ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS – DRAFT REPORT

City Utilities of Springfield

John Twitty Energy Center
Springfield, Missouri

Prepared for
United States Environmental Protection Agency
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CDM Smith Project No.:

CDM Smith

CDM Smith

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Table of Contents

Appendices

Section 1

CONCLUSIONS AND RECOMMENDATIONS

1.1 INTRODUCTION

On December 22, 2008 the dike of a coal combustion waste (CCW) ash pond dredging cell failed at a facility owned by the Tennessee Valley Authority in Kingston, Tennessee. The failure resulted in a spill of over one billion gallons of coal ash slurry, which covered more than 300 acres, damaging infrastructure and homes. In light of the dike failure, the United States Environmental Protection Agency (USEPA) is assessing the stability and functionality of existing CCW impoundments at coal-fired electric utilities to ensure that lives and property are protected from the consequences of a failure.

The assessment of the stability and functionality of the John Twitty Energy Center (JTEC) CCW impoundments is based on a review of available documents, site assessment conducted by CDM Smith on August 27 and 28, 2012, and technical information provided subsequent to the site visit. The JTEC was formerly named as the Southwest Power Station and is owned by the City Utilities of Springfield in Springfield, Missouri. This report will refer to the subject facility as the John Twitty Energy Center (JTEC).

In summary, the East and West CCW Impoundments' embankments at the JTEC are classified as **POOR** for continued safe and reliable operation. Static and seismic engineering studies following standard-of-care professional engineering practice to support acceptable safety factors have not been presented for all the embankments and related elements of the impoundments. Based on United States Army Corps of Engineers (USACE) Guidelines for Safety Inspection of Dams (1979), the East and West CCW Impoundments' embankments are classified as "small" and have a **LOW** Hazard Potential Rating due to a general absence of urban development downstream of the units.

It is critical to note that the condition of the embankments forming the impoundments depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the embankments will continue to represent the condition of these earth structures at some point in the future. Only through continued care and inspection can there be likely detection of unsafe conditions.

1.2 PURPOSE AND SCOPE

CDM Smith Inc. was contracted by the USEPA to perform dam safety assessments of selected CCW surface impoundments. As part of the contract, CDM Smith performed a safety assessment on two CCW impoundments at the JTEC, owned by the City Utilities of Springfield in Springfield, Missouri. The purpose of this report is to provide the results of the assessment and evaluation of the conditions and potential for waste release from the East and West CCW Impoundments.

A site visit was conducted by CDM Smith representatives on August 27 and 28, 2012, to collect relevant information, to inventory the impoundments, and perform visual assessment of the units.

1.3 CONCLUSIONS

Conclusions are based on visual observations during the assessment on August 27 and 28, and review of technical documentation provided by JTEC.

1.3.1 Conclusions Regarding the Structural Soundness of the Impoundments

Visual observations by CDM Smith during a field visit did not reveal any major structural defects; the embankments appeared structurally sound. However, JTEC personnel did not provide CDM Smith with full technical documentation to confirm the visual observations. Therefore, CDM Smith is unable to make an assessment of the structural soundness of the impoundments at this time based on the limited information provided by JTEC personnel.

If a breach in the current embankments forming the impoundments were to occur, the path of water discharged from such a breach would generally flow south of the plant and enter Wilson Creek. The route to Wilson Creek and potential for overflow of the banks would be expected to remain on land used primarily for agricultural purposes, with no expected significant damage to infrastructure or loss of life.

1.3.2 Conclusions Regarding the Hydrologic/Hydraulic Safety of the Impoundments

According to plant personnel, there has been no overtopping of the impoundments since original operation of the impoundments first use. The toe of the embankment slope around the outer perimeter appeared dry, with no observed evidence of seepage at the time of our visit. The plant has two CCW impoundments, but plant personnel indicated only one impoundment is in service at any given time. Although there was no documentation on hydrologic/hydraulic analysis regarding potential overtopping of the perimeter embankment of either impoundment, plant personnel indicated that the impoundment not in service would be opened to retain excess water in the event of an overtopping of the operational impoundment.

Information gathered during our investigation of plant records and visual observations of the facility give a general indication that the impoundments pose limited to no hydrologic/hydraulic safety risk at the current time. In CDM Smith's opinion, a lack of full documentation with regard to critical safety aspects of the impoundments (i.e. embankment stability, hydrologic/hydraulic analysis, etc.) does create the potential for an increased safety risk in the future.

1.3.3 Conclusions Regarding the Adequacy of Supporting Technical Documentation

Technical documentation available to CDM Smith with regard to the impoundments design was limited to a partial survey of the northwest corner of the West Impoundment, and a few cross section profiles of the embankments. No documentation of evaluation or analysis of stability or hydrologic/hydraulic safety aspects of the impoundments were available. In the opinion of CDM Smith, the supporting technical documentation is inadequate.

1.3.4 Conclusions Regarding the Description of the Impoundments

No as-built or recently surveyed description of the impoundments was available to CDM Smith, and descriptive information of the impoundments was limited to documents indicating the general location of the impoundments and number of impoundments included in the facility. CDM Smith's onsite visit confirmed the presence of two impoundments with the capability to switch discharge into the impoundments from one impoundment to the other.

1.3.5 Conclusions Regarding the Field Observations

CDM Smith staff was provided access to all areas of the impoundments for observation and assessment. In addition, two plant representatives accompanied CDM Smith staff on the assessment. No evidence was observed of prior releases, failures, or repairs. In general, the embankments appeared to be in good condition. The outlet structure, located near the south end of the common dividing embankment, appeared to be in good condition with water flowing freely through the system during the time of our visit.

1.3.6 Conclusions Regarding the Adequacy of Maintenance and Methods of Operation

According to the plant representatives, the impoundments are inspected quarterly. A copy of a recently completed inspection checklist used by the plant staff was provided to CDM Smith. In addition, the embankments were periodically mowed. In general, methods of operation and maintenance for the impoundments appeared adequate based on onsite observations and conversations regarding operating procedures with the plant representatives.

1.3.7 Conclusions Regarding the Adequacy of the Surveillance and Monitoring Program

There was no monitoring and surveillance instrumentation for the impoundments at the time of CDM Smith's onsite visit. Surveillance and monitoring of the impoundments is considered inadequate.

1.3.8 Classification Regarding Suitability for Continued Safe and Reliable Operation

Based on visual observations and conversations with plant personnel, it appeared the impoundments are currently providing acceptable performance. According to the NPDES permit for the impoundments, the design flow for the outfall is 9.6 million gallons per day (MGD) and the actual flow is 0.5 MGD, making the risk of overtopping unlikely. Although current performance is considered acceptable, conditions can change with time. Without sufficient documentation regarding static and seismic engineering studies for the impoundments to verify adequate safety factors for potential changes in the future, it is the opinion of CDM Smith that the impoundments at the JTEC should be classified as **POOR** for continued safe and reliable operation.

1.4 RECOMMENDATIONS

1.4.1 Recommendations Regarding the Hydrologic/Hydraulic Safety

CDM Smith recommends that hydrologic/hydraulic analyses be performed for the impoundments to evaluate the continued safe and reliable operation.

1.4.2 Recommendations Regarding the Technical Documentation for Structural Stability

CDM Smith recommends that a qualified professional engineer evaluate the static and seismic stability on representative embankment cross sections; it is also recommended to perform liquefaction analysis for the impoundments to enable a fair or satisfactory rating for structural stability.

CDM Smith also recommends that a detailed survey of the present impoundments be performed and periodically updated to monitor changing conditions (i.e. settlement) of the embankments.

1.4.3 Recommendations Regarding the Field Observations

The following are CDM Smith's recommendations:

a. The State of Missouri requires coal plants to have an emergency action plan (EAP) in case of a CCW impoundment release. Information JTEC provided CDM Smith did not contain an EAP. CDM Smith recommends an EAP be prepared for the impoundments;

b. Dense and tall vegetation on inside slopes should be trimmed and maintained to allow easy inspection of the embankment slopes;

c. Develop and maintain healthy grass cover on the earth embankments to fill in the bare areas; and

d. Vegetation should be cut at least annually following the first cutting, and more often if necessary to allow a healthy grass cover to grow on the earth embankments.

1.4.4 Recommendations Regarding the Surveillance and Monitoring Program

There was no surveillance and monitoring program at the time of CDM Smith's onsite visit. CDM Smith recommends a system of groundwater monitoring wells be installed and regular measurements of water levels recorded.

1.4.5 Recommendations Regarding Continued Safe and Reliable Operation

CDM Smith does not consider the above recommendations urgent, but they should be implemented within the next year, if possible, to ensure continued safe and reliable operation of the impoundments.

1.5 PARTICIPANTS AND ACKNOWLEDGMENT

1.5.1 List of Participants

Company	Name
John Twitty Energy Center	Robert Belk
John Twitty Energy Center	Ted Salveter
CDM Smith Inc.	Clement Bommarito
CDM Smith Inc.	Albert Ayenu-Prah

1.5.2 Acknowledgment and Signature

CDM Smith acknowledges that the impoundments referenced herein have been assessed on August 27 and August 28, 2012.

Clement Bommarito, P.E.

Albert Ayenu-Prah, Ph.D.

Section 2

DESCRIPTION OF THE COAL COMBUSTION WASTE MAMAGEMENT UNIT

2.1 LOCATION AND GENERAL DESCRIPTION

The John Twitty Energy Center (JTEC) is located in Greene County at 5100 West Farm Road 164, Springfield, Missouri 65801. The power station was formerly named the Southwest Power Station. JTEC is owned by the City Utilities of Springfield, Missouri (CUSM). The power station property is surrounded by crop fields, and the impoundments are south of the power plant, about half a mile south of State Highway 60. A vicinity map of the site is shown on **Figure 2-1**. The JTEC has two interconnected CCW impoundments as follows:

- West CCW Impoundment – Considered the primary impoundment for storage of bottom ash.
- East CCW Impoundment – Considered a backup impoundment during scheduled maintenance of the primary impoundment.

Typically, the two impoundments are operated with only one impoundment in service at any given time. The impoundments share a north-south embankment (common dividing embankment) and have a common pump station. An aerial view of the impoundments is shown on **Figure 2-2**.

2.2 COAL COMBUSTION WASTE HANDLING

2.2.1 Fly Ash

Fly ash is removed from the plant furnaces in a dry condition and is stored in silos, conditioned, and hauled by trucks to an on-site landfill located about a quarter of a mile southeast of the power station.

2.2.2 Bottom Ash

Bottom ash is transported by pipeline to the impoundments in slurry form. The impoundments are primarily used for containment of filtered CCW bottom ash slurry. This bottom ash slurry is routed through a series of three small concrete detention/sedimentation basins to remove as many ash solids as possible, prior to its discharge of the slurry into the impoundments. The bottom ash is periodically dredged from the sedimentation basins to air-dry, before it is disposed of at the on-site landfill.

The impoundments also receive water from a cooling system for plant equipment, boiler blow-down, rinse water from cleaning of the cooling towers north of the impoundments, and storm water from collection drains around the plant.

2.2.3 Boiler Slag

The JTEC plant has produced boiler slag; however it has not been stored in the CCW Impoundments.

2.2.4 Flue Gas Desulfurization Gypsum

The JTEC plant has produced flue gas desulfurization gypsum; however it has not been stored the CCW Impoundments.

2.3 SIZE AND HAZARD CLASSIFICATION

According to the plant representative, the JTEC impoundments are under the jurisdiction of the Missouri Department of Natural Resources (MDNR). The impoundments do not have a federal or state hazard potential classification or a size classification at this time.

The MDNR is not actively involved in periodic inspections of the impoundments. These inspections are performed quarterly by power station staff. A copy of the checklist typically used for these inspections is included in **Appendix C**.

Based on United States Army Corps of Engineers (USACE) Guidelines for Safety Inspection of Dams (1979), the impoundments are classified as "small" and have a "low hazard" classification (see Tables 2.1 and 2.2).

Table 2.1: USACE ER 1110-2-106, Size Classification

Category	Impoundment	
	Storage (Ac-ft)	Height (Ft)
Small	< 1000 and 50	< 40 and 25
Intermediate	1000 and < 50,000	40 and < 100
Large	50,000	100

Table 2.2: USACE ER 1110-2-106, Hazard Potential Classification

Category	Loss of Life (Extent of Development)	Economic Loss (Extent of Development)
Low	None Expected (No permanent structures for human habitation habitation)	Minimal (Undeveloped to occasional structures or agricultural)
Significant	Few (No urban development and no more than a small number of inhabitable structures)	Appreciable (Notable agriculture, industry, or structures)
High	More than a few	Excessive (Extensive community, industry, or agriculture)

Based on the USEPA classification system as presented on Page 2 of the USEPA checklist (**Appendix B**) and CDM Smith's review of the site and downstream areas, recommended hazard ratings have been assigned to the impoundments as summarized in **Table 2-3**:

Table 2-3 – Recommended Impoundment Hazard Classification Ratings		
Unit	Recommended Hazard Rating	Basis
East & West CCW Impoundment	Low Hazard	• A breach could release waste into Wilson's Creek, resulting in low economic and environmental loss. • Loss of human life is not anticipated

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

According to the plant representative, the West and East Impoundments have areas of 3.89 and 3.36 acres, respectively. Normal pool depth is 12 feet, which results in capacities of 46 acre-feet (15 million gallons) and 40 acre-feet (13 million gallons) for the West and East Impoundments respectively. Although only one impoundment is utilized at a time, the available total capacity is the sum of the two individual impoundment capacities.

