

US EPA ARCHIVE DOCUMENT

Report of Geotechnical Investigation  
Dam Safety Assessment of Coal Combustion  
Surface Impoundments  
Kentucky Utilities, a Subsidiary of E.ON U.S.  
Green River Station, Central City, KY

AMEC Project No. 3-2106-0177-0002

Prepared By:

AMEC Earth & Environmental, Inc.  
690 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, KY 40299

Prepared For:

Mr. Stephen Hoffman  
U.S. EPA  
Emergency Response Service  
Center  
1200 Pennsylvania Ave., NW  
Washington, DC 20460

September 2010

I certify that the management units referenced herein:

Kentucky Utilities a Subsidiary of E.ON U.S, Green River Power Station: Ash Treatment Basin #1 (Main Pond), Ash Treatment Basin #2, Finishing Pond #3, Scrubber Pond and the Former Ash Pond (coal runoff pond) were assessed on August 16, 2010.

Signature \_\_\_\_\_  
James Black, PE  
Project Engineer

List of AMEC Participants who have participated in the assessment of the management units and in preparation of the report:

- Chris Eger  
CADD Technician
- Dan Conn  
GIS Specialist
- Mary Sawitzki, PE  
Civil/Environmental Engineer
- Shea Carr, PE  
Project Engineer

## TABLE OF CONTENTS

SECTION	PAGE NO.
<b>1.0 INTRODUCTION AND PROJECT DESCRIPTION.....</b>	<b>1</b>
1.1 Introduction.....	1
1.2 Project Background.....	1
1.2.1 State Issued Permits .....	3
1.3 Site Description and Location .....	3
1.4 Process Ponds.....	3
1.4.1 Ash Handling and Flow Summary.....	3
1.4.2 Ash Treatment Basin #1 .....	4
1.4.3 Ash Treatment Basin #2 .....	6
1.4.4 Finishing Pond #3.....	7
1.4.5 Scrubber Pond .....	7
1.4.6 Coal Pile Runoff Pond .....	8
1.5 Previously Identified Safety Issues.....	8
1.6 Site Geology .....	8
1.7 Inventory of Provided Materials.....	9
<b>2.0 FIELD ASSESSMENT .....</b>	<b>10</b>
2.1 Visual Observations .....	10
2.2 Ash Treatment Basin #1 (Main Ash Pond) - Visual Observations.....	10
2.2.1 Ash Treatment Basin #1 - Embankments and Crest .....	10
2.2.2 Ash Treatment Basin #1 - Outlet Control Structure .....	11
2.3 Ash Treatment Basin #2 - Visual Observations .....	11
2.3.1 Ash Treatment Basin #2 - Embankments and Crest .....	11
2.3.2 Ash Treatment Basin #2 - Outlet Control Structure .....	11
2.4 Finishing Pond #3 - Visual Observations.....	11
2.4.1 Finishing Pond #3 - Embankments and Crest.....	12
2.4.2 Finishing Pond #3 - Outlet Control Structure.....	12
2.5 Scrubber Pond - Visual Observations .....	12
2.5.1 Scrubber Pond - Embankments and Crest.....	12
2.5.2 Scrubber Pond - Outlet Control Structure .....	12
2.6 Coal Pile Runoff Pond - Visual Observations .....	13
2.6.1 Coal Pile Runoff Pond - Embankments and Crest .....	13
2.6.2 Coal Pile Runoff Pond - Outlet Control Structure .....	13
2.7 Monitoring Instrumentation.....	13
<b>3.0 DATA EVALUATION .....</b>	<b>14</b>
3.1 Design Assumptions .....	14
3.2 Hydrologic and Hydraulic Design .....	14
3.2.1 2010 Hydrologic and Hydraulic Study .....	18
3.3 Structural Adequacy & Stability .....	23
3.3.1 Ash Treatment Basin #1 - Structural Adequacy & Stability.....	23
3.3.2 Ash Treatment Basin #2 and Scrubber Pond - Structural Adequacy & Stability.....	26
3.3.3 Finishing Pond #3 - Structural Adequacy & Stability .....	29
3.3.4 Coal Pile Runoff Pond - Structural Adequacy & Stability.....	29
3.4 Foundation Conditions .....	29
3.5 Operations and Maintenance .....	29
3.5.1 Instrumentation.....	29



3.5.2	Inspections .....	30
<b>4.0</b>	<b>COMMENTS AND RECOMMENDATIONS .....</b>	<b>36</b>
4.1	Acknowledgement of Management Unit Conditions .....	36
4.2	Ash Treatment Basin #1 or Main Pond.....	37
4.2.1	Hydrologic and Hydraulic Recommendations .....	37
4.2.2	Geotechnical and Stability Recommendations .....	37
4.2.3	Monitoring and Instrumentation Recommendations .....	39
4.2.4	Inspection Recommendations.....	39
4.3	Ash Treatment Basin #2.....	39
4.3.1	Hydrologic and Hydraulic Recommendations .....	39
4.3.2	Geotechnical and Stability Recommendations .....	40
4.3.3	Monitoring and Instrumentation Recommendations .....	41
4.3.4	Inspection Recommendations.....	41
4.4	Scrubber Pond.....	41
4.4.1	Hydrologic and Hydraulic Recommendations .....	41
4.4.2	Geotechnical and Stability Recommendations .....	42
4.4.3	Monitoring and Instrumentation Recommendations .....	43
4.4.4	Inspection Recommendations.....	43
4.5	Former Ash Pond or Coal Runoff Pond.....	44
4.5.1	Hydrologic and Hydraulic Recommendations .....	44
4.5.2	Geotechnical and Stability Recommendations .....	44
4.5.3	Monitoring and Instrumentation Recommendations .....	45
4.5.4	Inspection Recommendations.....	45
<b>5.0</b>	<b>CLOSING.....</b>	<b>46</b>

## TABLES

Table 1.	Site Visit Attendees .....	1
Table 2.	MSHA* Minimum Long Term Hydrologic Design Criteria .....	16
Table 3.	Ash Treatment Basin #1 Elevation Conditions.....	19
Table 4.	Ash Treatment Basin #2 Elevation Conditions.....	19
Table 5.	Scrubber Pond Elevation Conditions .....	21
Table 6.	Coal Pile Runoff Pond Elevation Conditions .....	22
Table 7.	Minimum Required Dam Safety Factors .....	23
Table 8.	Stability Analysis Soil Parameters - Ash Treatment Basin #1 .....	24
Table 9.	Factors of Safety for Ash Treatment Basin #1 Slope Failure Area .....	25
Table 10.	Factors of Safety for Ash Treatment Basin #1 at Critical Section .....	26
Table 11.	Soil Parameters - Ash Treatment Basin #2 and Scrubber Pond .....	27
Table 12.	Slope Stability Analyses Results for Ash Treatment Basin #2 and Scrubber Pond ....	28
Table 13.	Piezometer Information .....	30

## FIGURES

Site Location & Vicinity Map.....	Figure 1
Site Plan .....	Figure 2
Critical Infrastructure Map .....	Figure 3
Site Topographic Map.....	Figure 4
Ash Treatment Basin #1 Typical Cross-Sections.....	Figure 5
Ash Treatment Basin #2 Typical Cross-Sections.....	Figure 6
Scrubber Cross-Section .....	Figure 7

Coal Pile Runoff Typical Cross-Section.....	Figure 8
Ash Treatment Basin #1 Borings, Piezometers & Cross Sections Locations .....	Figure 9
Ash Treatment Basin #1 Slope Failure Cross Section .....	Figure 10
Ash Treatment Basin #1 Critical Slope Cross Section .....	Figure 11
Ash Treatment Basin #2 Borings, Piezometers & Cross Sections Locations .....	Figure 12

## APPENDICES

EPA Coal Combustion Dam Inspection Checklists and Coal Combustion	
Waste Impoundment Inspection Forms - August 2010 .....	Appendix A
Site Photo Log Maps and Site Photos .....	Appendix B
Inventory of Provided Materials .....	Appendix C

## 1.0 INTRODUCTION AND PROJECT DESCRIPTION

### 1.1 Introduction

AMEC was contracted by the United States Environmental Protection Agency (EPA), via contract BPA EP09W001702, to perform site assessments of selected coal combustion byproducts surface impoundments. As part of this contract with EPA, AMEC was assigned to perform a site assessment of Kentucky Utilities (a Subsidiary of E.ON U.S.) Green River Power Station, which is located, approximately 6 miles north of Central City, Kentucky as shown on Figure 1, the Project Location Map.

A site visit to Green River Power Station was made by AMEC on August 16, 2010. The purpose of the visit was to perform visual observations, to inventory coal combustion waste (CCW) surface impoundments, assess the containment dikes, and to collect relevant historical impoundment documentation.

AMEC engineers, James Black, PE and Shea Carr, PE were accompanied during the site visit by the following individuals:

**Table 1. Site Visit Attendees**

Company or Organization	Name and Title
E.ON U.S.	Michael Winkler, Manager- Environmental Programs
Kentucky Utilities	Travis Harper, Chemist III
E.ON U.S.	Tom Troost, Plant Manager, Green River Power Station
E.ON U.S.	David J. Millay, P.E., Civil Engineer

### 1.2 Project Background

CCW results from the power production processes at coal fired power plants like Kentucky Utilities (KU) Green River Power Station. Impoundments (dams) are designed and constructed to provide storage and disposal for the CCW that are produced. KU refers to the five CCW impoundments at the Green River Power Station as "Ash Treatment Basin #1 or Main Pond", "Ash Treatment Basin #2", "Finishing Pond #3", "Scrubber Pond", and the "Former Ash Pond or Coal Runoff Pond".

The National Inventory of Dams (NID), administered by the U.S. Army Corps of Engineers (USACE), provides a list of many dams within the United States, as well as hazard potentials related to the listed dams. According to documentation provided by Kentucky Utilities, Ash Treatment Basin #2, Finishing Pond #3, and the Former Ash Pond or Coal Runoff Pond do not appear on the NID. Ash Treatment Basin #1 (or Main Pond) and Scrubber Pond are listed on the NID, with each assigned a low hazard rating.

The Kentucky Department for Natural Resources and Environmental Protection's (KDRE) Division of Water (KDOW) defines the term *dam*, as well as regulates dam design, construction

and repair. According to KDOW, a dam is defined as “any structure that is 25 feet in height, measured from the downstream toe to the crest of the dam, or has a maximum impounding capacity of 50 acre-feet or more at the top of the structure.” KDOW also evaluates a dam’s structure and various other criteria related to the effects of dam failure to determine and assign a dam hazard classification to each structure. KDOW’s Engineering Memorandum No. 5 provides minimum hydrologic and hydraulics related design criteria, as well as hazard classification definitions for dam structures. Dam hazard classifications, outlined in KDOW’s Engineering Memorandum No. 5, include Low Hazard (A), Moderate Hazard (B), and High Hazard (C).

- A Low Hazard (A) classification is assigned to structures “located such that failure would cause loss of the structure itself but little or no additional damage to other property.”
- A Moderate Hazard (B) classification is assigned to structures that “are located such that failure may cause significant damage to property and project operation, but loss of human life is not envisioned.”
- A High Hazard (C) classification is assigned to “structures located such that failure may cause loss of life or serious damage to houses, industrial or commercial buildings, important public utilities, main highways or major railroads.”

According to KDOW, state inspections for dams with high (Class C) and moderate classifications (Class B) occur every two years, while dams with a low hazard classification (Class A) are inspected every five years. A Certification of Inspection is issued to the dam owner if, upon inspection, it is determined that the as-built structure meets all the necessary requirements as outlined in KDOW’s Engineering Memorandum No. 5. Following successful construction completion and inspection, the owner is given permission to impound water and the dam is placed on the KDOW inventory of dams.

KDOW has classified Ash Treatment Basin #1 (ID803) and Scrubber Pond (ID 804) as low hazard dams (Class A). According to the KDOW inspection document dated November 22, 2004, the Ash Treatment Basin #2, Finishing Pond #3, and the Former Ash Pond (Coal Runoff Pond) do “not meet the regulatory requirements and definition attributed to a ‘dam’”. Due to location, ash settlement and flow characteristics, operational methods of ash handling and lack of downstream development, it does not appear that overtopping of these impoundments would feasibly create any hydraulic (flooding) hazard downstream.”

As part of the observations and evaluations performed at Green River Power Station, AMEC completed EPA’s Coal Combustion Dam Inspection Checklists and Coal Combustion Waste (CCW) Impoundment Inspection Forms. Copies of the ash Impoundment Inspection Forms are provided in Appendix A. The Impoundment Inspection Forms include a section that assigns a “Hazard Potential” that is used to indicate what would occur following failure of an impoundment. “Hazard Potential” choices include “Less than Low,” “Low,” “Significant,” and “High.” Based on the site visit evaluation of the impoundments, AMEC engineers assigned a “Significant Hazard Potential” classification to the Ash Treatment Basin #1 or Main Pond, Ash Treatment Basin #2, Scrubber Pond, and the Former Ash Pond or Coal Runoff Pond, and no classification was assigned to the Finishing Pond #3. As defined on the Inspection Form, dams assigned a “Significant Hazard Potential” classification are those dams where failure or mis-operation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. AMEC assigned the “Significant Hazard Potential” classification to these impoundments based on their proximity to

Green River. AMEC did not assign a hazard potential classification to the Finishing Pond #3 because plant discharge flows have been rerouted and do not enter the pond; and, the dike has been removed.

### 1.2.1 State Issued Permits

The Kentucky Natural Resources and Environmental Protection Cabinet Department for Environmental Protection Division of Water has issued Kentucky Pollutant Discharge Elimination System (KPDES) Permit No. KY 0002011 to Kentucky Utilities Company. This KPDES Permit authorizes Kentucky Utilities to discharge from Green River Power Station into the Green River at mile points 81.3 and 81.6. The permit became effective on November 1, 2001 and expired on October 31, 2004. At the time of writing this report, KDOW stated the KPDES permit for Green River Power Station was under review.

KENTUCKY UTILITIES provided AMEC with a copy of the Certificate of Inspection for Ash Treatment Basin #1 and Scrubber Pond, which were dated November 22, 2004. Although KDOW regulations state that Class A dams shall be inspected every five years, no records were provided to show whether prior or subsequent inspections of the dam were performed. KENTUCKY UTILITIES stated that KDOW has not conducted an inspection at the facility since that time.

### 1.3 Site Description and Location

Kentucky Utilities Green River Power Station is located approximately 6 miles north of Central City, Kentucky. The area surrounding the plant boundary is primarily rural. The Green River is located to the south of the plant facilities. The distances between the closest point of the ash ponds and the Green River is approximately 400 feet for the coal pile runoff pond, and 75 feet for the Finishing Pond #3 (currently inactive pond). The Photo Site Plan, included as Figure 2, shows the location of the ash ponds and their proximity to the Green River.

An aerial photograph of the region indicating the location of Green River Power Station ash ponds in relation to schools, hospitals, and other critical infrastructure located within approximately 5 miles down gradient of the structures is included as Figure 3, the Critical Infrastructure Map. A table that provides names and coordinate data for the infrastructure is included on the map. Site topography is illustrated on Figure 4.

### 1.4 Process Ponds

#### 1.4.1 Ash Handling and Flow Summary

Green River Power Station utilizes coal in the production of electricity. In this process, two types of CCW ash are generated: bottom ash and fly ash. The Green River plant manages coal pile runoff and coal combustion waste using two Ash Treatment Basins (ATBs), a Coal Pile Runoff basin and a Flue Gas Desulfurization (FGD) Scrubber Pond.

Process flows to the ash basin primarily result from the operation of Green River Units 3 and 4 as well as management of residuals formed by the combustion of coal including:

- Fly ash and bottom ash sluicing flows;
- Coal mill rejects and pyrites;



- Boiler blowdown flows;
- Water demineralizer regeneration wastes and reverse osmosis system reject water flows;
- Miscellaneous filter backwash and floor drain flows (from plant sumps);
- Sewage treatment plant effluent flows;
- Miscellaneous once-thru cooling water flows; and,
- Coal pile runoff flows.

Once-through cooling water flows are used for the main condenser and are not routed through the ash basins. Instead, these flows are directed to the Green River downstream of the plant water intakes and buildings through a dedicated discharge stream. This flow also receives drainage from roof drains and intake filter backwash flows. The existing KPDES permit for the station addresses all of these flows. This includes monitoring requirements, limits and other conditions.

Documents provided by E.ON U.S. noted that the rainfall runoff areas to the ash basin include:

- Plant coal pile equipment maintenance areas located south of the plant boiler-turbine building;
- The coal pile runoff area. Runoff is collected in an approximately 5 acre pond which drains to the Ash Treatment Basin #2;
- Rainfall runoff flows associated with the watershed basin of the pond itself;
- Runoff from miscellaneous process areas of the plant include oil storage and delivery areas which are routed through an oil/water separator and the coal pile runoff pond prior to discharge to the Ash Treatment Basin #2.

#### **1.4.2 Ash Treatment Basin #1**

The Ash Treatment Basin #1 (Main Ash Pond) has an inside surface area of approximately 32 acres and receives process flows from plant operations and rainfall runoff flows. The basin discharges from a rectangular reinforced concrete decant structure that has stop-logs to control the pond water level. A floating skimmer upstream of the decant structure prevents potential discharge of floating solids or oil sheens. The discharge flow is conveyed to Ash Treatment Basin #2 through an open channel.

##### Current Pond Conditions

The Ash Treatment Basin #1 was constructed in 1977. The impoundment consists of three embankments along the east, south and west side of the pond. The north limits of the east and west embankments intersect a native hill. The total length of constructed embankment is approximately 2,700 linear feet. The design crest elevation is 450 feet National Geodetic

Vertical Datum of 1929 (NGVD) with a crest width of about 20 feet. The bottom of pond elevation is approximately 395 feet NGVD. The lowest toe elevation at the maximum section is approximately 400 feet NGVD resulting in a maximum dam height of approximately 50 feet. The downstream slope faces are nominally reported to be 2.5H:1V (horizontal to vertical) and the upstream slopes (wet side) are nominally 2H:1V. Figures 5 and 6 illustrate the Green River Main Ash Pond Plan View and Typical Cross Sections. Kentucky Utilities was unable to determine if the dam was constructed under the supervision of a professional engineer. Documentation indicates the dam was designed and is currently inspected by a professional engineer.

### Previous Pond Issues

We understand the Ash Treatment Basin #1's southern embankment has experienced two slope failures. During our site investigation, we observed a buttress has been constructed on the downstream slope of the dam beginning approximately 200 feet northeast of piezometer P3A. This structure is not shown on the original H.C. Nutting drawings and no other records could be located. However, it is known to have been constructed to repair a previous slope failure. The second slope failure occurred in November 2009 and a July 14, 2010 report entitled *Final Geotechnical Report, Main Ash Pond, Slope Stability Analysis and Repair, Green River Station*, prepared by Associated Engineers, Inc., discusses the stability of the entire Main Ash Pond dam along with analysis and design recommendations specific to the recent (2010) slope repair activities. Within the report the slope failure cause was described as follows;

*Based on the available data, the probable triggering mechanism of the slope failure was excessive moisture originating from a combination of factors including subtle grading at the top of the dam which directs drainage down the slope in this area, and possible focused surface and subsurface drainage along the base of the dam from the northeast due to topographic influence. Rutting and surface scarring that appeared to have occurred during mowing operations, along with poor vegetative cover conditions were also probable causation factors. High moisture conditions appeared to be restricted to a limited area in the outer portion of the dam material near the base and did not extend into the interior of the dam construction material. The lower portions of the fly ash and underlying dark grayish brown silty clay were wet and exhibited N-values of 6 to 8. Moisture may be contributed by these units but they were not part of the existing slump feature.*

The southern slope of the Main Ash Pond was repaired in May and June of 2010 by excavating and reconstructing the slope with rock. The recommendations were outlined in Associated Engineers report and are summarized below.

1. Excavate the cut slope on a 1:1 slope and reconstruct with rock on a 2:1 slope,
2. Place Geotextile Fabric, Type IV on excavated soil area meeting the requirements of Section 843, Type IV, of the current edition of the Kentucky KOT, Standard Specifications for Road and Bridge Construction (Appendix E). Install Geotextile Fabric according to Section 214 of the Standard Specifications for Road and Bridge Construction (Appendix E). Prepare the surface to a smooth condition, free of obstructions, debris, or sharp objects that may puncture the fabric. Place the fabric smooth and free of tension, stress, folds, wrinkles, or creases. Do not operate equipment directly on the fabric. Overlap strips at least

18 inches. Place transverse laps so the upslope strip laps over the downslope strip. Install fastener pins through both strips of overlapped fabric at no less than 5-foot intervals along a line through the midpoint of the overlap, and at any other locations as necessary to prevent any slippage of the fabric. Place fabric with the long dimension parallel to the long dimension of the section to be covered.

3. Install a 6" perforated pipe as shown on the plans. Place outlet at the lowest point of the excavation.
4. Use Kentucky Coarse Aggregate No. 2's, 3's, or 23's meeting the requirements of Sections 703 and 805 of the Standard Specifications for Road and Bridge Construction (Current Edition).

Associated Engineers noted in their report that their services were requested on May 18, 2010 to observe the repair construction of the slope failure area. A final inspection was performed on June 17, 2010 with Associated Engineers noting the only remaining issues were grouting of the toe drain pipe at the headwall and seeding and strawing at the toe of the repaired area.

#### **1.4.3 Ash Treatment Basin #2**

The Ash Treatment Basin #2 has an inside surface area of approximately 23 acres and receives flows from the Ash Treatment Basin #1, coal pile runoff pond, and rainfall runoff. Depending on seasonal rainfall, accumulated rainfall waters are also pumped from the Scrubber Pond to the Ash Treatment Basin #2. The discharge of this pond flows through a rectangular reinforced concrete decant structure consisting of stop-logs to control the pond water level. A floating skimmer upstream of the decant structure prevents potential discharge of floating solids or oil sheens. Flow is directed to the Kentucky Pollution Discharge Elimination System (KPDES) monitoring and sampling point. This monitoring/sampling point consists of a concrete structure with a rectangular concrete weir. Flow from the monitoring/sampling point structure discharges to a rip-rap lined open channel which directs flow to the Green River downstream of the plant buildings. Plant operations staff manages the pool elevation by adjusting stop log elevations as necessary to maintain freeboard.

##### Current Pond Conditions

Ash Treatment Basin #2 was formed out of the original plant "Settling Basin" constructed in 1949. In the 1970s, the south embankment of the original pond was expanded to the east and north, and a divider dike was constructed to create a two-cell pond. The east pond is referred to as the Ash Treatment Basin #2 which intersects the native hill side at the northern limit of the pond. The total length of constructed embankments for this complex is approximately 2,500 linear feet. The typical crest elevation for the Ash Treatment Basin #2 is 400 feet National Geodetic Vertical Datum of 1929 (NGVD) with a typical crest width of about 15 feet (per ATC inspection report dated October 2009). The bottom of pond elevation is approximately 385 feet NGVD. The downstream toe elevation varies with the lowest toe elevation of 385 feet NGVD resulting in a maximum dam height of approximately 15 feet. The downstream slopes are reported to be nominally 2H:1V (horizontal to vertical) and the upstream slopes (wet side) are nominally 2H:1V.

A plan view of Ash Treatment Basin #2 is provided on Figure 4; and, typical cross sections are illustrated on Figure 6. Kentucky Utilities was unable to determine if the dam was designed and



constructed under the supervision of a professional engineer, however documentation indicates the dam is currently inspected by a professional engineer.

#### 1.4.4 Finishing Pond #3

A Tertiary pond, Finishing Pond #3, previously maintained by the plant, was located downstream of the Ash Treatment Basin #2 immediately prior to final discharge into the Green River. The plant did not directly discharge ash or plant process materials into the pond; however, the pond has received carryover of coal combustion residual materials. Because the KPDES monitoring-sampling point was upstream of the pond, the pond had no functional necessity and was removed from service in 2010. Removal from service included:

- Rerouting the Ash Treatment Basin #2 discharge and KPDES monitoring-sampling point channel around the Tertiary pond and directly into the final KPDES Outfall discharge into the Green River. This rerouted channel is lined with a non-woven geotextile fabric installed beneath 12 inches of 4-6 inch diameter crushed limestone rip-rap;
- Regrading constructed embankment such that there is no feature present to impound water. Regrading included installation of crushed limestone blankets to control erosion;
- Removal of obsolete outlet structure; and,
- Regrading the former pond area to promote vegetation growth; and installing erosion control measures such as grass seeding, straw and silt fence.

Figures illustrating historic or current conditions of Finishing Pond #3 were not included in this report as documentation was not provided in a manner that would allow for clear representation of the pond's existing condition.

#### 1.4.5 Scrubber Pond

The Scrubber Pond has an inside surface area of approximately ten acres and has not received process water since 2003 due to retirement of Units 1 and 2 and their flue gas desulfurization (FGD) systems. The pond remains available for possible future FGD material storage if necessary for Units 3 and 4. Previously the pond received FGD slurry material by pipelines. The solids settled, and the water was recycled for use in the FGD system. Currently, the pond accumulates rainfall. Plant operations staff manages the pool elevation by pumping to the Ash Treatment Basin #2.

##### Current Pond Conditions

The Scrubber Pond (also known as the SO<sub>2</sub> Removal Pond) was constructed in 1975 to manage FGD residuals for Green River Power Station Units 1 and 2, and since these units retirement in 2001 the Scrubber Pond has not received FGD residuals. The impoundment consists of three embankments along the east, south and west side of the pond. The north limits of the east and west embankments intersect a native hill. The total length of constructed embankment is approximately 2,000 linear feet. The design crest elevation is 405 feet National Geodetic Vertical Datum of 1929 (NGVD) with a crest width of 10 feet. The bottom of pond elevation is approximately 385 feet NGVD. The downstream toe elevation varies with the lowest toe

elevation of 385 feet NGVD resulting in a maximum dam height of approximately 20 feet. The upstream and downstream slope faces were designed to be 2.5H:1V (horizontal to vertical).

A plan view of the Scrubber Pond is provided on Figure 4; and, typical cross sections are illustrated on Figure 7. Kentucky Utilities was unable to determine if the dam was constructed under the supervision of a professional engineer, however documentation indicates the dam was designed and is currently inspected by a professional engineer.

#### 1.4.6 Coal Pile Runoff Pond

The coal pile runoff basin has an inside surface area of approximately six acres and drains into the Ash Treatment Basin #2. In addition to the coal pile runoff, the pond receives plant sump/process flows from the oil-water separator and sewage treatment plant.

##### Current Pond Conditions

The Coal Pile Runoff Basin was formed out of the original plant "Settling Basin" constructed in 1949. In the 1970s, the south embankment of the original pond was expanded to the east and a divider dike was constructed to create a two-cell pond. The west pond is referred to as the Coal Pile Runoff Pond which intersects the native hillside at the northern limit of the pond. The total length of constructed embankments for this complex is approximately 1,200 linear feet. The typical crest elevation for the Coal Pile Runoff Pond is 405 feet National Geodetic Vertical Datum of 1929 (NGVD) with a typical crest width of about 15 feet. The bottom of pond elevation is approximately 385 feet NGVD resulting in a maximum dam height of approximately 20 feet. The downstream slope faces are nominally reported to be 2H:1V (horizontal to vertical) and the upstream slopes (wet side) are nominally 2.2H:1V.

A plan view of the Coal Pile Runoff Pond is provided on Figure 4; and, typical cross sections are illustrated on Figure 8. Kentucky Utilities was unable to determine if the dam was designed or constructed under the supervision of a professional engineer, however documentation indicates the dam is currently inspected by a professional engineer.

#### 1.5 Previously Identified Safety Issues

Discussions with plant personnel and review of provided documentation indicate that except for the slope stability issues previously mentioned for the Main Ash Pond, there are no other current or previously identified safety issues from the previous 5 years at Green River Power Station.

