REPORT

Dam Safety Assessment of CCW Impoundments

Sikeston Power Station

United States Environmental Protection Agency
Washington, DC

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O'BRIEN & GERE
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REPORT

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Sikeston Power Station

Prepared for:
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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 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 down gradient 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 Bottom Ash and Fly Ash Ponds at the Sikeston Power Station in Sikeston, Missouri. The above impoundments are owned and operated by the Sikeston Board of Municipal Utilities (BMU). In the course of this assessment, O'Brien & Gere obtained information through interviews with representatives of the BMU.

2. PROJECT/FACILITY DESCRIPTION

2.1. GENERAL

The Sikeston Power Station is located at 1551 W. Wakefield Avenue in Sikeston, Missouri. A Site Location Map is included as Figure 1. The generating station was commissioned in 1981 and includes a coal-fired electrical power generating facility with an approximate capacity of 235 megawatts (MW) gross generation capacity. The plant is comprised of one coal-fired electric generating unit commonly referred to as Unit 1. The plant was designed with provisions to expand its capacity to 400-MW based on projected population growth and energy needs. The need for additional capacity did not materialize, thus the expansion was not required. The unit is equipped with a flue-gas desulphurization (FGD) scrubber, which helps to remove emissions such as sulphur dioxide and nitrous oxide. Coal combustion waste that is produced during power generation is managed on-site with a CCW impoundment.

The facility utilizes one impoundment, separated by a dividing dike into two sections or ponds, referred to as the Bottom Ash Pond and the Fly Ash Pond, for CCW management. The impoundment is located on the east side of the site. Two additional impoundments known as the Settling Pond and the Process Waste Pond are present on-site, these are used to manage site stormwater runoff and flow out of the CCW impoundments prior to discharge from the site. This safety assessment report summarizes the April 2010 inspection of the CCW management ponds at the Sikeston Power Station facility.

2.2. MANAGEMENT UNIT DESCRIPTION

The two sections of the CCW impoundment inspected during this safety assessment are identified on Figure 2 – Facility Layout Plan. Neither portion of the impoundment meets the height requirement (35 feet) for regulation as a dam by the Missouri Department of Natural Resources (MoDNR).

CCW consists of bottom ash and fly ash. Bottom ash generated at the Sikeston Plant is hydraulically sluiced to the Bottom Ash Pond. Fly ash was previously pneumatically conveyed to the Fly Ash Pond and discharged under water but is now collected using electrostatic precipitators, pneumatically sluiced to storage silos, and finally sold for reuse. As stated above, the plant utilizes flue gas desulphurization (FGD) scrubbers to control emissions. A byproduct of the FGD process is synthetic gypsum, which is also disposed of in the Bottom Ash Pond.

2.2.1. Bottom Ash Pond

The Bottom Ash Pond forms the southern portion of the CCW impoundment. The impoundment was constructed in 1981 and has not been expanded since. Bottom ash is sluiced to the impoundment using groundwater pumped from a well located on the west side of the site, identified as Well No. 3. Water that is routed through the pond is discharged into an outlet structure, into the Process Waste Pond and ultimately to Richland Drainage Ditch No. 4, located to the west of the plant.

2.2.2. Fly Ash Pond

The Fly Ash Pond forms the northern portion of the CCW impoundment. This pond is currently used for overflow from the Bottom Ash Pond in times of above-normal pool levels and occasionally for fly ash disposal, if the fly ash generated cannot be sold. Water that is routed through the pond is discharged into an outlet structure, into the Process Waste Pond and ultimately to Richland Drainage Ditch No. 4.

2.2.3. Other Impoundments

A Facility Layout Map is provided as Figure 2, which shows the location of the various impoundments on the site. There are two additional impoundments on the north side of the plan identified as follows:

1) Settling Pond – receives stormwater runoff from the Coal Storage Area, and discharges into the Process Waste Pond located immediately to the north. It is a combination incised/diked structure though most of the storage is below natural-grade.

2) Process Waste Pond – receives overflow from the Settling Pond and discharge from the Bottom Ash and Fly Ash Ponds. It is also a combination incised/diked structure with most of the storage below natural-grade. Discharge from the Process Waste Pond flows into Richland Drainage Ditch No. 4 through a ditch located near the northwest corner of the Process Waste Pond.

2.3. HAZARD POTENTIAL CLASSIFICATION

The State of Missouri classifies dams or embankments in accordance with the Missouri Revised Statutes (RSMo) and Missouri Code of State Regulations (CSR). The regulations are administrated by the Missouri Department of Natural Resources (MoDNR), Dam and Reservoir Safety Unit of the Water Resources Center. The DNR defines a dam as any structure that is 35 feet or more in height from the natural bed of the stream or watercourse measured at the downstream toe of the barrier or dam, if it is not across a streambed or watercourse, or has a surface area of fifteen or more acres of water at the water storage elevation (RSMo Chapter 236.400).