The source of CCW ash slurry is limited to bottom ash from the power plant furnaces. Other types of ash generated by the furnaces are not discharged into the impoundments, and are disposed of by other means and methods.

2.5 PRINCIPAL PROJECT STRUCTURES

2.5.1 Earth Embankment

The south embankment (East and West Impoundments) and the common dividing embankment of the impoundments have slopes of approximately 2H:1V, and a crest width of at least 12 feet. The crest of the common dividing embankment is approximately El. 1235. The south embankment, which acts as a dam, is about 30 feet high. The crest of the south embankment is approximately El. 1243.

The grades on the outside slope of the north (East and West Impoundments), east (East Impoundment) and west (West Impoundment) embankments are relatively flat and generally transition to match the surrounding grade, with no discernible downward outer slope. The crest of the East and West Impoundments' north embankment and the East Impoundment's east embankment generally match the surrounding natural grade at El. 1243.

2.5.2 Outlet Structure

The East Impoundment and the West Impoundment do not have a direct hydraulic connection. A common outlet structure is located between the two impoundments, near the south end of the common dividing embankment. This outlet is a pump station, drawing water from the impoundments and pumping it through a 12-inch-diameter corrugated metal (CM) pipe to a weir south of the impoundments. Two 12-inch diameter CM pipes (one at each impoundment) collect water from the impoundment at the high water level (El.1237) and directs this water by gravity flow to the weir structure. The weir is used by plant personnel to measures flow rate and discharge volume from the impoundments, before directing this water through a 24-inch diameter gravity flow CM pipeline to discharge into an unnamed tributary of Wilson's Creek.

2.6 CRITICAL INFRASTRUCTURE WITHIN FIVE MILES DOWN GRADIENT

Discharge from the impoundments flows downslope into Wilson's Creek. This creek generally flows south, and shifts to the south-southwest approximately one mile north of the City of Battlefield (only infrastructure within 5 miles south of the plant). There is no critical infrastructure downgradient within the expected path (Wilson's Creek) of water discharged from the impoundments. A map illustrating the path of Wilson's Creek and its diversion around critical infrastructure to the south is shown on **Figure 2-3**.

A breach of the impoundments' embankments would most likely impact JTEC power station property and crop fields along the banks of Wilson's Creek, and is not expected to result in loss of human life or damage to critical infrastructure.

Section 3

SUMMARY OF RELEVANT REPORTS, PERMITS, AND INCIDENTS

3.1 SUMMARY OF REPORTS ON THE SAFETY OF THE IMPOUNDMENTS

Information provided by JTEC did not contain safety reports related to the CCW impoundments, with the exception of an example checklist used for quarterly inspections of the CCW impoundments. JTEC representatives indicated to their knowledge, there have been no known structural or operational problems or accidental CCW discharges associated with the impoundments.

3.2 SUMMARY OF LOCAL, STATE, AND FEDERAL ENVIRONMENTAL PERMITS

Under the National Pollutant Discharge Elimination System (NPDES), the power station is permitted by the MDNR, authorizing JTEC the right to discharge water into Wilson's Creek via an unnamed tributary in accordance with the terms of the permit. The permit number is MO-0089940, with effective and expiration dates of August 13, 2010 and August 12, 2015, respectively; there is also a modification date of January 25, 2012.

3.3 SUMMARY OF SPILL/RELEASE INCIDENTS

JTEC plant representatives verbally indicated that there have been no known accidental spills or releases of water from the impoundments, to their knowledge. The representatives also indicated that documentation of performance of the impoundments is not kept on a regular basis. Without records of operations and performance of the impoundments, CDM Smith cannot confirm or deny if an accidental spill or release has occurred.

Section 4

SUMMARY OF HISTORY OF CONSTRUCTION AND OPERATION

4.1 SUMMARY OF CONSTRUCTION HISTORY

4.1.1 Original Construction

The JETC (formerly Southwest Power Station) started operations in 1976. According to the plant representatives, the CCW impoundments were designed by Burns & McDonnell Engineering Company (B&M). B&M drawings provided by JTEC are included in Appendix C.

Bottom ash from the power station is transferred as slurry and discharged into the north end of the West Impoundment via a riprap-protected spillway. Dimensions of the spillway were not available from the representatives. The East Impoundment is used instead if the West Impoundment is due for maintenance.

The West and East CCW Impoundments cover areas of 3.89 and 3.36 acres, respectively, and share a common dividing embankment. Each of these impoundments is divided into north and south cells by a divider rock berm. The purpose of the divider rock berm across the north and south cells is to filter ash slurry, reducing the content of ash in suspension as water moves from the north cell to the south. Filtered water from the south cell is pumped back to the plant for reuse. Periodically, the north cell is dredged and the ash is disposed of in the plant's on-site landfill.

Construction plans for the common dividing embankment (the embankment that creates the East and West Impoundments) and the south embankments show inside and outside slopes designed at 2H:1V. Plans show inside slopes protected by a minimum 3-foot-thick layer of riprap. The riprap consists of rock ranging from 10 percent passing a No. 4 sieve to 18 inches in size. B & M design plans show the common dividing embankment crest as12 feet wide, with a final grade of El. 1235.0. A six-inch layer of crushed rock surfacing is shown on the embankment crest. The crest of the East and West Impoundments' embankment generally match the surrounding natural grade at El. 1243. According to the plant representatives, the impoundments were designed for a high water level at El. 1237, with a freeboard of 6 feet. The design drawings provided by JTEC did not include information for the other embankments.

Overall grades at the site indicate that the south embankment of the impoundments is at the downstream end of the impoundment footprint. Consistent with these conditions, the south embankment is the tallest (at the outside slope), and acts like a dam (although the MDNR does not consider it a dam in their records).

Construction plans for the common dividing embankment indicate the embankment was constructed of "compacted fill" with a cutoff trench located parallel to the embankment, directly beneath the centerline of the crest. Plans indicate the cutoff trench was constructed of select stockpile material, with a maximum particle size of 6 inches and a maximum depth and width of 7 feet and 8 feet,

respectively. The common dividing embankment construction plans also show a 12-inch thick pond liner (liner), comprised of compacted lime and fly ash.

Based on the construction plans for the impoundments, the outlet from the impoundments consists of a pump station and valves that discharge through piping to a regulated outfall in the form of a weir structure. The pump station is located near the south end of the common dividing embankment. Flow from the weir goes to an unnamed tributary of Wilson Creek. There are two 15-inch-diameter corrugated metal overflow pipes – one for each impoundment – that also discharge to the weir structure.

4.1.2 Significant Changes/Modifications in Design since Original Construction

According to the plant representatives, there have been no major changes or modifications to the impoundments since operations started, with the exception of three small sedimentation basins installed near the northeast corner of the impoundment. The basins are used for primary filtration and sedimentation of the bottom ash slurry. The first basin was installed in 1995, and the second and third basins were installed in 2011, with final grade work in this area completed in 2012.

4.1.3 Significant Repairs/Rehabilitation since Original Construction

Discussions with the plant representatives and visual observations of the impoundments indicate no major repairs/rehabilitations have been performed on the impoundments since original construction, with the exception of the liner near the bottom of the East Impoundment. An earthwork contractor was hired to clean out sediment at the bottom of the East Impoundment, but the excavation equipment operator over-excavated some areas and cut completely through the liner, requiring repair.

4.2 SUMMARY OF OPERATIONAL PROCEDURES

4.2.1 Original Operational Procedures

Documentation provided by the plant representatives did not include original operational procedures for the impoundments. According to the representatives, bottom ash was sluiced to the West Impoundment. The divider rock berm filtered the ash slurry, allowing only filtered water into the south cell, which was pumped back to the plant for reuse. The ash in the north cell was then dredged out periodically and allowed to dry, after which it was disposed of at the on-site landfill. Some of the water in the south cell was also discharged by pumping to an unnamed tributary of Wilson Creek. Fly ash was stored in silos, conditioned, and transported via trucks to the on-site landfill.

4.2.2 Significant Changes in Operational Procedures and Original Startup

As described in Section 4.1.2 above, three detention/sedimentation basins were added at the inlet riprap spillway of the West Impoundment. These basins act as a primary filter for the CCW slurry, so that only filtered water enters the impoundments.

4.2.3 Current Operational Procedures

JTEC representatives provided CDM Smith with process flow and water balance diagrams representing current operations of the power plant and impoundments (See Appendix C). According

to the diagrams and verbal descriptions by the representatives, the current operational procedure of the impoundments is as follows:

Bottom ash is sluiced to either the East Impoundment or the West Impoundment via three detention/sedimentation basins at the northwest portion of the impoundment. The basins are used for primary filtration and sedimentation of the ash slurry. The divider rock berm in the impoundment acts as secondary filtration, so that currently only filtered water is stored in the impoundment. Bottom ash is periodically dredged from the basins and disposed of at the on-site landfill.

4.2.4 Other Notable Events since Original Startup

Based on available information to CDM Smith and discussions with the plant representatives, there have been no other notable events since original startup of the impoundments.

Section 5

FIELD OBSERVATIONS

5.1 PROJECT OVERVIEW AND SIGNIFICANT FINDINGS

CDM Smith performed an impoundment safety assessment at JTEC on August 27 and August 28, 2012. The task included performing a visual assessment of the impoundments, and collecting relevant information regarding structural stability and design of the embankments and related structures.

CDM Smith representatives Clement Bommarito and Albert Ayenu-Prah were accompanied by the following JTEC representatives:

- Robert Belk – JTEC, Supervisor-Operations
- Ted Salveter – JTEC, Senior Engineer, Governmental Relations/Environmental Affairs

The assessments were completed following the general procedures and considerations contained in the Federal Emergency Management Agency's (FEMA) Federal Guidelines for Dam Safety (April 2004) regarding settlement, movement, erosion, seepage, leakage, cracking, and deterioration. A USEPA Coal Combustion Dam Inspection Checklist and a USEPA CCW Impoundment Inspection Form were completed on-site for the impoundments during the site visit. Copies of the forms are included in **Appendix B.** Photographs and photograph locations are included in **Appendix D.**

The weather on the days of the site visit was mostly clear with a high temperature of 90 degrees Fahrenheit and a low temperature of 60 degrees Fahrenheit. According to the National Weather Service, daily total precipitation prior to, and on the day of, the assessment is shown in **Table 5.1**. The weather data were recorded at the Springfield-Branson National Airport, located approximately 6 miles south of JTEC.

Table 5.1: Daily Total Precipitation for Week prior to Assessment

Site Visit on August 27 and August 28, 2012		
Day	**Date**	**Precipitation (inches)**
Wednesday	August 20	0.00
Thursday	August 21	0.00
Friday	August 22	0.00
Saturday	August 23	0.00
Sunday	August 24	0.00
Monday	August 25	0.14
Tuesday	August 26	0.44
Wednesday	August 27	0.00
Thursday	August 28	0.00
Total	**August 20 – 28**	**0.58**

5.2 WEST IMPOUNDMENT

At the time of the assessment, the West Impoundment had a freeboard of approximately 10 feet. The south embankment dam for the impoundment was constructed with a side-hill configuration. The site has a general downward grade towards the southeast. The East and West Impoundments share a north-south divider embankment (common dividing embankment). The west, north, and east embankments tie into the general grade of the power plant.

5.2.1 Crest

The crest of the embankment of the West Impoundment appeared to be generally in good condition (**Photograph 5.1**). The crest for the south embankment and the common dividing embankment between the East and West Impoundments are approximately 12 feet wide. Most of the embankment crests have crushed-rock visible at the surface to carry maintenance vehicle traffic (**Photograph 5.2**). At a few embankment crest locations, the crushed-rock surfacing appears deteriorated (**Photograph 5.3**). The south embankment crest has grass vegetation up to 12 inches in height, while the crest of the common dividing embankment has trimmed grass with a height up to about 4 inches (**Photograph 5.1**).

5.2.2 Inside Slope

The inside slopes of the impoundments' embankments were in fair condition. Visual observations and field measurements for estimation purposes indicate the inside slope of the south embankment and the common dividing are estimated to be 2H:1V (**Photograph 5.4**). The inside slope of the north embankment and the west embankment generally had slopes on the order of 6H:1V or flatter (**Photograph 5.5**).