#### 1.6 Site Geology

H.C. Nutting Company completed a geotechnical report entitled *Report of Geotechnical Investigation, Phase I, Proposed Fly Ash Disposal Area, Green River Power Station, For Kentucky Utilities Company, Inc.*, dated May 2, 1975. Within the report the site geology was described as follows;

*The plant is located more or less in the north central part of Muhlenberg County, Kentucky immediately north of the Green River and approximately 6 miles north of Central City, Kentucky. The site is situated near the center of the Western Kentucky coal fields. The bedrock underlying the site is part of the Pennsylvanian System of the upper Pennsylvanian Series. The geologic maps*

*indicate the No. 15 coal bed to outcrop at approximately elevation 450 ± and the No. 14A and No. 14 coal bed at some depth below elevation 390. The upper Pennsylvanian bedrocks at the site consist of sandstone, shale, coal and under clay. The predominant material is shale and sandstone. The shales range from clay shale to silty shales to sandy shales. The sandstones are typically fine to medium grained, micaceous, generally soft and friable, then to thick bedded and commonly irregularly bedded and cross bedded. The sandstones are usually massive where weathered.*

*The proposed ash retention area (Main Pond) is located on the foot slopes of the bedrock hills forming the north or northwest wall of the Green River valley. The flat area (valley floor) immediately south of (below) the proposed dam location consists of moderately deep alluvial clays, silts and fine sands above the buried bedrock.*

*During the geologic past there has been considerable faulting in Muhlenberg County; however, none have been mapped within about five miles of the site.*

### **1.7 Inventory of Provided Materials**

Kentucky Utilities provided AMEC with numerous documents pertaining to the design and operation of Green River Power Station. These documents were used in the preparation of this report and are listed in Appendix C, Inventory of Provided Materials.

## 2.0 FIELD ASSESSMENT

### 2.1 Visual Observations

AMEC performed visual assessments of Green River Power Station's five ash pond units on August 16, 2010. Assessment of the ash ponds was completed in general accordance with *FEMA's Federal Guidelines for Dam Safety, Hazard Potential Classification System for Dams, April 2004*. The EPA Coal Combustion Dam Inspection Checklist and Coal Combustion Waste (CCW) Impoundment Inspection Forms were completed for each ash pond during the site visit. The completed forms were provided to the EPA via email three days following the site visit. Copies of the completed checklists are included in Appendix A. In addition to completing the checklist and assessment forms, photographs were taken of each impoundment during the site visit. Photo site location maps and descriptive photos are included in Appendix B.

To maintain consistency with the utility and other associated reports/inspections, directions used herein are based on plant north (river is south) instead of true north (located approximately 45 to 60 degrees to the right).

### 2.2 Ash Treatment Basin #1 (Main Ash Pond) - Visual Observations

The Ash Treatment Basin #1 is currently active and receives/contains fly ash and bottom ash. The pond is also referred to as Main Ash Pond.

#### 2.2.1 Ash Treatment Basin #1 - Embankments and Crest

The ash pond has a side-hill configuration; and, a freeboard of approximately 4.5 feet between the top of water and top of dike was observed during the site visit (photo M-13). Original ground above the elevation of the pond is to the north. Dikes are present on the west, south and east sides of the pond. The crest of the dam and upstream slopes of the west and south dikes were primarily surfaced with crushed stone (photos M-1, M-6, M-8, and M-17). The surface of the downstream slopes of the dikes and the upstream slope of the east dike was primarily covered with grass (photos M-2, M-5, and M-17). Sparse grass cover was observed on the downstream slope of the west dike (photo M-2). Ash was observed to be stacked to a height just below the crest of the south dike at the southwest end of the pond (photo M-3). Two above ground pipes for sluicing ash to the pond are located on the west portion of the south dike. The pipes traverse the downstream slope of the south dike then cross the crest through a concrete culvert (photos M-25 and M-8). Two rock buttresses, reportedly installed due to shallow surface failures, were observed on the downstream slope of the south dike, one on the west and one on the east portions of the dike (photos M-9 and M-12). The buttresses reportedly include drains which are tied to a collector pipe and directed to the toe of the slope. Flowing water was observed from the outlet of the west buttress; however, flowing water was not observed at the east outlet (photos M-24 and M-21). Sparse grass cover and uneven slopes were observed on the mid-section of the downstream slope of the south dike beginning at the west buttress and extending for about 300 feet to the east (photo M-23). A stockpile of sand and gravel was observed at the north end of the east dike (photo M-20). Trees appeared to be growing within the interior at the northeast end of the pond, but they may be growing on fingers of original ground extending into the interior from the north (photo M-20). Old matting and straw was observed on the downstream slope of the west dike. Reportedly, the slope was seeded and matted last fall but weather killed most of the planting. Kentucky Utilities stated they had bid out a contract to reseed the slopes this fall.

## 2.2.2 Ash Treatment Basin #1 - Outlet Control Structure

The primary outlet for Ash Treatment Basin #1 is a concrete structure located adjacent to the south dike at the east end of the pond (photo M-10). The concrete structure supports a floating perimeter skimmer and adjustable stop log unit that facilitates water level adjustments as needed, based on plant operations (photos M-13, M-14, and M-15). Flow from this primary outlet structure is conveyed through a 36-inch diameter reinforced concrete pipe to the discharge point which is located at the downstream toe of the south dike (photos M-12 and M-22). Erosion along the sides of the outlet sidewall was observed during the field visit (photo M-22). The outfall from Ash Treatment Basin #1 flows south in an open ditch and discharges into Ash Treatment Basin #2 (photo M-12).

## 2.3 Ash Treatment Basin #2 - Visual Observations

Ash Pond 2, or Ash Treatment Basin #2 (ATB#2), is located adjacent and to the east of the Coal Pile Runoff Pond (photo CR-6). Ash Pond 2 receives discharge from the Main Pond, the Coal Pile Runoff Pond and periodically from the Scrubber Pond.

### 2.3.1 Ash Treatment Basin #2 - Embankments and Crest

Ash Treatment Basin #2 has a diked configuration with a connection to natural ground located on the north end of the basin. Ash is currently stacked on the southwest end of the pond and the northeast portion, approximately 40% of the total pond area, is water (photos 2-1 and 2-11). A freeboard of approximately 3 feet between the top of water and top of dike was observed during the site visit (photo 2-11). The west dike is common with the Coal Pile Runoff Pond. The crest of the dam was surfaced with crushed stone (photos CR-8, 2-1, and 2-8). Upstream slopes of the dike were covered with grass and/or rock (photo 2-1, 2-2, and 2-8). Except for approximately one-half of the length of the slope on the west end of the south dike, the downstream slopes were covered with rock (photos 2-3, 2-9, and 2-10).

### 2.3.2 Ash Treatment Basin #2 - Outlet Control Structure

The outlet structure for Ash Treatment Basin #2 consists of a concrete riser structure located on the north end of the east dike. The riser structure supports a floating metal pipe and rubber perimeter skimmer and an adjustable stop log unit that facilitates water level adjustment as needed, based on plant operations (photos 2-11 and 2-12). A 30-inch diameter culvert pipe empties the riser into a concrete box that is located beyond the toe of the downstream embankment. The concrete box contains a fixed overflow weir, most likely used as a flow measurement device for the permitted NPDES discharge location 001 (photos 2-13 and 2-14). The flow then enters a rock lined channel that ultimately discharges to Green River (photos 2-6 and 2-16). KU representatives present during the field visit indicated the roadway was the south embankment for the Coal Pile Runoff Pond and Ash Pond 2. A distinct drop in elevation was observed on the south dike/road at Ash Treatment Basin #2 (photo 2-4). An interior mound of ash located north of the south dike appeared to carry the same top of dike elevation from the Coal Pile Runoff Pond (photos 2-1, 2-2, 2-3, and 2-4). If the road is the dike, the interior mound of ash is above the dike elevation.

## 2.4 Finishing Pond #3 - Visual Observations

Finishing Pond #3 is located to the south of Ash Treatment Basin #2 and north of the Green River. Formerly, Finishing Pond #3 was used as a finishing pond (below the NPDES outfall)



prior to discharging the site water to the Green River. The Ash Treatment Basin #3 dike was located to the south, west, and east. The dike has been removed/regraded and the resulting area armored with rip-rap, hence, Ash Treatment Basin #3 is no longer in service. Photos of the current site outlet pipe and ditch, which are located to the east of pond, former area of the pond, and regraded dike are presented in photos SP-1, SP-2, and SP-3.

#### **2.4.1 Finishing Pond #3 - Embankments and Crest**

The dike for Finishing Pond #3 has been regraded. This pond is considered to be no longer in service. It is our understanding ash was not removed from within the interior of the pond when the dike was removed.

#### **2.4.2 Finishing Pond #3 - Outlet Control Structure**

The dike for Finishing Pond #3 has been regraded, the pond taken out of service, and it does not presently have an outlet structure.

### **2.5 Scrubber Pond - Visual Observations**

The Scrubber Pond is located to the east of Ash Treatment Basin #2. The Scrubber pond is active but does not receive liquid-borne CCW materials. The scrubber pond receives rainfall and surface water runoff and the water level is adjusted about twice a year.

#### **2.5.1 Scrubber Pond - Embankments and Crest**

The Scrubber Pond has a side-hill/incised configuration. The connection to natural ground at the Scrubber Pond is located on the pond's north side. Ash is currently stacked on the pond's north and south ends, with water in approximately 60% of the total pond area (photo SP-4). A freeboard of approximately five feet between the top of the water and top of the south dike was observed during the site visit (photo SP-3). The upstream embankment is covered with grass (photos SP-1, SP-2, SP-5, SP-6, and SP-7). The crest of the dam was surfaced with crushed stone (photos SP-1, SP-2, SP-5, SP-6, and SP-7). The surface of the downstream embankment was also covered with grass (photos SP-8, SP-10, SP-11, SP-12, and SP-13). Ash within the pond was observed to be approximately one foot below the elevation of the west dike (photo SP-1). An uneven elevation across the crest (dipping to the interior) was also observed along the west dike (photo SP-1). Ash and/or piles of debris were observed above the elevation of the north dike (photo SP-2). Uneven/steepened slopes were observed on the upstream slopes of the south and east dikes (photos SP-5 and SP-6). This condition was reportedly caused by recent use of equipment to remove or flatten vegetation on or near the slope. Areas with sparse vegetation were observed on the downstream slopes of the west, south and east dikes (photos SP-8, SP-10, SP-11, and SP-12). A recent repair of a small surface slide was observed on the downstream slope near the southwest corner of the pond (photo SP-10). Repairs at and below the toe of the downstream slope were observed at the west end of the south dike (photo SP-11).

#### **2.5.2 Scrubber Pond - Outlet Control Structure**

The scrubber pond does not have a formal outlet structure. The means to remove water from the pond is via a floating pump platform located at the southwest end of the pond (photo SP-3). It has been reported that the pond receives only rainfall and surface water; and, that the pond is pumped down about twice a year with the outflow discharging to Ash Treatment Basin #2.

## **2.6 Coal Pile Runoff Pond - Visual Observations**

The Coal Pile Runoff Pond is located below and to the southwest of the Main Ash Pond (photo M-9). The pond was a former ash pond for the plant; however, it now serves to receive surface water runoff from an adjacent coal pile, located to its west, and other liquid forms of plant waste. The east dike of the Coal Pile Runoff Pond is a common dike with Ash Treatment Basin #2.

### **2.6.1 Coal Pile Runoff Pond - Embankments and Crest**

The Coal Pile Runoff Pond generally has a diked configuration with dikes on the west, south and east embankments and a tie-in to natural ground located to the north. Ash is currently stacked on the south half of the pond and the north half is water (photos CR-3 and CR-9). A freeboard of approximately three feet between the operating water surface and the east dike crest was observed during the site visit (photo CR-4). The crest along the south and east dikes of the pond is covered with crushed stone (photos CR-2, CR-3, and CR-10). The surface of the upstream and downstream embankments was covered with grass (photos CR-1, CR-3, and CR-10). The downstream slope of the south dike (road) was observed to be steep with areas of sparse grass cover (photo CR-1). The west side of the pond is higher ground from the coal pile and includes a separating berm associated with the coal pile (photos CR-5 and CR-9).

### **2.6.2 Coal Pile Runoff Pond - Outlet Control Structure**

The primary outlet for the Coal Pile Runoff Pond is located at the northeast end of the pond (photo CR-4). The outlet consists of a metal and boom perimeter skimmer and a corrugated metal pipe (photo CR-7). Flow from the outlet pipe is conveyed through the embankment to discharge into Ash Treatment Basin #2 (photo CR-8).

## **2.7 Monitoring Instrumentation**

Historically, impoundment monitoring equipment has not been used at the Green River Power facility. However, new piezometers were recently installed at Ash Treatment Basin #1 (5), the Coal Pile Runoff Pond (1), Ash Treatment Basin #2 (3), and the Scrubber Pond (3). Operating data was not submitted in reference to the piezometers due to their recent installation.

### 3.0 DATA EVALUATION

#### 3.1 Design Assumptions

This section provides a summary of accepted minimum design criteria for dams and impoundments with respect to hydrologic, hydraulic and stability design of those structures. The relevant, methodology, design criteria, data, and analyses information that was provided for the particular project impoundments concerning hydrologic and hydraulic issues, as well as for structural adequacy and stability issues, is then presented and compared to the accepted minimum industry criteria.

#### 3.2 Hydrologic and Hydraulic Design

##### KDOW

The Kentucky Department for Natural Resources and Environmental Protection, Division of Water, Engineering Memorandum No. 5 (EM No. 5), Section C, provides minimum hydrologic design criteria for all dams, as defined by KRS 151.100, and all other impounding obstructions which might create a hazard to life or property, that are constructed within the state of Kentucky. EM No. 5 provides equations to determine the minimum hydrologic criteria to be used in the development of emergency and spillway hydrographs for the structures. Definitions provided in EM No. 5 for emergency and hydrograph spillways are as follows:

“The emergency-spillway hydrograph is that hydrograph used to establish the minimum design dimensions of the emergency spillway.”

“The freeboard hydrograph is the hydrograph used to establish the minimum elevation of the top of the dam.”

Precipitation values to be used in determination of the emergency and freeboard hydrographs for low, moderate, and high hazard class dams are provided by EM No. 5 and are as follows. .

##### Emergency Spillway Hydrograph

$$\text{Class (A) Low Hazard Structure} \quad P_A = P_{100} \quad (1)$$

$$\text{Class (B) Moderate Hazard Structure} \quad P_B = P_{100} + [0.12 \times (\text{PMP} - P_{100})] \quad (2)$$

$$\text{Class (C) High Hazard Structure} \quad P_C = P_{100} + [0.26 \times (\text{PMP} - P_{100})] \quad (3)$$

##### Freeboard Hydrograph

$$\text{Class (A) Low Hazard Structure} \quad P_A = P_{100} + [0.12 \times (\text{PMP} - P_{100})] \quad (4)$$

$$\text{Class (B) Moderate Hazard Structure} \quad P_B = P_{100} + [0.40 \times (\text{PMP} - P_{100})] \quad (5)$$

$$\text{Class (C) High Hazard Structure} \quad P_C = \text{PMP} \quad (6)$$

where, P refers to 6-hour precipitation,  $P_{100}$  refers to 6-hour, 100-year precipitation, and PMP refers to 6-hour Probable Maximum Precipitation.



According to EM No. 5, the freeboard hydrograph rainfall depth established by the equation “does not eliminate the need for sound engineering judgment but only establishes the lowest limit of design considered acceptable.” Several sources are provided in EM No. 5 regarding where to obtain rainfall values to use in the equations. Engineering Memorandum No. 2 (EM No. 2), issued by KDOW and last revised on June 1, 1979, is entitled “Rainfall Frequency Values for Kentucky”, and is noted as an acceptable data source for rainfall data for locations in Kentucky.

With respect to the principal spillway, EM No. 5 states that “It is desirable that the retarding pool be emptied in ten (10) days or less. It may be assumed that this requirement has been met if eighty (80) percent of the maximum volume of retarding storage has been evacuated in the ten (10) day period.” KDOW defines retarding pool at “the reservoir space allotted to the temporary impoundment of floodwater. Its upper limit is the elevation of the crest of the emergency spillway.” According to discussions with KDOW Dam Safety personnel, in the absence of an emergency spillway, the upper limit would be considered to be the crest of the dam.

Emergency spillway hydrographs are to be routed “through the reservoirs beginning at the water surface elevation of the principal spillway or the water surface elevation after 10 days drawdown, whichever is greater.” Class (A) and (B) structures shall have freeboard “routed through the structure beginning at the same water surface elevation as for the emergency spillway hydrograph.” The crest of the principal spillway shall be the starting point for routing hydrographs for Class (C) structures.

With respect to structures located in series, Section B.II of EM No. 5 states when “structures are spaced so that the failure of an upper structure could endanger the safety of a lower structure, the possibility of a multiple failure must be considered assigning the structure classification of the upstream structure. Additional safety can be provided in either structure by (1) increasing the retarding storage and/or (2) increasing the emergency spillway.” Additionally, Section C.I.A describes hydrologic criteria for structures in series. With respect to structures located in series, Section B- II of EM No. 5 states;

*When structures are spaced so that the failure of an upper structure could endanger the safety of a lower structure, the possibility of a multiple failure must be considered [when] assigning the structure classification of the upstream structure. Additional safety can be provided in either structure by (1) increasing the retarding storage and/or (2) increasing the emergency spillway.*

Additionally, Section C.I.A of EM No. 5 describes hydrologic criteria for structures in series. The memo states that;

*For the design of a lower structure in series, if the total drainage area above a lower structure exceeds 10 square miles and Section B-II of this memorandum applies, it is necessary to apply two sets of storms for the development of both the emergency spillway and the freeboard hydrographs.*

The memo continues by describing the selection criteria for the two sets of storms and notes that the designer should use the storm which results in the “most severe flow condition” at the lower structure.

Additional discussions with the Dam Safety Division of KDOW indicate that in that absence of an emergency spillway, the crest of the dam is considered the uppermost elevation. A

temporary water surface may exist within an impoundment as a result of the design storm occurrence; however, the discharge structure must be shown to be capable of returning the water surface elevation to normal levels within 10 days following the storm. Routing hydrographs are necessary to show the discharge capabilities of the principal spillway within the structure. Stability analyses that reflect adequate stability for the “pond full” condition are also important.

#### Mine Safety and Health Administration

Chapter 8 - Impoundment Design Guidelines of the Mining Safety and Health Administration (MSHA) Coal Mine Impoundment Inspection and Plan Review Handbook (Number PH07-01) published by the U.S. Department of Labor, Mine Safety and Health Administration, Coal Mine Safety and Health, October 2007 provides another source for minimum hydrologic design criteria.

When detailing impoundment design storm criteria, MSHA states that dams need “to be able to safely accommodate the inflow from a storm event that is appropriate for the size of the impoundment and the hazard potential in the event of failure of the dam.” Additionally, MSHA notes that sufficient freeboard, adequate factors of safety for embankment stability, and the prevention of significant erosion to discharge facilities, are all design elements that are required for dam structures under their review. Additional impoundment and design storm criteria are as shown in Table 2, MSHA Minimum Long Term Hydrologic Design Criteria.

**Table 2. MSHA\* Minimum Long Term Hydrologic Design Criteria**

Hazard Potential	Impoundment Size	
	< 1000 acre-feet < 40 feet deep	≥ 1000 acre-feet ≥ 40 feet deep
Low - Impoundments located where failure of the dam would result in no probable loss of human life and low economic and/or environmental losses.	100 - year rainfall**	½ PMF
Significant/Moderate - Impoundments located where failure of the dam would result in no probable loss of human life but can cause economic loss, environmental damage, or disruption of lifeline facilities.	½ PMF	PMF
High - Facilities located where failure of the dam will probably cause loss of human life.	PMF	PMF

\*Mining Safety and Health Administration (MSHA) Coal Mine Impoundment Inspection and Plan Review Handbook (Number PH07-01) published by the U.S. Department of Labor, Mine Safety and Health Administration, Coal Mine Safety and Health, October 2007

\*\*Per MSHA, the 24-hour duration shall be used with the 100-year frequency rainfall.

Probable maximum flood (PMF) is, per MSHA, “the maximum runoff condition resulting from the most severe combination of hydrologic and meteorological conditions that are considered reasonably possible for the drainage area.” Additionally, MSHA notes the designer should consider several components of the PMF that are site specific. These components are said to

include: “antecedent storm; principal storm; subsequent storm; time and spatial distribution of the rainfall and snowmelt; and runoff conditions.” Basic agreement, it was noted, exists between dam safety authorities regarding “combinations of conditions and events that comprise the PMF;” however, there are “differences in the individual components that are used.” MSHA provided the following as a “reasonable set of conditions for the PMF:

- Antecedent Storm: 100-year frequency, 24 hour duration, with antecedent moisture condition II (AMC II), occurring 5 days prior to the principal storm.
- Principal Storm: Probable maximum precipitation (PMP), with AMC III. The principal storm rainfall must be distributed spatially and temporally to produce the most sever conditions with respect to impoundment freeboard and spillway discharge.
- Subsequent Storm: A subsequent storm is considered to be handled by meeting the “storm inflow drawdown criteria,” as described subsequently in the document.

With regard to storm influent drawdown criteria, MSHA Impoundment Design Guidelines noted that:

*Impoundments must be capable of handling the design storms that occur in close succession. To accomplish this, the discharge facilities must be able to discharge, within 10 days, at least 90 percent of the volume of water stored during the design storm above the allowable normal operating water level. The 10-day drawdown criterion begins at the time the water surface reaches the maximum elevation attainable for the design storm. Alternatively, plans can provide for sufficient reservoir capacity to store the runoff from two design storms, while specifying means to evacuate the storage from both storms in a reasonable period of time - generally taken to be at a discharge rate that removes at least 90% of the second storm inflow volume within 30 days.....When storms are stored, the potential for an elevated saturation level to affect the stability of the embankment needs to be taken into account.*

In Mineral Resources Department of Labor Mine Safety and Health Administration Title 30 CFR § 77.216-2 *Water, sediment, or slurry impoundments and impounding structures; minimum plan requirements; changes or modifications, certification*, information relevant to the duration of the probable maximum precipitation is given. Sub-section (10) of 77.216-2 states that a “statement of the runoff attributable to the probable maximum precipitation of 6-hour duration and the calculations used in determining such runoff” shall be provided at minimum in submitted plans for water, sediment or slurry impoundments and impounding structures.

The definition of design freeboard, according to the MSHA Guidelines, is “the vertical distance between the lowest point on the crest of the embankment and the maximum water surface elevation resulting from the design storm.” Additionally, the Handbook states that “Sufficient documentation should be provided in impoundment plans to verify the adequacy of the freeboard.” Recommended items to consider when determining freeboard include “potential wave run-up on the upstream slope, ability of the embankment to resist erosion, and potential for embankment foundation settlement.” Lastly, the Handbook states, “Without documentation, and absent unusual conditions, a minimum freeboard of 3 feet is generally accepted for impoundments with a fetch of less than 1 mile.”

MSHA addresses structures in series in Section 2 of the Impoundment Design Guidelines by noting;

*For impoundments located in series, where failure of an upstream dam could contribute to failure of a downstream dam, assessment of the consequences of failure of the upstream dam must include the additional consequences of failure of any downstream dams. In such cases, the design storm for an upper impoundment must be equal to or greater than the design storm for the lower impoundment. Also, the design of a downstream impoundment must take into account the discharge from an upper impoundment, including a breach hydrograph, if appropriate, based on the design storm for the lower impoundment occurring over the entire contributing drainage area.*

### 3.2.1 2010 Hydrologic and Hydraulic Study

MACTEC Engineering and Consulting, Inc. completed a hydrologic analysis of the Ash Treatment Basin #2, Scrubber Pond and Coal Pile Runoff Pond as part of their August 12, 2010 report entitled *Assessment of Spillway Hydrologic Adequacy for the Coal Pile Pond, Ash Treatment Basin No. 2, and Scrubber Pond at Green River Generating Station*. The purpose of MACTEC's investigation was to assess hydrologic and hydraulic conditions associated with the spillway discharges from the Coal Pile Runoff Pond, Ash Treatment Basin #2, and the Scrubber Pond at the Green River Power Station and identify appropriate hydraulic criteria and facility modifications to meet those criteria.

According to the MACTEC report, the primary hydrologic analyses to evaluate the Ash Treatment Basin #2, Scrubber Pond, and the Coal Pile Runoff Pond spillways were completed using HEC-HMS, an event-based rainfall runoff model (Hydrologic Engineering Center, U.S. Army Corps of Engineers). Design storm events of various return periods and of various durations, including 6 hours, 24 hours and 48 hours, were used in the analyses. MACTEC made note of the fact that additional resources used in the analysis included construction plans provided by KU, available topographic mapping, as well as field observations made by MACTEC. Curve numbers and times of concentration were developed to characterize the watershed.

#### Ash Treatment Basin #1

According to the MACTEC report, a dam permit has been issued for the Ash Treatment Basin #1 by the Kentucky Department of Natural Resources and Environmental Protection, Division of Water (KDEP-DOW). The dam has been classified as a Class A Low Hazard Dam. MACTEC noted in their report that while Ash Treatment Basin #1 is not a structure subject to investigation, analysis of the basin was required for their overall analysis due to the fact that discharges from this basin are routed through Ash Treatment Basin #2. Ash Treatment Basin #1 was found to have a minimum freeboard of 1.54 ft for the DNREP-DOW Class A freeboard design hydrograph (FDH) and a freeboard of 2.11 ft for the 100-year, 48-hour design storm event. According to the MACTEC report, the characteristics for the Ash Treatment Basin #1 are as follows:

*The drainage area to Ash Treatment Basin #1 is approximately 71 acres. The outflow from ATB 1 (Ash Treatment Basin #1) is through a concrete riser structure equipped with concrete stop-logs creating a 5.0-ft long weir. The stop-logs weir crest can be varied by adding or removing stop-logs, but normally has a*



crest elevation of 445.9 ft NAVD 1988 as indicated on topographic mapping (FMSM February 1998). The riser structure is connected to a 36-inch diameter concrete pipe culvert that conveys water overflow to ATB 2. There are no inflows to ATB 1 other than precipitation runoff.

Table 3 below identifies various existing and proposed elevation conditions related to the hydrologic analysis of Ash Treatment Basin #1 that were summarized in the MACTEC report.

**Table 3. Ash Treatment Basin #1 Elevation Conditions**

Elevation Condition	Elevation
Ash Treatment Basin #1, 100-yr, 48-hr Flood Elevation (ft)	447.29
Existing Dam Crest Minimum Elevation (ft)	449.40
Current Operating Water Surface Elevation (ft)	445.9
Current Operating Freeboard (ft)	$449.40 - 445.9 = 3.5$
100-year (48-hour) Flood Elevation Freeboard (ft)	2.11

According to the MACTEC report, the Ash Treatment Basin #1 would not experience an overflow event for the 100-year, 48-hour duration event.

#### Ash Treatment Basin #2

According to the MACTEC report, the characteristics for the Ash Treatment Basin #2 are as follows:

*ATB 2 receives discharges from the CPP, ATB 1, the SP, and a small upland drainage area. The total drainage area to ATB 2 is approximately 149 acres, with direct runoff to ATB 2 from approximately 47 acres with the remaining 102 acres being from ATB 1, CPP and SP discharges.*

Table 4 below identifies various existing and proposed elevation conditions related to the hydrologic analysis of Ash Treatment Basin #2 that were summarized in the MACTEC report.

**Table 4. Ash Treatment Basin #2 Elevation Conditions**

Elevation Condition	Elevation*
Ash Treatment Basin #2, 100-yr, 48-hr Flood Elevation (ft)	399.27
Existing Dam Crest Minimum Elevation (ft)	398.94
Current Operating Water Surface Elevation (ft)	397.4**
Current Operating Freeboard (ft)	$398.94 - 397.4 = 1.54$
100-year (48-hour) Flood Elevation Freeboard (ft)	-0.33

\*Elevations based the 2010 hydrographic survey.

\*\*MACTEC report stated the weir is normally set with a crest elevation of 397.4 ft.