In the State of Missouri, dam hazard classifications are established by the owner or owner's engineer in accordance with 10 CSR 22-3.020(2) and (3). Dams are classified as Environmental Class I, II, or III in accordance with 10 CSR 22-2.040(1).

> (2) *"The owner must provide a determination of an environmental class for each dam and reservoir. The method, data and assumptions used by the owner to determine environmental class shall conform to practices reputable and in current use in the engineering, geologic and construction professions or the chief engineer may reject the owner's classification. If an owner chooses not to have this done by an experienced professional engineer or an agency engineer, the chief engineer will assign the dam and reservoir to environmental class I or s/he may assign the dam and reservoir to another environmental class if s/he has justification to do so."*
>
> (3) *The anticipated consequences of a dam failure with respect to public safety, life and property damage are important considerations in establishing acceptable methods for specific investigations and sites. Methods used in exploration design, construction and maintenance must be in accordance with good engineering practices reputable and in current use in the engineering, geologic and construction professions.*

2.3.1. Bottom Ash Pond

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 Bottom Ash Pond is **HIGH.** This rating would generally be synonymous with the State of Missouri Environmental Class I, if the impoundment met the height requirement for classification as a dam**.** A failure of the Bottom Ash Pond embankments could cause loss of life if the CCW and the sluice water were released into the residential neighborhood located immediately to the east of the pond.

2.3.2. Fly Ash Pond

Based on the checklist definitions and as a result of this assessment, the hazard potential rating recommended for the Fly Ash Pond is **SIGNIFICANT.** A failure of the Fly Ash Pond embankments is not likely to cause loss of life; a failure, however, is likely to cause significant environmental damage to off-site properties and/or significant economic losses, specifically to the residential neighborhood located northeast of the impoundment.

2.4. IMPOUNDING STRUCTURE DETAILS

The following sections summarize the structural components and basic operations of the Bottom Ash Pond and the Fly Ash Pond. The location of these impoundments on the Sikeston Plant site is shown on Figure 2. A smaller scale plan of the two ponds, and photo location identifiers is provided as Figure 3. Additionally, photos taken during the visual inspection are incorporated in a Photographic Log provided as Appendices B and C for the Bottom Ash Pond and Fly Ash Pond, respectively.

2.4.1. Embankment Configuration

Bottom Ash Pond

The Bottom Ash Pond is a combined incised/diked earthen embankment structure with a total surface area of approximately 54 acres, according to information provided by the Sikeston BMU in the EPA Request for Information. However, the area currently used is less than 9 acres, the remaining storage area is filled with CCW. The Bottom Ash Pond is diked over the length of its perimeter; the height of the dike is approximately 12 feet above the outboard toe of slope and approximately 4 feet of storage is incised below the outboard toe. The crest is approximately at elevation (EL) 322 feet above mean sea level. The inboard and outboard dike slopes were designed at an inclination of 2H:1V. The pond was designed with a 2-foot thick clay liner on the bottom of the pond and the inboard slope of the dike. A 30-inch pipe through the dividing dike connects the Bottom Ash and the Fly Ash Ponds. The pipe is generally closed to flow and its swing gate is reportedly only opened when the water surface elevation in the Bottom Ash Pond rises due to heavy rainfall. The swing gate is located on the Bottom Ash Pond side of the pipe (upstream control).

Fly Ash Pond

The Fly Ash Pond is also a combined incised/diked earthen embankment structure with a total surface area of approximately 30 acres, according to information provided by the Sikeston BMU in the EPA Request for Information. However, the area currently used is less than 4 acres, the remaining storage area is filled with CCW. The Fly Ash Pond is diked over the length of its perimeter; the height of the dike ranges from approximately 12 to 15 feet above the outboard toe of slope and approximately 4 feet of storage is incised below the outboard toe. As with the Bottom Ash Pond, the crest is approximately at elevation (EL) 322 feet above mean sea level. The inboard and outboard dike slopes were designed at an inclination of 2H:1V. The pond was designed with a 2-foot thick clay liner on the bottom of the pond and the inboard slope of the dike.

In addition to the impoundments described above, there are two ponds located to the west of the CCW impoundment known as the Settling Pond and Process Waste Pond. These ponds primarily function as storm water runoff sedimentation basins, but do receive discharge from the Bottom Ash and Fly Ash Ponds. These ponds were not assessed as part of this CCW impoundment assessment since their purpose is not to store CCW, although some ash fines may be transported into the Process Waste Pond.

2.4.2. Type of Materials Impounded

Bottom Ash Pond

Currently, influent into the Bottom Ash Pond includes water with solids consisting of primarily bottom ash and synthetic gypsum, with lesser quantities of miscellaneous fines composed of coal fines and fly ash. Scrubber sludge was previously sluiced to the Bottom Ash Pond, but the plant stopped generating this type of waste in 1998.