The inside slope of the south embankment and the common dividing embankment were covered with thick vegetation growing to heights up to 4 feet with riprap protection near the normal level of the water when the impoundment is in use (**Photograph 5.4**). The inside slopes of the west and north embankments had sparse vegetation; however, plant personnel indicated the area was recently seeded (**Photograph 5.6**).

5.2.3 Outside Slope

The outside slope of the south embankment appeared to be uniformly graded and generally had a slope of about 2H:1V (**Photograph 5.7**). The outside slope of this embankment is covered with areas of grass and brush up to about 4 feet in height. Unvegetated areas have riprap protection. No evidence of animal burrows, cracks, or erosion was observed on the outside slope of this embankment; there was also no observed evidence of seepage on the ground surface. The grades on the outside slope of the north, and west embankments are relatively flat and generally transition to match the surrounding grade, with no discernible downward outer slope.

5.3 EAST IMPOUNDMENT

5.3.1 Crest

The crest of the embankments of the East Impoundment appeared to be generally in good condition (**Photograph 5.1**). The crest for the south embankment and the common dividing embankment are approximately 12 feet wide. Most of the embankment crests have crushed-rock visible at the surface to carry maintenance vehicle traffic (**Photograph 5.2**). At a few embankment crest locations, the crushed-rock surfacing appears deteriorated (**Photograph 5.3**). The south embankment crest has

grass vegetation up to 12 inches in height, while the crest of the common dividing embankment has trimmed grass with a height up to about 4 inches (**Photograph 5.1**).

5.3.2 Inside Slope

The inside slopes of the impoundments' embankments were in fair condition. Visual observations and field measurements for estimation purposes indicate the inside slope of the south embankment and the common dividing are estimated to be 2H:1V (**Photograph 5.4**). The inside slope of the north embankment and the east embankment generally had slopes on the order of 6H:1V or flatter (**Photograph 5.5**).

The inside slope of the south embankment and the common dividing embankment were covered with thick vegetation growing to heights up to 4 feet with riprap protection near the normal level of the water when the impoundment is in use (**Photograph 5.4**). The inside slope of the east embankment was grass-covered growing to heights up to 4 inches. The inside slope of the north embankment had sparse vegetation; however, plant personnel indicated the area was recently seeded (**Photograph 5.6**).

5.3.3 Outside Slope

The outside slope of the south embankment appeared to be uniformly graded and generally had a slope of about 2H:1V (**Photograph 5.7**). The outside slope of this embankment is covered with areas of grass and brush up to about 4 feet in height. Unvegetated areas have riprap protection. No evidence of animal burrows, cracks, or erosion was observed on the outside slope of this embankment; there was also no observed evidence of seepage on the ground surface. The grades on the outside slope of the north and east embankments are relatively flat and generally transition to match the surrounding grade, with no discernible downward outer slope.

5.4 OUTLET STRUCTURES

5.4.1 Overflow Discharge Structure

The overflow structure for each impoundment consisted of a 15-inch-diameter corrugated metal pipe that went through the south embankment. These overflow discharge pipes extended south through the embankment to a single outlet weir structure located near the toe of the outside slope. The visible portion of these pipes appeared to be in good condition (**Photograph 5.8**).

5.4.2 Outlet Conduit

The outlet system consists of a pump station, a weir structure and associated valves and piping. The system appeared to be in good condition, and water was flowing through the weir indicating it is operational (**Photographs 5.9, 5.10, 5.11**). The weir is a concrete structure covered with a steel grate located on the outside slope of the south embankment. According to the plant representatives, the weir structure is used to measure discharge through the outlet.

5.4.3 Emergency Spillway

CDM Smith's on-site visual observations indicated that the JTEC impoundments had no emergency spillway associated with their design.

5.4.4 Low Level Outlet

Based on our visual observations at the site, discussions with JTEC personnel and review of the information provided by JTEC, the impoundments do not have low-level outlets.

Section 6

HYDROLOGIC/HYDRAULIC SAFETY

6.1 SUPPORTING TECHNICAL DOCUMENTATION

6.1.1 Flood of Record

Documentation provided by JTEC did not include information regarding the flood of record (FR) for the ash impoundments. Plant representatives verbally indicated that there has been no known flooding of the JTEC impoundments to their knowledge although written records of flood events and impoundment water levels have not been recorded in the past.

6.1.2 Inflow Design Flood/Design Maximum Precipitation Event

Information provided by JTEC did not include data or analysis related to the hydrologic/hydraulic characteristics of the impoundments. Information on the capacity of the existing impoundment outlets, pump station and associated piping to discharge water from the impoundments during a sudden rise in water levels in the impoundment(s) are needed to evaluate the factor of safety related to design precipitation and flooding events.

Without the necessary hydrologic/hydraulic information on the rate of rise in the impoundment water level and the total volume of water anticipated for an extreme precipitation event, CDM Smith cannot provide an assessment of the safety of the impoundment in this regard. In general terms, the size of the impoundments and allowable outflow rates provided in the NPDES Permit indicate complete filling of both impoundments leading to overtopping is unlikely.

MDNR requires low hazard dams (MDNR Class III) built prior to August 13, 1981 to pass the 100-year storm event. Based on NOAA Atlas 14 Volume 8 Version 2 "Precipitation-Frequency Atlas of the United States" for Springfield, MO in "Mississippi Valley" Climate Region 4, the 100-year storm event in the vicinity of the site over a 24-hour period is approximately 7.72 inches. The drainage area contributing to the impoundments at this site appears to be limited to the storage area within the impoundments. Preliminary evaluations indicate that there is enough storage capacity and freeboard in the impoundments at the current operating pools to safely store a 100-year storm event without being overtopped.

6.1.3 Spillway Rating

Information provided by JTEC did not include the outfall rating for the impoundments. The NPDES Permit No. MO-0089940 for the power station provides an allowable flow for Outfall #002 (associated with discharge of water derived from the impoundments) of 9.6 million gallons per day (MGD). JTEC personnel indicated an actual flow of 0.5 MGD.

6.1.4 Downstream Flood Analysis

A downstream flood analysis for the impoundments was not part of the documentation provided by JTEC. From CDM Smith's visual observations, overall grades in the area of the impoundments and surrounding areas slope to the south, roughly parallel to Wilson Creek and the tributary where JTEC discharges water from the impoundments. Based on the grades south and the plant's property

boundaries, a breach of the embankment would be expected to result in a discharge across undeveloped (grass covered with occasional trees) JTEC property south of the plant and land further to the south used for agricultural purposes, eventually draining into the unnamed tributary of Wilson Creek used for the current permitted discharge. Wilson Creek continues several miles to the south-southwest through areas generally free of commercial or residential structures, and most areas are used for agricultural purposes. Based on these conditions, a breach in the embankments is not expected to result in significant damage to property and infrastructure or loss of human life.

6.2 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

The supporting hydrologic/hydraulic documentation available with the JTEC is considered inadequate for the impoundment. Little to no information was provided by JTEC representatives regarding the design flood or probable maximum precipitation event or the capacity for the pump station to discharge excess water from the impoundments other than a visual examination of the facility.

6.3 ASSESSMENT OF HYDROLOGIC/HYDRAULIC SAFETY

There is inadequate documentation to support an assessment of the hydrologic/hydraulic safety of the JTEC impoundments. During normal operations of the power station, one impoundment is usually in service while the other is kept off line. Plant personnel indicated that use of one impoundment at a time gives them the option to add the second impoundment in cases when there is a risk of overtopping in the operational impoundment. The option to increase the normal operating capacity of the operational impoundment with use of the second impoundment lessens the risk of overtopping, and is consistent with comments by JTEC personnel indicating there have not been any overtopping of the embankments since the impoundments' initial operation.

Section 7

STRUCTURAL STABILITY

7.1 SUPPORTING TECHNICAL DOCUMENTATION

7.1.1 Stability Analyses and Load Cases Analyzed

JTEC did not provide documentation containing stability analyses for CDM Smith's review. MDNR has recommended guidelines for stability evaluation for new dams and modifications to existing dams. These guidelines include procedures established by the USACE, the United States Bureau of Reclamation, the Federal Energy Regulatory Commission, and the United States Natural Resources Conservation Service. MDNR requires that engineering analyses for new dams meet the minimum safety criteria in the Missouri Code of State Regulations (CSR) and the dam safety law. MDNR defines new dams as those constructed after August 13, 1981. According to the CSR, engineers do not have to show that existing dams meet the stability criteria unless significant modifications are made to the height, slope or water storage elevation of the earthen structure.

The impoundments at JTEC were put in operation in 1976. According to the CSR, owners of these older facilities do not have to show that existing dams meet the stability criteria, unless significant modifications are made to the height, slope or water storage elevation of the earthen structure. It is our understanding from JTEC personnel that no significant changes have been made to the impoundments since their original construction, with the exception of small reductions in the impoundments' size on the east side of the impoundment. Based on the MDNR requirements, the embankments forming the JTEC impoundments were constructed earlier than August 13, 1981, and therefore stability analyses are not mandatory for this facility. In any case, the information JTEC provided CDM Smith did not include stability analyses for the earth embankments. Without stability analyses, CDM Smith is unable to make an assessment of the structural stability and safety of the earth embankments.

7.1.2 Design Parameters and Dam Materials

The documentation CDM Smith received from JTEC did not include information on design parameters for fill used for construction of the impoundment embankments. Therefore, CDM Smith is unable to evaluate design parameters for the embankments at this time.

7.1.3 Uplift and/or Phreatic Surface Assumptions

Discussions with JTEC representatives indicated there are currently no piezometers or other groundwater measuring devices for the impoundments. Without this groundwater information, CDM Smith cannot make accurate assumptions on the uplift forces or water levels.

7.1.4 Factors of Safety and Base Stresses

JTEC did not have soil stratigraphy, laboratory soil testing or groundwater data for analysis of slope stability of critical sections of the embankment perimeter. Without this information, CDM Smith cannot perform an evaluation of the adequacy of factors of safety of existing slopes and the magnitude of base stresses for the embankments.

As a general reference, **Table 7.1** shows the minimum required factors of safety recommended by the USACE for new dams. According to the USACE, if stability analyses for an existing dam appear questionable, long-term stability under steady-state seepage conditions, and rapid drawdown should be evaluated. It is not necessary to analyze end-of-construction stability for existing dams unless the cross section is modified. **Table 7.2** shows recommended minimum required seismic factors of safety by the *FEMA Federal Guidelines for Dam Safety, Earthquake Analyses and Design of Dams.*

Table 7.1: Minimum Required Factors of Safety: New Earth and Rock-Fill Dams[1]

Analysis Condition	Required Minimum Factor of Safety	Slope
End-of-Construction (including staged construction)	1.3	Upstream and Downstream
Long-term (steady seepage, maximum storage pool, spillway crest or top of gates)	1.5	Downstream
Maximum surcharge pool	1.4	Downstream
Rapid drawdown	1.1-1.3[2]	Upstream

[1]*Table 3-1 in USACE's EM 1110-2-1902, October 31, 2003*

[2]*FS = 1.1, drawdown from maximum surcharge pool; FS = 1.3, drawdown from maximum storage pool*

Table 7.2: Minimum Required Seismic Factors of Safety[1]

Analysis Condition	Required Minimum Factor of Safety
Seismic Condition at Normal Pool Elevation	1.0
Liquefaction	1.3

[1]*FEMA Federal Guidelines for Dam Safety – Earthquake Analyses and Design of Dams (pgs. 31, 32, 38), May 2005*

7.1.5 Liquefaction Potential

Documentation provided by JTEC to CDM Smith did not include information on soil characteristics, soil stratigraphy and/or related data required for use in a liquefaction analysis for the impoundments. Without the required soil data and/or an existing analysis of liquefaction for review, CDM Smith is unable to comment on the potential for liquefaction of the embankment and foundation soils at this site.

7.1.6 Critical Geological Conditions and Seismicity

The geology of the Springfield region consists primarily of sedimentary rocks of the Late Cambrian to Early Pennsylvanian age. The major types of sedimentary rocks present are carbonate rocks, with shale and siltstone being present in smaller quantities. Most of the bedrock consists of Gasconade, Roubidoux, Jefferson City and Cotter Dolomites. Towards the western portion of the region, Mississippian rocks of mostly cherty and fossiliferous limestone are also present. The Pennsylvanian rocks are mostly medium-grained, medium to thickly bedded sandstone, fissile shale, and pebble to cobble chert conglomerate.

The United States Department of Agriculture soil survey for Greene County indicates the top 5 feet of soils in the project area consist of gravelly clay and gravelly silt, underlain by bedrock.

Information on the website of the United States Geological Survey (USGS) indicates that the impoundments are in an area of generally low seismic hazard. Based on a 2008 USGS seismic hazard map for Missouri, the dam site is located in an area with a potential to experience 0.08g (horizontal) ground acceleration with a probability of exceedance of 2 percent in 50 years.