According to the MACTEC report, the Ash Treatment Basin #2 would experience an over topping event at the low point of the dam crest with an approximate 25-year, 24-hour event with the 10-year, 24-hour event the freeboard is estimated to be 0.07 feet when starting at normal pond water level (397.4 ft). MACTEC's report stated that the 100-year, 48-hour duration storm was determined to be the critical storm event. Based on a existing minimum dam crest elevation of 398.94, the water surface elevation for this event is calculated to be 399.27 thereby

reflecting in an overtopping event (freeboard = -0.33 ft). MACTEC recommends the following modifications to provide a suitable hydrologic condition for the unregulated (as a dam) Ash Treatment Basin #2:

- *Remove two 6-inch stop-logs to lower the normal water level 1.0 ft to 396.4 ft (weir crest elevation);*
- *Construct an emergency spillway with an overflow crest elevation of 399.0 ft. (spillway crest length of 50 ft, but crest length could be modified with discussed below by a design analysis); and*
- *Raise the embankment crest minimum crest elevation to 400.0 ft to provide a minimum freeboard of 6 inches for the 100-year event. The amount of dam, emergency spillway width, and desired freeboard are inter-related and further engineering investigation would be required to determine to optimum approach. As identified previously, a 1.0 ft freeboard would be more desirable, but a 0.5 ft freeboard may be acceptable if the embankment is sufficiently wide, uniform, has a good grass cover, littoral vegetation to dissipate wind-generated waves is present along the shoreline, and the embankment meets other desirable characteristics that would minimize erosion potential.*

According to the MACTEC report, the Kentucky Department of Natural Resources and Environmental Protection, Division of Water (KDEP-DOW) has not classified Ash Treatment Basin #2; therefore, dam permits have not been issued for this dam.

### Finishing Pond #3

No hydrologic or hydraulic design criteria or calculations were provided for the Finishing Pond #3.

### Scrubber Pond

According to the MACTEC report, the characteristics for the Scrubber Pond are as follows:

*Discharge from the SP is by pumping to ATB 2. A manually operated duplex pump system pumps at a rate 350 gallons per minute (gpm). . . A natural upland drainage area of approximately 6-7 acres would drain to the SP but runoff is intercepted by two diversion ditches, one draining to the east and the other draining to the west. The capacity and efficiency of the diversions are not accurately known. The ditches are apparent on the topographic mapping, but there is insufficient detail to reliably estimate the flow capacity. A culvert appears to exist under the access road to the dam crest but is not specifically identified on the topographic mapping and type and size are not known. It was assumed that for the existing condition the ditches can convey a total of 10 cfs around the SP (discharging into ATB 3) and any runoff from the upstream contributing 7-acres drainage area in excess of 10 cfs would flow into the SP. No inflows were assumed to the SP other than precipitation runoff.*

During AMEC's site visit performed on August 16, 2010, no drainage ditches were observed to be discharging into the Scrubber Pond.

Table 5 below identifies various existing and proposed elevation conditions related to the hydrologic analysis of Scrubber Pond that were summarized in the MACTEC report.

**Table 5. Scrubber Pond Elevation Conditions**

<b>Elevation Condition</b>	<b>Elevation</b>
Scrubber Pond, 100-yr, 48-hr Flood Elevation (ft)	403.17
Existing Dam Crest Minimum Elevation (ft)	403.77
Current Operating Water Surface Elevation (ft)	402.5
Current Operating Freeboard (ft)	$403.77 - 402.5 = 1.27$
100-year (48-hour) Flood Elevation Freeboard (ft)	0.60

According to the MACTEC report, a dam permit has been issued for the Scrubber Pond by the Kentucky Department of Natural Resources and Environmental Protection, Division of Water (KDEP-DOW). The dam has been classified as a Class A Low Hazard Dam. Permitted structures in Kentucky (Water Resources Memo No. 5, Section F.I.A.) require that an emergency spillway be constructed and that the capacity of the emergency spillway will in no case be less than 200 cfs. MACTEC's report stated that, although the Scrubber Pond is a permitted structure, the criteria outlined in Memo 5 appeared to be inappropriate and excessive for the structure. KDEP-DOW acknowledged this exception in a letter dated October 2, 1975 that states the absence of an emergency spillway is acceptable for the Scrubber Pond provided that the principal spillway and storage capacity are such that the required freeboard is met for the freeboard design hydrograph.

MACTEC reports the results for the Scrubber Pond indicate marginally sufficient capacity, with the 100-year (48-hour) principal spillway design flood having a calculated freeboard equal to 0.6 ft. MACTEC recommends the following modifications to provide a suitable hydrologic condition for the regulated (as a dam) Scrubber Pond:

- Lower the normal operating water level from 402.5 to 402.0 ft; and
- Install an emergency spillway with crest elevation of 402.5 ft (small outlet similar in capacity to an 18-inch diameter culvert or a riprap chute; variance or exception required from DNREP-DOW).

#### Coal Pile Runoff Pond

According to the MACTEC report, the characteristics for the Coal Pile Runoff Pond are as follows:

*The CPP discharge to ATB 2 is through an 18-inch corrugated metal pipe (CMP). The 40-ft long culvert has an upstream flow-line (FL) elevation of 400.8 ft and an outlet FL elevation of 400.2 ft. The earthen embankment has a crest elevation near the culvert of approximately 406 ft, based on available topographic mapping (FMSM Engineers, Existing Conditions and Baseline Layout, Ash Treatment Basin No. 4, Sheet 4 of 51, February 1998) the low point of the earthen embankment is between 404 ft and 406 ft. Based on the configurations of the elevation contour lines, it was estimated that the minimum embankment elevation is approximately 405 ft near the southern end of the dam segment that separates the CPP from ATB 2. There is no identified emergency spillway. There are no inflows to the CPP other than precipitation runoff from the approximately 14.4 acres of drainage area to the CPP.*

Table 6 below identifies various existing and proposed elevation conditions related to the hydrologic analysis of Coal Pile Runoff Pond that were summarized in the MACTEC report.

**Table 6. Coal Pile Runoff Pond Elevation Conditions**

Elevation Condition	Elevation
Coal Pile Runoff, 100-yr, 48-hr Flood Elevation (ft)	402.83
Existing Dam Crest Minimum Elevation (ft)	405.0
Current Operating Water Surface Elevation (ft)	401.8
Current Operating Freeboard (ft)	405.0 - 401.8 = 3.2
100-year (48-hour) Flood Elevation Freeboard (ft)	2.17

MACTEC reports the results indicate the Coal Pile Runoff Pond has a freeboard of 2.4 ft, 2.2 ft, and 1.7 ft for the 100-year, 24-hour event, 100-year, 48-hour event, and 24-hour Kentucky freeboard design storm, respectively based on a normal pond elevation of 401.8 ft. MACTEC's reports states that the Coal Pile Runoff Pond spillway would appear to be adequate in terms of hydrologic performance and potentially appropriate design criteria.



### 3.3 Structural Adequacy & Stability

The Commonwealth of Kentucky Department of Natural Resources Environmental Protection, Bureau of Environmental Protection, Division of Water, dated June 1, 1980 provides guidelines for the geotechnical investigation and analysis of existing earth dams. The guidelines were written pursuant to the provisions set forth in KRS 151.125(2). Earthen dams, when analyzed using the methods, guidelines, and procedures of the agencies listed in the guidelines to determine safety factors, can be considered to have acceptable stability if the analyses yield at least the minimum safety factors shown in Table 3.

Two well known sources for embankment design and evaluation criteria include The United States Army Corps of Engineers (USACE) and the United States Mine Safety and Health Administration (MSHA). Minimum recommended factors of safety for different loading conditions can be found in those agency publications, as shown in Table 7 below.

**Table 7. Minimum Required Dam Safety Factors**

LOAD CASE	KDOW <sup>1</sup>	MSHA CRITERIA <sup>2</sup>	USACE <sup>3</sup>
Rapid Drawdown	1.2	1.3	1.1 <sup>4</sup> -1.3 <sup>5</sup>
Long-Term Steady State Seepage	1.5	1.5	1.5
Earthquake Loading	1.0	1.2	--- <sup>6</sup>

<sup>1</sup> Guidelines for the Geotechnical Investigation and Analysis of Existing Earth Dams, 1980, Kentucky Division of Water

<sup>2</sup> Coal Mine Impoundment Inspection and Plan Review Handbook, 2007, US Mine Safety and Health Administration

<sup>3</sup> Slope Stability Publication, EM1110-2-1902, 2003, US Army Corps of Engineers, Table 3-1: New Earth and Rock-Fill Dams

<sup>4</sup> Applies to drawdown from maximum surcharge pool

<sup>5</sup> Applies to drawdown from maximum storage pool

<sup>6</sup> Referred to USACE Engineer Circular "Dynamic Analysis of Embankment Dams" document that is still in preparation

AMEC reviewed the July 14, 2010 report entitled *Final Geotechnical Report, Main Ash Pond, Slope Stability Analysis and Repair, Kentucky Utilities, Green River Station* prepared by Associated Engineers, Inc. and the September 3, 2010 report entitled *Geotechnical Exploration and Slope Stability Analysis Data Package, Kentucky Utilities (KU), Green River Power Station, Number 2 Pond & Scrubber Pond, South Carrollton, Muhlenburg County, Kentucky* prepared by MACTEC Engineering and Consulting, Inc. The recently completed stability analyses are summarized in Section 3.3.1 and 3.3.2. MACTEC included the Coal Pile Runoff Pond into their analysis for Ash Treatment Basin #2. To analyze the structural adequacy and stability of the Main Ash Pond, Coal Pile Runoff Pond, Ash Treatment Basin #2, and Scrubber Pond at Green River Generating Station, AMEC reviewed the material provided by Kentucky Utilities with respect to the load cases shown in Table 7. Factors of safety documented in the provided material were compared with those factors outlined in the table to help determine whether the impoundments meet the requirements for acceptable stability.

#### 3.3.1 Ash Treatment Basin #1 - Structural Adequacy & Stability

Associated Engineers, Inc. recently (July 2010) completed the report entitled *Final Geotechnical Report Main Ash Pond Slope Stability Analysis and Repair*, for the Green River Station. According to Associated Engineers, the report presents "the results of investigations including boring logs, laboratory data, description of subsurface conditions and stability analysis." Additionally, the report includes "repair recommendations and an inspection summary specific to a slope failure which was corrected during May and June of 2010."

### Field and Subsurface Investigation

Visual inspection of the slope failure area and toe of the dam was performed as part of the initial site reconnaissance. A buttress was noted to have “been constructed on the downstream slope of the dam beginning approximately 200 feet northeast of piezometer 3A.” It was noted that the buttress was “not shown on the original H. C. Nutting drawings”. Additionally, although “no other records could be located....it is known to have been constructed to repair a previous slope failure.”

The subsurface investigation included in the report was undertaken to “determine the extent of the slope failure and provide strength parameters for stability analysis.” Drilling operations began in late December 2009, using a rotary drill rig and hollow stem augers per ASTM D-1452. Representative soil samples were collected by “split barrel (Standard Penetration Test) sampling procedure” per ASTM D-1586. Procedures outlined in ASTM D-1587 were used to collect representative undisturbed samples using 3-inch diameter Shelby tubes. Associated Engineers noted that “In some cases, soil compaction was such that the tube could not penetrate the material sufficiently to obtain adequate recovery for testing.” Figure 9 illustrates boring locations, stability cross sections, and piezometer locations for this study.

### Laboratory Testing

Soil analyses performed on representative samples included moisture content, sieve analysis, Atterberg limits, unit weight, and consolidated-undrained (CU) triaxial compression tests that included both total and effective stress analysis. The report stated that “Triaxial testing for stability analysis included samples from P1, P2, and P3.” Associated Engineers noted that they were unable to collect sufficient undisturbed fly ash samples; therefore, they conservatively estimated strength parameters based on “N-values, experience with similar materials, and published data.” Table 8 below summarizes soil data used in the stability analyses.

**Table 8. Stability Analysis Soil Parameters - Ash Treatment Basin #1**

Soil Layer Elevation (ft)	Soil Description	Saturated Unit Weight (pcf)	Effective Cohesion, C (psf)	Friction Angle, $\Phi$ (degrees)
“Back In” Slope Failure				
450 - 425	Sandy lean clay	130.0	195.0	33.6
425 - 405	Sandy lean clay	130.0	250.0	28.0
405 - 402	Sandy lean clay-old fill	110.0	0	26.0
402 - 393	Fly ash and clay	133.0	359.0	30.2
393 - 385	Silty clay with shale fragments	138.0	0	22.0
	Bedrock			
Critical Slope				
450 - 433	Sandy lean clay/lean clay with sand	133.8	174	26.4
433 - 410	Sandy lean clay/lean clay with sand	138.2	258	28.1

Soil Layer Elevation (ft)	Soil Description	Saturated Unit Weight (pcf)	Effective Cohesion, C (psf)	Friction Angle, $\Phi$ (degrees)
410 - 390	Silty clay/ sandy lean clay/lean clay with sand	131.8	565	23.8
390 - 385	Silty clay	130.2	195	33.6
	Bedrock			

### Slope Failure Area Stability

Discussion of slope stability analyses were presented for the slope failure area using the cross section A-A' as shown on Figure 10. The REAME2008 computer program that utilizes rotational equilibrium methodology was used in the analyses. Associated Engineers also noted that the seismic safety factor that was used "is based on the pseudo-static method using a seismic coefficient."

The report noted that the failure area cross section A-A' was first analyzed for stability using strength data that had been obtained from testing. Long-term, steady state seepage and earthquake loading analyses resulted in factors of safety equal to "1.53 and 1.25", respectively. Associated Engineers noted that these favorable results indicated that the "overall configuration of the dam is stable." As a result, rapid drawdown analysis was "deemed to be unnecessary since backfilling with CCB has occurred to within 12 feet of the tip of the dam on the upstream side."

Following the initial analyses, Associated Engineers evaluated the failure area stability using a "back in" approach. The soil strength parameters required to yield a safety factor of 1.0 (imminent failure), as well as a slip surface that closely reflected the actual failure surface, were determined. The resulting soil strength angle, phi, and cohesion for material above the original ground surface, C, were found to be equal to 22 degrees and zero (0) pounds per square foot. Associated Engineers noted that these results indicate that the stability model is conservative "since higher strength values were obtained from the interior of the dam."

Associated Engineers noted that numerous design options were evaluated to correct the failure area on Ash Treatment Basin #1 (Main Ash Pond) embankment, with the chosen design as described previously in Section 1.4.2 of this Draft Assessment Report. Stability analyses performed at cross section A-A' for the repaired area, resulted in calculated factors of safety as shown in Table 9.

**Table 9. Factors of Safety for Ash Treatment Basin #1 Slope Failure Area**

Analysis	Factors of Safety	
	Long Term	Earthquake Loading
Required Minimum Safety Factor	1.5	1.0
Existing Condition (Pre-failure)	1.51	1.22
"Back In" Analysis	0.94	--
25 ft. Rock Bench/Berm Slide Repair	1.55	1.23

Associated Engineers noted that factors of safety that resulted from the stability analyses are greater than the minimum values required by KDOW; therefore, in their opinion, the stability of the dam at the repair location should be considered acceptable.

#### Global Dam Stability

Associated Engineers evaluated the overall stability of the dam by reviewing cross sections and drilling data contained within a report completed in July 2010 by H. C. Nutting, as well as by analyzing a chosen critical cross section labeled B-B', as shown on Figure 11. The dam at cross section B-B' was noted to have a maximum height (from crest to downstream toe), and to contain close to a maximum thickness of fill material (measured from the top of the dam vertically downward). Cross section B-B' was also chosen for stability evaluation because, Associated Engineers noted, it "does not overlie a stabilizing drainage layer based on the H. C. Nutting data (cross sections 9+50 to 10+00)." AMEC reviewed the H.C. Nutting design data and Sheet 4 (of 29) of the drawings, dated revised May 1976, indicates drainage layers were constructed on the south embankment at three locations: +/- Station 7+25 to +/- Station 9+25, +/- Station 11+25 to +/- Station 12+90, and +/- Station 17+75 to +/- Station 19+25.

Dam fill material was modeled based on strength data from soil collected from all drilling locations. The report noted that the "worst case" condition used values from boring P2 because these values were noted to collectively represent the lowest soil strengths obtained across the dam for fill construction. The soil interval below the original ground surface was represented using soil data from borings P2 and P3. Associated Engineers noted that with respect to triaxial strength data that "values from P3 were representative of an upper interval directly below the ground surface variably consisting of lean clays and silty clays"; additionally, a "lower unit of silty clay occurring down to refusal exhibited significantly higher SPT values and was modeled using triaxial data from P2." With respect to the water surface model input, Associated Engineers noted that the "phreatic surface was modeled from the ground surface at the toe of the dam extending directly to the highest recorded depth in piezometer P2."

Calculated factors of safety for the critical cross section B-B' are shown in Table 10.

**Table 10. Factors of Safety for Ash Treatment Basin #1 at Critical Section**

Analysis	Factors of Safety	
	Long Term	Earthquake Loading
Required Minimum Safety Factor	1.5	1.0
Existing Condition	1.64	1.30

Minimum factors of safety, per KDOW, were again included in the table by Associated Engineers for comparative purposes. Factors of safety for the critical section were determined to be greater than KDOW specified minimums, therefore the structural integrity of the dam was considered to be satisfactory.

#### **3.3.2 Ash Treatment Basin #2 and Scrubber Pond - Structural Adequacy & Stability**

MACTEC Engineering and Consulting, Inc. (MACTEC) completed a report entitled *Geotechnical Exploration and Slope Stability Analysis Data Package, Kentucky Utilities Green River Power Station, Number 2 Pond & Scrubber Pond*, dated September 3, 2010. The report presented a summary of guidance documents and data that were reviewed, the geotechnical exploration that

was performed to obtain additional data for use in evaluation of the ponds' structural stability, as well as the results of the structural stability analyses that were completed for two cross sections from each pond. It was noted that the study was not complete and a final report with analyses for a total of five cross sections from each pond will be submitted later.

Subsurface data was collected from five "critical" cross sections for each pond. "Critical" slopes were chosen "based on topography and nature of the exposed slope." Ten soil test borings were drilled along the pond crests and thirteen soil test borings were drilled along the toe of the embankments, with each boring being advanced up to 40 feet. Three piezometers were installed along each pond's embankment crest to enable monitoring of piezometric levels within each embankment.

Soil classification tests included Atterberg limits, grain-size analyses, specific gravity, and unit weight determinations. Strength tests included consolidated undrained triaxial shear tests with pore pressure monitoring to determine both total stress and effective stress parameters. MACTEC noted that strength tests for this site are ongoing and that test results would be provided with their final report of geotechnical exploration and slope stability analyses. Statistical analysis was reportedly used with results from the Standard Penetration Test "to delineate subsurface conditions and estimate anticipated soil properties based on correlations and published data."

Purdue University's computer program PCSTABL was used to conduct slope stability analyses. MACTEC noted that "The program uses a two-dimensional limit equilibrium method of analysis and calculates the factor of safety based on the Modified Bishop Method of Slices." MACTEC analyzed the embankments using steady state/maximum flooding conditions, rapid drawdown, and seismic conditions. Analyses results for the two completed sections, cross section 4 (Ash Treatment Basin #2) and 7 (Scrubber Pond) were included in the report. Cross section locations are as shown on Figure 12.

Bathymetric pond surveys and various topographic maps were utilized to determine site geometry for the analyses. Hand-held GPS units were reported used to estimate boring and cross section locations. The final report will contain a topographic survey of the cross sections.

MACTEC reported that generally "the dikes were constructed of sandy clay fill reportedly excavated from the incised portion of the ponds." Alluvial soils that exist beneath the placed fill were found to be comprised of silty to sandy, lean clay. Table 11 summarizes the soil parameters that were selected for the slope stability analyses for both the Ash Treatment Basin #2 and Scrubber Ponds. Soil parameters were chosen "based on various resources including the results of the extensive laboratory testing described above, field testing and observations, published information on similar soil types and our experience."

**Table 11. Soil Parameters - Ash Treatment Basin #2 and Scrubber Pond**

Soil Type No.	Soil Description	Unit Weight		Effective Stress	
		Total (pcf)	Saturated (pcf)	Cohesion C' (psf)	Friction Angle $\Phi'$ (degrees)
Ash Treatment Basin #2					
1	CL fill	128	133	20	34
2	CL alluvium	120	125	0	34



Soil Type No.	Soil Description	Unit Weight		Effective Stress	
		Total (pcf)	Saturated (pcf)	Cohesion C' (psf)	Friction Angle $\Phi'$ (degrees)
3	CL alluvium	127	132	6	32
4	CCW	90	95	0	30
<b>Scrubber Pond</b>					
1	CL fill	121	126	60	30
2	CL alluvium	120	125	0	33
3	CL alluvium	118	123	0	28
4	CCW	90	95	0	30

Using published guidance for the site location, MACTEC reported that seismic conditions for the site were reported as modeled under dynamic loading conditions using a peak ground acceleration value of 0.150g, for horizontal and vertical movement, for a two percent probability of exceedence in 50 years.

MACTEC noted that the “maximum operating pool was conservatively modeled as the crest elevation for each pond.” Crest piezometer water level readings were used and modeled to extend across the pond through the embankments to simulate a “worst case” condition. The amount of CCW in the pond was estimated using the results of the bathymetric survey completed by MACTEC.

Results of the stability analyses performed for Cross Sections 4 (Number 2 Pond) and 7 (Scrubber Pond) are shown in Table 12. Slopes that were used for each section model are included in the Table.

**Table 12. Slope Stability Analyses Results for Ash Treatment Basin #2 and Scrubber Pond**

Critical Section	Upstream Slope (H:V)	Downstream Slope (H:V)	Long Term Steady State/Max Surge Pool		Rapid Drawdown		Seismic	
			Target FOS*	FOS	Target FOS*	FOS	Target FOS*	FOS
Number 2 Pond								
Cross Section 4 (Upstream)	3.0:1.0	--	1.5/1.4	2.9	1.2	1.5	1.2	1.4
Cross Section 4 (Downstream)	--	2.0:1.0	1.5/1.4	1.6	1.2	1.6	1.2	1.2
Scrubber Pond								
Cross Section 7 (Upstream)	2.2:1.0	--	1.5/1.4	2.5	1.2	1.2	1.2	1.4
Cross Section 7 (Downstream)	--	3.2:1.0	1.5/1.4	2.3	1.2	2.3	1.2	1.3

Target Factor of Safety References: (1) Design Criteria for Dams & Associated Structures (401 USACE EM 1110-2-1902: Slope Stability, (3) MSHA Engineering and Design Manual. KAR 4:030, KAR 4:040), (2)

MACTEC noted that the analyses, performed using the parameters and geometry described, indicated that the cross sections analyzed to this point provide factors of safety that meet or exceed the published factors of safety for the cases analyzed.

### 3.3.3 Finishing Pond #3 - Structural Adequacy & Stability

Stability analyses were not provided for this structure.

### 3.3.4 Coal Pile Runoff Pond - Structural Adequacy & Stability

Stability analyses were not provided for this structure.

## 3.4 Foundation Conditions

MACTEC's report entitled *Geotechnical Exploration and Slope Stability Analyses Data Package, Kentucky Utilities (KU), Green River Power Station, Number 2 Pond & Scrubber Pond, South Carrollton, Muhlenburg County, Kentucky* prepared by MACTEC Engineering and Consulting, Inc dated September 3, 2010 briefly describes foundations conditions. The report states "In general, the dikes were constructed of sandy clay fill reportedly excavated from the incised portion of the ponds. The fill was placed overlying existing alluvial soils comprised of silty to sandy, lean clay." Geotechnical borings performed in 1975 and 1976 by H.C. Nutting Company indicate the natural soils in the area of the Coal Pile Runoff Pond and the Ash Treatment Basin #2 consist of silty to sandy, clays with varying amounts of rock fragments overlying sandstone. The 2010 Associated Engineers, Inc. stability report for the Ash Treatment Basin #1 and repair area encountered foundation soils described as lean clay to sandy lean clay variably grading to silty clay with variable sand content.

## 3.5 Operations and Maintenance

According to Kentucky Utilities, personnel perform weekly safety and surveillance inspections for the ash ponds at the Green River Power Station. KU only provided three weekly inspection reports beginning at the end of July, 2010 as documentation. ATC Associates performed inspections on the ash ponds in October 2009. The reports indicated areas of surface erosion, soil sediment build-up in seepage pipes, a scarp on the main ash pond south embankment, animal burrows, steep slopes, and un-vegetated areas. See section 3.5.2 for further details regarding the ATC inspections. Several of the issues appeared to be addressed at the time of the site visit. No safety issues were reported in the documented reports that were reviewed. The site visit and observation performed by AMEC in August 2010 showed no major operational or maintenance issues that needed to be addressed.

### 3.5.1 Instrumentation

During Associated Engineers Ash Treatment Basin #1 slope stability analysis, piezometers were installed in borings P2, P2A, P3, and P4 as part of the overall dam stability investigation; and, borings P1, P1A, and P5 were drilled and completed as standpipe piezometers located at the area of the slope failure. It was noted that in P5, installed below the toe of the recent slope failure, water was measured over 2 feet above ground level indicating a hydraulic head at this location. Associated Engineers states that "it is possible that communication exists with water saturated in fly ash deposits below and upstream from the dam". After data collection was complete, piezometers P2 and P3 were removed from service through placement of cement grout backfill from the bottom of the boring upward. Associated Engineers noted that "accessibility issues" did not allow placement of borings/piezometers "along the downstream toe of the dam within an area generally between P2 and the previously described buttress." Figure 9 illustrates the piezometer locations for the Associated Engineers study.

Historically, impoundment monitoring equipment has not been used at the Green River Power Station. MACTEC Engineering installed six piezometers in support of the August 2010 slope stability analyses (subsequent to AMEC's site inspection). The piezometers were installed in Borings B-2C, B-3C, B-4C, B-6C, B-8C, and B-10C. Figure 12 illustrates the piezometer locations for the MACTEC study.

Piezometer information is summarized and shown in Table 13.

**Table 13. Piezometer Information**

Piezometer ID	Location	Boring Elevation	Screen Depth (BSG, ft)	Water Level Data	
				Elevation	Date
B-2C	Ash Treatment Basin #2	399.7	15-25	379.7	8/24/10
B-3C	Ash Treatment Basin #2	399.4	25.5-35.5	387	8/24/10
B-4C	Ash Treatment Basin #2	399.1	20-30	392.6	8/24/10
B-6C	Scrubber Pond	404.7	15-25	393.2	8/24/10
B-8C	Scrubber Pond	404.5	29-39	398.8	8/24/10
B-10C	Scrubber Pond	403.9	15-25	378.9	8/24/10
P-1	Ash Treatment Basin #1	449.30	46.2-51.2	437.34	3/8/10
P-1A	Ash Treatment Basin #1	449.29	17.5-25	438.35	7/2/10
P-2	Ash Treatment Basin #1	449.70		433.65	3/29/10
P-2A	Ash Treatment Basin #1	449.74	48-53	434.92	7/2/10
P-3A	Ash Treatment Basin #1	449.62	25-30	430.79	7/2/10
P-4	Ash Treatment Basin #1	412.69	5-10	409.18	7/2/10
P-5	Ash Treatment Basin #1	403.31	7-15	405.38	7/2/10

In summary, a total of 12 piezometers were placed at the Green River Ash Ponds in 2010 at the following locations: three at the main ash pond, three at the Ash Treatment Basin #2, three at the Scrubber Pond, and one at the Coal Runoff Pond. Two of the piezometers have been removed. Due to the recent installation of the instrumentation, a trend in the phreatic surface cannot be noted at this time.

### 3.5.2 Inspections

#### State Inspections

The Ash Treatment Basin #1 and Scrubber Pond are considered a Low Hazard dam by the Kentucky Division of Water. The Ash Treatment Basin #2, Finishing Pond #3, and the Coal Runoff Pond are not classified by the Kentucky Division of Water. State regulations indicate that KDOW will inspect Class A (low hazard) dams every 5 years, and Class B (moderate hazard) and Class C (high hazard) every 2 years. The regulations state that a Certificate of Inspection shall be issued to the dam owner upon completion of a successful inspection. The most recent inspection performed by the Kentucky Division of Water at Green River Power Station was performed in November 2004. Review of the inspection indicated the Scrubber Pond required filling in of the low areas and re-grading the crest and all trees less than six inches in diameter removed from downstream slope. No documentation was provided to show



that the State's recommendations/directives were addressed. No items were noted for the Ash Treatment Basin #1.

### 2009 Inspection

ATC Associates Inc. completed an assessment of each pond at the Green River Power Station in October 2009.

