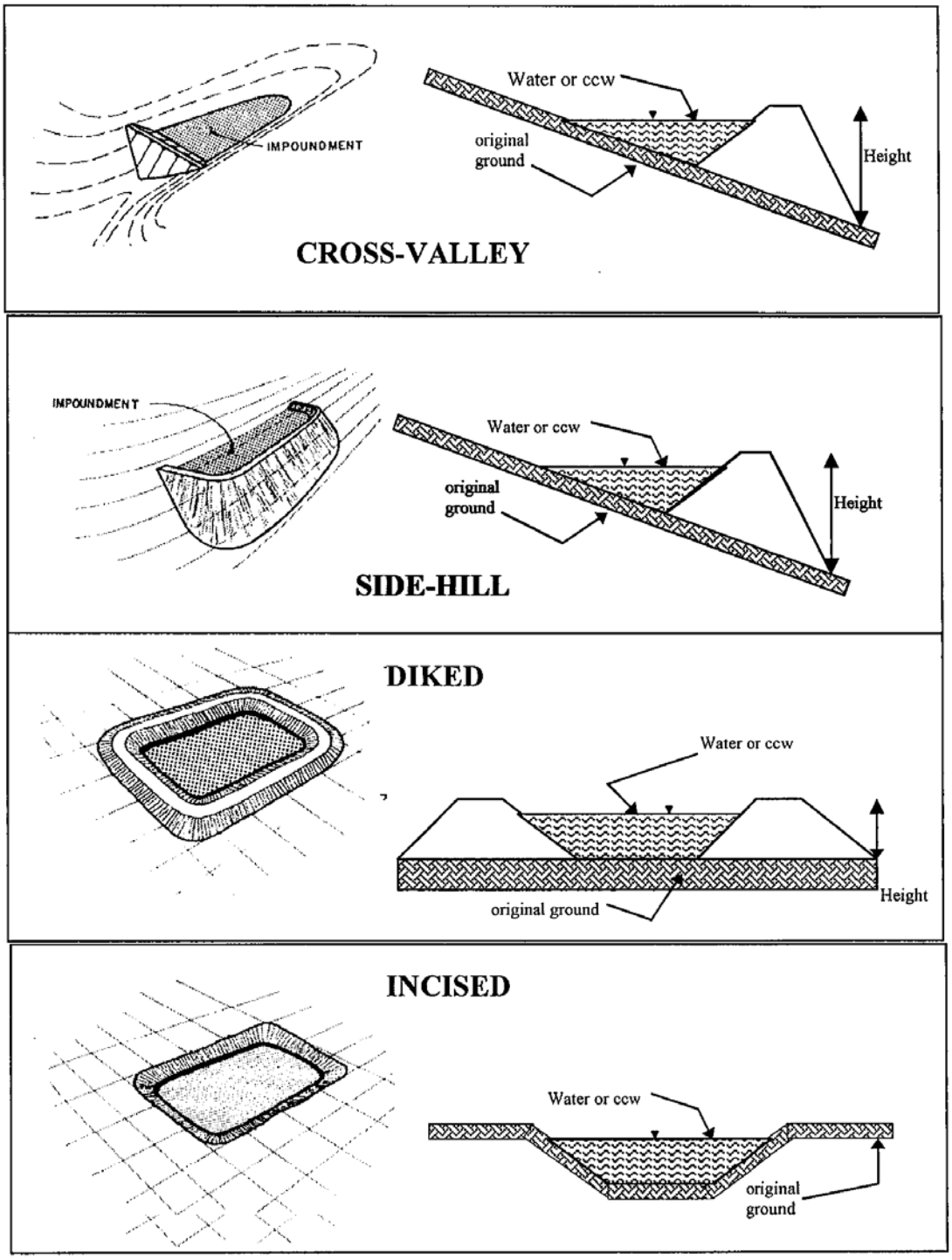
_____ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. 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:

North Pond has limited water volume stored and failure would likely discharge to low area between impoundment and railroad tracks. South Pond water volume mainly present in the East and Northeast of the Pond. If impoundment failed, water would likely flow to East and South into the low area between impoundment and railroad tracks, where current Ash Ponds outfall travels to Ohio River. Since Electric Energy, Inc. owns property to the East and South of the Ash Ponds, including the railroad tracks, impact would principally be to their property. Inhabited areas to the East are separated from the Ash Ponds by the low area bounded by the embankment and the railroad.