7.2 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

JTEC did not have all of the necessary information for CDM Smith to perform a review of structural stability for the impoundments. Based on this lack of documentation, it is CDM Smith's opinion that the supporting technical documentation is inadequate for the impoundments.

7.3 ASSESSMENT OF STRUCTURAL STABILITY

Information provided by representatives of JTEC for use in CDM Smith's evaluation of the impoundments did not include sufficient data regarding the structural adequacy or stability of the impoundment embankments. CDM Smith is, therefore, unable to provide an assessment of the structural stability of the embankments of these impoundments.

Section 8

ADEQUACY OF MAINTENANCE AND METHODS OF OPERATION

8.1 OPERATING PROCEDURES

The documentation JTEC provided CDM Smith did not include a manual on operating procedures for the impoundments. A verbal description of the method of operation for the impoundments was provided by a representative of JTEC as described in Section 4.2.3.

8.2 MAINTENANCE OF THE DAM AND PROJECT FACILITIES

Information JTEC provided CDM Smith did not include a written set of maintenance procedures for the impoundments. According to the plant representatives, the embankments are periodically inspected for any potential safety issues. In addition, the embankments are periodically mowed by plant staff. In general, regular mowing of the slopes is evident, although the inside slopes of the south and the common dividing embankments were overgrown with dense vegetation of up to about 4 feet in height.

8.3 ASSESSMENT OF MAINTENANCE AND METHODS OF OPERATIONS

8.3.1 Adequacy of Operating Procedures

Documents made available by JTEC for operation of the impoundments were limited to a process flow diagram and a water balance diagram for the plant. The plant representatives' verbal description of operational procedures, in combination with the process flow and water balance diagrams, and CDM Smith's on-site observations, gives a general indication that the operational procedures for the impoundments appear adequate. Although the operational procedures for the impoundments appear adequate, CDM Smith recommends JTEC implement a written set of operational procedures and establish a system for consistent documentation of the impoundments.

8.3.2 Adequacy of Maintenance

In general, maintenance of the embankments and outlet structures of the impoundments appear adequate, with the exception noted in Section 8.2. Major maintenance issues were not apparent at the time of CDM Smith's site visit. Although visual observations of the impoundments and the maintenance procedures described by JTEC personnel appear to be adequate, CDM Smith recommends JTEC implement a written set of maintenance procedures and establish a system for consistent documentation of these procedures on a regular basis.

Section 9

ADEQUACY OF SURVEILLANCE AND MONITORING PROGRAM

9.1 SURVEILLANCE PROCEDURES

According to JTEC representatives, the impoundment embankments are inspected once every three months. Although the documents JTEC provided CDM Smith did not include historical records of the inspections, the plant representatives provided a completed checklist for a recent inspection. A copy of the checklist is included in **Appendix C**.

9.2 INSTRUMENTATION MONITORING

At the time of CDM Smith's on-site visual assessment, there were no monitoring instruments or observation wells installed. JTEC representatives confirmed that monitoring equipment has not been installed.

9.3 ASSESSMENT OF SURVEILLANCE AND MONITORING PROGRAM

9.3.1 Adequacy of Surveillance Program

Based on verbal communications with JTEC representatives and CDM Smith's review of the available information, the inspection program for the impoundments at JTEC appears adequate. CDM Smith suggests records of inspections and actions required and taken as a result of these inspections be retained for reference purposes.

9.3.2 Adequacy of Instrumentation Monitoring Program

At the time of CDM Smith's on-site visit, JTEC had no instrumentation monitoring available for the impoundments. JTEC representatives confirmed the absence of instrumentation monitoring for the impoundments. Monitoring wells would need to be installed and regular measurements taken to begin an ongoing record of water levels in order to recognize and investigate unusual fluctuations and determine their source.

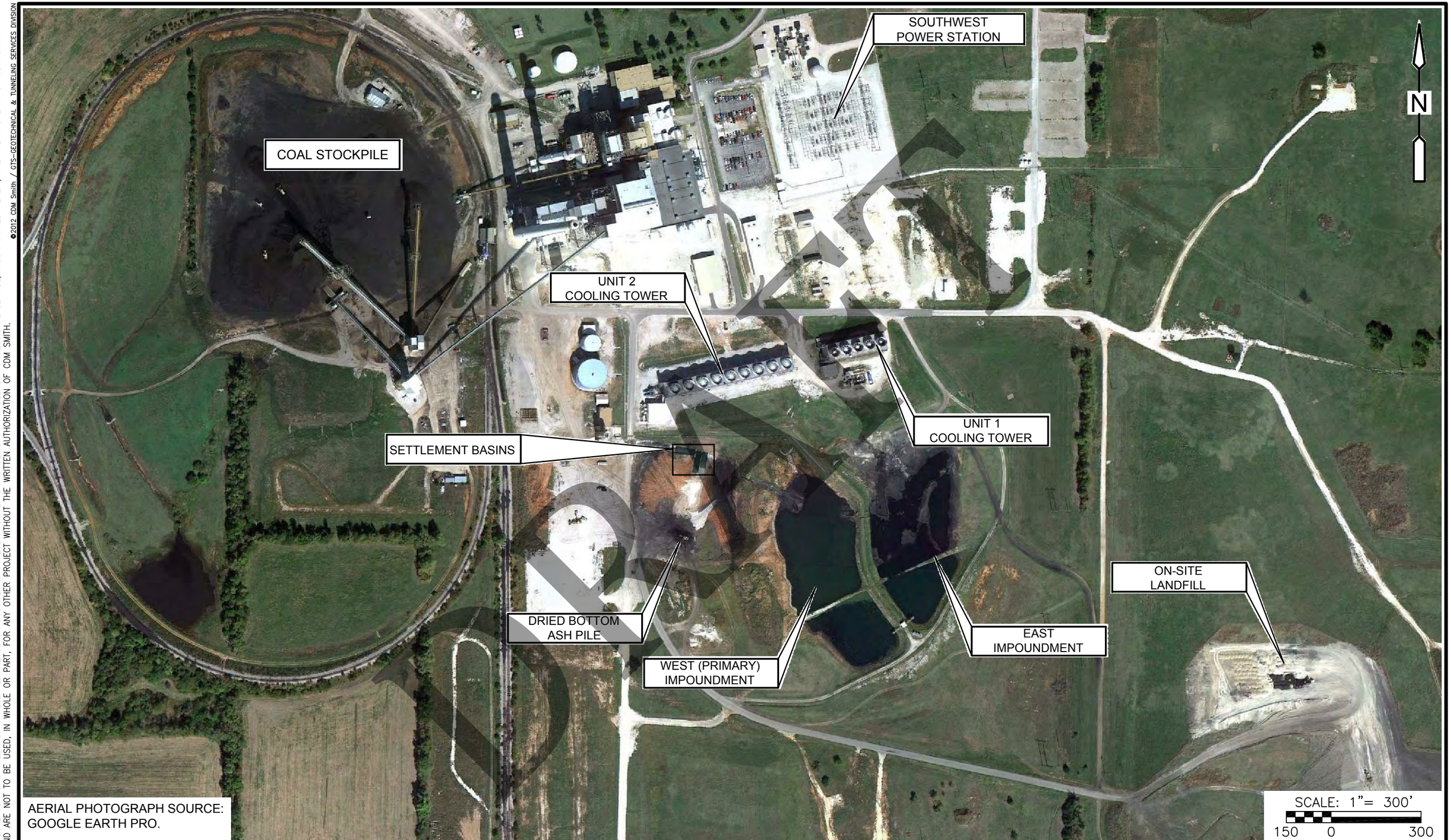
Appendix A

Figures

AERIAL PHOTOGRAPH SOURCE:
GOOGLE EARTH PRO.

CDM Smith

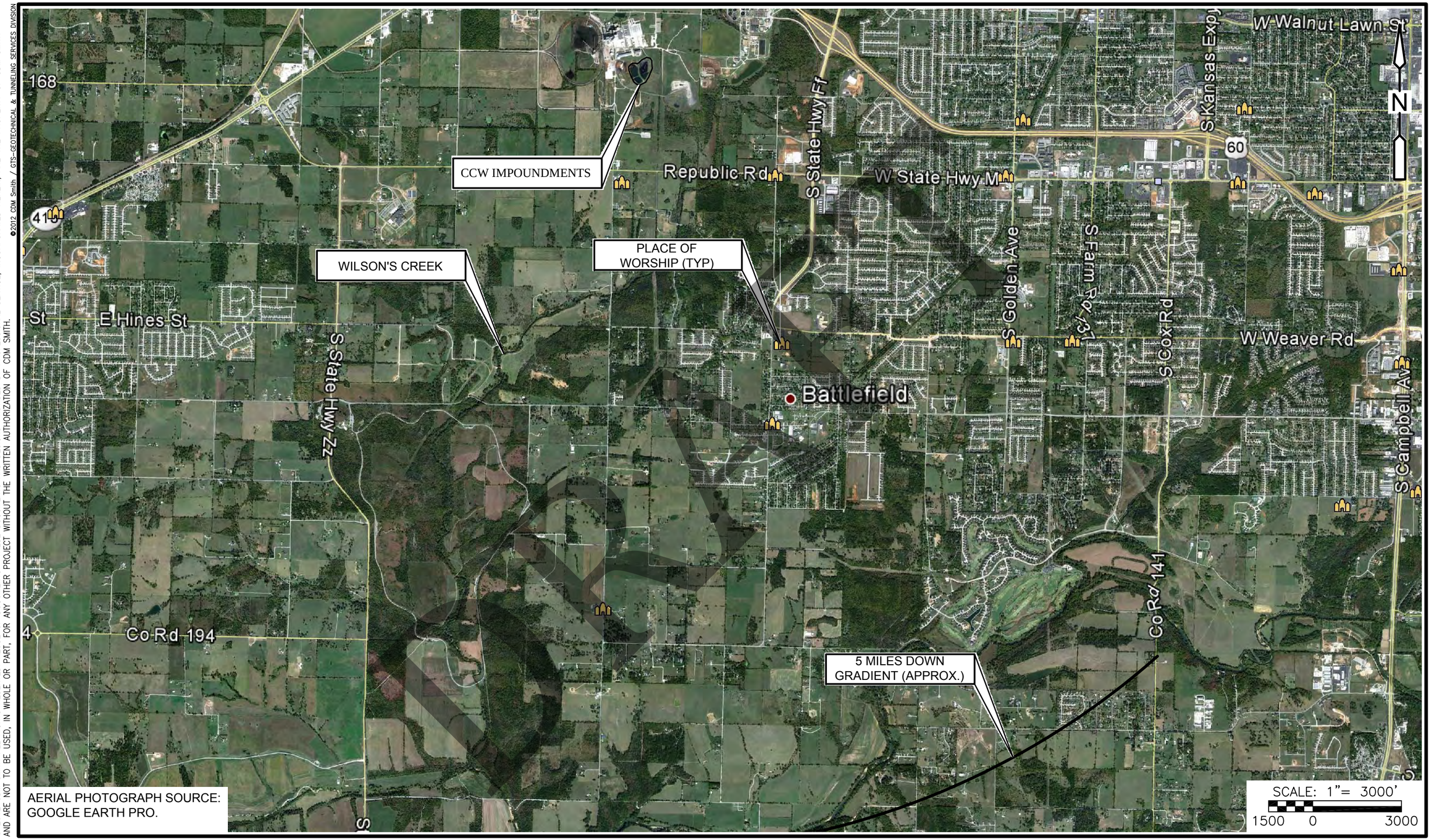
SOUTHWEST POWER STATION
SPRINGFIELD, MISSOURI
LOCUS PLAN
FIGURE 2-1



AERIAL PHOTOGRAPH SOURCE: GOOGLE EARTH PRO.

CDM Smith

SOUTHWEST POWER STATION
SPRINGFIELD, MISSOURI
AERIAL PLAN
FIGURE 2-2



CDM Smith

SOUTHWEST POWER STATION
SPRINGFIELD, MISSOURI
CRITICAL INFRASTRUCTURE PLAN
FIGURE 2-3

Appendix B

Assessment Checklists

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name: Southwest Power Station - Springfield, MO	Date: August 27, 2012 - August 28, 2012
Unit Name: East/West Ash Pond	Operator's Name: City Utilities of Springfield, MO
Unit I.D.: n/a	Hazard Potential Classification: High Significant (Low)
Inspector's Name: Clement Bommarito, Albert Ayenu-Prah	

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?	3 months		18. Sloughing or bulging on slopes?		x
2. Pool elevation (operator records)?	1225.0'		19. Major erosion or slope deterioration?		x
3. Decant inlet elevation (operator records)?	1225.0'		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	1227.8'		Is water entering inlet, but not exiting outlet?		x
5. Lowest dam crest elevation (operator records)?	1235.0'		Is water exiting outlet, but not entering inlet?		x
6. If instrumentation is present, are readings recorded (operator records)?		x	Is water exiting outlet flowing clear?	x	
7. Is the embankment currently under construction?		x	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)?		x	From underdrain?		x
9. Trees growing on embankment? (If so, indicate largest diameter below)		x	At isolated points on embankment slopes?		x
10. Cracks or scarps on crest?		x	At natural hillside in the embankment area?		x
11. Is there significant settlement along the crest?		x	Over widespread areas?		x
12. Are decant trashracks clear and in place?		x	From downstream foundation area?		x
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		x	"Boils" beneath stream or ponded water?		x
14. Clogged spillways, groin or diversion ditches?		x	Around the outside of the decant pipe?		x
15. Are spillway or ditch linings deteriorated?		x	22. Surface movements in valley bottom or on hillside?		x
16. Are outlets of decant or underdrains blocked?		x	23. Water against downstream toe?		x
17. Cracks or scarps on slopes?		x	24. Were Photos taken during the dam inspection?	x	

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
2, 3, 5:	Elevations from Operator records and conversations with plant representative; datum is NAVD 88.
4:	One open channel spillway with riprap armoring to west pond; spillway crest elevation from documentation provided by Owner.