ATC rated the overall condition of the Green River Ash Treatment Basin #1 as poor, which is defined as:

*A potential safety deficiency is clearly recognized for normal loading conditions. Immediate actions to resolve the deficiency are recommended; reservoir restrictions may be necessary until problem resolution.*

The report noted a total of 17 action items. Two items were regarded as „high’ importance, which indicates that action be addressed as soon as possible. The two items included:

1. Evaluate stability of embankment under steady state, and earthquake loading; and,
2. Monitor existing scarp on downstream slope for changes, maintain lower water level in pond until repairs to scarp are made.

Eleven maintenance items were given a „moderate’ rating indicating the action item be addressed during next construction season. These included the following:

3. Mow interior slope of entire pond and spray with herbicide;
4. Cut woody vegetation on exterior dam face and mow remaining areas not mowed at end of 2009. Mow 20 feet below exterior toe of slope;
5. Inspect entire interior slope after mowing for presence of burrowing animals. Potential locations of burrow are noted;
6. Repair and re-establish vegetation in areas damaged by mowing equipment;
7. Fill in and revegetate erosion gullies on exterior slope;
8. Armor groin ditch west end of south embankment below culvert outlet;
9. Armor groin ditch east end of south embankment below toe;
10. Clean out 5 seepage pipe drains to promote rapid drainage and remove accumulated material from pipe interior;
11. Install permanent outlet protection for 5 seepage pipes;
12. Repair scarp on downstream slope of south embankment, approximately 120 feet in length; and,
13. Evaluate presence of wet areas on south embankment, approximately 120 feet in length.

Four maintenance items were given a „normal’ rating indicating the action item be addressed as part of ongoing maintenance of the structure. These included the following:

14. Repair animal burrows along south embankment;
15. Regrade drain at toe of west slope to prevent ponding of water;
16. Re-position ash discharge pipes into existing concrete cradle up exterior slope; and,
17. Place rip rap at culvert outlet to protect and mark area for mowing (at west end).

The July 14, 2010 report entitled *Final Geotechnical Report, Main Ash Pond, Slope Stability Analysis and Repair, Green River Station*, prepared by Associated Engineers, Inc., discusses

the stability of the entire Main Ash Pond dam along with analysis and design recommendations specific to the recent (2010) slope repair activities. The southern slope of the Main Ash Pond was repaired in May and June of 2010 under the observation of Associated Engineers, Inc. based on their evaluations they consider recommendation items 1 and 2 above to be cleared.

ATC rated the overall condition of the Green River Ash Treatment Basin #2 as poor, which is defined as:

*a potential safety deficiency is clearly recognized for normal loading conditions. Immediate actions to resolve the deficiency are recommended; reservoir restrictions may be necessary until problem resolution.*

The assessing professional engineer's comments concerning the overall condition of the pond included;

*considerable slope maintenance required both for interior and exterior slopes. Crest elevation needs to be determined and low areas filled. Movement of outfall ditch from toe of east slope is needed to prevent erosion of toe. Flattening of slopes to allow mowing should be considered. Minimum freeboard requirement should be established based on hydraulic and hydrologic evaluation of spillway/impoundment. Secondary spillway may be needed. Perform stability analysis of east slope due to numerous scarps present on slopes.*

The report noted a total of 18 action items. Nine items were regarded as „high’ importance, which indicates that action be addressed as soon as possible. The nine items included:

1. Reduce and maintain pool level to provide at least 2 feet of freeboard;
2. Perform elevation survey of dam crest elevations. Place fill as needed to return crest to design elevation;
3. Mark principal spillway to prevent stop log placement which would result in overtopping of crest;
4. Perform hydrologic and hydraulic analysis of pond to evaluate need for secondary spillway to prevent pond overtopping (24" freeboard);
5. Evaluate need to armor east embankment toe along outfall channel, flow in channel eroding vertical scarps into toe;
6. Trap and remove burrowing animals from pond;
7. Perform stability analysis of east embankment;
8. Dress up exterior slope of south embankment after completion of tree removal; and,
9. Remove or grout dredge cell inlet pipe, upstream of pond embankment.

Eight maintenance items were given a „moderate’ rating indicating the action item be addressed during next construction season. These included the following:

10. Repair animal burrows along east embankment;
11. Mow vegetation on exterior slope and around principal spillway outlet;
12. Cut vegetation on interior slope, spray with herbicide;
13. Perform follow up assessment of slopes after vegetation is removed for wave erosion and burrowing animals;
14. Repair scarps along exterior slope of south end of east embankment;

15. Repair erosion at Principal Spillway outfall channel, flow eroding east toe exposing 5 feet vertical scarp;
16. Repair erosion at south end of east toe, outfall channel flow eroded embankment toe exposing 4 feet vertical scarp approx. 100 feet in length; and,
17. Move spillway discharge channel away from east embankment toe. Erosion of embankment toe occurring along full length of east exterior slope;

The remaining one maintenance item was given a „normal’ rating indicating the action item be addressed as part of ongoing maintenance of the structure. The item is listed as follows:

18. Evaluate need to include pond on KY inventory of dams.

ATC rated the overall condition of the Green River Finishing Pond #3 as unsatisfactory, which is defined as:

*a dam safety deficiency exists for normal conditions. Immediate remedial action is required for problem resolution.*

The assessing professional engineer’s comments concerning the overall condition of the pond included:

*recommend evaluation whether dam should be breached or repaired and kept in service. Evaluation in progress during inspection.*

The report noted a total of 11 action items. Nine items were regarded as „high’ importance, which indicates that action be addressed as soon as possible. The nine items included:

1. Clean vegetation and remove curtain around principal spillway inlet for skimmer;
2. Repair numerous animal burrows in slopes;
3. Place aggregate berm against exterior slope in area of old discharge channel, slope near vertical, over 20 feet high;
4. Perform hydraulic and hydrologic analysis of pond to evaluate Principal Spillway and freeboard requirements;
5. Evaluate stability of vertical slope below Principal Spillway discharge;
6. Perform stability analysis of pond embankment;
7. Cut vegetation and trees along south and east interior slopes;
8. Evaluate stability enhancement and erosion resistance provided by trees and vegetation along Green River bank to determine whether to cut trees; and,
9. Evaluate frequency and depth of inundation from Green River flood events. Perform rapid drawdown stability evaluation of slope facing Green River.

The remaining two maintenance items were given a „moderate’ rating indicating the action item be addressed during next construction season. These included the following:

10. Design modifications to dam cross section to improve stability; and,
11. Evaluate need for secondary spillway to prevent pond overtopping.

ATC rated the overall condition of the Green River Scrubber Pond as satisfactory, which is defined as:

*no existing or potential dam safety deficiencies recognized. Safe performance is expected under all anticipated loading conditions, including such events as infrequent hydrologic and/or seismic events. Project files contain necessary hydrologic and other engineering calculations to verify dam safety and performance.*

The report noted a total of 8 action items. Five items were regarded as „moderate’ importance, which indicating the action item be addressed during next construction season. These five items included the following:

1. Revegetate areas damaged by mowing and construction equipment;
2. Cut vegetation on interior slope and spray with herbicide;
3. Inspect entire interior slope after cutting vegetation for wave erosion and burrowing animals, repair as necessary;
4. Evaluate need for gravity fed spillway to prevent overtopping; and,
5. Replace roadbed aggregate on crest access road to fill in ruts and eliminate ponding water.

The remaining three maintenance items were given a „normal’ rating indicating the action item be addressed as part of ongoing maintenance of the structure. These three items included the following:

6. Repair erosion gully on downstream slope at SW corner;
7. Mow vegetation on east embankment exterior slope and east end of south embankment; and,
8. Regrade area south of pond to prevent ponding water.

ATC rated the overall condition of the Green River Coal Pile Runoff Pond as fair, which is defined as:

*no existing dam safety deficiencies are recognized for normal loading conditions. Infrequent hydrologic and/or seismic events would probably result in a dam safety deficiency.*

The assessing professional engineer’s comments concerning the overall condition of the pond included:

*some maintenance required. After cutting of trees is complete, establishment of grass on slopes is needed to prevent erosion. Repair and flattening of exterior slope may be needed on south embankment in area of previous scarp.*

The report noted a total of 8 action items. Six maintenance items were given a „moderate’ rating indicating the action item be addressed during next construction season. These six items included the following:

1. Dress up exterior slope of south embankment after tree removal, establish grass vegetation;
2. Repair old scarp on south embankment;
3. Mow vegetation on interior and exterior slopes and remove trees;

4. Cut trees flush with ground on all interior and exterior slopes, establish grass cover after cutting;
5. Flatten south exterior slope, currently too steep; and,
6. Clear vegetation and clear sediment from intake on spillway to Ash Pond 2 (*Ash Treatment Basin #2*).

The remaining two maintenance items were given a „normal’ rating indicating the action item be addressed as part of ongoing maintenance of the structure. These two items included the following:

7. Perform hydrologic and hydraulic analysis on pond to evaluate need for secondary spillway to prevent pond overtopping; and,
8. Evaluate support needed for 2 HDPE ash lines to Main Ash Pond on west embankment, approximately 8 foot long section is undermined near north end of west embankment.



## 4.0 COMMENTS AND RECOMMENDATIONS

Condition assessment definitions, as accepted by the National Dam Safety Review Board, are as follows:

### **SATISFACTORY**

No existing or potential dam safety deficiencies are recognized. Acceptable performance is expected under all loading conditions (static, hydrologic, seismic) in accordance with the applicable regulatory criteria or tolerable risk guidelines.

### **FAIR**

No existing dam safety deficiencies are recognized for normal loading conditions. Rare or extreme hydrologic and/or seismic events may result in a dam safety deficiency. Risk may be in the range to take further action.

### **POOR**

A dam safety deficiency is recognized for loading conditions which may realistically occur. Remedial action is necessary. POOR may also be used when uncertainties exist as to critical analysis parameters which identify a potential dam safety deficiency. Further investigations and studies are necessary.

### **UNSATISFACTORY**

A dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution.

### **NOT RATED**

The dam has not been inspected, is not under state jurisdiction, or has been inspected but, for whatever reason, has not been rated.

## 4.1 Acknowledgement of Management Unit Conditions

I certify that the management units referenced herein (Ash Treatment Basin #1 or Main Pond, Ash Treatment Basin #2, Finishing Pond #3, Scrubber Pond, and the Former Ash Pond or Coal Runoff Pond) were personally assessed by me and was found to be in the following condition:

### **Ash Treatment Basin #1 or Main Pond: Poor**

The Ash Treatment Basin #1 or Main Pond is rated poor because further critical studies or investigations are needed to identify potential dam safety deficiencies.

### **Ash Treatment Basin #2: Poor**

The Ash Treatment Basin #2 is rated poor because further critical studies or investigations are needed to identify potential dam safety deficiencies.

**Scrubber Pond: Poor**

The Scrubber Pond is rated poor because further critical studies or investigations are needed to identify potential dam safety deficiencies.

**Former Ash Pond (or Coal Runoff Pond): Poor**

The Former Ash Pond (or Coal Runoff Pond) is rated poor because further critical studies or investigations are needed to identify potential dam safety deficiencies.

**Former Finishing Pond #3: Not Rated**

The Former Finishing Pond #3 is not rated because it was removed in 2010. It is our understanding ash was not removed from within the interior of the pond when the dike was removed. An assessment for the presence and extent of ash present in the pond should be performed. Any ash that can be feasibly removed should be excavated and stored in one of the other ash ponds.

**4.2 Ash Treatment Basin #1 or Main Pond****4.2.1 Hydrologic and Hydraulic Recommendations**

An August 2010 report by MACTEC Engineering and Consulting, Inc. titled *Assessment of Spillway Hydrologic Adequacy for the Coal Pile Pond, Ash Treatment Basin No. 2, and Scrubber Pond at Green River Generating Station* provides a hydrologic analysis that is specific to Ash Treatment Basin #1. Design storm events of various returns periods and of various durations, including 6 hours, 24 hours and 48 hours, were used in the analyses. Additionally, MACTEC's report was unclear if the present ash material located in the pond profile was included in their analysis. MACTEC noted in their report that while Ash Treatment Basin #1 is not a structure subject to investigation, analysis of Ash Treatment Basin #1 was required for their analysis and it was found to have a minimum freeboard of 1.54 ft for the DNREP-DOW Class A freeboard design hydrograph (FDH) and a freeboard of 2.11 ft for the 100-year, 48-hour design storm event.

AMEC recommends that an appropriately conservative design storm rainfall and freeboard depth in accordance with MSHA guidelines be applied to the impoundment's watershed to assure that the dam and decant system can safely store, control, and discharge the design flow. Based on the large size and significant rating for Ash Treatment Basin #1, the MSHA design storm would be the PMF. Hydraulic calculations should also be completed to determine the rate at which the discharge structure and associated piping could pass the design storm, if necessary, or draw down elevated water surfaces following such an event. The study should consider all critical stages over the life of the pond including pond full conditions. MSHA guidelines recommend a minimum freeboard of 3 feet. Since Ash Treatment Basin #1 discharges into Ash Treatment Basin #2, MSHA's guidelines for impoundments in series should be utilized.

**4.2.2 Geotechnical and Stability Recommendations**

In the opinion of the assessing professional engineer, the criteria for minimum safety factors should be in accordance with USACE EM 1110-2-1902 with a minimum seismic safety factor of 1.2 as recommended by 2007 *MSHA Coal Mine Impoundment Inspection and Plan Review*

*Handbook*, page 88. Likewise, if the dam does not meet the above seismic factor of safety, then the stability of the embankment should be analyzed and the amount of embankment deformation or settlement that may occur should be evaluated to assure that sufficient section of the crest will remain intact to prevent a release from the impoundment.

A July 2010 report by Associated Engineers, Inc. titled *Final Geotechnical Report Main Ash Pond Slope Stability Analysis and Repair*, for the Green River Station presents two stability analyses for Ash Treatment Basin #1 including a slope failure located on the downstream slope of the south embankment north of the outlet structure, and a global stability (also referred to as critical slope). Based on the results and recommendations in this report, the slope failure was repaired during May and June of 2010.

The repair stability adjusts the friction and phi angle for the material above the ground surface from elevation 385 feet to 393 feet. However, the report notes the slide extending down to approximate elevation 400 feet. From elevation 393 feet to 402 feet a fly ash and clay material was encountered. On the boring log for P-1, this material within the embankment is described as wet. The report also notes that the water levels observed in the piezometer installed in Boring P-5 below the toe of the slide were up to two feet above the pipe and stated there must be a connection between the fly ash in the embankment and fly ash below the slope. It is assumed that the lowering of the parameters in the layer above the bedrock by "backing in" to a safety factor of less than 1 and then designing a repair with a safety factor over 1.5 will compensate for the failure and that the repair will provide adequate stability. This area should be regularly and closely monitored for any changes in piezometers readings or surficial movement.

The global stability was reviewed for the maximum section at B-B'. The dam at cross section B-B' was noted to have a maximum height (from crest to downstream toe), and to contain close to a maximum thickness of fill material (measured from the top of the dam vertically downward). The results of the stability analyses provided factors of safety of 1.6 for long-term and 1.3 for seismic conditions. A review of the slopes used for the downstream embankment indicated about a 2.7H:1V was used in the analyses. The design slope for the downstream embankment is 2.5H:1V. During the site visit, this area was noted for possible uneven and over-steepened slopes. A survey should be performed at the cross-section to determine the actual configuration of the existing slope. In addition, the minimum depth of slice used in the program was 10 feet. The analysis should be performed with a 5 feet minimum depth of slice to identify shallow failure surfaces.

The analysis should consider all critical stages over the life of the pond including pond full conditions. These conditions would need to be determined in conjunction with the hydraulic recommendations above. The hydraulic analysis should provide a phreatic surface through the embankment. A rapid-drawdown should be performed for the A-A' section in case the pond would need to be lowered in response to a problem. The friction angle value used for the CCW in the analysis appears high for ash material. Typical ash friction values are 28 degrees for compacted, 24 degrees for loosely compacted, and 11 degrees for uncompacted material. Consideration should be given for lowering strength values to account for inconsistencies within the fill or foundation materials. Consideration should also be given to allow water levels in the piezometers to develop and stabilize. The analyses presented appear limited to a circular surface; different types of failure surfaces should be analyzed and optimized.

In the opinion of the assessing professional engineer, the analyses should be revised in accordance with these recommendations. The analysis should consider all critical stages over

the life of the pond including pond full conditions. These conditions would need to be determined in conjunction with the hydrologic and hydraulic recommendations above. The hydrologic and hydraulic analysis will provide maximum water levels in the pond and a phreatic surface through the embankment.

#### **4.2.3 Monitoring and Instrumentation Recommendations**

Twelve piezometers, of which 10 are remaining, were installed in 2010 (July and August) to support the recent stability analyses. It would be prudent for the Green River Power Station to maintain and protect these instruments, and document monitoring frequently until base line phreatic readings are apparent. After that time, a regular frequency should be maintained and the results evaluated by an engineer. Monitoring should include pond and river levels and should include additional readings and evaluation in response to elevated pond levels or specific rainfall events. AMEC recommends additional instrumentation, especially at the crest and toe of critical slopes, be installed as budgets or development of any future problems allow.

#### **4.2.4 Inspection Recommendations**

AMEC has reviewed provided information and inspection records for the Green River Ash Ponds: Ash Treatment Basin #1, Ash Treatment Basin #2, Scrubber Pond and Coal Runoff Pond and determined that Kentucky Utilities has begun adequate inspection practices. Finishing Pond #3 was removed from service in 2010, therefore, no inspection services have been provided for this pond. AMEC recommends that the current inspection program by the plant be expanded to include at least monthly instrumentation monitoring and pond and river levels.

AMEC has reviewed the 2009 inspection reports and determined Kentucky Utilities has adequate annual inspections by a Profession Engineer. In addition to the inspections by facility personnel, we recommend this type of annual inspection program and report by a Professional Engineer be continued at least yearly basis. Due to the recent slide repair on the south dike of Ash Treatment Basin #1 and the Coal Runoff Pond, the recent surficial slide repair at the southwest corner of the Scrubber Pond and recent repair of the east dike of Ash Treatment Basin #2, AMEC recommends additional inspections be performed by Professional Engineer should any problems, such as seepage, scarps, etc., be encountered with the repairs or if new similar problems develop.

### **4.3 Ash Treatment Basin #2**

#### **4.3.1 Hydrologic and Hydraulic Recommendations**

An August 2010 report by MACTEC Engineering and Consulting, Inc. titled *Assessment of Spillway Hydrologic Adequacy for the Coal Pile Pond, Ash Treatment Basin No. 2, and Scrubber Pond at Green River Generating Station* provides a hydrologic analysis that is specific to Ash Treatment Basin 2. Design storm events of various returns periods and of various durations, including 6 hours, 24 hours and 48 hours, were used in the analyses. The analyses for Ash Treatment Basin #2 indicated a minimum freeboard of -0.73 ft for the DNREP-DOW Class A freeboard design hydrograph (FDH) and a freeboard of -0.33 ft for the 100-year, 48-hour design storm event.

AMEC recommends that an appropriately conservative design storm rainfall and freeboard depth in accordance with MSHA guidelines be applied to the impoundment,s watershed to assure that the dam and decant system can safely store, control, and discharge the design flow. Based on the small size and significant rating for Ash Treatment Basin #2, the MSHA design



storm would be the  $\frac{1}{2}$  PMF. Hydraulic calculations should also be completed to determine the rate at which the discharge structure and associated piping could pass the design storm, if necessary, or draw down elevated water surfaces following such an event. The study should consider all critical stages over the life of the pond including pond full conditions. MSHA guidelines recommend a minimum freeboard of 3 feet. In addition, Ash Treatment Basin #2 will be required to utilize MSHA's guidelines for impoundments in series.

#### 4.3.2 Geotechnical and Stability Recommendations

In the opinion of the assessing professional engineer, the criteria for minimum safety factors should be in accordance with USACE EM 1110-2-1902 with a minimum seismic safety factor of 1.2 as recommended by 2007 *MSHA Coal Mine Impoundment Inspection and Plan Review Handbook*, page 88. Likewise, if the dam does not meet the above seismic factor of safety, then the stability of the embankment should be analyzed and the amount of embankment deformation or settlement that may occur should be evaluated to assure that sufficient section of the crest will remain intact to prevent a release from the impoundment.

A September 2010 report by MACTEC Engineering and Consulting, Inc. titled *Geotechnical Exploration and Slope Stability Analyses Data Package*, for the Green River Power Station presents stability analyses for Ash Treatment Basin #2 and the Scrubber Pond. Five sections were chosen for analyses on each structure. Section 1 is located on the south embankment of the Coal Runoff Pond. Sections 2 through 5 are located at Ash Treatment Basin #2 on the south embankment (2), southeast corner (3) and east embankment (4 and 5). Sections 6 through 10 are located at the Scrubber Pond on the west embankment (6), south embankment (7 and 8), southeast corner (9) and east embankment (10). For this preliminary report, results for sections 4 and 7 were presented.

Section 4 is located on the east embankment of Ash Treatment Basin #2. AMEC is concerned with the configuration and soil strength parameters used in the analyses. The 2009 ATC inspection report noted erosion in the outfall channel which had eroded the eastern toe of this slope. During AMEC's site visit in August 2010, the downstream embankment on the east dike was observed to be recently repaired with a rip-rap surface and the outfall channel had been relocated to the east of the toe. AMEC also observed wet/saturated areas along the eastern toe of this slope, this area was discussed with the personnel listed in Table 1 of this report. We were informed while onsite the wet/saturated soils were due to improper grading (i.e., water standing from a recent rain event); however, AMEC recommends this section be reviewed for existing conditions and parameters adjusted to reflect softer conditions at the toe. The wet areas may also reflect seepage from the pond; and therefore, higher water levels would need to be utilized in the pond and embankment analyses. In addition, soft layers of clay and ash were shown in the Section 2 borings, other sections yet to be analyzed may be more critical. Consideration should also be given to the extension of the south embankment and construction of the east embankment (estimated to be performed in the early 1970s). Construction documents and construction details are very limited from this era. As evidenced by the ash encountered in the Section 2 borings, it is suspected that portions of the extension and formation of Ash Treatment Basin #2 were constructed over and possibly with the CCW material. Consequently, embankments constructed over ash would be susceptible to piping and slope failures.

The analysis should consider all critical stages over the life of the pond including pond full conditions. These conditions would need to be determined in conjunction with the hydraulic recommendations above. The hydraulic analysis should provide a phreatic surface through the



embankment. A rapid-drawdown should be performed for upstream embankment in case the pond would need to be lowered in response to a problem, and the downstream embankment in relation to flooding of Green River. The friction angle value used for the CCW in the analysis appears high for ash material. Typical ash friction values are 28 degrees for compacted, 24 degrees for loosely compacted, and 11 degrees for uncompacted material. Consideration should be given for lowering strength values to account for inconsistencies within the fill or foundation materials. Consideration should also be given to allowing some time for water levels in the piezometers to develop and stabilize. The analyses presented appear limited to a circular surface; different types of failure surfaces should be analyzed and optimized.

In the opinion of the assessing professional engineer, the analyses should be revised in accordance with these recommendations. The analysis should consider all critical stages over the life of the pond including pond full conditions. These conditions would need to be determined in conjunction with the hydrologic and hydraulic recommendations above. The hydrologic and hydraulic analysis will provide maximum water levels in the pond and a phreatic surface through the embankment.

#### **4.3.3 Monitoring and Instrumentation Recommendations**

Twelve piezometers, of which 10 are remaining, were installed in 2010 (July and August) to support the recent stability analyses. It would be prudent for the Green River Power Station to maintain and protect these instruments, and document monitoring frequently until base line phreatic readings are apparent. After that time, a regular frequency should be maintained and the results evaluated by an engineer. Monitoring should include pond and river levels and should include additional readings and evaluation in response to elevated pond levels or specific rainfall events. AMEC recommends additional instrumentation, especially at the crest and toe of critical slopes, be installed as budgets or development of any future problems allow.

#### **4.3.4 Inspection Recommendations**

AMEC has reviewed provided information and inspection records for the Green River Ash Ponds: Ash Treatment Basin #1, Ash Treatment Basin #2, Scrubber Pond and Coal Runoff Pond and determined that Kentucky Utilities has begun adequate inspection practices. Finishing Pond #3 was removed from service in 2010, and therefore, no inspection services have been provided for this pond. AMEC recommends that the current inspection program by the plant be expanded to include at least monthly instrumentation monitoring and pond and river levels.

AMEC has reviewed the 2009 inspection reports and determined KENTUCKY UTILITIES has adequate annual inspections by a Profession Engineer. We recommend this type of annual inspection program and report by a Professional Engineer be continued at least yearly, in addition to the inspections by facility personnel. Due to the recent slide repair on the south dike of Ash Treatment Basin #1 and the Coal Runoff Pond, the recent surficial slide repair at the southwest corner of the Scrubber Pond and recent repair of the east dike of Ash Treatment Basin #2, AMEC recommends additional inspections be performed by Professional Engineer should any problems, such as seepage, scarps, etc., be encountered with the repairs or if new similar problems develop.

### **4.4 Scrubber Pond**

#### **4.4.1 Hydrologic and Hydraulic Recommendations**

An August 2010 report by MACTEC Engineering and Consulting, Inc. titled *Assessment of Spillway Hydrologic Adequacy for the Coal Pile Pond, Ash Treatment Basin No. 2, and Scrubber Pond at Green River Generating Station* provides a hydrologic analysis that is specific to Ash Treatment Basin 2. Design storm events of various returns periods and of various durations, including 6 hours, 24 hours and 48 hours, were used in the analyses. The analyses for the Scrubber Pond indicated a minimum freeboard of 0.22 feet for the DNREP-DOW Class A freeboard design hydrograph (FDH) and a freeboard of 0.60 feet for the 100-year, 48-hour design storm event.

AMEC recommends that an appropriately conservative design storm rainfall and freeboard depth in accordance with MSHA guidelines be applied to the impoundment's watershed to assure that the dam and decant system can safely store, control, and discharge the design flow. Based on the small size and significant rating for the Scrubber Pond, the MSHA design storm would be the  $\frac{1}{2}$  PMF. Hydraulic calculations should also be completed to determine the rate at which the discharge structure and associated piping could pass the design storm, if necessary, or draw down elevated water surfaces following such an event. The study should consider all critical stages over the life of the pond including pond full conditions. MSHA guidelines recommend a minimum freeboard of 3 feet.

#### 4.4.2 Geotechnical and Stability Recommendations

In the opinion of the assessing professional engineer, the criteria for minimum safety factors should be in accordance with USACE EM 1110-2-1902 with a minimum seismic safety factor of 1.2 as recommended by 2007 *MSHA Coal Mine Impoundment Inspection and Plan Review Handbook*, page 88. Likewise, if the dam does not meet the above seismic factor of safety, then the stability of the embankment should be analyzed and the amount of embankment deformation or settlement that may occur should be evaluated to assure that sufficient section of the crest will remain intact to prevent a release from the impoundment.

A September 2010 report by MACTEC Engineering and Consulting, Inc. titled *Geotechnical Exploration and Slope Stability Analyses Data Package*, for the Green River Power Station presents stability analyses for Ash Treatment Basin #2 and the Scrubber Pond. Five sections were chosen for analyses on each structure. Section 1 is located on the south embankment of the Coal Runoff Pond. Sections 2 through 5 are located at Ash Treatment Basin #2 on the south embankment (2), southeast corner (3) and east embankment (4 and 5). Sections 6 through 10 are located at the Scrubber Pond on the west embankment (6), south embankment (7 and 8), southeast corner (9) and east embankment (10). For this preliminary report, results for sections 4 and 7 were presented.

Section 7 is located on the west end of the south embankment of the Scrubber Pond. This section is near a recently repaired surface area on the downstream embankment (located to the west). On first glance of the section reported, it appears from the plan sheet that Section 8 would have a steeper downstream slope and would be more critical. During the site visit, wet conditions were noted below the toe of the south embankment. Given this section may not represent the critical section, further review will not be performed at this time but rather at the completion of the study when recommendations herein have been incorporated into the analyses. Recommendations mentioned in the previous sections such as the configuration of the slope and adjustment of soil strength parameters and a detailed discussion of the methods and parameters should be included in the final report.