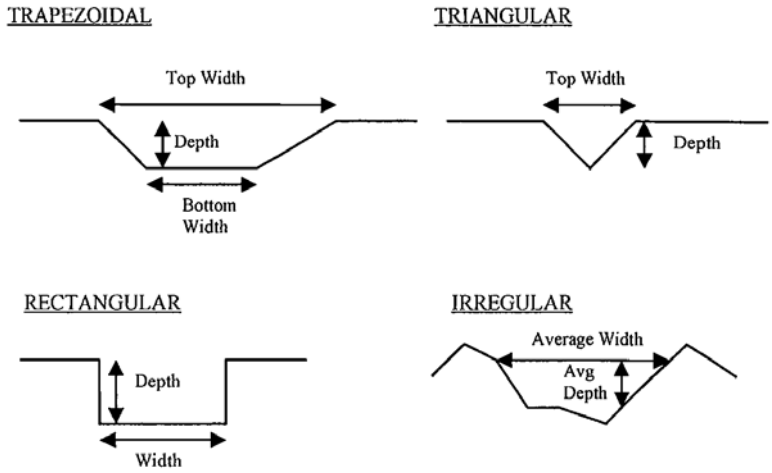
CONFIGURATION:



_____ Cross-Valley
_____ Side-Hill
__X___ Diked
_____ Incised (form completion optional) _____ Combination Incised/Diked
Embankment Height: max. 45' (based on design drawings)
Embankment Material: _silt, sand, possibly fly-ash
Pool Area _____32_____ acres Liner _____none_____
Current Freeboard ____6_____ feet Liner Permeability __N/A_____

TYPE OF OUTLET (Mark all that apply)

_____ **Open Channel Spillway**
_____ Trapezoidal
_____ Triangular
_____ Rectangular
_____ Irregular

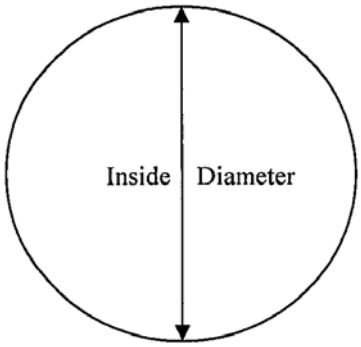


_____ depth
_____ bottom (or average) width
_____ top width

__X___ **Outlet**

__24___ inside diameter

Material
_____ corrugated metal
_____ welded steel
_____ concrete
__X___ plastic (hdpe, pvc, etc.)
_____ other (specify)
_____



Is water flowing through the outlet? YES ___X____ NO _____

_____ **No Outlet**

_____ **Other Type of Outlet** (specify) _Secondary outlet from South to North Basin is 36-inch corrugate metal pipe through dividing dike_____

The Impoundment was Designed By _Wapora, inc._____
_____

Has there ever been a failure at this site? YES _____ NO ___X_____

If So When? _____

If So Please Describe: _____

Has there ever been significant seepages at this site? YES _____ NO ___X____

If So When? _____

IF So Please Describe: _____

Has there ever been any measures undertaken to monitor/lower Phreatic water able levels based on past seepages or breaches at this site? YES _____NO ____X____

If so, which method (e.g., piezometers, gw pumping,...)? _____

If so Please Describe : _____

APPENDIX B

Photographs

Photo 1 – Central Dike, looking west. Note vegetative growth on inboard slope of Southern Pond.

Photo 2 – Central Dike Culvert entrance in Southern Pond.
Note water surface elevation in pond in relation to pipe invert.

Photo 3 – Interior of Central Dike Culvert. Note riprap “dam” limiting pipe’s capacity.

Photo 4 – Interior of Northern Pond, looking north from Central Dike.
Channel to direct flow from Culvert to Pond outlet structure.

Photo 5 – Interior of Northern Pond, looking south from northern corner.
Note vegetative growth on inboard slope..

Photo 6 – Outboard slope of Northern Pond near the northern end.

Photo 7 – Outboard slope of Northern Pond near the northern end.
Note repairs near the crest.

Photo 8 – Outboard slope of Northern Pond near the northern end.
Note reedy grasses at toe.

Photo 9 – pH balance outlet structure. Note HDPE pipe running parallel to toe (Southern Pond discharge) joining with concrete pipe (Northern Pond discharge) outside of structure.

Photo 10 – Runoff from drainage area east of Ash Pond merging with Pond effluent..

Photo 11 – Ash Pond outlet channel transitioning from open channel to underground culvert.

Photo 12 – Northern Pond outlet structure, located at northern end of impoundment.

Photo 13 – CCW discharge from Joppa Plant into Ash Pond at southwestern corner of Southern Pond..

Photo 14 – Channel dredged into CCW that conveys inflow from pipes to eastern side of Southern Pond.

Photo 15 – Southern Pond primary outlet structure.

Photo 16 – Interior of Southern Pond primary outlet structure.

Photo 17 – Interior of Southern Pond, looking south from primary outlet structure.

Photo 18 – Outboard slope of southern embankment of Southern Pond.
Note Jersey barrier blocking vehicular access to eastern embankment.

Photo 19 – Outboard slope of eastern embankment of Southern Pond.
Note repairs near crest and partially completed access road along toe.

Photo 20 – Outboard slope of Southern Pond near power lines.

Photo 21 – Erosion on east embankment of Southern Pond below the power lines.

Photo 22 – Slides and sloughs on east embankment of Southern Pond, approximately 200 feet south of power lines.

Photo 23 – Outboard toe of Southern Pond eastern embankment approximately 500 feet north of power lines. Note reedy grasses indicating moist conditions, signs of seepage.

Photo 24 – Seepage at toe of east embankment of Southern Pond, near location indicated in Photo 23 above.

Photo 25 – Ash Pond outlet channel pass-through below EEI railroad siding.