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # MO-0089940

INSPECTOR Clement Bommarito, Albert Ayenu-Prah

Date August 27, 2012 - August 28, 2012

Impoundment Name East/West Ash Pond

Impoundment Company Southwest Power Station, Springfield, MO

EPA Region 7

State Agency (Field Office) Addresss Department of Natural Resources
P.O. Box 176
Jefferson City, MO 65102

Name of Impoundment West Ash Pond
(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 CCW (bottom ash)

Nearest Downstream Town : Name Cape Fair, Missouri

Distance from the impoundment 20 miles

Impoundment Location:

Longitude -93 Degrees 23 Minutes 7 Seconds (Source: Google Earth)

Latitude 37 Degrees 8 Minutes 54 Seconds

State MO County Greene

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

If So Which State Agency? Missouri Department of Natural Resources

In this Report:
n/a = not available
d/n/a = does not apply

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.

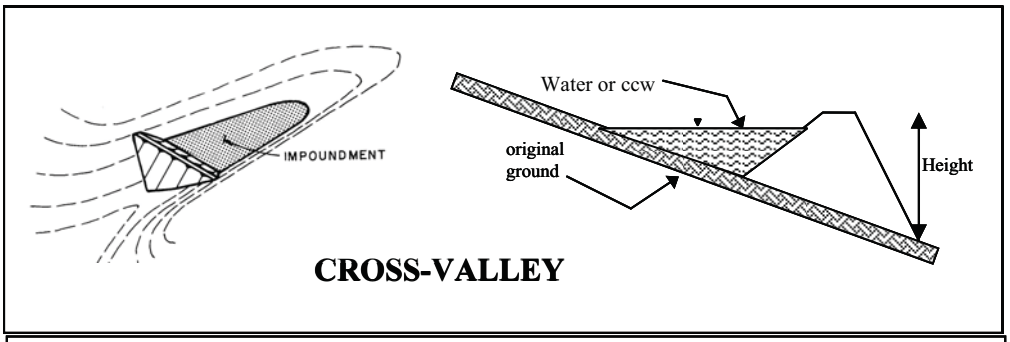
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

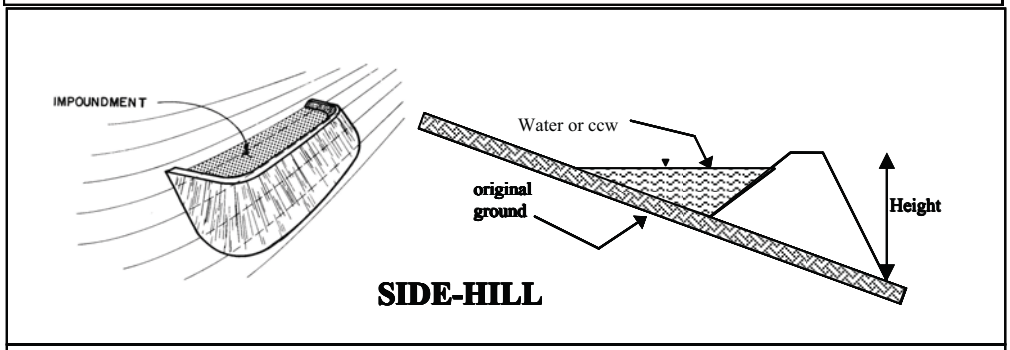
1. In the event of a breach, the downstream flow of waste would remain on Operator's property, consisting of grass and some small trees to its normal discharge into a tributary of Wilson Creek.

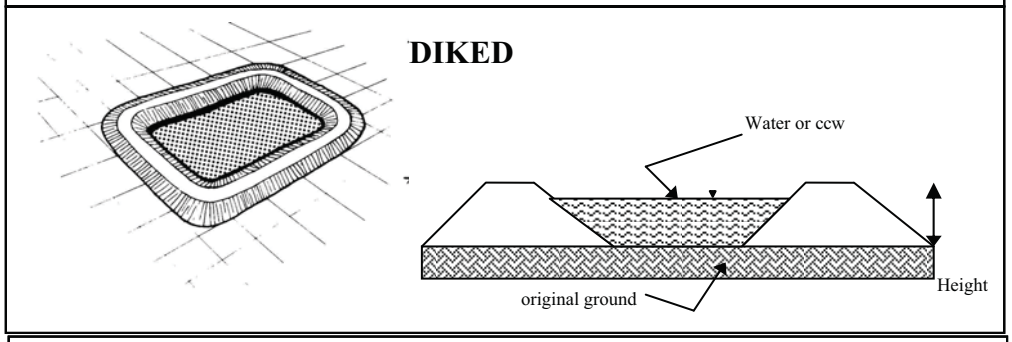
2. A breach could release waste into Wilson's Creek via an unnamed tributary, causing environmental impacts.

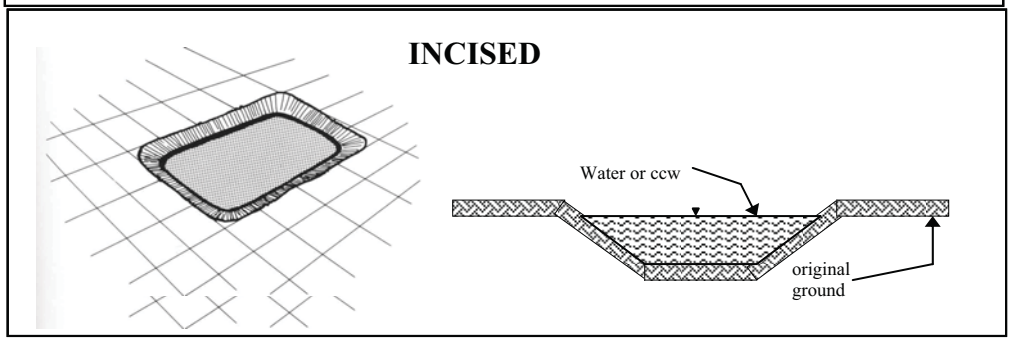
3. A breach in the embankment is not expected to result in loss of human life.

CONFIGURATION:









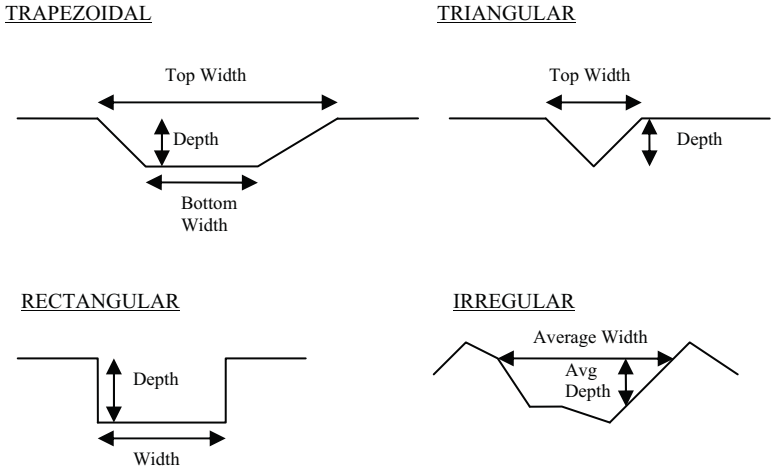
_____ Cross-Valley
__x__ Side-Hill
_____ Diked
_____ Incised (form completion optional)
_____ Combination Incised/Diked

Embankment Height __30__ feet Embankment Material __Clay__
Pool Area (Source: Google Earth) __7__ acres Liner __Clay__
Current Freeboard __10__ feet Liner Permeability __n/a__

TYPE OF OUTLET (Mark all that apply)

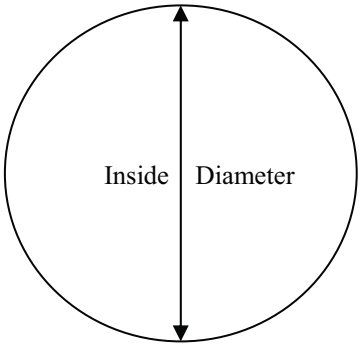
d/n/a **Open Channel Spillway**
_____ Trapezoidal
_____ Triangular
_____ Rectangular
_____ Irregular

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



x **Outlet**

20" inside diameter



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

_____

Is water flowing through the outlet? YES x NO _____

_____ **No Outlet**

_____

_____ **Other Type of Outlet** (specify) _____

The Impoundment was Designed By Burns & McDonald
_____

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 table 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 : _____

ADDITIONAL INSPECTION QUESTIONS

Concerning the embankment foundation, was the embankment construction built over wet ash, slag, or other unsuitable materials? If there is no information just note that.

Untitled and undated drawings provided by John Twitty Energy Center staff indicate the embankments were constructed over scarified and re-compacted "existing grade". Existing grade is not defined in the plans provided. It cannot be stated definitively that the embankments are not constructed over wet ash, slag or other unsuitable materials.

Did the dam assessor meet with, or have documentation from, the design Engineer-of-Record concerning the foundation preparation?

The assessor did not meet with, or have documentation from, the design Engineer of Record concerning foundation preparation.

From the site visit or from photographic documentation, was there evidence of prior releases, failures, or patchwork on the dikes?

There was no indication of prior releases, failures or patchwork on the embankments.

Appendix C

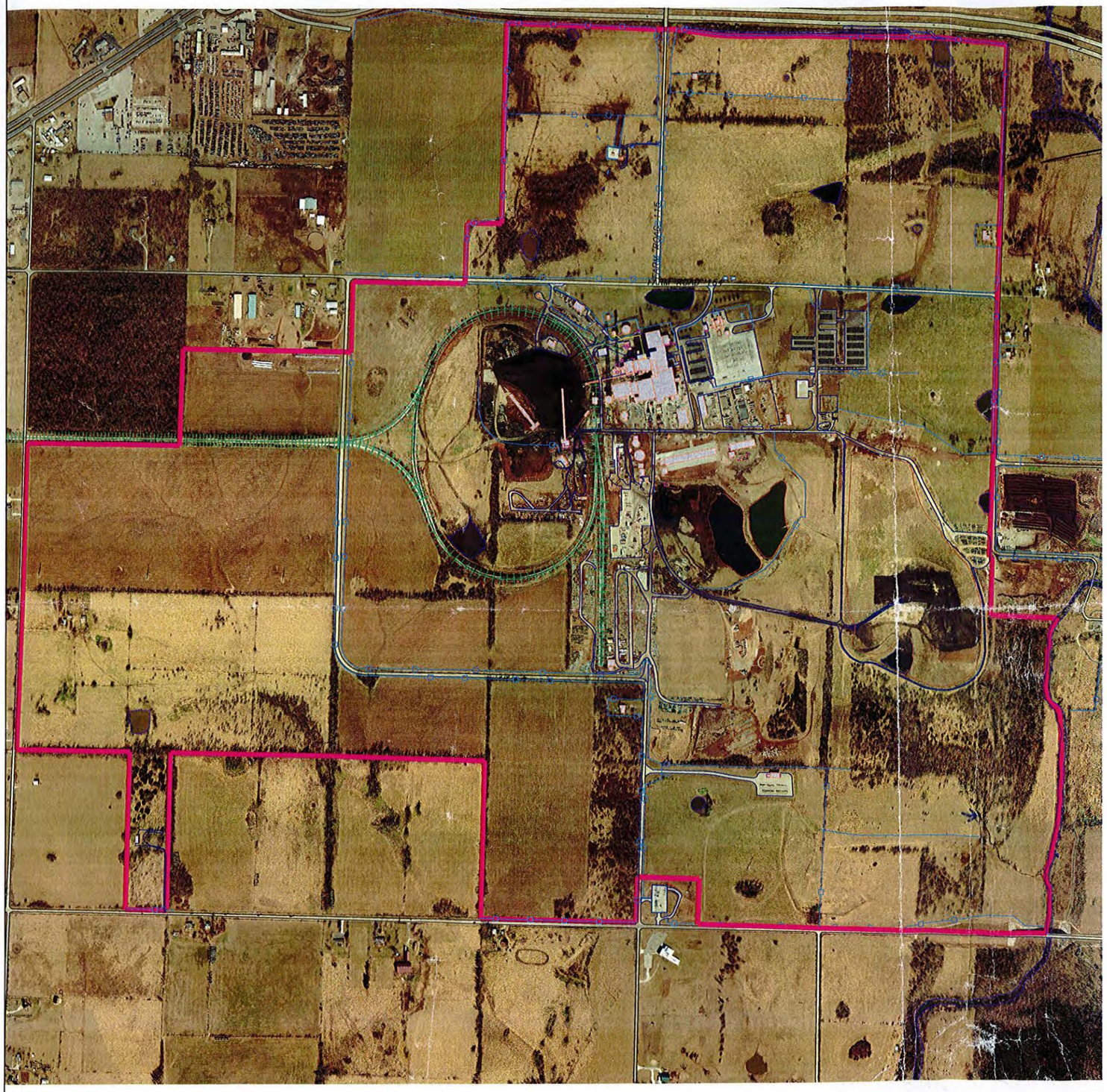
Documentation from John Twitty Energy Center

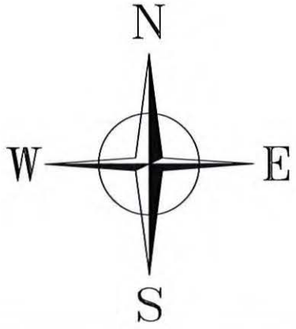
Appendix C

Doc 01: Power Station Property Map

MAP – 1

CITY UTILITIES OF SPRINGFIELD, MISSOURI
SOUTHWEST POWER STATION
PLANT ID: 5265





CITY UTILITIES
Bringing Power Home.