The analysis should consider all critical stages over the life of the pond including pond full conditions. These conditions would need to be determined in conjunction with the hydraulic recommendations above. The hydraulic analysis should provide a phreatic surface through the embankment. A rapid-drawdown should be performed for upstream embankment in case the pond would need to be lowered in response to a problem, and the downstream embankment in relation to flooding of Green River. The friction angle value used for the CCW in the analysis appears high for ash material. Typical ash friction values are 28 degrees for compacted, 24 degrees for loosely compacted, and 11 degrees for uncompacted material. Consideration should be given for lowering strength values to account for inconsistencies within the fill or foundation materials. Consideration should also be given to allowing some time for water levels in the piezometers to develop and stabilize. The analyses presented appear limited to a circular surface; different types of failure surfaces should be analyzed and optimized.

In the opinion of the assessing professional engineer, the analyses should be revised in accordance with these recommendations. The analysis should consider all critical stages over the life of the pond including pond full conditions. These conditions would need to be determined in conjunction with the hydrologic and hydraulic recommendations above. The hydrologic and hydraulic analysis will provide maximum water levels in the pond and a phreatic surface through the embankment.

#### **4.4.3 Monitoring and Instrumentation Recommendations**

Twelve piezometers, of which 10 are remaining, were installed in 2010 (July and August) to support the recent stability analyses. It would be prudent for the Green River Power Station to maintain and protect these instruments, and document monitoring frequently until base line phreatic readings are apparent. After that time, a regular frequency should be maintained and the results evaluated by an engineer. Monitoring should include pond and river levels and should include additional readings and evaluation in response to elevated pond levels or specific rainfall events. AMEC recommends additional instrumentation, especially at the crest and toe of critical slopes, be installed as budgets or development of any future problems allow.

#### **4.4.4 Inspection Recommendations**

AMEC has reviewed provided information and inspection records for the Green River Ash Ponds: Ash Treatment Basin #1, Ash Treatment Basin #2, Scrubber Pond and Coal Runoff Pond and determined that Kentucky Utilities has begun adequate inspection practices. Finishing Pond #3 was removed from service in 2010, and therefore, no inspection services have been provided for this pond. AMEC recommends that the current inspection program by the plant be expanded to include at least monthly instrumentation monitoring and pond and river levels.

AMEC has reviewed the 2009 inspection reports and determined KENTUCKY UTILITIES has adequate annual inspections by a Profession Engineer. We recommend this type of annual inspection program and report by a Professional Engineer be continued at least yearly, in addition to the inspections by facility personnel. Due to the recent slide repair on the south dike of Ash Treatment Basin #1 and the Coal Runoff Pond, the recent surficial slide repair at the southwest corner of the Scrubber Pond and recent repair of the east dike of Ash Treatment Basin #2, AMEC recommends additional inspections be performed by Professional Engineer should any problems, such as seepage, scarps, etc., be encountered with the repairs or if new similar problems develop.

## 4.5 Former Ash Pond or Coal Runoff Pond

### 4.5.1 Hydrologic and Hydraulic Recommendations

An August 2010 report by MACTEC Engineering and Consulting, Inc. titled *Assessment of Spillway Hydrologic Adequacy for the Coal Pile Pond, Ash Treatment Basin No. 2, and Scrubber Pond at Green River Generating Station* provides a hydrologic analysis that is specific to Ash Treatment Basin 2. Design storm events of various returns periods and of various durations, including 6 hours, 24 hours and 48 hours, were used in the analyses. The analyses for the Coal Runoff Pond indicated a minimum freeboard of 1.74 feet for the DNREP-DOW Class A freeboard design hydrograph (FDH) and a freeboard of 2.17 feet for the 100-year, 48-hour design storm event.

AMEC recommends that an appropriately conservative design storm rainfall and freeboard depth in accordance with MSHA guidelines be applied to the impoundment's watershed to assure that the dam and decant system can safely store, control, and discharge the design flow. Based on the small size and significant rating for the Scrubber Pond, the MSHA design storm would be the  $\frac{1}{2}$  PMF. Hydraulic calculations should also be completed to determine the rate at which the discharge structure and associated piping could pass the design storm, if necessary, or draw down elevated water surfaces following such an event. The study should consider all critical stages over the life of the pond including pond full conditions. MSHA guidelines recommend a minimum freeboard of 3 feet.

### 4.5.2 Geotechnical and Stability Recommendations

In the opinion of the assessing professional engineer, the criteria for minimum safety factors should be in accordance with USACE EM 1110-2-1902 with a minimum seismic safety factor of 1.2 as recommended by 2007 *MSHA Coal Mine Impoundment Inspection and Plan Review Handbook*, page 88. Likewise, if the dam does not meet the above seismic factor of safety, then the stability of the embankment should be analyzed and the amount of embankment deformation or settlement that may occur should be evaluated to assure that sufficient section of the crest will remain intact to prevent a release from the impoundment.

A September 2010 report by MACTEC Engineering and Consulting, Inc. titled *Geotechnical Exploration and Slope Stability Analyses Data Package*, for the Green River Power Station presents stability analyses for Ash Treatment Basin #2 and the Scrubber Pond. Five sections were chosen for analyses on each structure. Section 1 is located on the south embankment of the Coal Runoff Pond. Sections 2 through 5 are located at Ash Treatment Basin #2 on the south embankment (2), southeast corner (3) and east embankment (4 and 5). Sections 6 through 10 are located at the Scrubber Pond on the west embankment (6), south embankment (7 and 8), southeast corner (9) and east embankment (10). For this preliminary report, results for sections 4 and 7 were presented.

Section 1 is located on the south embankment of the Coal Runoff Pond. The 2009 ATC inspection report mentions needed repairs for a surface failure on the downstream slope in this area. During our site visit, the toe and the area below the downstream slope had been recently repaired. Details of the repair were not provided. The analysis for this section was not provided in the preliminary report. The results of the analyses should be reviewed when the final report is completed.



The analysis should consider all critical stages over the life of the pond including pond full conditions. These conditions would need to be determined in conjunction with the hydraulic recommendations above. The hydraulic analysis should provide a phreatic surface through the embankment. A rapid-drawdown should be performed for upstream embankment in case the pond would need to be lowered in response to a problem, and the downstream embankment in relation to flooding of Green River. The friction angle value used for the CCW in the analysis appears high for ash material. Typical ash friction values are 28 degrees for compacted, 24 degrees for loosely compacted, and 11 degrees for uncompacted material. Consideration should be given for lowering strength values to account for inconsistencies within the fill or foundation materials. Consideration should also be given to allowing some time for water levels in the piezometers to develop and stabilize. The analyses presented appear limited to a circular surface; different types of failure surfaces should be analyzed and optimized.

In the opinion of the assessing professional engineer, the analyses should be performed in accordance with these recommendations. The analysis should consider all critical stages over the life of the pond including pond full conditions. These conditions would need to be determined in conjunction with the hydrologic and hydraulic recommendations above. The hydrologic and hydraulic analysis will provide maximum water levels in the pond and a phreatic surface through the embankment.

#### **4.5.3 Monitoring and Instrumentation Recommendations**

Twelve piezometers, of which 10 are remaining, were installed in 2010 (July and August) to support the recent stability analyses. It would be prudent for the Green River Power Station to maintain and protect these instruments, and document monitoring frequently until base line phreatic readings are apparent. After that time, a regular frequency should be maintained and the results evaluated by an engineer. Monitoring should include pond and river levels and should include additional readings and evaluation in response to elevated pond levels or specific rainfall events. AMEC recommends additional instrumentation, especially at the crest and toe of critical slopes, be installed as budgets or development of any future problems allow.

#### **4.5.4 Inspection Recommendations**

AMEC has reviewed provided information and inspection records for the Green River Ash Ponds: Ash Treatment Basin #1, Ash Treatment Basin #2, Scrubber Pond and Coal Runoff Pond and determined that Kentucky Utilities has begun adequate inspection practices. Finishing Pond #3 was removed from service in 2010, and therefore, no inspection services have been provided for this pond. AMEC recommends that the current inspection program by the plant be expanded to include at least monthly instrumentation monitoring and pond and river levels.

AMEC has reviewed the 2009 inspection reports and determined KENTUCKY UTILITIES has adequate annual inspections by a Profession Engineer. We recommend this type of annual inspection program and report by a Professional Engineer be continued at least yearly, in addition to the inspections by facility personnel. Due to the recent slide repair on the south dike of Ash Treatment Basin #1 and the Coal Runoff Pond, the recent surficial slide repair at the southwest corner of the Scrubber Pond and recent repair of the east dike of Ash Treatment Basin #2, AMEC recommends additional inspections be performed by Professional Engineer should any problems, such as seepage, scarps, etc., be encountered with the repairs or if new similar problems develop.



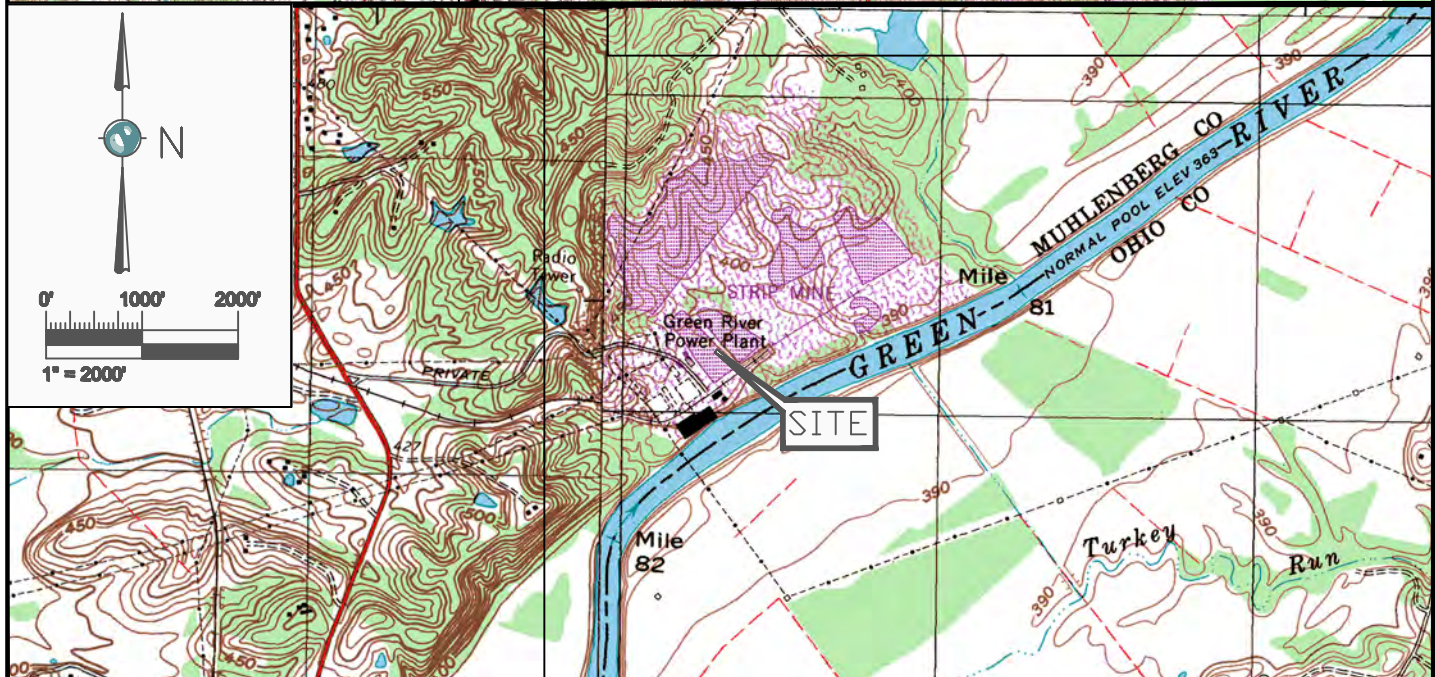
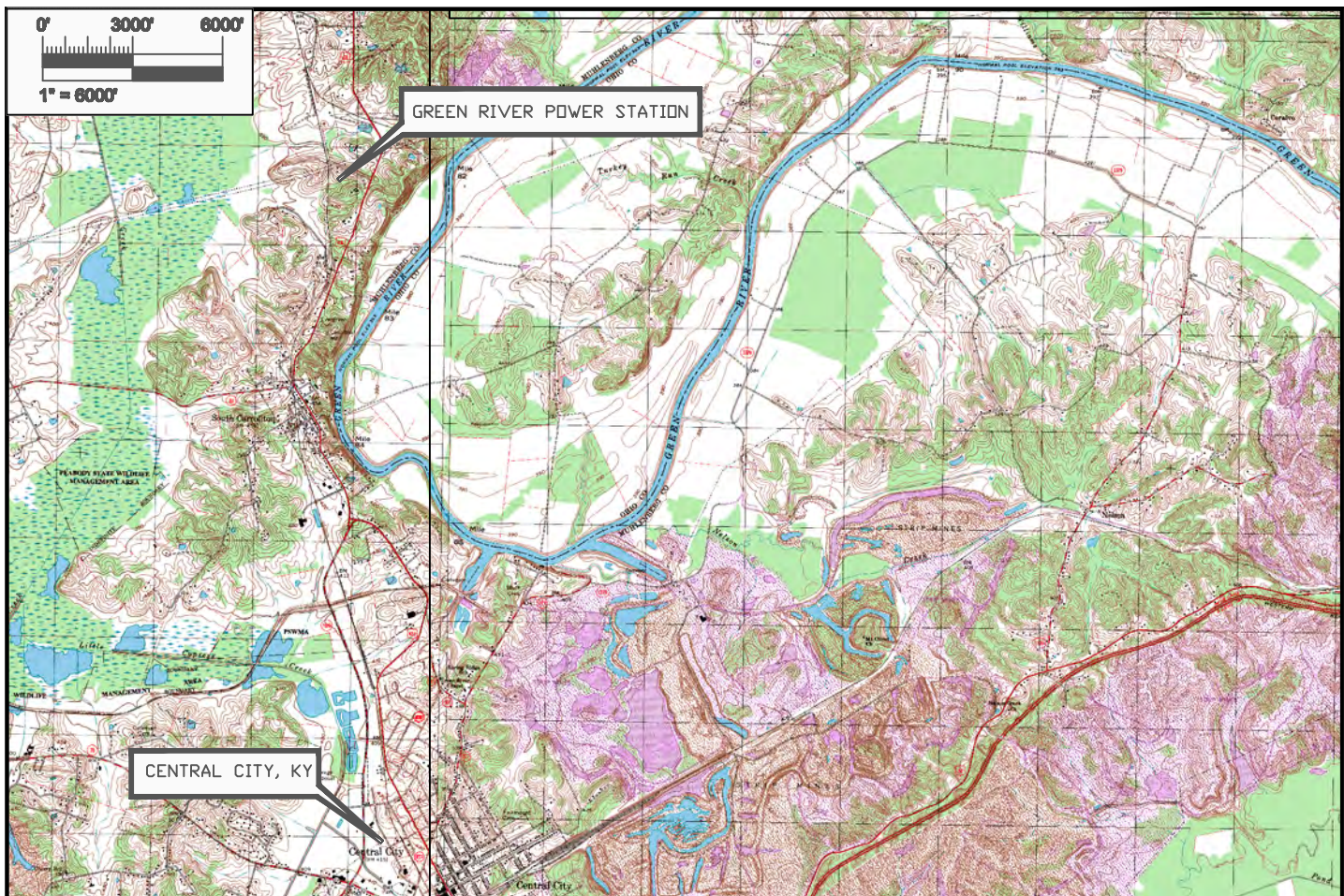
## 5.0 CLOSING

This report is prepared for the exclusive use of the Environmental Protection Agency for the site and criteria stipulated herein. This report does not address regulatory issues associated with storm water runoff, the identification and modification of regulated wetlands, or ground water recharge areas. Further, this report does not include review or analysis of environmental or regional geo-hydrologic aspects of the site, except as noted herein. Questions or interpretation regarding any portion of the report should be addressed directly by the geotechnical engineer.

Any use, reliance on, or decisions to be made based on this report by a third party are the responsibility of such third parties. AMEC accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

The conclusions and recommendations given in this report are based on visual observations, our partial knowledge of the history of Green River Power Station impoundments, and information provided to us by others. This report has been prepared in accordance with normally accepted geotechnical engineering practices. No other warranty is expressed or implied.





## AMEC Earth & Environmental

690 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40239  
(502) 267-0700



### CLIENT LOGO



### CLIENT

UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY

PROJECT  
ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

TITLE  
KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.  
GREEN RIVER POWER STATION, CENTRAL CITY, KY  
SITE LOCATION & VICINITY MAP

DWN BY: CAE

CHK'D BY: MSC

PROJECTION:

DATUM:

REV. NO.:

SCALE:

AS SHOWN

DATE: 9/13/10

PROJECT NO: 3-2108-0177-0003

FIGURE No.

1



ASH TREATMENT BASIN #1  
MAIN ASH POND

ASH TREATMENT  
BASIN #2

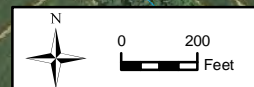
SCRUBBER  
POND

FINISHING POND  
# 3

COAL PILE RUNOFF POND

POWER PLANT DR

GREEN RIVER



UNITED STATES  
ENVIRONMENTAL PROTECTION AGENCY

DWN BY: DJC

CKD BY: MS

Datum: NAD 83

Projection: Albers

Scale: As Shown

ASSESSMENT OF DAM SAFETY OF  
COAL COMBUSTION SURFACE IMPOUNDMENTS

REV. No.: A

Date: 9-14-10

Project No:

3-2106-0177-0002

Figure No:

2

AMEC Earth & Environmental  
690 Commonwealth Business Center  
11003 Bluegrass Parkway  
Louisville, KY 40299



GREEN RIVER POWER STATION  
CENTRAL CITY, KY  
SITE PLAN



CRITICAL INFRASTRUCTURE	ID	LONGITUDE	LATITUDE
Equality Church	1	-87.072773	37.393101
Oak Grove Church	2	-87.076385	37.419768
Smallhouse Church	3	-87.082774	37.384489





AMEC Earth & Environmental  
690 Commonwealth Business Center  
11003 Bluegrass Parkway  
Louisville, KY 40299




UNITED STATES  
ENVIRONMENTAL PROTECTION AGENCY

DRAWN BY: DJC
CHKD BY: MS
DATUM: NAD83
PROJECTION: Albers
SCALE: AS SHOWN
DATE: 5/21/2010

ASSESSMENT OF DAM SAFETY OF  
COAL COMBUSTION SURFACE IMPOUNDMENTS

KENTUCKY UTILITIES  
GREEN RIVER POWER STATION, CENTRAL CITY, KY  
CRITICAL INFRASTRUCTURE



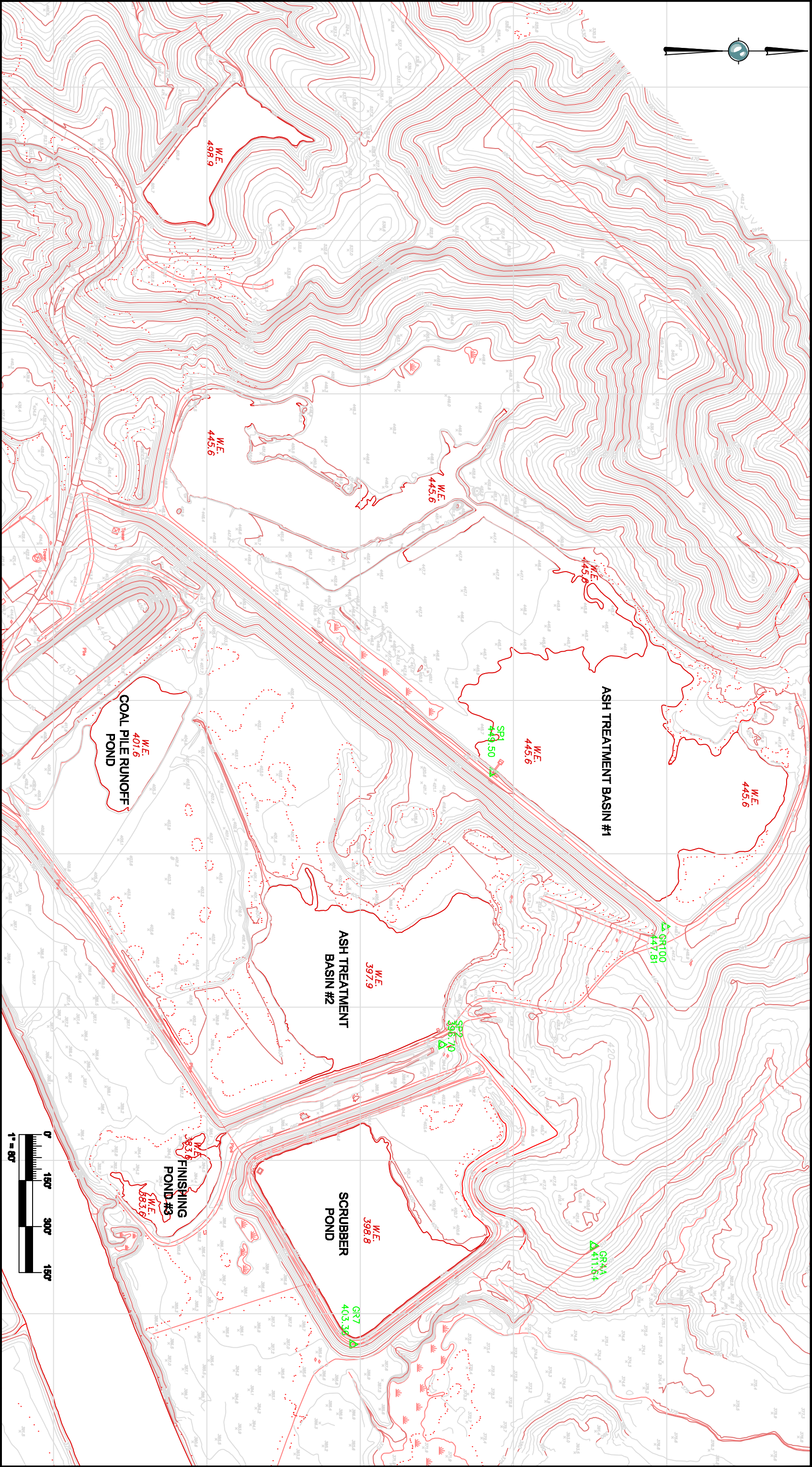
0 1 Miles

0 1 Kilometers

Notes: Critical infrastructure data provided by ESRI

FIGURE 3





NOTE: THIS DRAWING SHOULD BE READ IN CONJUNCTION  
WITH THE AMEC EARTH & ENVIRONMENTAL REPORT

CLIENT LOGO



CLIENT:

UNITED STATES ENVIRONMENTAL  
PROTECTION AGENCY

**AMEC Earth & Environmental**

680 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, KY 40289  
(502) 267-0700



DWN. BY: CAE

CHKD BY: MSC

DATE:

PROJECTION:

SCALE: AS SHOWN

PROJECT: ASSESSMENT OF DAM SAFETY OF COAL  
COMBUSTION SURFACE IMPOUNDMENTS

TITLE

KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.  
GREEN RIVER POWER STATION, CENTRAL CITY, KY  
SITE TOPOGRAPHIC MAP

DATE:

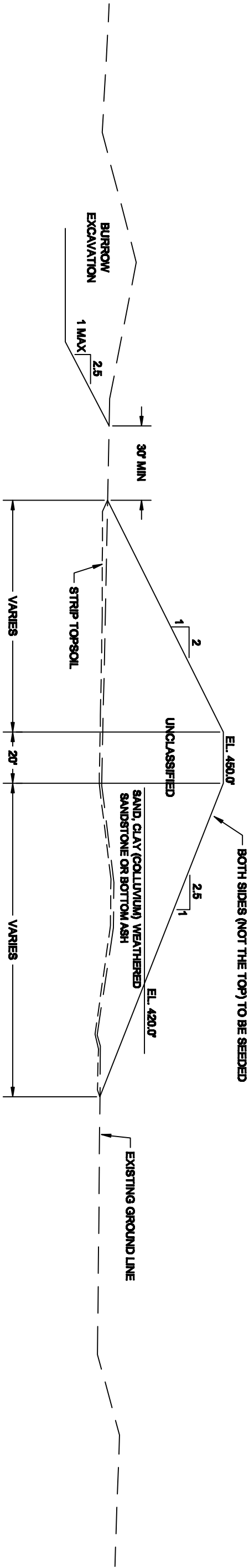
PROJECT NO:

REV. NO.:

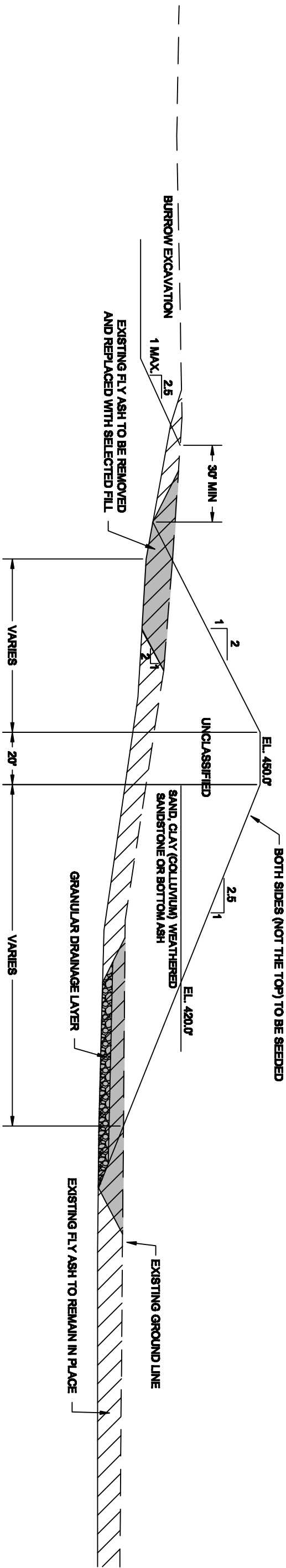
FIGURE NO.