Fly Ash Pond

Under normal plant operation, the Sikeston Plant does not discharge into the Fly Ash Pond; the fly ash is captured pneumatically and stored in silos. During periods of rain, or other times when the Bottom Ash Pond reaches an above-normal pool level, a swing gate in a connecting pipe within the dividing dike between the Bottom Ash and Fly Ash Ponds may be opened to allow for outflow from the Bottom Ash Pond into the Fly Ash Pond. In addition, on rare occasions, fly ash may be directly deposited into the Fly Ash Pond.

2.4.3. Outlet Works

Bottom Ash Pond

The Bottom Ash Pond is an incised/diked impoundment that has been designed to receive sluice flows and direct precipitation. The primary outlet structure, located near the northwestern corner of the impoundment, consists of a three-sided concrete weir equipped with stop logs to govern the water level in the pond. A metal screen serves to exclude floating debris from the discharge. The effluent discharges into a 12-inch fiberglass-wrapped steel pipe that extends below grade to an outfall in the Process Waste Pond. The Process Waste Pond discharge into Richland Drainage Ditch No. 4 is permitted under MoDNR permit # MO-0095575.

Fly Ash Pond

The Fly Ash Pond is also an incised/diked impoundment designed to receive sluice flows and direct precipitation. The primary outlet structure, located near the northwestern corner of the impoundment, consists of a three-sided concrete weir equipped with stop logs and slide gates to govern the water level in the pond. The effluent discharges to the west into a 24-inch corrugated metal pipe (CMP) that extends to an outfall in the Process Waste Pond. A slide gate on the north side of the concrete weir may be opened to allow discharge from the Fly Ash Pond through a 24-inch CMP directly out to West Wakefield Avenue.

3. RECORDS REVIEW

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

Table 3.1 *Summary of Documents Reviewed*

Document	Dates	By	Description
Design Drawings	1982	Burns & McDonnell Engineers – Architects - Consultants	Site plan, grading plan, sections and details of Bottom Ash and Fly Ash Ponds
Conceptual Design Report for Water Pollution Control Facilities	1981	Burns & McDonnell Engineers – Architects - Consultants	Engineering report concerning "the waste flows, waste constituents being added to the process water, method of waste treatment, and expected effluent characteristics of the subject facility"
Pond Life-Span Calculations	Unknown, assumed 1981	Unknown, assumed Burns & McDonnell	Calculations to determine useable life-span of the ponds given (then) current use rate
NPDES Permit MO-0095575	2009	State of Missouri	State of Missouri Department of Natural Resources NPDES Permit for the Sikeston Plant
Daily Inspection Form		Sikeston BMU	Blank copy of the "Daily Pond Checks" checklist used by BMU personnel on routine/daily inspections of the impoundments
Response to EPA RFI	2009	Sikeston BMU	Utility's response to EPA questionnaire regarding CCW impoundments

3.1. ENGINEERING DOCUMENTS

Review of the design drawings revealed information on the design details for the Bottom Ash and Fly Ash Ponds which is summarized below.

- The Bottom Ash and Fly Ash Ponds were originally constructed during the early 1980's at the time of the Sikeston Power Station construction.
- Originally, the Bottom Ash Pond received bottom ash and scrubber sludge. Scrubber sludge is no longer generated at the facility after upgrades to the system.
- Originally, the Fly Ash Pond received sluiced fly ash. Fly ash is currently collected pneumatically and sold for beneficial reuse.
- The Bottom Ash and Fly Ash Ponds were constructed to a crest elevation of 322 feet above mean sea level (msl). The crests have not been raised since their completion.
- The Ponds were constructed as combined incised/diked structures. The excavated material was used to construct the dikes.
- The embankments were not keyed into the underlying foundation.
- The bottom of the ponds and the inboard dike slopes were designed and constructed with a 2-foot thick clay liner.
- Geotechnical reports/studies and slope stability analyses for the design of the embankments were not found. Representatives of the BMU stated that the impoundment was designed for appropriate earthquake loading.

3.1.1. Stormwater Inflows

Stormwater inflows to both the Bottom Ash and the Fly Ash 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 dikes.

3.1.2. Stability Analyses

As stated above, no geotechnical reports or records of design or as-built slope stability analyses were provided in the records made available by The Sikeston BMU. Based on our discussion with plant personnel, geotechnical/slope stability records were prepared in the design of the facility but could not be located in preparation for the visit. No significant indications of slope distress were observed during the visual inspections of the ponds.

3.1.3. Instrumentation

No instrumentation is present at either of the two ponds.

3.2. PREVIOUS INSPECTIONS

The Bottom Ash Pond and the Fly Ash Pond are not regulated by the MoDNR; therefore, no regular inspections by state personnel are performed. BMU personnel perform daily informal inspections of the ponds during their security detail.

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 Bottom Ash Pond and the Fly Ash Pond:

Table 3.2 *List of Participants*

Name	Affiliation	Title
Chester Cardwell	Sikeston BMU	Plant Manager
Randal Pick	Sikeston BMU	Results Engineer Designated Rep.
Steve Turnbow	Sikeston BMU	
Russell Rowe	Sikeston BMU	
Johan Anestad, PE	O'Brien & Gere	Technical Associate
Robert Brodowski, PE	O'Brien & Gere	Technical Director

Facility personnel provided good background information, general plant operation and requested historical documentation for the Bottom Ash Pond and the Fly Ash Pond.