SOUTHWEST POWER STATION

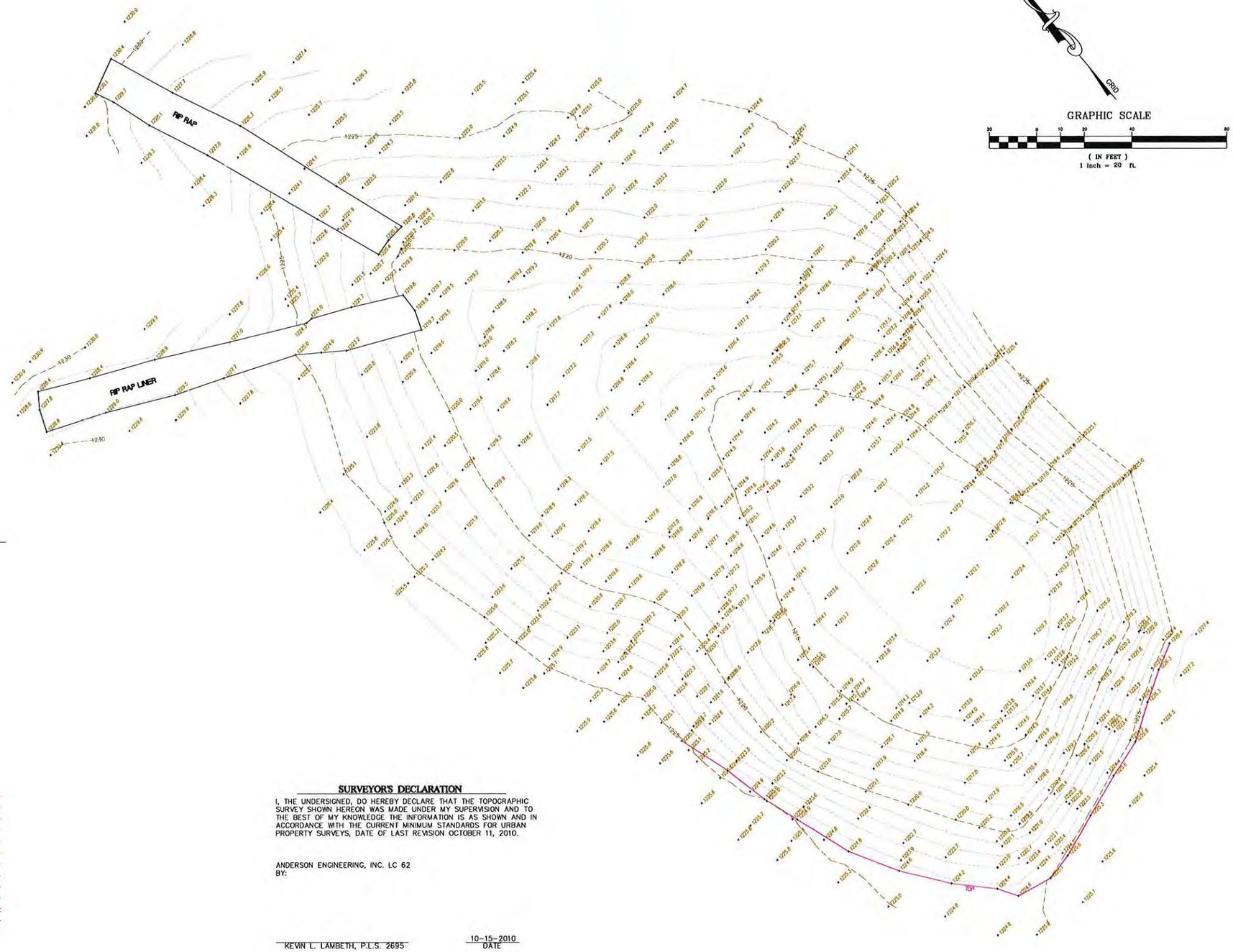
DRAWN BY:	SCALE:
ASR	1" = 400'

Appendix C

Doc 02: Power Station Surveys

LOCATION SKETCH
SEC 7, T28N, R22W
SCALE: 1"=2000'

MISSOURI ONE CALL SYSTEM, INC.
1-800-344-7483
STOP-CALL BEFORE YOU DIG!



GRAPHIC SCALE
20 0 10 20 40 80
(IN FEET)
1 inch = 20 ft.

LEGEND

CP	CONTROL POINT
IP	FOUND IRON PIN
IP	SET IRON PIN
RWM	RIGHT-OF-WAY MARKER
PP GY	POWER POLE W/ GUY
MH	MANHOLE
SCO	SEWER CLEANOUT
GM	GAS METER
LP	LIGHT POLE
	SIGN
WM	WATER METER
WV	WATER VALVE
GV	GAS VALVE
FH	FIRE HYDRANT
TR	TELEPHONE RISER
	BUMPER POST
	GRATE INLET
	TREELINE
	BUSH
ER	ELECTRICAL RISER
TS	TRAFFIC SIGNAL BOX
NB	MAIL BOX
PROPERTY LINE	
SANITARY SEWER	SS
STORM SEWER	SW
TELEPHONE LINE	T
UNDERGROUND TELEPHONE	UT
GAS LINE	G
WATER LINE	W
ELECTRIC LINE	E
UNDERGROUND ELECTRIC	UE
FENCE LINE	X
RETAINING WALL	
LINE LABELS	MEASURED 100' M; DEED 100' D

SURVEYOR'S DECLARATION

I, THE UNDERSIGNED, DO HEREBY DECLARE THAT THE TOPOGRAPHIC SURVEY SHOWN HEREON WAS MADE UNDER MY SUPERVISION AND TO THE BEST OF MY KNOWLEDGE THE INFORMATION IS AS SHOWN AND IN ACCORDANCE WITH THE CURRENT MINIMUM STANDARDS FOR URBAN PROPERTY SURVEYS, DATE OF LAST REVISION OCTOBER 11, 2010.

ANDERSON ENGINEERING, INC. LC 62
BY:

KEVIN L. LAMBETH, P.L.S. 2695 — 10-15-2010 DATE

DATE OF FIELD SURVEY OCTOBER 08, 2010

ANDERSON ENGINEERING, INC
ENGINEERS - SURVEYORS - LABORATORIES - DRILLING
2045 W. WOODLAND - SPRINGFIELD, MISSOURI 65807 - PHONE (417) 866-2741
COA # 000862

REVISIONS			
NO.	DESCRIPTION	BY	DATE

DRAWING INFO.	
FIELD BY:	AP & JE
DRAWN BY:	BAC
CHECK BY:	KLL
DATE:	10-11-10
FIELD BOOK:	
JOB NUMBER:	38207

CITY UTILITIES OF SPRINFIELD

WEST ASH POND ASBUILT SURVEY

SOUTHWEST POWER STATION
SPRINGFIELD, MISSOURI

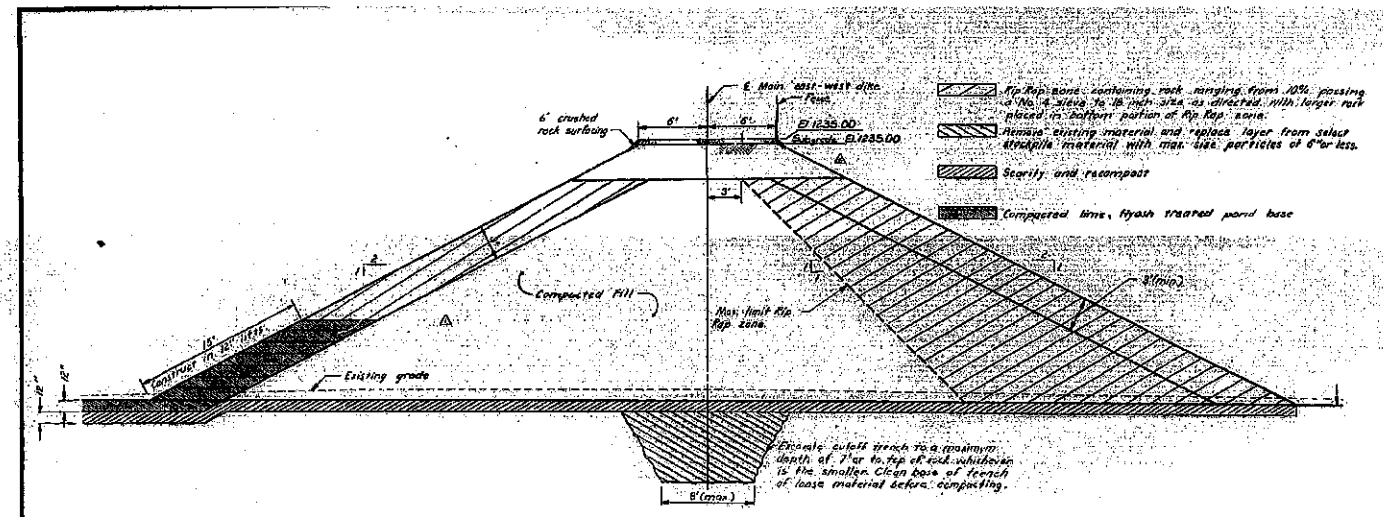
DRAWING NO. WB 108-826

SHEET NUMBER 1 OF 1

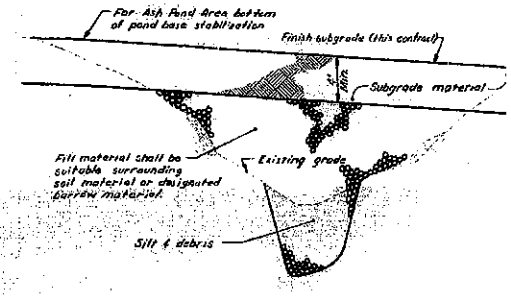

AREA UPDATED
OCTOBER 02, 2003
132 KV
GRASS
1230
1240
1220
1200
1210
120.8
119.2
LANDFILL
HAUL ROAD
RESTORED
RUBBER
LANDFILL
1230
1240
1240

Appendix C

Doc 03: Power Station Drawings

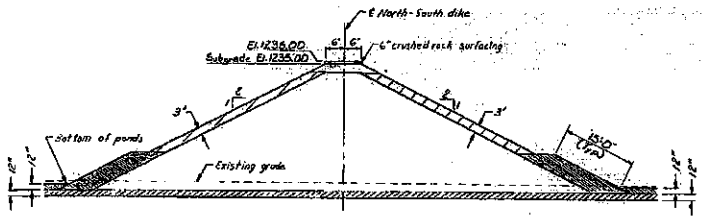


SECTION 45-E-45
Not to Scale



NOTES:
1. All encountered sinkholes shall be cleaned to a min. depth of 4' below proposed grade. Remove all silt & debris prior to filling to a min. depth of 4'.