4





TYPICAL CROSS-SECTION  
NO UNDERCUTTING REQUIRED



NOTE: THIS DRAWING SHOULD BE READ IN CONJUNCTION  
WITH THE AMEC EARTH & ENVIRONMENTAL REPORT

CLIENT LOGO



CLIENT:

UNITED STATES ENVIRONMENTAL  
PROTECTION AGENCY

**AMEC Earth & Environmental**  
680 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40299  
(502) 267-0700



DWN BY:

CAE

CHKD BY:

MSC

DATE:

PROJECT:

ASSESSMENT OF DAM SAFETY OF COAL  
COMBUSTION SURFACE IMPOUNDMENTS  
KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.,  
GREEN RIVER POWER STATION, CENTRAL CITY, KY  
ASH TREATMENT BASIN #1 TYPICAL CROSS SECTIONS

DATE:

9/14/10

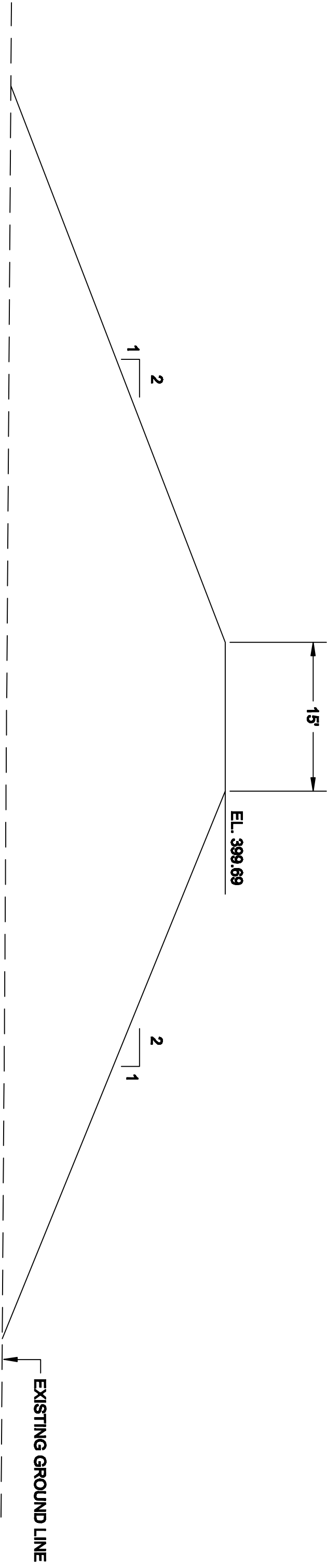
PROJECT NO:



3-2108-0177-0003

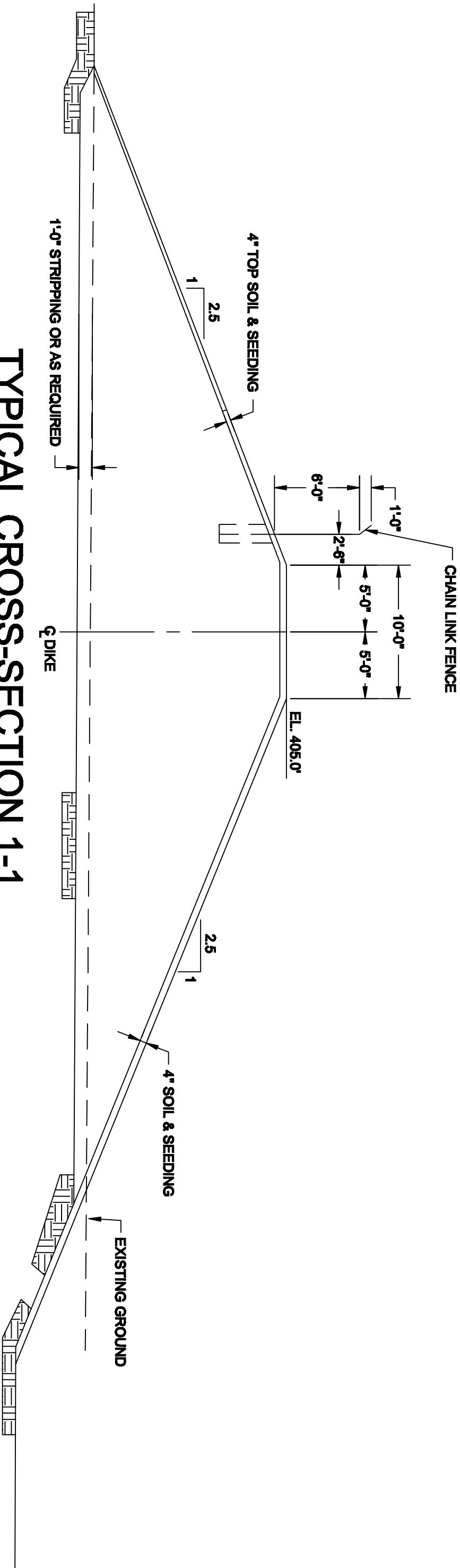
REV. NO:

FIGURE NO.




5

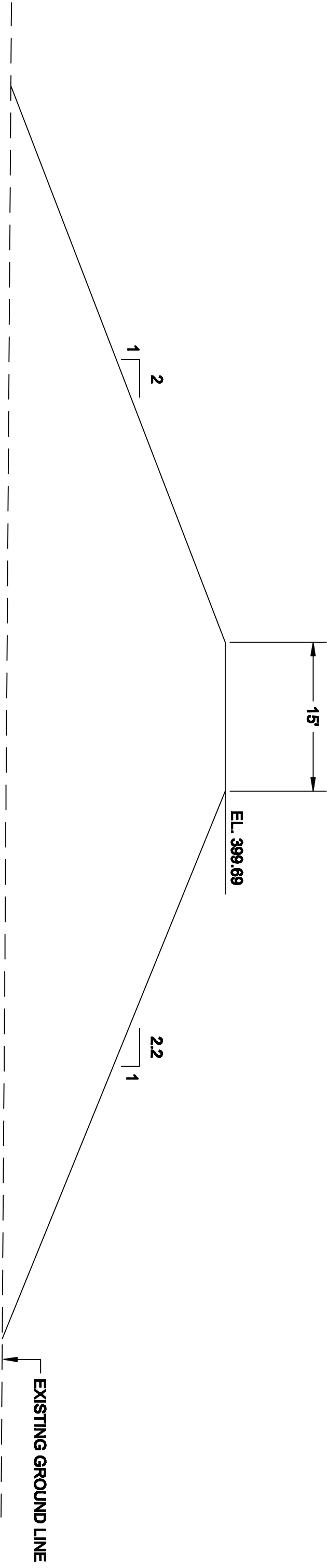




NOTE: THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE AMEC EARTH & ENVIRONMENTAL REPORT		CLIENT LOGO 	
CLIENT:  UNITED STATES ENVIRONMENTAL PROTECTION AGENCY		CLIENT LOGO 	
		AMEC Earth & Environmental 680 Commonwealth Center 11003 Bluegrass Parkway Louisville, Ky 40299 (502) 267-0700	
amec		amec	
DWN BY: CAE		PROJECT ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS	
CHKD BY: MSC		DATE: 9/14/10	
DATUM:		PROJECT NO: 3-2108-0177-0003	
PROJECTION:		REV. NO:	
SCALE: NTS		FIGURE No. 6	
TITLE KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S., GREEN RIVER POWER STATION, CENTRAL CITY, KY COAL PILE RUN OFF POND CROSS-SECTION			



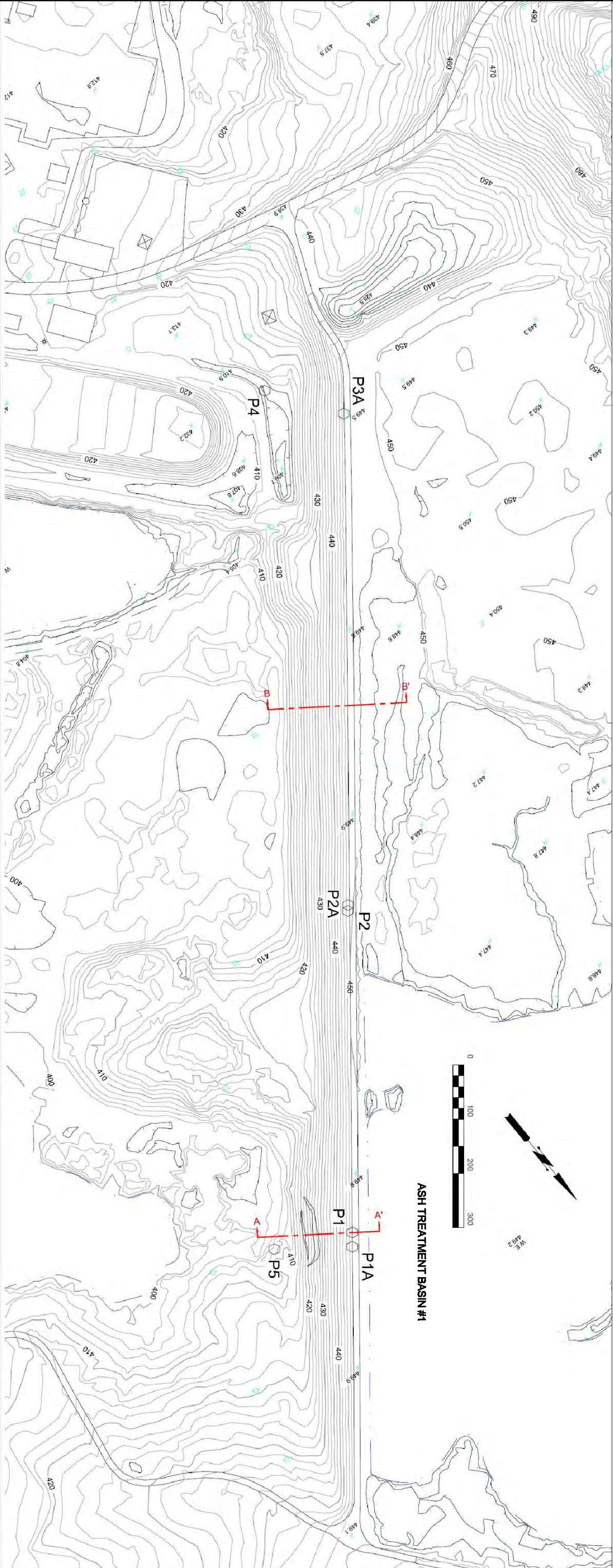
TYPICAL CROSS-SECTION 1-1

NOTE: THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE AMEC EARTH & ENVIRONMENTAL REPORT		CLIENT LOGO		CLIENT: UNITED STATES ENVIRONMENTAL PROTECTION AGENCY		DRAWN BY: CAE		PROJECT: ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS		DATE: 9/14/10	
				CHECKED BY: MSC		PROJECT NO: 3-2108-0177-0003		TITLE: KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S. GREEN RIVER POWER STATION, CENTRAL CITY, KY SCRUBBER POND CROSS-SECTION		REV. NO: 7	
660 Commonwealth Center 11003 Bluegrass Parkway Louisville, KY 40259 (502) 267-0700				DATE: 3-2108-0177-0003		PROJECT NO: 3-2108-0177-0003		TITLE: KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S. GREEN RIVER POWER STATION, CENTRAL CITY, KY SCRUBBER POND CROSS-SECTION		REV. NO: 7	
SCALE: NTS		PROJECT NO: 3-2108-0177-0003		PROJECT NO: 3-2108-0177-0003		PROJECT NO: 3-2108-0177-0003		PROJECT NO: 3-2108-0177-0003		PROJECT NO: 3-2108-0177-0003	
SCALE: NTS		PROJECT NO: 3-2108-0177-0003		PROJECT NO: 3-2108-0177-0003		PROJECT NO: 3-2108-0177-0003		PROJECT NO: 3-2108-0177-0003		PROJECT NO: 3-2108-0177-0003	
SCALE: NTS		PROJECT NO: 3-2108-0177-0003		PROJECT NO: 3-2108-0177-0003		PROJECT NO: 3-2108-0177-0003		PROJECT NO: 3-2108-0177-0003		PROJECT NO: 3-2108-0177-0003	





NOTE: THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE AMEC EARTH & ENVIRONMENTAL REPORT		CLIENT LOGO		CLIENT: UNITED STATES ENVIRONMENTAL PROTECTION AGENCY		DWN BY: CAE		PROJECT DATE: 9/14/10			
		<b>AMEC Earth &amp; Environmental</b> 680 Commonwealth Center 11003 Bluegrass Parkway Louisville, Ky 40299 (502) 267-0700				CHK'D BY: MSC		PROJECT NO: 3-2108-0177-0003			
						DATUM:		TITLE KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S. GREEN RIVER POWER STATION, CENTRAL CITY, KY COAL PILE RUN OFF POND CROSS-SECTION			
						PROJECTION:				REV. NO:	
						SCALE:				FIGURE NO.	
		NTS				8					

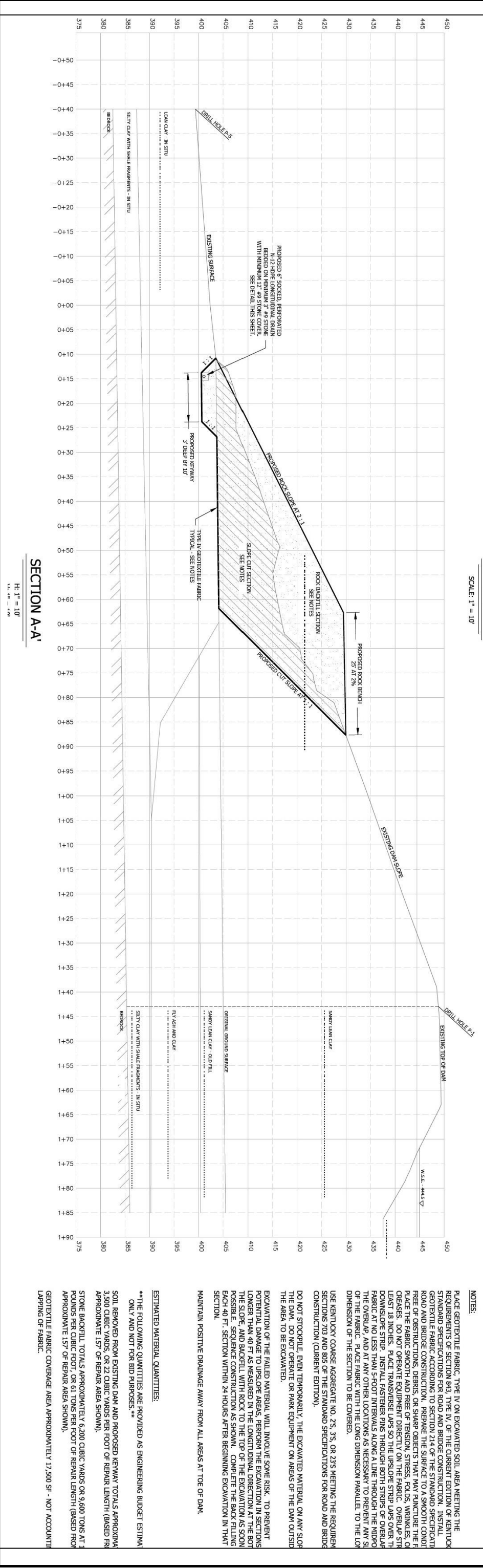


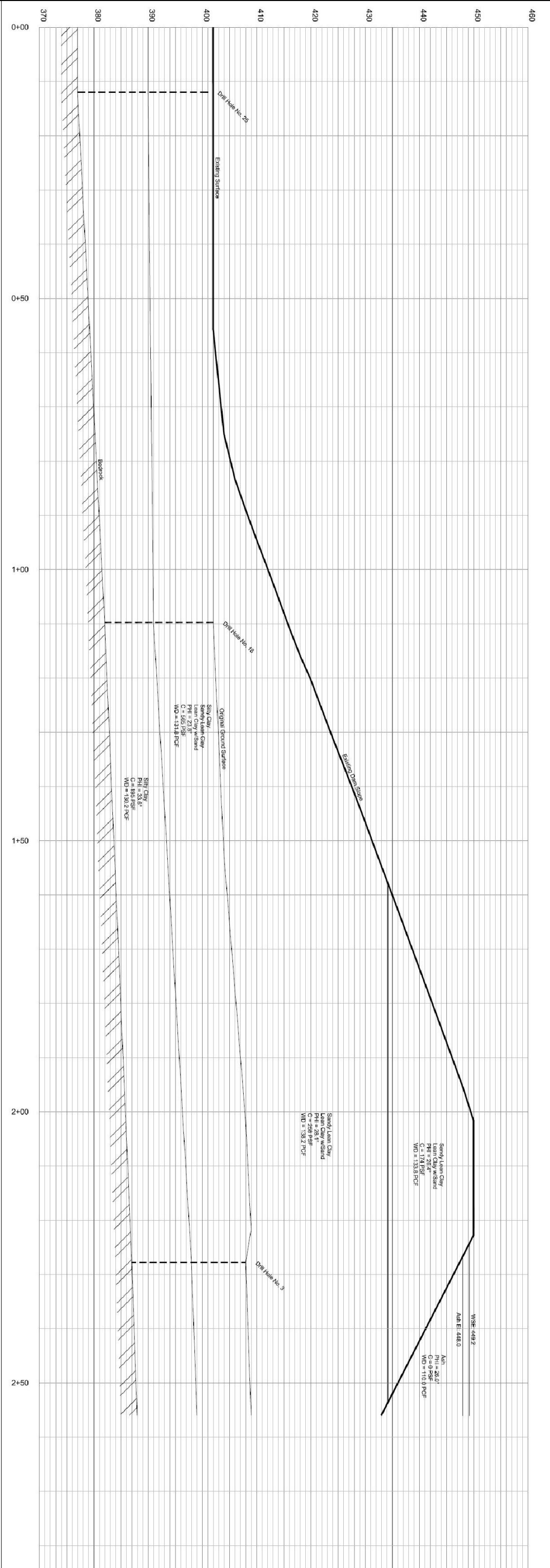


 P4      PIEZOMETER AND BORING LOCATIONS



NOTE: THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE AMEC EARTH & ENVIRONMENTAL REPORT		CLIENT LOGO	
			
CLIENT:		UNITED STATES ENVIRONMENTAL PROTECTION AGENCY	
AMEC Earth & Environmental			
680 Commonwealth Center 11003 Bluegrass Parkway Louisville, Ky 40298 (502) 267-0700			
DWN BY:	CAE	PROJECT	ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS
CHK'D BY:	MSC	TITLE	KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S. GREEN RIVER POWER STATION, CENTRAL CITY, KY ASH TREATMENT BASIN #1 BORING, PIEZOMETER, & CROSS SECTIONS LOCATIONS
DATUM:		REV. NO.:	
PROJECTION:		FIGURE NO.	9
SCALE:	AS SHOWN		







SECTION B-B'  
CRITICAL SLOPE CROSS SECTION

NOTE: THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE AMEC EARTH & ENVIRONMENTAL REPORT		CLIENT LOGO		CLIENT: UNITED STATES ENVIRONMENTAL PROTECTION AGENCY	
				AMEC Earth & Environmental 680 Commonwealth Center 11003 Bluegrass Parkway Louisville, KY 40298 (502) 267-0700	
					
DWN BY: CAE		PROJECT: ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS		DATE: 9/14/10	
CHKD BY: MSC		TITLE: KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S. GREEN RIVER POWER STATION, CENTRAL CITY, KY ASH TREATMENT BASIN #1 CRITICAL SLOPE CROSS SECTION		PROJECT NO: 3-2108-0177-0003	
DATUM: AS SHOWN		PROJECTION: SCALE: AS SHOWN		REV. NO: FIGURE No. 11	





APPROXIMATE BORING LOCATION

APPROXIMATE PIEZOMETER LOCATION

NOTE: THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE AMEC EARTH & ENVIRONMENTAL REPORT

CLIENT LOGO



CLIENT:

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

AMEC Earth & Environmental

680 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40299  
(502) 267-0700



DWN BY:

CAE

CHKD BY:

MSC

DATUM:

PROJECTION:

SCALE: AS SHOWN

PROJECT

ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

TITLE

KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.  
GREEN RIVER POWER STATION, CENTRAL CITY, KY  
BORING LOCATION PLAN AND SLOPE STABILITY SECTIONS

DATE:

9/14/10

PROJECT NO:

3-2108-0177-0003

REV. NO:

FIGURE NO.

12



**APPENDIX A**  
**Waste Impoundment Inspection Forms**



**Coal Combustion Waste (CCW)  
Impoundment Inspection**

Impoundment NPDES Permit # KY 0002011 INSPECTOR James Black/Shea Carr  
Date 08/16/2010

Impoundment Name Ash Treatment Basin #1 (or Main Pond)  
Impoundment Company Kentucky Utilities (KU) Company (A subsidiary of EON-US)  
EPA Region 4  
State Agency (Field Office) Address 200 Fair Oaks Lane  
Frankfort, KY 40601  
Name of Impoundment ATB #1 (Ash Treatment Basin #1 or Main Pond)  
(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New ☒ Update ☐

	Yes	No
Is impoundment currently under construction?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Is water or ccw currently being pumped into the impoundment?	<input checked="" type="checkbox"/>	<input type="checkbox"/>

**IMPOUNDMENT FUNCTION:** Storage and management coal combustion waste (CCW) byproducts

Nearest Downstream Town : Name Livermore, Kentucky  
Distance from the impoundment 9 miles  
Impoundment Location:  
Longitude -87 Degrees 7 Minutes 18.54 Seconds  
Latitude 37 Degrees 22 Minutes 11.09 Seconds  
State KY County Muhlenberg

Does a state agency regulate this impoundment? YES ☒ NO ☐

If So Which State Agency? State of Kentucky Division of Water



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

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

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

**X 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.

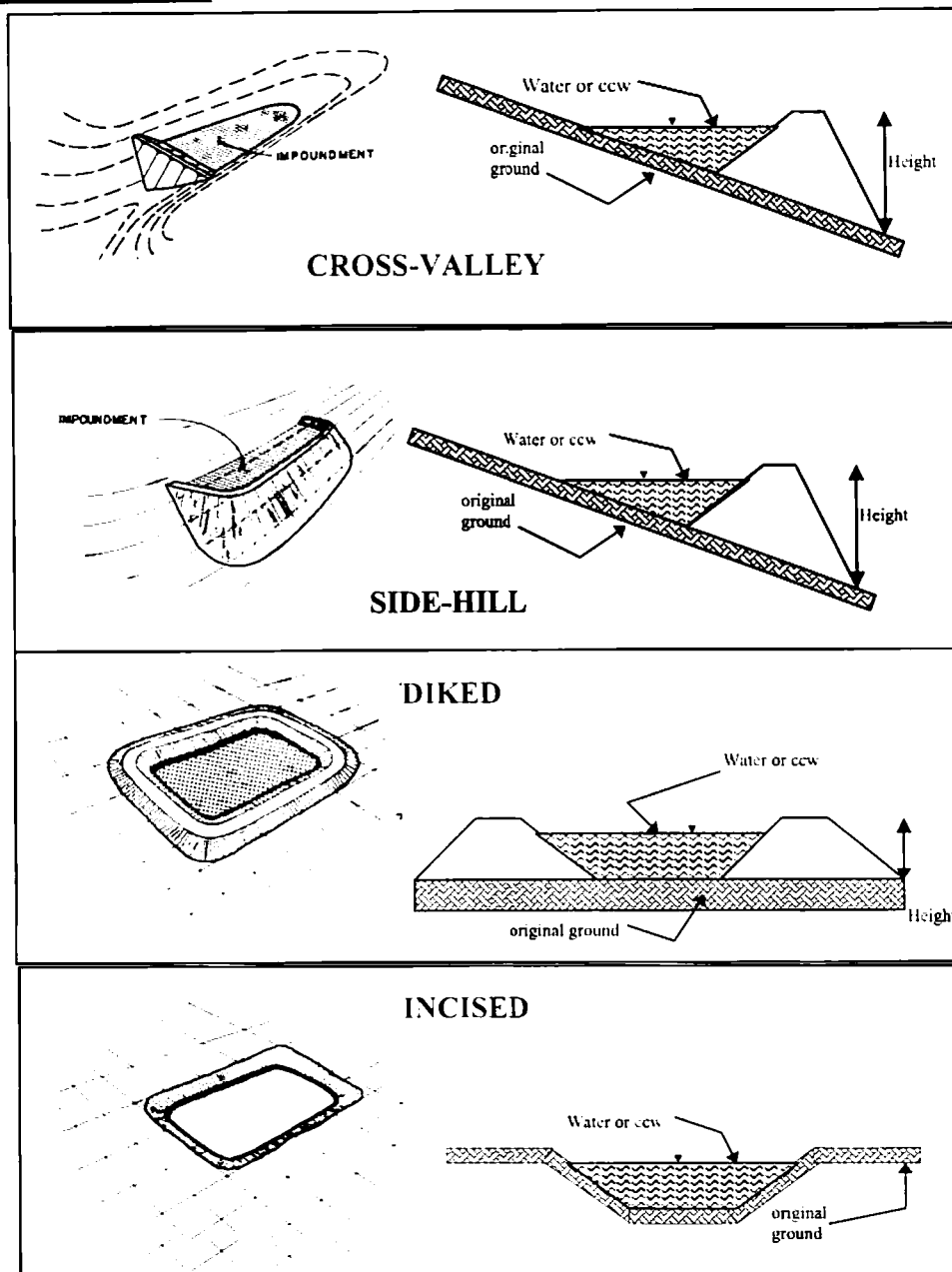
**HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

**DESCRIBE REASONING FOR HAZARD RATING CHOSEN:**

### Failure to Pond 2 to outlet ditch to Green River

[illegible]

# **CONFIGURATION:**



<input type="checkbox"/>	Cross-Valley
<input checked="" type="checkbox"/>	Side-Hill
<input type="checkbox"/>	Diked
<input type="checkbox"/>	Incised (form completion optional)
<input type="checkbox"/>	Combination Incised/Diked
Embankment Height	49.5 feet
Pool Area	32 acres
Current Freeboard	4.5 feet
Embankment Material	Earthen Fill
Liner	N.A.
Liner Permeability	N.A.

**TYPE OF OUTLET** (Mark all that apply)

       **Open Channel Spillway**

       Trapezoidal

       Triangular

       Rectangular

       Irregular

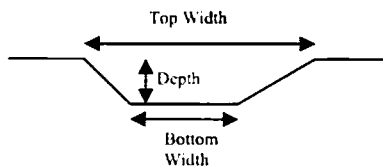
       depth

       bottom (or average) width

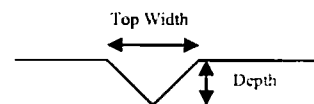
       top width

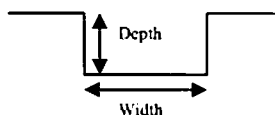
TRAPEZOIDAL



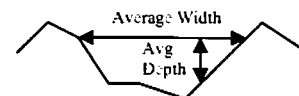
TRIANGULAR



RECTANGULAR



IRREGULAR



  X   **Outlet**

  36"   inside diameter

Material

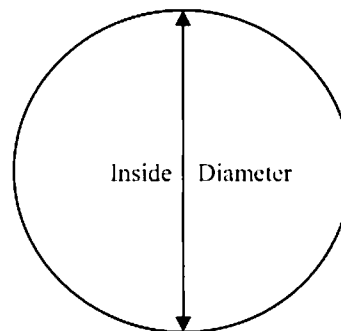
       corrugated metal

       welded steel

  X   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   H.C. Nutting - James J. Flaig, PE







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,...)? 5 piezometers

If so Please Describe : Five piezometers installed in Q1 of 2010

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



Site Name:	Green River Power Station	Date:	08/16/2010
Unit Name:	ATB #1 (or Main Pond)	Operator's Name:	Kentucky Utilities
Unit I.D.:	Hazard Potential Classification: High Significant Low		
Inspector's Name: James Black, Shea Carr			

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

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	weekly		18. Sloughing or bulging on slopes?	✓	
2. Pool elevation (operator records)?	445.0		19. Major erosion or slope deterioration?		✓
3. Decant inlet elevation (operator records)?	444.5		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)?	449.5		Is water exiting outlet, but not entering inlet?		✓
6. If instrumentation is present, are readings recorded (operator records)?	✓		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)?	✓		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

17. No issues noted/observed; however, two slides on southern embankment have been previously repaired.

18. Based on visual observations possible slope irregularities.





## Coal Combustion Waste (CCW) Impoundment Inspection

Impoundment NPDES Permit # KY INSPECTOR James Black/Shea Carr  
Date 08/16/2010

Impoundment Name Ash Treatment Basin #2  
 Impoundment Company Kentucky Utilities (KU) Company (A subsidiary of EON-US)  
 EPA Region 4  
 State Agency (Field Office) Address 200 Fair Oaks Lane  
Frankfort, KY 40601

Name of Impoundment Ash Treatment Basin #2  
(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New      X      Update

	Yes	No
Is impoundment currently under construction?	<u>          </u>	<u>X</u>
Is water or ccw currently being pumped into the impoundment?	<u>X</u>	<u>          </u>

**IMPOUNDMENT FUNCTION:** Storage and management coal combustion waste (CCW) byproducts

Nearest Downstream Town : Name Livermore, Kentucky  
Distance from the impoundment 9 miles  
Impoundment  
Location: Longitude -87 Degrees 7 Minutes 4.95 Seconds  
Latitude 37 Degrees 22 Minutes 5.14 Seconds  
State KY County Muhlenburg

Does a state agency regulate this impoundment? YES \_\_\_\_\_ NO X

### If So Which State Agency?

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

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

**\_\_\_\_\_ 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.

**X 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.

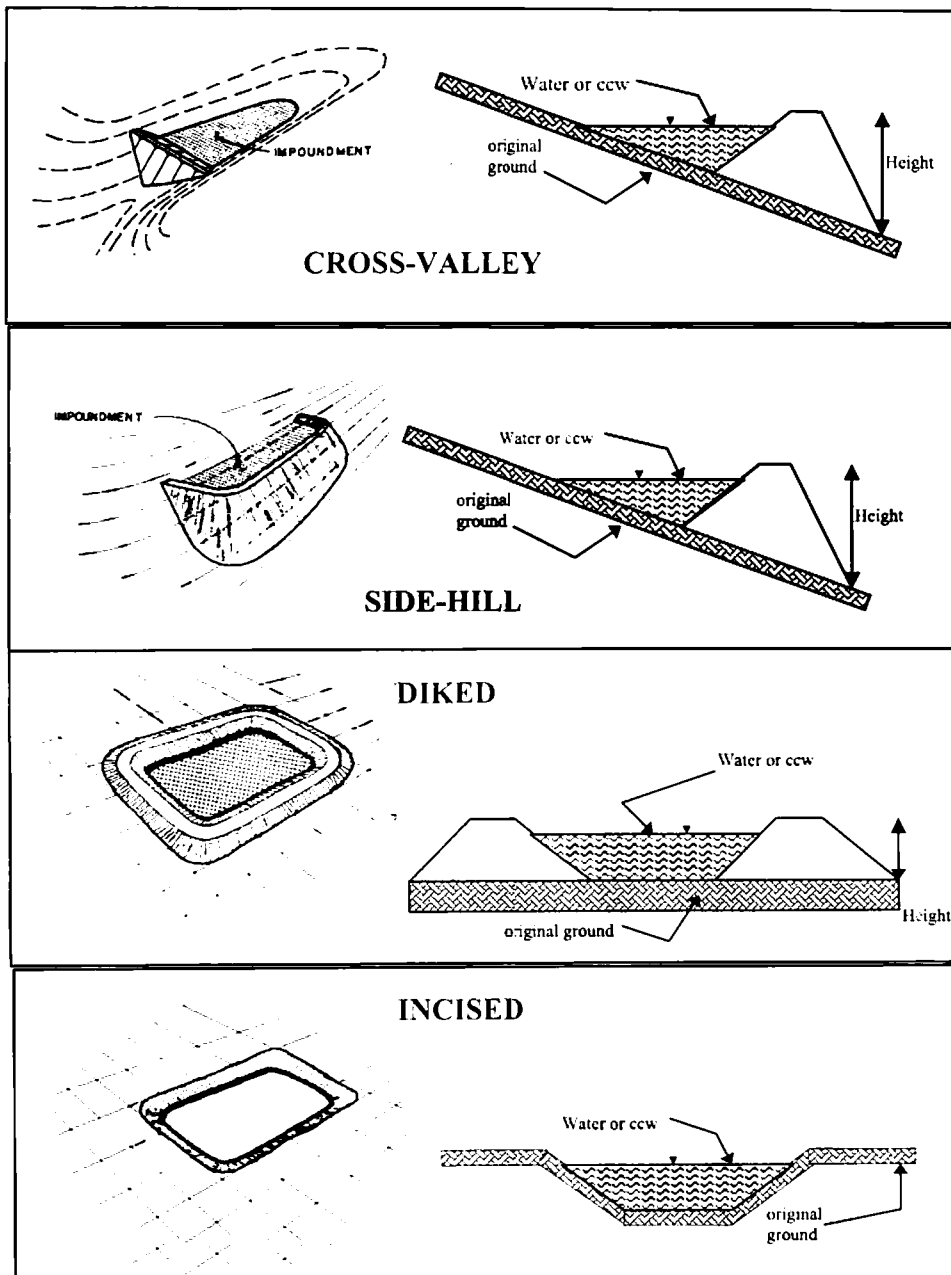
**HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

**DESCRIBE REASONING FOR HAZARD RATING CHOSEN:**

## Outfall to Green River

[illegible]

# CONFIGURATION:



☐ Cross-Valley

☐ Side-Hill

☒ Diked

☐ Incised (form completion optional)

☐ Combination Incised/Diked

Embankment Height 15 feet

Pool Area 23 acres

Current Freeboard 3 feet

Embankment Material Earthen Fill

Liner N.A.