4. VISUAL INSPECTION

The following sections summarize the inspection of the Bottom Ash Pond and the Fly Ash Pond, which occurred on April 28 and 29, 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 5, 2010. Copies of the completed inspection checklists are included as Appendix A.

4.1. GENERAL

The weather on the dates of the inspection was clear and approximately 60 - 75 degrees. The visual inspection consisted of a thorough site walk along the crest and perimeter of both ash ponds. O'Brien & Gere team members made observations along the toe, outboard slope, and crest of the embankments, and along exposed portions of the inboard slopes. The team also inspected the inlet/outlet structures. The plant was shut down for routine maintenance during the visit; therefore, there was no discharge of CCW into either pond during the inspection.

Photos of relevant features and conditions observed during the inspection were taken by O'Brien & Gere and are provided in Appendix B and C for the Bottom Ash Pond and the Fly Ash Pond, respectively. A Site Plan of the Bottom Ash Pond and the Fly Ash Pond is presented as Figure 3, which also provides photograph locations and directions.

4.2. SUMMARY OF FINDINGS

<u>Bottom Ash Pond</u>

The following observations were made during the inspection:

- Sluiced CCW by-product discharge enters the pond in the northwestern corner (Appendix B – Photo 1) and sluice water exits the pond through a concrete weir structure on the northwest side of the north embankment (Appendix B – Photo 2).
- The CCW has accumulated above the normal pool level over an estimated 85 percent of the pond area Appendix B – Photo 6). Water in the pond is isolated to primarily the northeastern corner of the pond (Figures 2 & 3, Appendix B - Photo 7).
- A drainage ditch runs along the length of the outboard toe. Due to the flat topography of the site, the ditch was constructed with very little pitch and consequently drains poorly. Standing water was present throughout the length of the ditch and it appears to have caused a small portion of the northwestern corner of the outboard toe of the embankment to become spongy (Appendix B – Photo 3).
- The outboard slope is generally covered with well maintained grass, though reedy grasses such as cattails and some small trees and shrubbery are growing along the western portion and the southwest corner of the embankment (Appendix B – Photos 4 & 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 embankment appears to have been constructed steeper than 2H:1V at the corner.
- The inboard slope is either obscured/covered with CCW, or well vegetated, with riprap visible along the normal pool water surface elevation (Appendix B – Photo 9). Several small (approx. 6" diameter) trees were observed growing on the inboard slope near the outlet structure (Appendix B – Photo 11).
- A residential neighborhood is located to the southeast of the impoundment; this neighborhood represents the hazard area that could potentially be inundated by a release of sluice water and CCW from the Bottom Ash Pond (Appendix B – Photos 7 & 8).
- The outlet structure appeared to be in good condition and functioning normally (Appendix B – Photo 1).

- The swing gate on the 30-inch connecting line between the Bottom Ash and Fly Ash Ponds was open but the water surface elevation was below the invert of the pipe (Appendix B – Photo 10). The structure appears to be in good condition.

Based on conversations with plant personnel, no releases have occurred from the Bottom Ash Pond impoundment. No patchwork repair on the embankment appears to have been performed.

Fly Ash Pond

The following observations were made during the visual inspection:

- Sluiced CCW by-product discharge currently does not enter the pond on a regular basis. Overflow from the Bottom Ash Pond may be diverted to the Fly Ash Pond through a 30-inch pipe during periods of above-normal pool in the Bottom Ash Pond.
- Water exits the pond through a concrete weir structure near the northwestern corner of the impoundment. The structure allows for discharge into the Process Waste Pond (normal condition) or directly out to West Westfield Avenue. The operators for the Outlet Structure's slide gates are bent and appear to be inoperable (Appendix C – Photos 1 - 3).
- The outlet structure appears to be in good condition and functioning normally.
- The 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 northwestern corner of the pond (Figures 2 & 3, Appendix C – Photo 4).
- The outboard slope is generally covered with well maintained grass, though reedy grasses such as cattails are growing along the toe of the embankment (Appendix C – Photos 5 & 6).
- A drainage ditch runs along the length of the outboard toe. Due to the flat topography of the site, the ditch was constructed with very little pitch and consequently drains poorly (Appendix C - Photos 7 & 8).
- A more significant wet area was observed on the downstream toe near the outlet structure (Appendix C - Photo 9)
- Some minor rutting, probably caused by mowing equipment, was observed at isolated areas on the outboard slopes.
- 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 embankment appears to have been constructed at steeper than 2H:1V at the curved corner sections.
- Portions of the embankment appear to have been constructed higher than the design height of 12 to 15 feet.
- The inboard slope is either obscured/covered with CCW, or well vegetated with riprap visible along the normal pool water surface elevation (Appendix C – Photo 10).
- The 30-inch connecting line between the Bottom Ash and Fly Ash Ponds was open but the water surface elevation was below the invert of the pipe (Appendix B – Photo 10). The structure appears to be in good condition.
- A small residential neighborhood is located along West Westfield Avenue to the northeast of the Fly Ash Pond. The residences appear to be constructed above the normal pool elevation in the Fly Ash Pond and therefore should not represent a hazard area for the impoundment (Appendix C – Photo 11).
- A pump can bring water to the impoundment to wet the accumulated CCW during dry conditions to prevent excessive blow-off of the dried sediments.