SINKHOLE REPAIR DETAIL
TYPICAL EMBANKMENT AREAS
Not to Scale



SECTION 45-H-49
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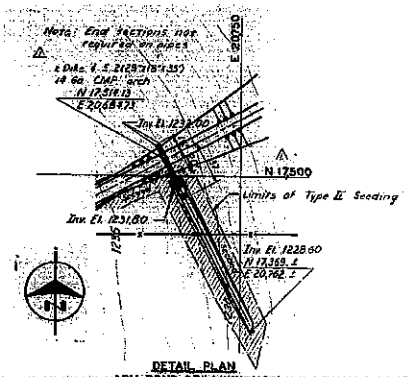
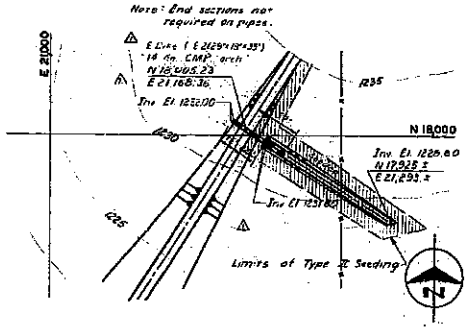
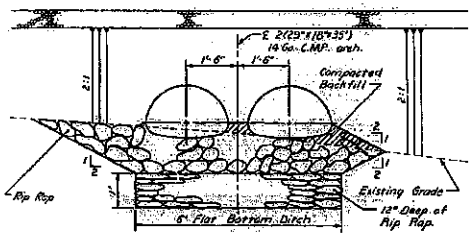


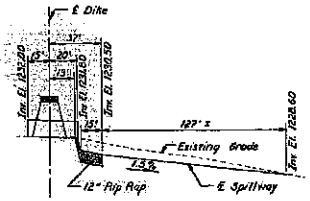
DETAIL PLAN
ASH POND SPILLWAY NO. 1
SCALE IN FEET



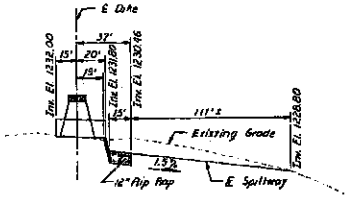
DETAIL PLAN
ASH POND SPILLWAY NO. 2
SCALE IN FEET



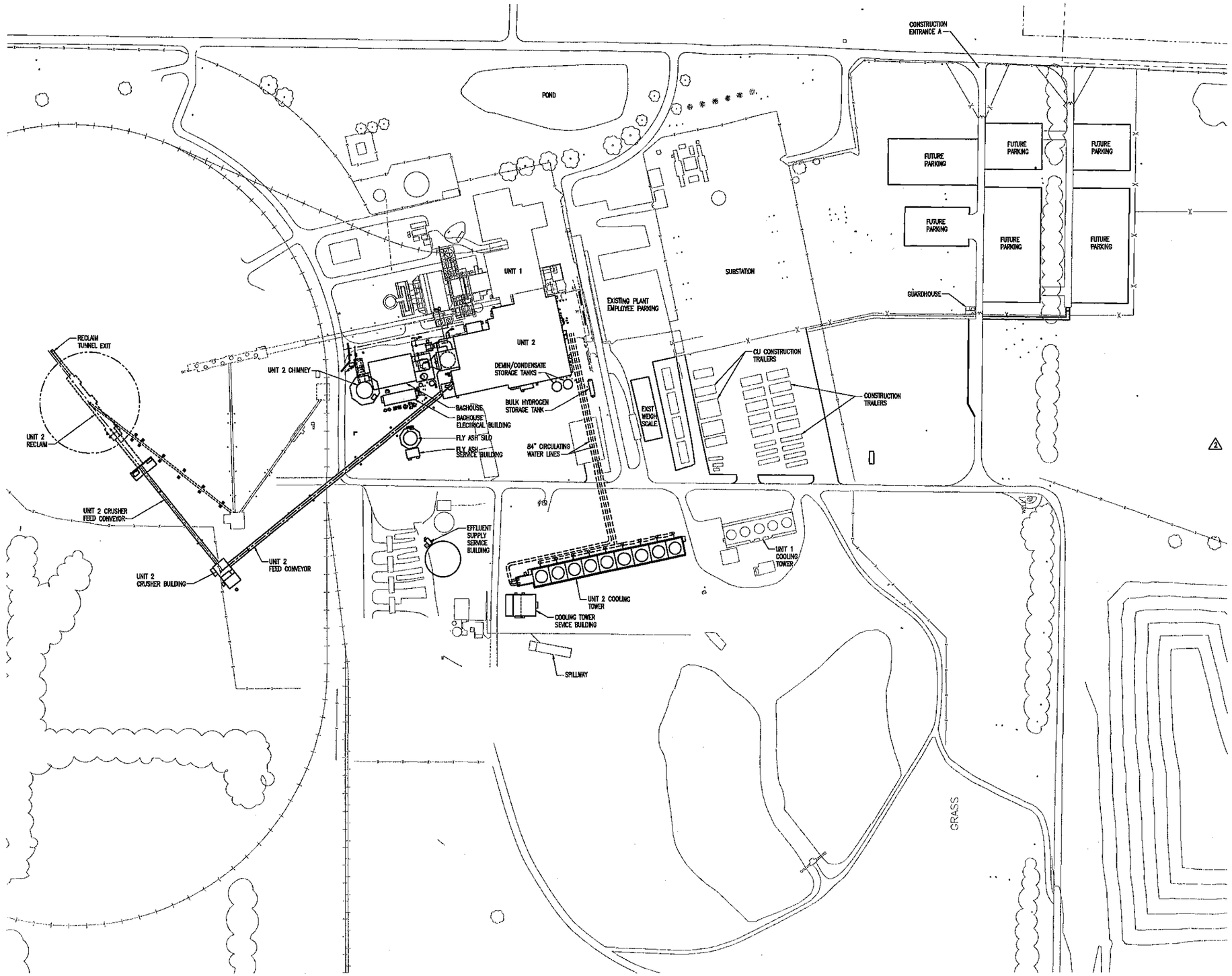
TYPICAL SECTION
SPILLWAY NO. 1 & 2
Not to Scale



PROFILE
ASH POND SPILLWAY NO. 1
Not to Scale



PROFILE
ASH POND SPILLWAY NO. 2
Not to Scale



NOTES:

1. NOT ALL DRAWINGS ARE ISSUED WITH EACH CONTRACT, SEE DRAWING INDEX FOR DRAWINGS INCLUDED.

THE ORIGINAL OF THIS DRAWING WAS SIGNED, SEALED, AND CERTIFIED BY:

REV:0	KORY C. TURNER	11-10-07
NO.REG.NO. PE-2000029713	EXP. DATE	12-31-08
REV:1	KORY C. TURNER	12-14-07
NO.REG.NO. PE-2000029713	EXP. DATE	12-31-08
REV:2	CATHERINE S. WENZEL	6-12-09
NO.REG.NO. PE-2007032447	EXP. DATE	12-31-09
REV:3	CATHERINE S. WENZEL	6-10-10
NO.REG.NO. PE-2007032447	EXP. DATE	12-31-11
REV:4		
NO.REG.NO.	EXP. DATE	
REV:5		
NO.REG.NO.	EXP. DATE	

FOR RECORD DRAWINGS, STANLEY CONSULTANTS PROVIDED ONLY DRAFTING SERVICES BASED ON MARK-UP PROVIDED BY OTHERS. STANLEY CONSULTANTS TAKES NO RESPONSIBILITY FOR ACCURACY OF THE MARK-UP OR ANY FIELD DESIGN CHANGES REFLECTED THEREIN.

NO.	REVISIONS	DWN	APVD	APVD	DATE
4	RECORD DRAWING FOR CONTRACT 281	DLW	CSW	MAE	6-1-11
3	RECORD DRAWING FOR CONTRACT 262	DLW	CSW	MAE	8-13-10
2	REVISED LEGEND	BCR	CSW	MAE	3-13-08
1	ISSUED FOR CONSTRUCTION	GAG	KCT	MAE	12-14-07

Stanley Consultants INC.