Liner Permeability N.A.



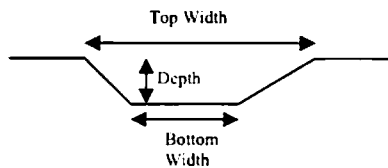
**TYPE OF OUTLET** (Mark all that apply)

       **Open Channel Spillway**

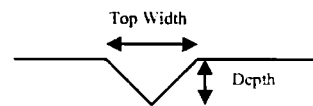
- Trapezoidal  
       Triangular  
       Rectangular  
       Irregular

- depth  
       bottom (or average) width  
       top width

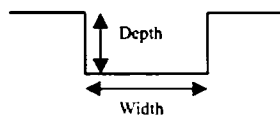
TRAPEZOIDAL



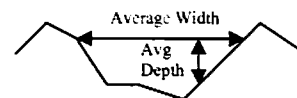
TRIANGULAR



RECTANGULAR



IRREGULAR

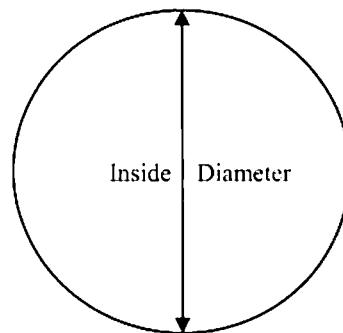


  X   **Outlet**

  30"   inside diameter

**Material**

- X   corrugated metal  
       welded steel  
       concrete  
       plastic (hdpe, pvc, etc.)  
       other (specify) \_\_\_\_\_



Is water flowing through the outlet?    YES \_\_\_\_\_ NO \_\_\_\_\_

       **No Outlet**

       **Other Type of Outlet (specify)** \_\_\_\_\_

The Impoundment was Designed By   N.A.   Constructed in 1971





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

YES \_\_\_\_\_ NO     X    

If so, which method (e.g., piezometers, gw pumping,...)? 3 piezometers

If so Please Describe : Three piezometers installed in August 2010

[illegible]





Site Name:	Green River Power Station	Date:	08/16/10
Unit Name:	Ash Pond #2	Operator's Name:	Kentucky Utilities
Unit I.D.:	Hazard Potential Classification: High <input checked="" type="checkbox"/> Significant <input checked="" type="checkbox"/> Low <input type="checkbox"/>		
Inspector's Name: James Black, Shea Carr			

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

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?		weekly	18. Sloughing or bulging on slopes?		<input checked="" type="checkbox"/>
2. Pool elevation (operator records)?		397.0	19. Major erosion or slope deterioration?		<input checked="" type="checkbox"/>
3. Decant inlet elevation (operator records)?		397.5	20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?		N/A	Is water entering inlet, but not exiting outlet?		<input checked="" type="checkbox"/>
5. Lowest dam crest elevation (operator records)?		400.0	Is water exiting outlet, but not entering inlet?		<input checked="" type="checkbox"/>
6. If instrumentation is present, are readings recorded (operator records)?	<input checked="" type="checkbox"/>		Is water exiting outlet flowing clear?	<input checked="" type="checkbox"/>	
7. Is the embankment currently under construction?		<input checked="" type="checkbox"/>	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?		<input checked="" type="checkbox"/>
9. Trees growing on embankment? (If so, indicate largest diameter below)		<input checked="" type="checkbox"/>	At isolated points on embankment slopes?		<input checked="" type="checkbox"/>
10. Cracks or scarps on crest?		<input checked="" type="checkbox"/>	At natural hillside in the embankment area?		<input checked="" type="checkbox"/>
11. Is there significant settlement along the crest?		<input checked="" type="checkbox"/>	Over widespread areas?		<input checked="" type="checkbox"/>
12. Are decant trashracks clear and in place?	<input checked="" type="checkbox"/>		From downstream foundation area?		<input checked="" type="checkbox"/>
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		<input checked="" type="checkbox"/>	"Boils" beneath stream or ponded water?		<input checked="" type="checkbox"/>
14. Clogged spillways, groin or diversion ditches?	N/A		Around the outside of the decant pipe?		<input checked="" type="checkbox"/>
15. Are spillway or ditch linings deteriorated?	N/A		22. Surface movements in valley bottom or on hillside?		<input checked="" type="checkbox"/>
16. Are outlets of decant or underdrains blocked?		<input checked="" type="checkbox"/>	23. Water against downstream toe?		<input checked="" type="checkbox"/>
17. Cracks or scarps on slopes?		<input checked="" type="checkbox"/>	24. Were Photos taken during the dam inspection?	<input checked="" type="checkbox"/>	
<p><b>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.</b></p>					

Inspection Issue #	Comments
5.	Regrading has increased crest from topo map of 399.1 to 400
6.	New PZ's (3) installed August 2010



**Coal Combustion Waste (CCW)  
Impoundment Inspection**

Impoundment NPDES Permit # KY 0002011 INSPECTOR James Black/Shea Carr  
Date 08/16/2010

Impoundment Name Finishing Pond #3  
Impoundment Company Kentucky Utilities (KU) Company (A subsidiary of EON-US)  
EPA Region 4  
State Agency (Field Office) Address 200 Fair Oaks Lane  
Frankfort, KY 40601

Name of Impoundment Finishing Pond #3  
(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New X Update \_\_\_\_\_

	Yes	No
Is impoundment currently under construction?	_____	<u>X</u>
Is water or ccw currently being pumped into the impoundment?	_____	<u>X</u>

Storage and management coal combustion waste

**IMPOUNDMENT FUNCTION:** (CCW) byproducts

Nearest Downstream Town : Name Livermore, Kentucky  
Distance from the impoundment 9 miles  
Impoundment  
Location: Longitude -87 Degrees 6 Minutes 56.76 Seconds  
Latitude 37 Degrees 2 Minutes 58.63 Seconds  
State KY County Muhlenberg

Does a state agency regulate this impoundment? YES \_\_\_\_\_ NO X

If So Which State Agency? \_\_\_\_\_



**HAZARD POTENTIAL** (In the event the impoundment should fail, the following would occur): N/A Embankment slopes removed

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

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

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

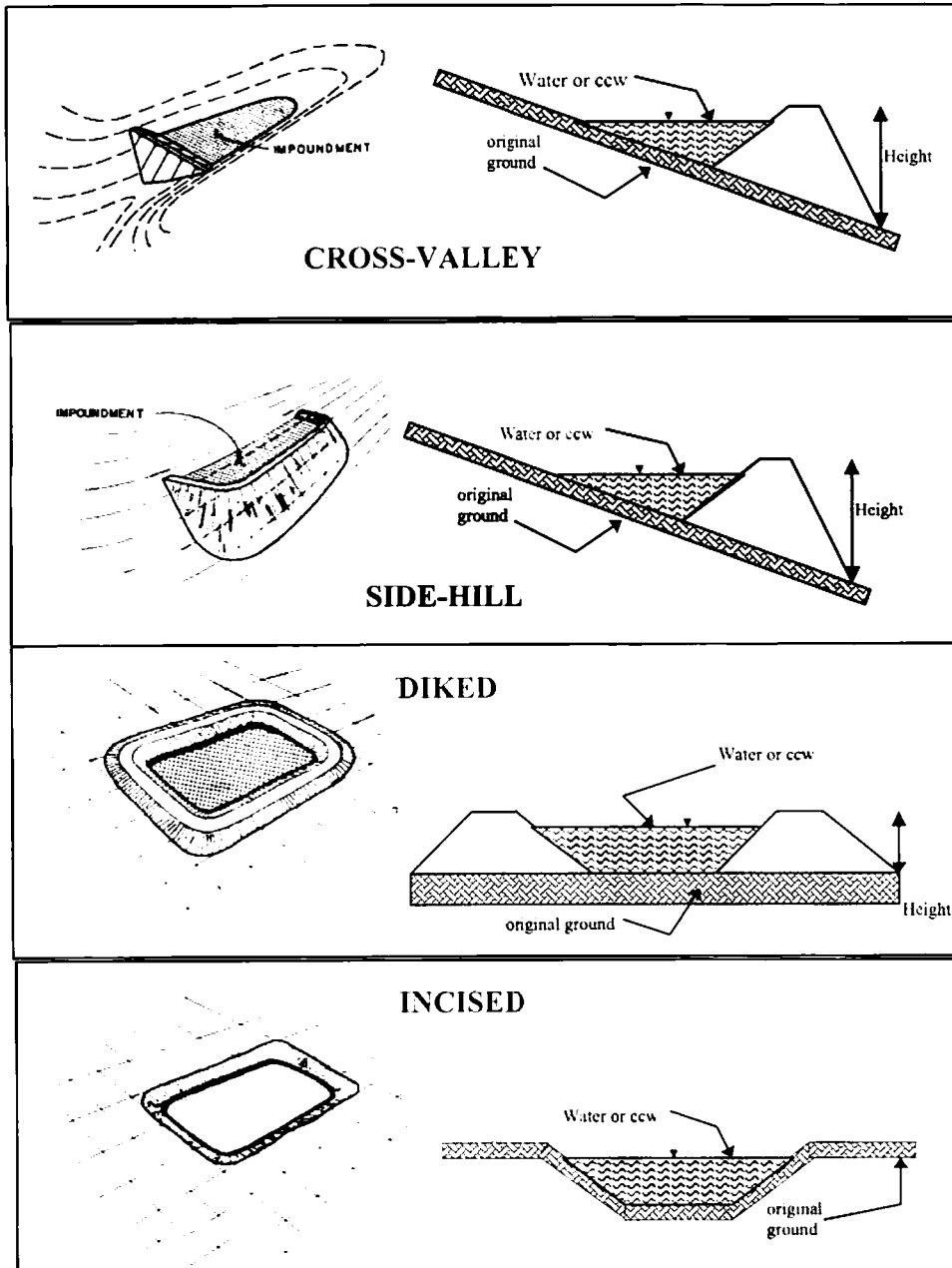
**HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

**DESCRIBE REASONING FOR HAZARD RATING CHOSEN:**

Embankment slopes have been removed; therefore, a hazard potential classification was not assigned.

[illegible]

# CONFIGURATION:



- ☒ Cross-Valley  
☐ Side-Hill  
☐ Diked  
☐ Incised (form completion optional)  
☐ Combination Incised/Diked

Embankment Height \* N.A. feet      Embankment Material \_\_\_\_\_  
 Pool Area 2 acres      Liner \_\_\_\_\_  
 Current Freeboard \_\_\_\_\_ feet      Liner Permeability \_\_\_\_\_

\* Not a current storage basin. Outlet has been removed.



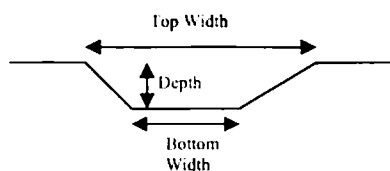
**TYPE OF OUTLET** (Mark all that apply)

**Open Channel Spillway**

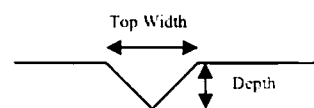
- ☐ Trapezoidal  
☐ Triangular  
☐ Rectangular  
☐ Irregular

- ☐ depth  
☐ bottom (or average) width  
☐ top width

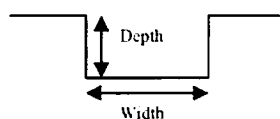
TRAPEZOIDAL



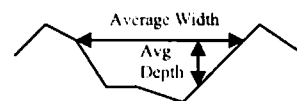
TRIANGULAR



RECTANGULAR



IRREGULAR

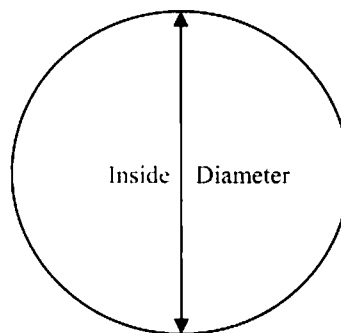


**Outlet**

- ☐ inside diameter

**Material**

- ☐ corrugated metal  
☐ welded steel  
☐ concrete  
☐ plastic (hdpe, pvc, etc.)  
☐ other (specify) \_\_\_\_\_



Is water flowing through the outlet? YES \_\_\_\_\_ NO \_\_\_\_\_

☒ **No Outlet**

☐ **Other Type of Outlet (specify)** \_\_\_\_\_

The Impoundment was Designed By N.A.



Has there ever been significant seepages at this site? YES \_\_\_\_\_ NO  X

If So When? \_\_\_\_\_

IF So Please Describe: \_\_\_\_\_

[illegible]

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 : \_\_\_\_\_

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.





Site Name:	Finishing Pond #3	Date:	08/16/10
Unit Name:	Finishing Pond #3	Operator's Name:	Kentucky Utilities
Unit I.D.:	Hazard Potential Classification: High Significant Low		
Inspector's Name: James Black, Shea Carr			

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?			18. Sloughing or bulging on slopes?		
2. Pool elevation (operator records)?			19. Major erosion or slope deterioration?		
3. Decant inlet elevation (operator records)?			20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?			Is water entering inlet, but not exiting outlet?		
5. Lowest dam crest elevation (operator records)?			Is water exiting outlet, but not entering inlet?		
6. If instrumentation is present, are readings recorded (operator records)?			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)?			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 \_\_\_\_\_

Embankment slopes removed.



**Coal Combustion Waste (CCW)  
Impoundment Inspection**

Impoundment NPDES Permit # KY 0002011 INSPECTOR James Black/Shea Carr  
Date 08/16/2010

Impoundment Name Scrubber Pond  
Impoundment Company Kentucky Utilities (KU) Company (A subsidiary of EON-US)  
EPA Region 4  
State Agency (Field Office) Address 200 Fair Oaks Lane  
Frankfort, KY 40601

Name of Impoundment Scrubber 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?	_____	<u>X</u>
Is water or ccw currently being pumped into the impoundment?	_____	<u>X</u>

Storage and management coal combustion waste

**IMPOUNDMENT FUNCTION:** (CCW) byproducts

Nearest Downstream Town : Name Livermore, Kentucky  
Distance from the impoundment 9 miles  
Impoundment  
Location: Longitude -87 Degrees 6 Minutes 54.83 Seconds  
Latitude 37 Degrees 22 Minutes 5.26 Seconds  
State KY County Muhlenberg

Does a state agency regulate this impoundment? YES X NO \_\_\_\_\_

If So Which State Agency? State of Kentucky Division of Water

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

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

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

**X 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.

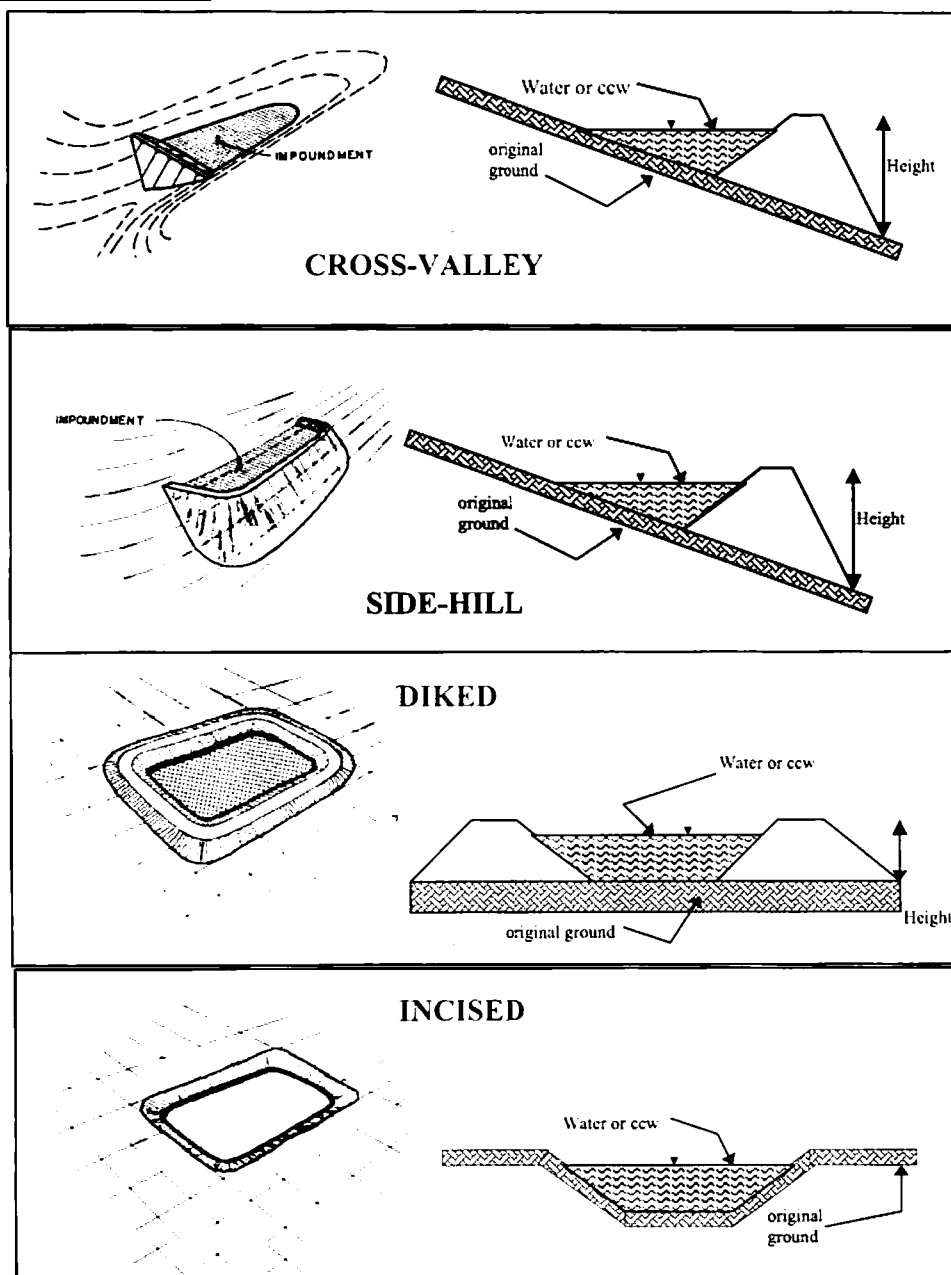
**DESCRIBE REASONING FOR HAZARD RATING CHOSEN:**

## Failure would reach Green River

[illegible]



# CONFIGURATION:



<input type="checkbox"/>	Cross-Valley
<input checked="" type="checkbox"/>	Side-Hill
<input type="checkbox"/>	Diked
<input checked="" type="checkbox"/>	Incised (form completion optional)
<input type="checkbox"/>	Combination Incised/Diked
Embankment Height	<u>17</u> feet
Pool Area	<u>10</u> acres
Current Freeboard	<u>5</u> feet
Embankment Material	<u>Earthen Fill</u>
Liner	<u>N.A.</u>
Liner Permeability	<u>N.A.</u>



**TYPE OF OUTLET** (Mark all that apply)

☐ **Open Channel Spillway**

☐ Trapezoidal

☐ Triangular

☐ Rectangular

☐ Irregular

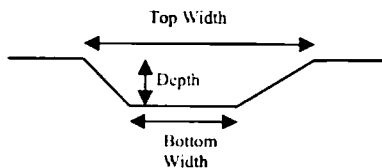
☐ depth

☐ bottom (or average) width

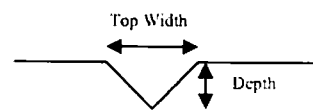
☐ top width

☐ \_\_\_\_\_

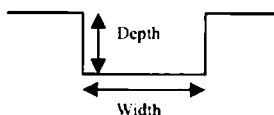
TRAPEZOIDAL



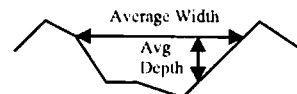
TRIANGULAR



RECTANGULAR



IRREGULAR



☐ **Outlet**

☐ inside diameter

Material

☐ corrugated metal

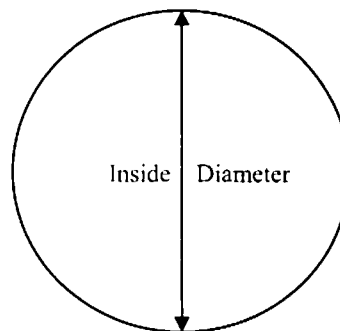
☐ welded steel

☐ concrete

☐ plastic (hdpe, pvc, etc.)

☐ other (specify) \_\_\_\_\_

☐ \_\_\_\_\_



Is water flowing through the outlet? YES \_\_\_\_\_ NO \_\_\_\_\_

☒ **No Outlet** Scrubber pond is pumped to pond #2 twice a year

☐ **Other Type of Outlet** (specify) \_\_\_\_\_

The Impoundment was Designed By 1974 Sargent and Lundy

\_\_\_\_\_

Has there ever been a failure at this site? YES \_\_\_\_\_ NO   X  

If So When? \_\_\_\_\_

If So Please Describe : \_\_\_\_\_

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



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

YES \_\_\_\_\_ NO   X  

If so, which method (e.g., piezometers, gw pumping,...)? 3 piezometers

If so Please Describe : Three piezometers installed in August 2010

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.





Site Name:	Green River Power Station	Date:	08/16/10
Unit Name:	Scrubber Pond	Operator's Name:	Kentucky Utilities
Unit I.D.:	Hazard Potential Classification: High Significant Low		
Inspector's Name: James Black, Shea Carr			

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

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	weekly		18. Sloughing or bulging on slopes?		✓
2. Pool elevation (operator records)?	398.5		19. Major erosion or slope deterioration?	✓	
3. Decant inlet elevation (operator records)?	N/A		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)?	403.6		Is water exiting outlet, but not entering inlet?		✓
6. If instrumentation is present, are readings recorded (operator records)?	✓		Is water exiting outlet flowing clear?		N/A
7. Is the embankment currently under construction?		✓	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation, stumps, topsoil in area where embankment fill will be placed)?	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?		N/A	22. Surface movements in valley bottom or on hillside?		✓
16. Are outlets of decant or underdrains blocked?		N/A	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

19. Inside face of south and east face of dike

21. South and west dike - some isolated wet areas at the toe of embankment (possibly from recent rain due to poor grading).