Based on conversations with plant personnel, no releases have occurred from the Fly Ash Pond impoundment. No patchwork repair on the embankment appears to have been performed.

5. CONCLUSIONS

Bottom Ash Pond

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 Bottom Ash Pond is considered to be **FAIR**. Acceptable performance is expected under all loading conditions; however, some minor deficiencies exist that require repair and/or additional studies or investigations. The deficiencies include the following:

- The drainage ditch that runs along the outboard toe was not constructed with an adequate slope to properly drain stormwater runoff. This has resulted in the presence of standing water along the outboard toe of the embankment and a spongy area located near the northwestern corner of the outboard slope.
- Some deleterious vegetation has taken root along the western and southern portions of the outboard slope and the northwestern portion of the inboard slope.

Other than the conditions cited above, the owner has implemented regular inspections and maintenance which enable the impoundment to be kept in good working order. The Sikeston BMU has plans in development to address the deficiencies cited above. Replacement of a section of the poorly draining ditch with subsurface drainage piping is reportedly included in the Plant Capital Improvement budget for the next fiscal year. Budget constraints rquire a phased program for replacing the entire ditch with piping. In addition to the physical deficiencies, it was noted that no geotechnical data or associated slope stability analyses are on record for the earth embankment sections. Completion of these additional studies for critical slopes (highest and steepest) should be performed, to formally document the stability of the embankment in accordance with applicable safety criteria for earth dams.

Fly Ash Pond

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 Fly Ash Pond is considered to be **FAIR**. Acceptable performance is expected under all loading conditions; however, some minor deficiencies exist that require repair and/or additional studies or investigations. The deficiencies include the following:

- The drainage ditch that runs along the outboard toe was not constructed with an adequate slope to properly drain stormwater runoff.
- A more significant wet area was observed at the outboard toe near the outlet structure.
- The outlet structures slide gate operator stems are bent and appear to be inoperable.

Other than the conditions cited above, the owner has implemented regular inspections and maintenance which enable the impoundment to be kept in good working order. The Sikeston BMU has plans in development to address the deficiencies cited above. Replacement of the poorly draining ditch with subsurface drainage piping will reportedly be included in future Capital Improvement budgets. Budget constraints require a phased program for replacing the entire ditch with piping. In addition to the physical deficiencies, it was noted that no geotechnical data or associated slope stability analyses are on record for the earth embankment sections. Completion of these additional studies for critical slopes/locations (such as the area near the outlet structure) should be performed, to formally document the stability of the earth structure in accordance with applicable safety criteria for the embankment.

6. RECOMMENDATIONS

Based on the findings of our visual inspection and review of the available records for the Bottom Ash Pond and the Fly Ash Pond, O'Brien & Gere recommends that geotechnical investigations and analyses be performed and that additional maintenance of the embankments be completed to correct the drainage and other miscellaneous 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 additional investigations/analyses and corrective actions should be implemented in the near future as part of a regular maintenance plan. The recommended maintenance/improvement actions are described below:

Bottom Ash Pond

- Outboard slopes – remove deleterious vegetation and continue regular maintenance of the slopes.
- Outboard toe – Implement plan to replace the ditch with drain piping along the toe to improve drainage.
- Inboard slopes – remove the small trees growing along the northern portion of the embankment. 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 slopes. Install piezometers to monitor phreatic levels within the embankment. Analyze for normal pool with steady state seepage, maximum surcharge pool, and seismic loading conditions.

Fly Ash Pond

- Outboard slopes – remove deleterious vegetation and continue regular maintenance of the slopes.
- Outboard toe – Implement plan to replace the ditch with drain piping along the toe to improve drainage.
- Inboard slopes – keep vegetation under control to allow for visual inspection of the exposed portion of the slope above the waterline.
- Repair or replace the slide gate operator stems.
- Additional studies – perform geotechnical investigation, cross-sectional topographic survey, and slope stability analyses of critical slopes. Install piezometers to check phreatic levels within the embankment. Analyze for normal pool with steady state seepage, maximum surcharge pool, and seismic loading conditions. Installation of the piezometers will help to verify if the wet area near the outlet structure is the result of seepage through or beneath the embankment or is perched groundwater or stagnant surface water.

6.3. MONITORING AND FUTURE INSPECTION

Consideration should be given to regular inspections by licensed dam safety engineers to document the continued proper maintenance and operation of the Bottom Ash and Fly Ash Ponds. Consideration should be given to development of an O&M Plan that would establish a firm schedule for operations, maintenance, and inspection activities.