225 Iowa Avenue, Muscatine, Iowa 52761-3764
www.stanleyconsultants.com

CITY UTILITIES OF SPRINGFIELD MISSOURI
SOUTHWEST UNIT 2
SPRINGFIELD, MISSOURI

PLANT SITE ARRANGEMENT PLAN

DESIGNED C.S. WENZEL
DRAWN GA 2008
CHECKED C.S. WENZEL
APPROVED K.C. TURNER
APPROVED M.A. ELLIOTT
DATE OCTOBER 11, 2007

SCALE: 1"=100'
NO. 18000
GG200
REV. 4

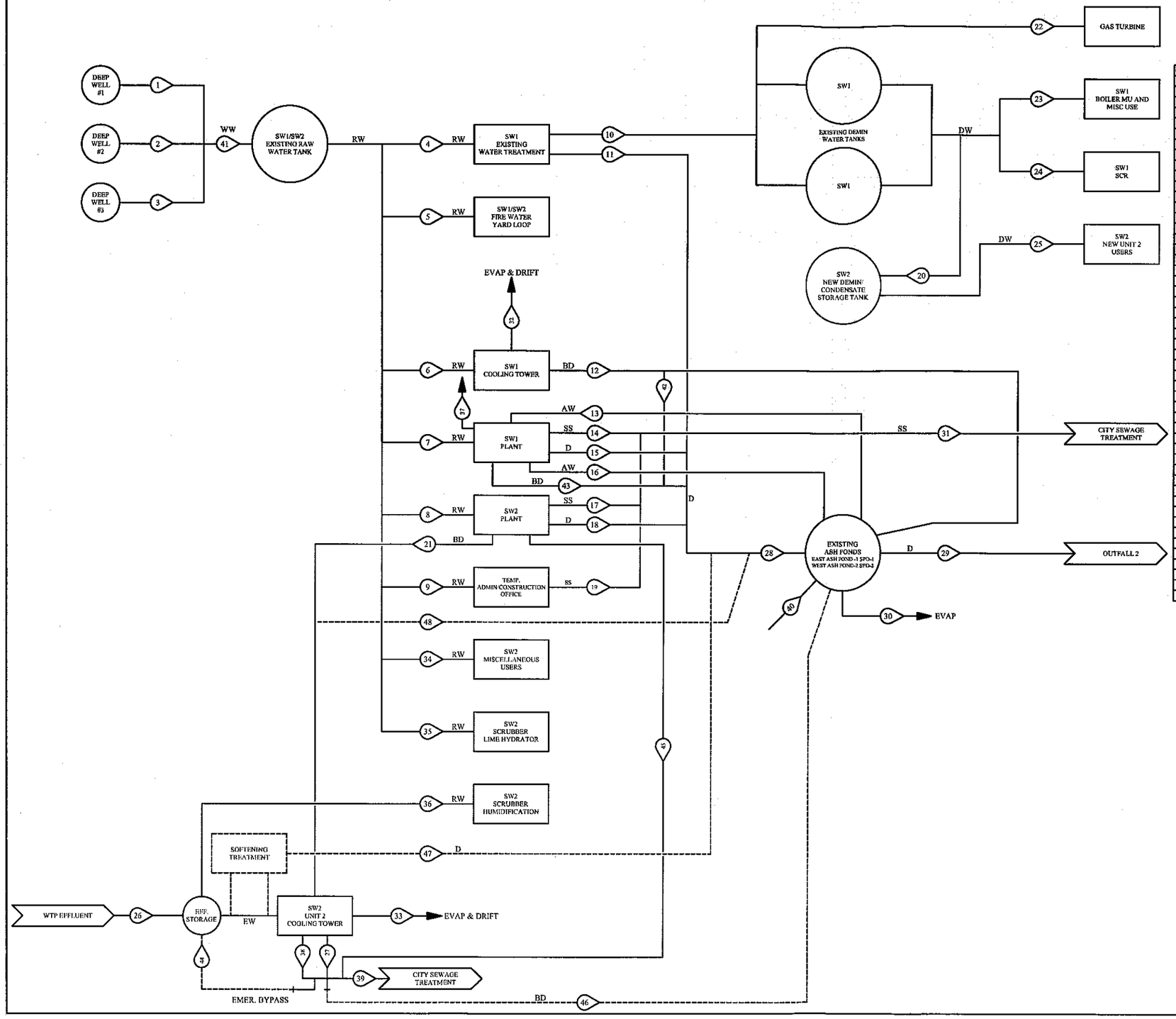
13D STANLEY CONSULTANTS

Appendix C

Doc 04: Power Station Process Diagrams

WB-1

CITY UTILITIES OF SPRINGFIELD, MISSOURI
SOUTHWEST POWER STATION
PLANT ID: 5265



CU LINE NO.	GENERAL DESCRIPTION	WATER TYPE	GPM PEAK	MGD PEAK	GPM AVG	MGD AVG
1	DEEP WELL #1	WELL	1600	2.30	1162	1.67
2	DEEP WELL #2	WELL	500	0.72	0	-
3	DEEP WELL #3	WELL	1600	2.30	1162	1.67
4	ION EXCHANGE RAW FEED	RAW	450	0.65	58	0.08
5	FIRE LINE FEED	RAW	3700	5.33	5	<0.01
6	SW1 COOLING TOWER MAKEUP	RAW	2217	3.19	2176	3.13
7	SW1 MISC. MAKEUP	RAW	26	0.04	15	0.02
8	SW2 RAW WATER IN	RAW	416	0.59	56	0.08
9	SW2 TEMP. CONST. OFF	RAW	12	0.02	1	<0.01
10	ION EXCHANGE WATER OUT	IX	250	0.36	40	0.06
11	ION EXCHANGE WASTE WATER	WASTE	450	0.65	18	0.03
12	SW1 COOLING TOWER BLOWDOWN	WASTE	312	0.45	271	0.39
13	SW1 ASH SLUICE IN	RECYCLE	2842	4.09	300	0.43
14	SW1 SEWER	SEWER	12	0.02	1	<0.01
15	SW1 PLANT DRAINS	WASTE	14	.02	14	0.02
16	SW1 ASH SLUICE OUT	RECYCLE	2775	4.0	233	0.36
17	SW2 SEWER	WASTE	2	<0.01	2	<0.01
18	SW2 PLANT DRAINS	WASTE	14	0.02	14	0.02
19	SW2 TEMP. CONST. OFF	SEWER	12	0.02	1	<0.01
20	ION EXCHANGE TRANSFER SW1 TO SW2	IX	40	0.03	20	0.06
21	SW2 BLR. BLOWDOWN TO SW2 CT	WASTE	400	0.58	40	0.06
22	ION EXCHANGE TO GAS TURBINE	IX	250	0.36	X	-
23	SW1 BLR. MAKEUP/MISC	IX	22	0.03	18	0.03
24	SW1 SCR	IX	2	<0.01	2	<0.01
25	SW2 BLR. MAKEUP/MISC	IX	40	0.06	20	0.03
26	SWTP EFFLUENT IN	EFF	3826	5.51	3460	4.98
27	SW2 COOLING TOWER BLOWDOWN	WASTE	1314	1.89	644	0.93
28	SW1 & SW2 WASTE STREAM TO ASH POND	WASTE	618	0.89	129	0.19
29	FLOW TO 002 OUTFALL	WASTE	2847	4.10	361	0.52
30	ASH POND EVAP		-	-	17	0.02
31	SW1/SW2 SANITARY SEWER	SEWER	24	0.03	2	<0.01
32	SW1 COOLING TOWER EVAP/DRIFT		1905	2.74	1905	2.74
33	SW2 COOLING TOWER EVAP/DRIFT		-	-	2635	3.79
34	SW2 MISCELLANEOUS	RAW	40	0.06	5	<0.01
35	RAW WATER TO LIME HYDRATER	RAW	7	0.01	7	0.01
36	SWTP EFFLUENT TO SW2 SCRUBBER	EFF	221	0.32	221	0.32
37	SW1 FURNACE SEAL AND BOTTOM ASH EVAP	RECYCLE	67	0.01	67	0.01
38	SW2 COOLING TOWER OUTAGE DRAIN	CIRC	1350	1.94	0	-
39	SW2 CT TO SWTP	CIRC	970	1.40	644	0.93
40	STORM WATER RUNOFF		2550	3.67	118	0.17
41	DEEPWELL TO RAW WATER TANK		3700	5.33	2323	3.35
42	SW1 COOLING TOWER BLOWDOWN TO SW1 FLASH TANK	CIRC	125	0.18	75	0.11
43	SW1 BLR. BLOWDOWN	BLR	15	0.02	8	0.01
44	EXCESS SW2 COOLING TOWER BLOWDOWN	CIRC	344	0.49	0	-
45	CLOSED COOLING WATER MAINT.	CIRC	43	0.06	0	<0.01
46	COOLING TOWER BLOWDOWN (CONTINGENCY)	CIRC	970	1.40	644	0.93
47	SOFTENING TREATMENT WASTE FLOW	WASTE			0.1	0.1
48	SW2 BLR. BLOWDOWN (CONTINGENCY)	WASTE	400	0.58	40	0.06

(XX) - FLOW STREAM NUMBER AND DIRECTION

AW - ASH WATER
BD - BLOWDOWN
D - DRAIN
DW - DEMINERALIZED WATER
BW - WTP EFFLUENT WATER
PW - POTABLE WATER
RW - RAW WATER
SS - SANITARY SEWER
WW- WELL WATER

—— = EXISTING SW1 AND COMMON
—— = SW2
- - - = CONTINGENCY

SOUTHWEST POWER PLANT

CITY UTILITIES
Bringing Power Home.

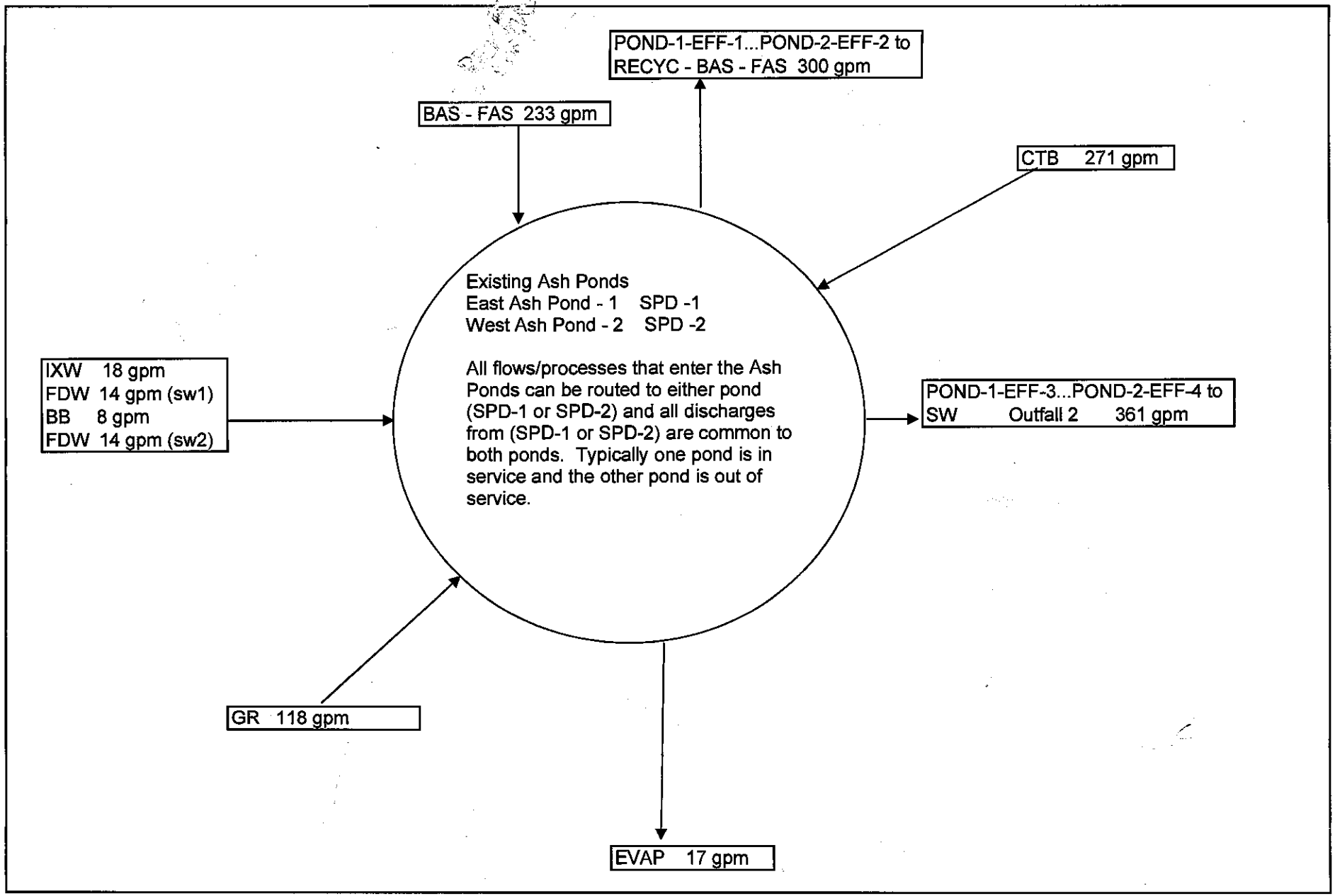
PROCESS FLOW DIAGRAM WATER BALANCE SOUTHWEST UNITS 1 & 2

ENGINEERED BY: JH	APPROVED BY: JH	DATE:	DATE ISSUED: 9/29/2010	MAP NO.:
DRAWN BY: B.HAWKINS	AGENCY NO.:		PLOT DATE/TIME: 9/30/2010	SCALE: NTS
APPLICATION NO.:	PERMIT NO.:		SHEET 2 OF 2	DRAWING NO.: CU-XM102

REV.:

Water Balance Block Diagram

WB-2
Plant ID: 5265
Southwest Power Station



Data for this diagram based on 4/28/2010 NPDES water balance

Appendix D

Photographs

Photograph 5.1. Crest of Embankment Dividing East and West Impoundments Looking South

Photograph 5.2. Crest of South Embankment showing West Impoundment Looking West

Photograph 5.3. Crest of South Embankment showing East Impoundment Looking West (showing traces of gravel pavement)

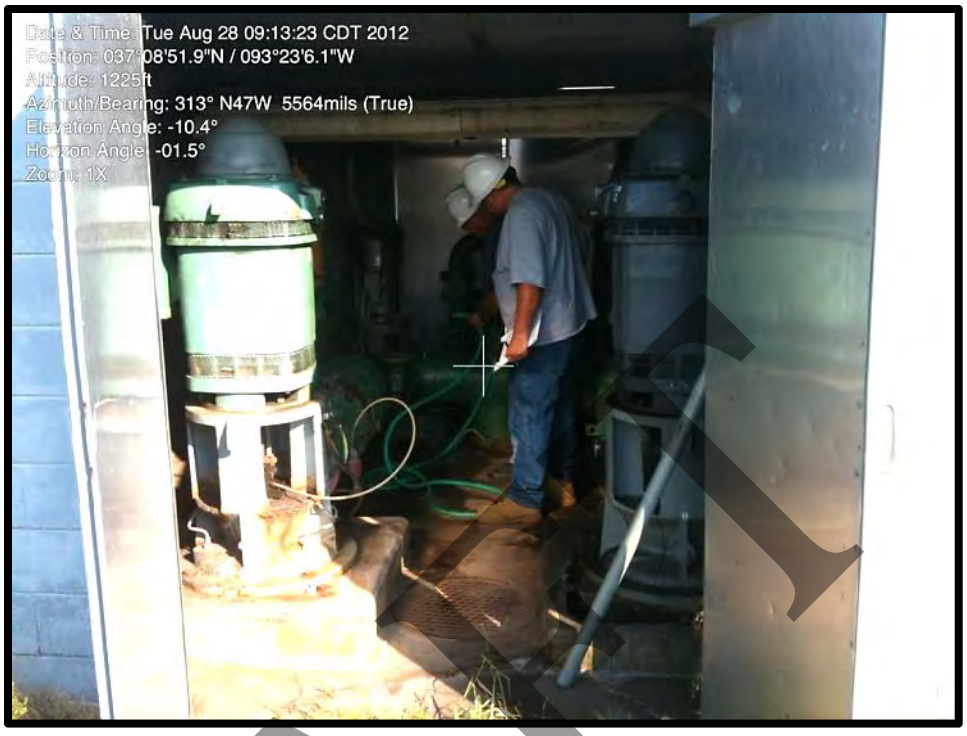
Photograph 5.4. Inside Slope of Embankment Dividing East and West Impoundments Showing East Impoundment Looking North

Photograph 5.5. Inside Slope of West Embankment for West Impoundment Looking North

Photograph 5.6. Inside Slope of West Embankment of West Impoundment Looking South

Photograph 5.7. Outside Slope of South Embankment (Dam) of East Impoundment Looking West (Typ.)

Photograph 5.8. 15-in Overflow Pipe for West Impoundment Looking South



Photograph 5.9. Pump Station Regulating Outlets for both Impoundments

Photograph 5.10. Valves Regulating East Impoundment Outlet Looking North

Photograph 5.11. Covered Outlet Weir with Valve for both Impoundments (also showing overflow pipes)

Appendix D
Photo GPS Locations

Site: Southwest Power Station
Datum: NAD 1983
Coordinate Units: Decimal Degrees

Photograph	Latitude	Longitude
5.1	37.14900	-93.38564
5.2	37.14744	-93.38508
5.3	37.14847	-93.38417
5.4	37.14769	-93.38478
5.5	37.14717	-93.38578
5.6	37.14964	-93.38733
5.7	37.14769	-93.38444
5.8	37.14775	-93.38514
5.9	37.14775	-93.38503
5.10	37.14769	-93.38500
5.11	37.14719	-93.38506

AERIAL PHOTOGRAPH SOURCE: GOOGLE EARTH PRO.

CDM Smith

SOUTHWEST POWER STATION
SPRINGFIELD, MISSOURI
PHOTOGRAPH LOCATIONS PLAN