6.4. TIME FRAME FOR COMPLETION OF REPAIRS/IMPROVEMENTS

Based on conversations with representatives of the BMU, funds for improving a section of the drainage ditch are budgeted in the Capital Improvements plan for the next fiscal year. It is O'Brien & Gere's recommendation that the owner continue toward this schedule as planned. It is recommended that the other improvements and stability analyses recommended above be completed in a timely manner.

6.5. CERTIFICATION STATEMENT

I acknowledge that the Bottom Ash Pond and the Fly Ash Pond CCW management units referenced herein were personally inspected by me on April 28 and 29, 2010 and were found to be in the following condition:

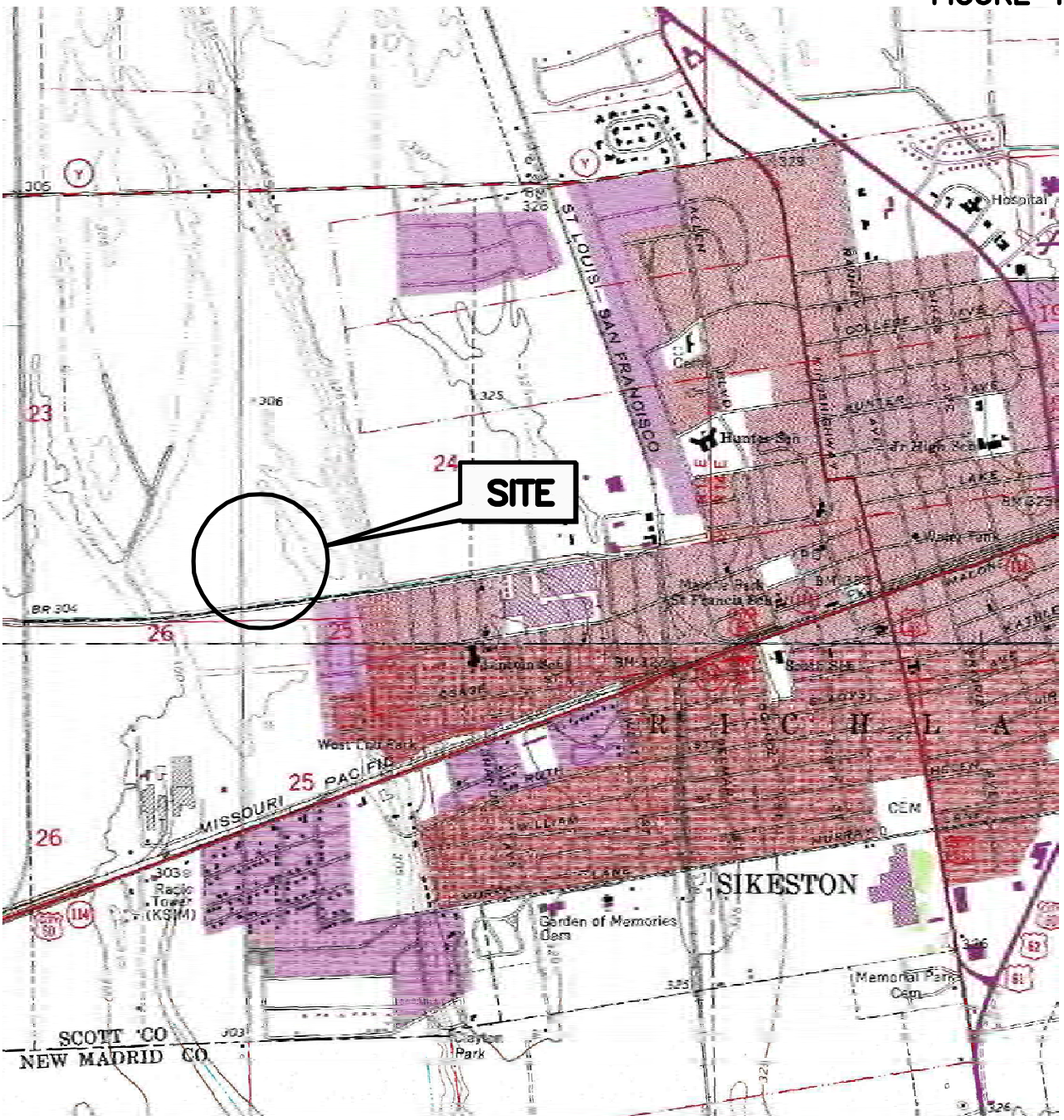
~~SATISFACTORY~~
FAIR
~~POOR~~
~~UNSATISFACTORY~~

Signature: Robert F. Brodowski Date: September 13, 2010

Robert F. Brodowski, PE
MO PE # 2000172984

FIGURES

FIGURE 1



ADAPTED FROM: SIKESTON NORTH & SOUTH QUADRANGLES, MISSOURI U.S.G.S. 7.5 MIN. QUADS

QUADRANGLE LOCATION

US EPA
DAM SAFETY ASSESSMENT
OF CCW IMPOUNDMENTS

SIKESTON POWER STATION
SIKESTON, MISSOURI

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-SIKESTON-F01
SEPTEMBER 2010

O'BRIEN & GERE

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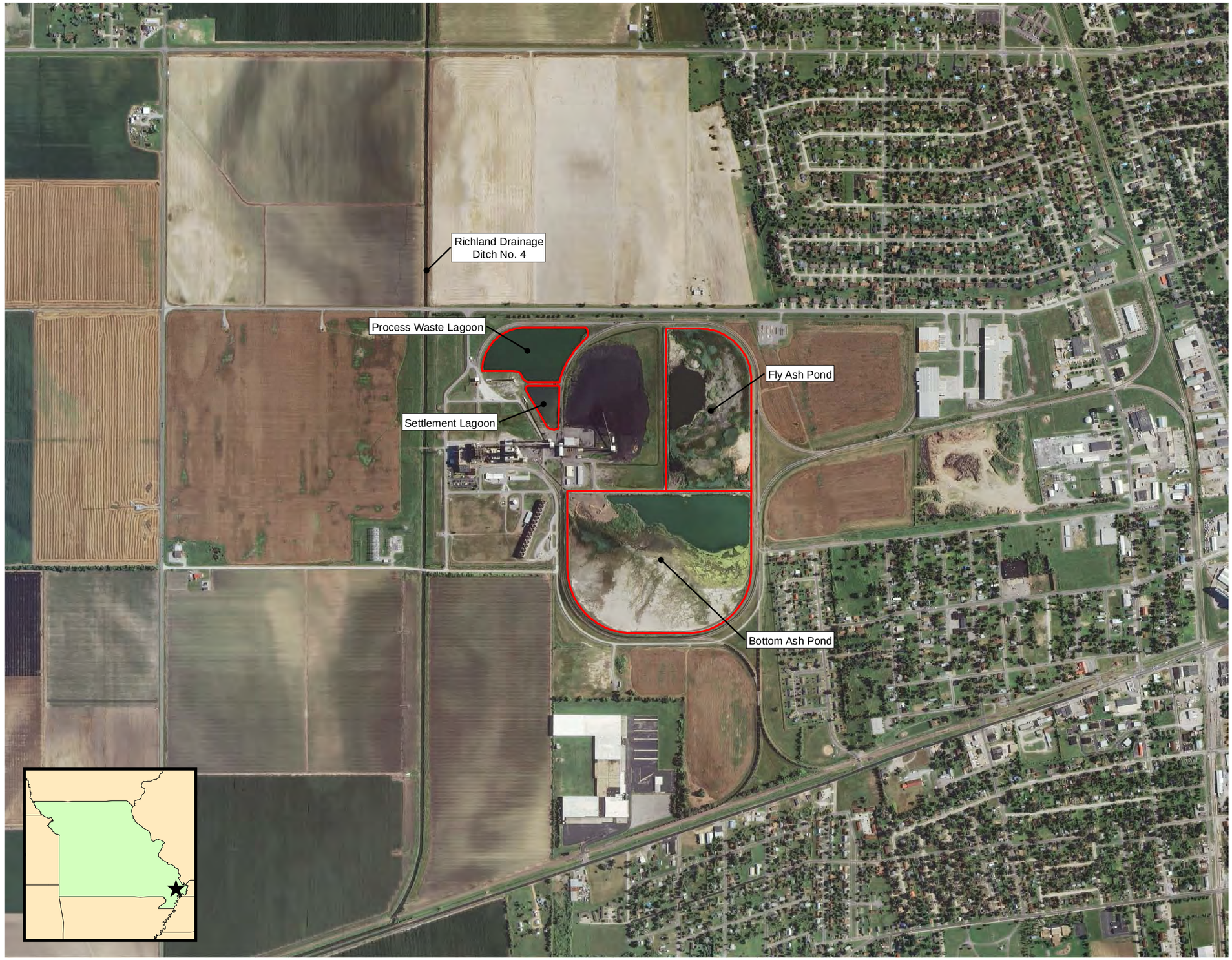
I:\US-EPA.13498\46122.ASSESS-OF-DAM-S\DOCS\DWG\SHEETS\46122-SIKESTON-F01.DWG, 09/14/2010 10:12AM

FIGURE 2



N

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

SIKESTON BOARD OF MUNICIPAL UTILITIES
SIKESTON POWER STATION
SIKESTON, MISSOURI

SITE LAYOUT MAP

0 500 1,000 2,000
Feet

SEPTEMBER 2010
13498/46122

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PATH: I:\Us-Epa.13498\STDS\GIS\Coal_Impoundments\Figures\Sikeston_FIG-2_site.mxd
NAME: KaufmaDR
DATE: 9/1/2010 11:00:55 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.

SIKESTON BOARD OF MUNICIPAL UTILITIES
SIKESTON POWER STATION
SIKESTON, MISSOURI

PHOTO LOCATION MAP

0 150 300 600
Feet

SEPTEMBER 2010
13498/46122

O'BRIEN & GERE
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PATH: I:\Us-Epa.13498\STDS\GIS\Coal_Impoundments\Figures\Sikeston_FIG-3_photo.mxd

NAME: KaufmaDR

DATE: 9/1/2010 11:03:58 AM

APPENDIX A

Visual Inspection Checklists

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name: Sikeston Power Station	Date: 4/29/2010
Unit Name: Bottom Ash Pond	Operator's Name: Sikeston Board of MU
Unit I.D.:	Hazard Potential Classification: (High) Significant Low
Inspector's Name: RF Browdowski, P.E./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?	Daily		18. Sloughing or bulging on slopes?		✓
2. Pool elevation (operator records)?	317		19. Major erosion or slope deterioration?		✓
3. Decant inlet elevation (operator records)?	317		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	N/A		Is water entering inlet, but not exiting outlet?		✓
5. Lowest dam crest elevation (operator records)?	322 ft		Is water exiting outlet, but not entering inlet?		✓
6. If instrumentation is present, are readings recorded (operator records)?	N/A		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)?	N/A		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?		✓	Around the outside of the decant pipe?		✓
15. Are spillway or ditch linings deteriorated?		✓	22. Surface movements in valley bottom or on hillside?		✓
16. Are outlets of decant or underdrains blocked?		✓	23. Water against downstream toe?	✓	
17. Cracks or scarps on slopes?		✓	24. Were Photos taken during the dam inspection?	✓	

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

Inspection Issue # Comments

9. <2" diameter brush outboard slope on west and south embankment, 6" diameter from inboard face of north embankment near outlet structures.

~~23. Standing water in drainage ditch along embankment toe - may be due to recent heavy rain.~~

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name: Sikeston Power Station	Date: 4/28/2010
Unit Name: Fly Ash Pond	Operator's Name: Sikeston Board of MU
Unit I.D.:	Hazard Potential Classification: High (Significant) Low
Inspector's Name: RF Browdowski, P.E./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?	Daily		18. Sloughing or bulging on slopes?		✓
2. Pool elevation (operator records)?	317		19. Major erosion or slope deterioration?		✓
3. Decant inlet elevation (operator records)?	317		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	N/A		Is water entering inlet, but not exiting outlet?		✓
5. Lowest dam crest elevation (operator records)?	322 ft		Is water exiting outlet, but not entering inlet?		✓
6. If instrumentation is present, are readings recorded (operator records)?	N/A		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)?	N/A		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?		✓	Around the outside of the decant pipe?		✓
15. Are spillway or ditch linings deteriorated?		✓	22. Surface movements in valley bottom or on hillside?		✓
16. Are outlets of decant or underdrains blocked?		✓	23. Water against downstream toe?	✓	
17. Cracks or scarps on slopes?		✓	24. Were Photos taken during the dam inspection?	✓	

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

Inspection Issue # Comments

23. Drainage ditch location along toe is continuously wet. May be due to recent heavy rain.

APPENDIX B

Photographs – Bottom Ash Pond

Photo 1 – Northwestern corner, note effluent pipe in background.

Photo 2 –Outlet structure.

Photo 3 – Outside slope of northwestern corner.
Note reedy grass growth, some wet areas observed in this location.

Photo 4 – Western embankment looking north.
Note vegetative growth on outboard slope.

Photo 5 – South embankment, looking east.

Photo 6 – Interior of Bottom Ash Pond filled with CCW.

Photo 7 – East embankment, looking south.
Note residences near impoundment.

Photo 8 – Residences adjacent to the Bottom Ash Pond.

Photo 9 – Inboard slope of east embankment. Note riprap at waterline.

Photo 10 – 30-inch connecting pipe through the Dividing Dike. Swing gate in open position.

Photo 11 – Dividing Dike, looking east. Note trees growing on Bottom Ash side of Dike.

Photos 12 & 13– Discharge from Bottom Ash Pond into the Process Waste Pond.

APPENDIX C

Photographs – Fly Ash Pond

Photo 1 – Outlet structure. Note bent gate operator stems.

Photo 2 –Interior of Outlet structure.
Flow discharges through open gate on the left to the Process Waste Pond.

Photo 3 – Downstream end of outlet pipe from Fly Ash Pond to West Westfield Ave.

Photo 4 – Interior of Fly Ash Pond, filled with CCW.

Photo 5 – East embankment. Note growth in drainage channel.

Photo 6 – North embankment.

Photo 7 – West embankment, looking north.
Note standing water in drainage swale.

Photo 8 – Northwestern corner. Note minor erosion at toe.

Photo 9 – Standing water, outboard toe near the Outlet Structure. Note discoloration, possible indication of seepage.

Photo 10 – Inboard slope of west embankment. Reeds have overgrown riprap slope protection.

Photo 11 – Northeastern corner. Note residences in background, appear to be above normal pool elevation..

Photo 12– Outlet of discharge pipe from the Fly Ash Pond into the Process Waste Pond.