6. Piezometers installed in August 2010.





**Coal Combustion Waste (CCW)  
Impoundment Inspection**

Impoundment NPDES Permit # KY 0002011 INSPECTOR James Black/Shea Carr  
Date 08/16/2010

Impoundment Name Former Ash Pond (Current coal run-off pond)  
Impoundment Company Kentucky Utilities (KU) Company (A subsidiary of EON-US)  
EPA Region 4  
State Agency (Field Office) Address 200 Fair Oaks Lane  
Frankfort, KY 40601

Name of Impoundment Former Ash Pond (Current coal run-off 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?	_____	<u>X</u>
Is water or ccw currently being pumped into the impoundment?	<u>X</u>	_____

Storage and management coal combustion waste

**IMPOUNDMENT FUNCTION:** (CCW) byproducts

Nearest Downstream Town : Name Livermore, Kentucky  
Distance from the impoundment 9 miles  
Impoundment  
Location: Longitude -87 Degrees 7 Minutes 10.90 Seconds  
Latitude 37 Degrees 21 Minutes 56.05 Seconds  
State KY County Muhlenberg

Does a state agency regulate this impoundment? YES \_\_\_\_\_ NO X

If So Which State Agency? \_\_\_\_\_

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

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

           **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.

**X 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.

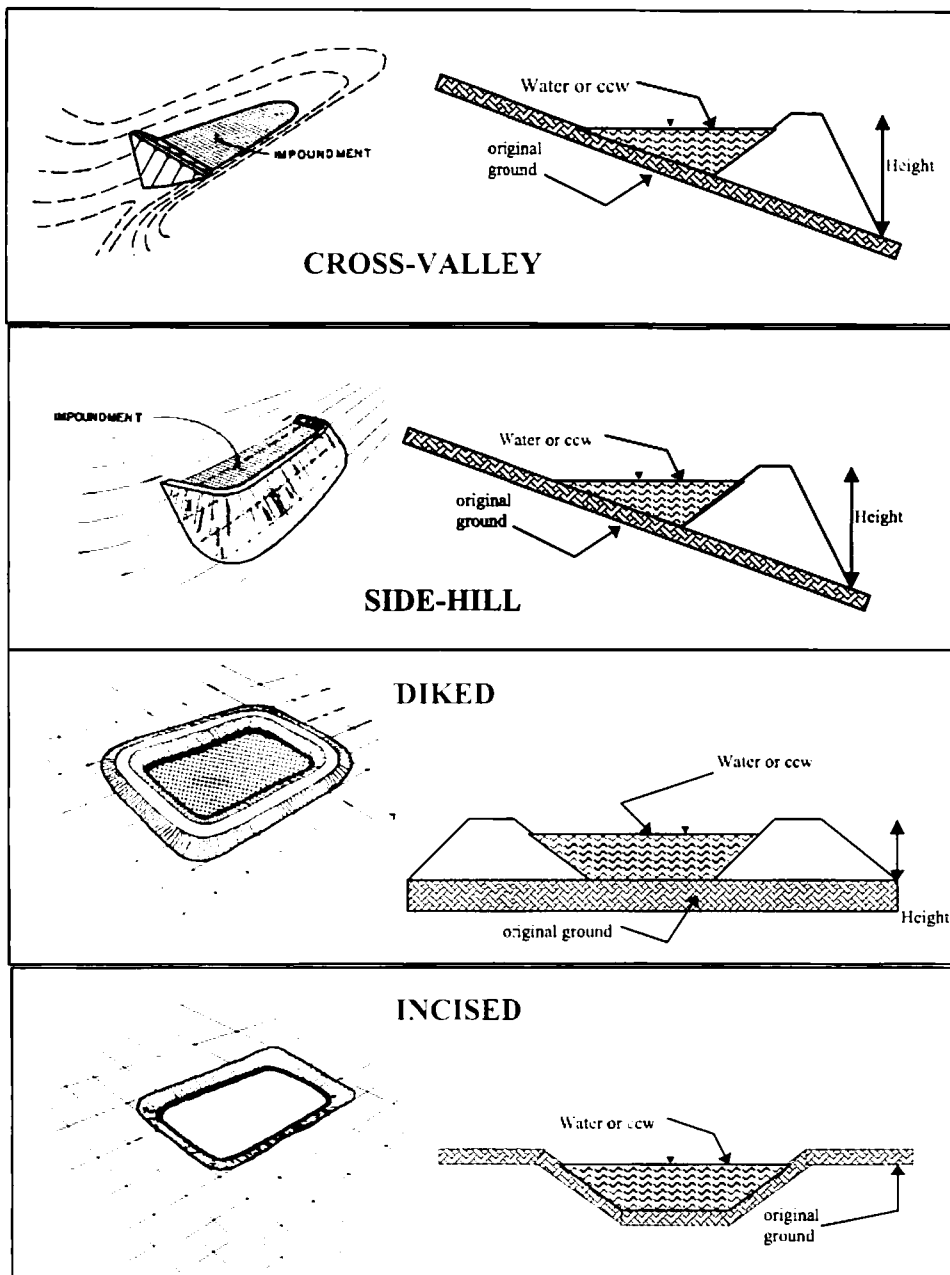
**HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

**DESCRIBE REASONING FOR HAZARD RATING CHOSEN:**

### Failure to Pond 2 to outlet ditch to Green River

[illegible]

# **CONFIGURATION:**



☐ Cross-Valley  
☐ Side-Hill  
☒ Diked  
☐ Incised (form completion optional)  
☐ Combination Incised/Diked

Embankment Height 20 feet      Embankment Material Earthen embankment  
 Pool Area 6 acres      Liner N.A. \*  
 Current Freeboard 3.4 feet      Liner Permeability N.A. \*

\* constructed in late 1940's



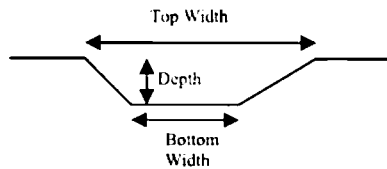
**TYPE OF OUTLET** (Mark all that apply)

       **Open Channel Spillway**

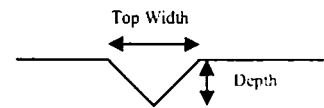
- Trapezoidal  
       Triangular  
       Rectangular  
       Irregular

- depth  
       bottom (or average) width  
       top width

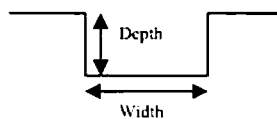
TRAPEZOIDAL



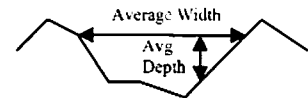
TRIANGULAR



RECTANGULAR



IRREGULAR

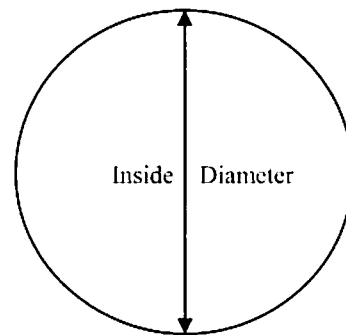


  X   **Outlet**

  18"   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   N.A.   Constructed in mid-1940's



Has there ever been significant seepages at this site? YES \_\_\_\_\_ NO  X

If So When? \_\_\_\_\_

IF So Please Describe: \_\_\_\_\_

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

YES \_\_\_\_\_ NO   X  

1 piezometer

One piezometer installed in August 2010.

No measurements taken at this time.

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.





Site Name:	Green River Power Station	Date:	08/16/10
Unit Name:	Coal run-off pond	Operator's Name:	Kentucky Utilities
Unit I.D.:	Hazard Potential Classification: High Significant <input checked="" type="checkbox"/> Low		
Inspector's Name: James Black, Shea Carr			

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

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	weekly		18. Sloughing or bulging on slopes?		<input checked="" type="checkbox"/>
2. Pool elevation (operator records)?	401.6		19. Major erosion or slope deterioration?		<input checked="" type="checkbox"/>
3. Decant inlet elevation (operator records)?	400.8		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	N/A		Is water entering inlet, but not exiting outlet?		<input checked="" type="checkbox"/>
5. Lowest dam crest elevation (operator records)?	405.1		Is water exiting outlet, but not entering inlet?		<input checked="" type="checkbox"/>
6. If instrumentation is present, are readings recorded (operator records)?	<input checked="" type="checkbox"/>		Is water exiting outlet flowing clear?	<input checked="" type="checkbox"/>	
7. Is the embankment currently under construction?		<input checked="" type="checkbox"/>	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?		<input checked="" type="checkbox"/>
9. Trees growing on embankment? (If so, indicate largest diameter below)		<input checked="" type="checkbox"/>	At isolated points on embankment slopes?		<input checked="" type="checkbox"/>
10. Cracks or scarps on crest?		<input checked="" type="checkbox"/>	At natural hillside in the embankment area?		<input checked="" type="checkbox"/>
11. Is there significant settlement along the crest?		<input checked="" type="checkbox"/>	Over widespread areas?		<input checked="" type="checkbox"/>
12. Are decant trashracks clear and in place?	<input checked="" type="checkbox"/>		From downstream foundation area?		<input checked="" type="checkbox"/>
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		<input checked="" type="checkbox"/>	"Boils" beneath stream or ponded water?		<input checked="" type="checkbox"/>
14. Clogged spillways, groin or diversion ditches?	N/A		Around the outside of the decant pipe?		<input checked="" type="checkbox"/>
15. Are spillway or ditch linings deteriorated?	N/A		22. Surface movements in valley bottom or on hillside?		<input checked="" type="checkbox"/>
16. Are outlets of decant or underdrains blocked?		<input checked="" type="checkbox"/>	23. Water against downstream toe?		<input checked="" type="checkbox"/>
17. Cracks or scarps on slopes?		<input checked="" type="checkbox"/>	24. Were Photos taken during the dam inspection?	<input checked="" type="checkbox"/>	

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
6. One new PZ installed August 2010	

**APPENDIX B**  
**Site Photo Log Map and Site Photos**



# LEGEND

Photo Location



UNITED STATES  
ENVIRONMENTAL PROTECTION AGENCY

DWN BY: DJC

CKD BY: MS

Datum: NAD 83

Projection: Albers

Scale: As Shown

ASSESSMENT OF DAM SAFETY OF  
COAL COMBUSTION SURFACE IMPOUNDMENTS

GREEN RIVER POWER STATION  
CENTRAL CITY, KY  
ASH PONDS  
PHOTO LOCATION MAP

REV. No.: A

Date: 9-14-10

Project No: 3-2106-0177-0002

Figure No: B-1

AMEC Earth & Environmental  
690 Commonwealth Business Center  
11003 Bluegrass Parkway  
Louisville, KY 40299





Note: Direction(s) in Photos from Plant North (Green River is South)



**M-1**

**LOOKING NW AT WEST DIKE - CREST, UPSTREAM SLOPE, POND INTERIOR**



**M-2**

**LOOKING NW AT WEST DIKE - CREST AND DOWNSTREAM SLOPE, SPARSE GRASS COVER**

**AMEC Earth & Environmental**

690 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40289  
(502) 267-0700



CLIENT LOGO



CLIENT

**UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY**

PROJECT  
**ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS**

DWN BY: CAE

DATUM:

DATE: 8/19/10

TITLE  
**KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.  
GREEN RIVER POWER STATION, CENTRAL CITY., KY  
ASH TREATMENT BASIN #1 SITE PHOTOS**

CHK'D BY: MGS

REV. NO.:

PROJECT NO:  
**3-2106-0177-0002**

PROJECTION:

SCALE:

PAGE NO.

**B-2**



Note: Direction(s) in Photos from Plant North (Green River is South)



**M-3**

**LOOKING NW FROM WEST END OF SOUTH DIKE -  
ASH STACKED TO NEAR CREST OF SOUTH DIKE**



**M-4**

**LOOKING S AT WEST DIKE - CREST AND UPSTREAM SLOPE**

**AMEC Earth & Environmental**

690 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40289  
(502) 267-0700



CLIENT LOGO



CLIENT

**UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY**

PROJECT  
**ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS**

DWN BY: CAE

DATUM:

DATE: 8/19/10

TITLE  
**KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.  
GREEN RIVER POWER STATION, CENTRAL CITY., KY  
ASH TREATMENT BASIN #1 SITE PHOTOS**

CHK'D BY: MGS

REV. NO.:

PROJECT NO: 3-2106-0177-0002

PROJECTION:

SCALE:

PAGE NO.

**B-3**

Note: Direction(s) in Photos from Plant North (Green River is South)



**M-5**

**LOOKING E FROM WEST END OF SOUTH DIKE - DOWNSTREAM SLOPE**



**M-6**

**LOOKING E FROM WEST PORTION OF SOUTH DIKE -  
CREST, NEW PZ-P3A ON SOUTH EDGE OF ROAD**

**AMEC Earth & Environmental**

890 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40289  
(502) 267-0700



**CLIENT**  
**UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY**

**PROJECT**  
**ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS**

**DWN BY:**  
**CAE**

**DATUM:**

**DATE:**  
**8/19/10**

**TITLE**  
**KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.**  
**GREEN RIVER POWER STATION, CENTRAL CITY., KY**  
**ASH TREATMENT BASIN #1 SITE PHOTOS**

**CHK'D BY:**  
**MGS**

**REV. NO.:**

**PROJECT NO:**  
**3-2106-0177-0002**

**PROJECTION:**

**SCALE:**

**PAGE NO.:**

**B-4**



Note: Direction(s) in Photos from Plant North (Green River is South)



**M-7**

**LOOKING S FROM WEST PORTION OF SOUTH DIKE -  
CREST, NEW PZ BEYOND TOE, EDGE OF COAL PILE**



**M-8**

**LOOKING W FROM WEST PORTION OF SOUTH DIKE - SLUICE PIPES CROSSING  
EMBANKMENT, ASH STACKED TO NEAR CREST OF SOUTH DIKE**

**AMEC Earth & Environmental**

690 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40289  
(502) 267-0700



**CLIENT LOGO**



**CLIENT**

**UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY**

**PROJECT**  
**ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS**

**DWN BY:**  
**CAE**

**DATUM:**

**DATE:**  
**8/19/10**

**TITLE**  
**KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.**  
**GREEN RIVER POWER STATION, CENTRAL CITY., KY**  
**ASH TREATMENT BASIN #1 SITE PHOTOS**

**CHK'D BY:**  
**MGS**

**REV. NO.:**

**PROJECT NO:**  
**3-2106-0177-0002**

**PROJECTION:**

**SCALE:**

**PAGE NO.:**

**B-5**

Note: Direction(s) in Photos from Plant North (Green River is South)



### M-9

LOOKING S FROM SOUTH DIKE - AREAS WITH SPARSE GRASS ON DOWNSTREAM  
CREST, WEST BUTTRESS, AND COAL RUNOFF POND IN BACKGROUND



### M-10

LOOKING E FROM SOUTH DIKE - CRUSHED STONE CREST,  
UPPER POND INTERIOR AND OUTLET STRUCTURE

#### AMEC Earth & Environmental

690 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40289  
(502) 267-0700



#### CLIENT LOGO



#### CLIENT

UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY

PROJECT  
ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

DWN BY: CAE

DATUM:

DATE: 8/19/10

TITLE  
KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.  
GREEN RIVER POWER STATION, CENTRAL CITY., KY  
ASH TREATMENT BASIN #1 SITE PHOTOS

CHK'D BY: MGS

REV. NO.:

PROJECT NO: 3-2106-0177-0002

PROJECTION:

SCALE:

PAGE NO.

B-6



Note: Direction(s) in Photos from Plant North (Green River is South)



**M-11**

**LOOKING E FROM SOUTH DIKE - DOWNSTREAM SLOPE**



**M-12**

**LOOKING E FROM SOUTH DIKE - AREAS OF SPARSE GRASS COVER, PIPE OUTLET  
OF OUTLET STRUCTURE ON RIGHT, AND EAST BUTTRESS**

## AMEC Earth & Environmental

690 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40289  
(502) 267-0700



### CLIENT LOGO



### CLIENT

**UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY**

**PROJECT**  
**ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS**

**DWN BY:**  
**CAE**

**DATUM:**

**DATE:**  
**8/19/10**

**TITLE**  
**KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.**  
**GREEN RIVER POWER STATION, CENTRAL CITY., KY**  
**ASH TREATMENT BASIN #1 SITE PHOTOS**

**CHK'D BY:**  
**MGS**

**REV. NO.:**

**PROJECT NO:**  
**3-2106-0177-0002**

**PROJECTION:**

**SCALE:**

**PAGE NO.:**

**B-7**

Note: Direction(s) in Photos from Plant North (Green River is South)



### M-13

LOOKING NE AT OUTLET STRUCTURE, PERIMETER SKIMMER AND POND INTERIOR TO NATURAL HILLSIDE IN BACKGROUND, STACK OF CONCRETE STOP LOGS IN FOREGROUND



### M-14

LOOKING DOWN INTO INLET OF OUTLET STRUCTURE

## AMEC Earth & Environmental

690 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40289  
(502) 267-0700



### CLIENT LOGO



### CLIENT

UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY

PROJECT  
ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

TITLE  
KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.  
GREEN RIVER POWER STATION, CENTRAL CITY., KY  
ASH TREATMENT BASIN #1 SITE PHOTOS

DWN BY: CAE

CHK'D BY: MGS

PROJECTION:

DATUM:

REV. NO.:

SCALE:

DATE: 8/19/10

PROJECT NO: 3-2106-0177-0002

PAGE NO.

B-8





**M-15**

LOOKING NW AT OUTLET STRUCTURE, PERIMETER SKIMMER AND POND INTERIOR  
TO NATURAL HILLSIDE IN BACKGROUND. STACK OF CONCRETE STOP LOGS IN FOREGROUND



**M-16**

LOOKING NE AT EAST END OF SOUTH DIKE AND  
POND INTERIOR, NATURAL GROUND IN BACKGROUND

**AMEC Earth & Environmental**

890 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40289  
(502) 267-0700



**CLIENT LOGO**



**CLIENT**

**UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY**

**PROJECT**  
ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

**DWN BY:**  
CAE

**DATUM:**

**DATE:** 8/19/10

**TITLE**  
KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.  
GREEN RIVER POWER STATION, CENTRAL CITY., KY  
ASH TREATMENT BASIN #1 SITE PHOTOS

**CHK'D BY:**  
MGS

**REV. NO.:**

**PROJECT NO:**  
3-2106-0177-0002

**PROJECTION:**

**SCALE:**

**PAGE NO.:**

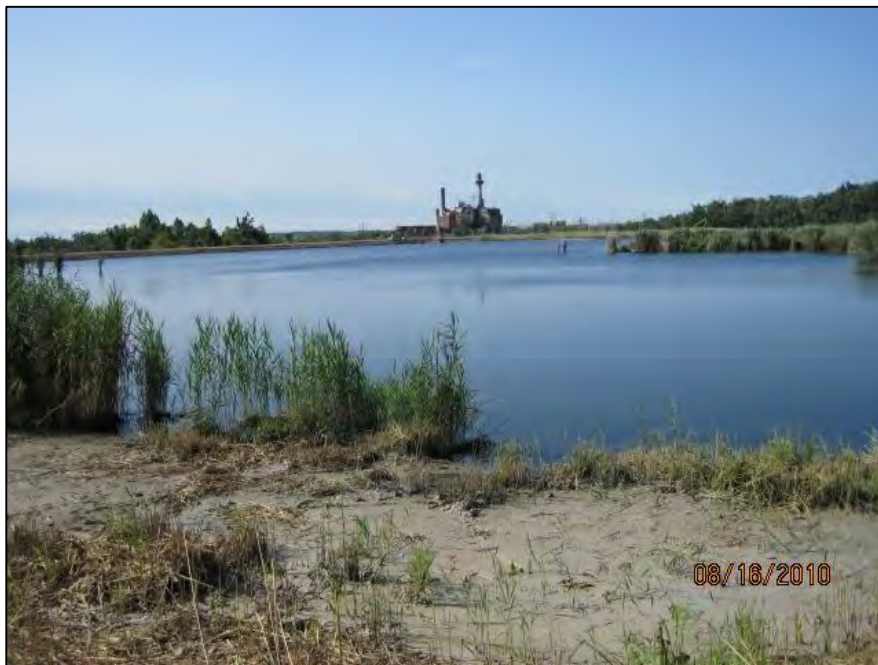
**B-9**

Note: Direction(s) in Photos from Plant North (Green River is South)



**M-17**

**LOOKING N AT EAST DIKE, PRIMARILY ORIGINAL GROUND ON EAST SIDE**



**M-18**

**LOOKING SE FROM EAST DIKE TOWARD PLANT**

**AMEC Earth & Environmental**

690 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40289  
(502) 267-0700



CLIENT LOGO



CLIENT

**UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY**

PROJECT  
**ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS**

DWN BY: CAE

DATUM:

DATE: 8/19/10

TITLE  
**KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.  
GREEN RIVER POWER STATION, CENTRAL CITY., KY  
ASH TREATMENT BASIN #1 SITE PHOTOS**

CHK'D BY: MGS

REV. NO.:

PROJECT NO: 3-2106-0177-0002

PROJECTION:

SCALE:

PAGE NO.: B-10





**M-19**

**TIE-IN OF NORTH END OF EAST DIKE TO ORIGINAL GROUND**



**M-20**

**GRAVEL AND SAND STOCKPILE AT NORTH END OF EAST DIKE. TREES APPEAR TO BE GROWING IN POND INTERIOR.  
TREES COULD BE GROWING ON FINGER OF ORIGINAL HILLSIDE**

**AMEC Earth & Environmental**

690 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40289  
(502) 267-0700



**CLIENT LOGO**



**CLIENT**

**UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY**

**PROJECT**  
**ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS**

**DWN BY:**  
**CAE**

**DATUM:**

**DATE:**  
**8/19/10**

**TITLE**  
**KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.**  
**GREEN RIVER POWER STATION, CENTRAL CITY., KY**  
**ASH TREATMENT BASIN #1 SITE PHOTOS**

**CHK'D BY:**  
**MGS**

**REV. NO.:**

**PROJECT NO:**  
**3-2106-0177-0002**

**PROJECTION:**

**SCALE:**

**PAGE NO.**  
**B-11**



**M-21**

**EAST BUTTRESS AND DRAIN OUTLET ON SOUTH DIKE**



**M-22**

**PRINCIPAL OUTFALL AT TOE OF SOUTH DIKE,  
SOME EROSION ON OUTSIDE SIDEWALLS**

**AMEC Earth & Environmental**

690 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40289  
(502) 267-0700



**CLIENT LOGO**



**CLIENT**

**UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY**

**PROJECT**  
**ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS**

**DWN BY:**  
**CAE**

**DATUM:**

**DATE:**  
**8/19/10**

**TITLE**  
**KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.**  
**GREEN RIVER POWER STATION, CENTRAL CITY., KY**  
**ASH TREATMENT BASIN #1 SITE PHOTOS**

**CHK'D BY:**  
**MGS**

**REV. NO.:**

**PROJECT NO:**  
**3-2106-0177-0002**

**PROJECTION:**

**SCALE:**

**PAGE NO.:**  
**B-12**





### M-23

LOOKING EAST ON SOUTH DIKE, UNEVEN SLOPES AND SPARSE GRASS ON DOWNSTREAM  
SLOPE FROM WEST BUTTRESS TO ABOUT 300 FEET EAST



### M-24

TOE DRAIN OUTLET FOR WEST BUTTRESS ON SOUTH DIKE

## AMEC Earth & Environmental

690 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40289  
(502) 267-0700



#### CLIENT LOGO



#### CLIENT

UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY

PROJECT  
ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

DWN BY: CAE

DATUM:

DATE: 8/19/10

TITLE  
KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.  
GREEN RIVER POWER STATION, CENTRAL CITY., KY  
ASH TREATMENT BASIN #1 SITE PHOTOS

CHK'D BY: MGS

REV. NO.:

PROJECT NO: 3-2106-0177-0002

PROJECTION:



SCALE:

PAGE NO.

B-13



**M-25**  
**LOOKING NW AT SLUICE PIPES ON SOUTH DIKE**

<b>AMEC Earth &amp; Environmental</b> 690 Commonwealth Center 11003 Bluegrass Parkway Louisville, Ky 40289 (502) 267-0700			<b>CLIENT LOGO</b> 	<b>CLIENT</b> <b>UNITED STATES ENVIRONMENTAL PROTECTION AGENCY</b>	
<b>PROJECT</b> ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS		<b>DWN BY:</b> CAE	<b>DATUM:</b>	<b>DATE:</b> 8/19/10	
<b>TITLE</b> KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S. GREEN RIVER POWER STATION, CENTRAL CITY., KY ASH TREATMENT BASIN #1 SITE PHOTOS		<b>CHK'D BY:</b> MGS	<b>REV. NO.:</b>	<b>PROJECT NO:</b> 3-2106-0177-0002	
		<b>PROJECTION:</b>	<b>SCALE:</b>	<b>PAGE NO.</b> B-14	





**CR-1**

**LOOKING W AT SOUTH DIKE (ROAD), EROSION, SPARSE GRASS, STEEP SLOPE**



**CR-2**

**LOOKING W AT SOUTH DIKE (ROAD), CREST AND UPSTREAM SLOPE**

**AMEC Earth & Environmental**

690 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40289  
(502) 267-0700



**CLIENT LOGO**



**CLIENT**

**UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY**

**PROJECT**  
**ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS**

**TITLE**  
**KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.**  
**GREEN RIVER GENERATING STATION, CENTRAL CITY., KY**  
**COAL RUN-OFF POND SITE PHOTOS**

**DWN BY:**  
**CAE**

**CHK'D BY:**  
**MGS**

**PROJECTION:**

**DATUM:**

**REV. NO.:**

**SCALE:**

**DATE:**  
**8/19/10**

**PROJECT NO:**  
**3-2106-0177-0002**

**PAGE NO.:**  
**B-15**



**CR-3**

LOOKING N AT EAST DIKE (COMMON WITH ASH POND 2)



**CR-4**

LOOKING NW ON EAST DIKE, POND INTERIOR AND TIE-IN IN BACKGROUND

**AMEC Earth & Environmental**

690 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40299  
(502) 267-0700



**CLIENT LOGO**



**CLIENT**

**UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY**

**PROJECT**  
ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

**DWN BY:**  
CAE

**DATUM:**

**DATE:** 8/19/10

**TITLE**  
KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.  
GREEN RIVER GENERATING STATION, CENTRAL CITY., KY  
COAL RUN-OFF POND SITE PHOTOS

**CHK'D BY:**  
MGS

**REV. NO.:**

**PROJECT NO:**  
3-2106-0177-0002

**PROJECTION:**

**SCALE:**

**PAGE NO.:**  
B-16





### CR-5

LOOKING W FROM EAST DIKE, POND INTERIOR AT NORTH END, WEST BERM AT COAL PILE



### CR-6

LOOKING S FROM NORTH END OF EAST DIKE (COMMON WITH ASH POND 2),  
DOWNSTREAM SLOPE (=UPSTREAM SLOPE AP 2)

## AMEC Earth & Environmental

890 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40299  
(502) 267-0700



#### CLIENT LOGO



#### CLIENT

**UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY**

**PROJECT**  
ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

**DWN BY:**  
CAE

**DATUM:**

**DATE:** 8/19/10

**TITLE**  
KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.  
GREEN RIVER GENERATING STATION, CENTRAL CITY., KY  
COAL RUN-OFF POND SITE PHOTOS

**CHK'D BY:**  
MGS

**REV. NO.:**

**PROJECT NO:**  
3-2106-0177-0002

**PROJECTION:**

**SCALE:**

**PAGE NO.:**  
B-17



### CR-7

METAL AND BOOM SKIMMER AND CMP PIPE INLET AT NORTH END OF EAST DIKE



### CR-8

CMP PIPE OUTLET TO ASH POND 2

## AMEC Earth & Environmental

690 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40299  
(502) 267-0700



### CLIENT LOGO



### CLIENT

UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY

PROJECT  
ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

TITLE  
KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.  
GREEN RIVER GENERATING STATION, CENTRAL CITY., KY  
COAL RUN-OFF POND SITE PHOTOS

DWN BY: CAE

CHK'D BY: MGS

PROJECTION:

DATUM:

REV. NO.:

SCALE:

DATE: 8/19/10

PROJECT NO: 3-2106-0177-0002

PAGE NO. B-18





**CR-9**

**LOOKING SW FROM EAST DIKE AT POND INTERIOR (ABOUT 50% WATER)**



**CR-10**

**LOOKING N FROM EAST DIKE AT TIE-IN**

**AMEC Earth & Environmental**

690 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40299  
(502) 267-0700



**CLIENT LOGO**



**CLIENT**

**UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY**

**PROJECT**  
**ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS**

**DWN BY:**  
**CAE**

**DATUM:**

**DATE:**  
**8/19/10**

**TITLE**  
**KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.**  
**GREEN RIVER GENERATING STATION, CENTRAL CITY., KY**  
**COAL RUN-OFF POND SITE PHOTOS**

**CHK'D BY:**  
**MGS**

**REV. NO.:**

**PROJECT NO:**  
**3-2106-0177-0002**

**PROJECTION:**

**SCALE:**

**PAGE NO.:**

**B-19**



**2-1**

**LOOKING E FROM WEST CORNER AT SOUTH DIKE (ROAD?), UPSTREAM SLOPE  
AND CREST, MOUND TO NORTH**



**2-2**

**LOOKING NE ON SOUTH DIKE, ASH ABOVE LEVEL OF ROAD, TREES IN INTERIOR**

**AMEC Earth & Environmental**

690 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40299  
(502) 267-0700



**CLIENT LOGO**



**CLIENT**

**UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY**

**PROJECT**  
**ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS**

**DWN BY:**  
**CAE**

**DATUM:**

**DATE:**  
**8/19/10**

**TITLE**  
**KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.**  
**GREEN RIVER GENERATING STATION, CENTRAL CITY, KY**  
**ASH TREATMENT BASIN #2 SITE PHOTOS**

**CHK'D BY:**  
**MGS**

**REV. NO.:**

**PROJECT NO:**  
**3-2106-0177-0002**

**PROJECTION:**

**SCALE:**

**PAGE NO.:**  
**B-20**





**2-3**

**LOOKING E AT RIP-RAP ON DOWNSTREAM SLOPE OF ROAD (SOUTH DIKE?), STEEP SLOPE**



**2-4**

**LOOKING W AT DOWNSTREAM SLOPE OF ROAD (SOUTH DIKE?),  
STEEP SLOPE AND SPARSE GRASS**

**AMEC Earth & Environmental**

690 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40299  
(502) 267-0700



**CLIENT LOGO**



**CLIENT**

**UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY**

**PROJECT**  
**ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS**

**DWN BY:**  
**CAE**

**DATUM:**

**DATE:**  
**8/19/10**

**TITLE**  
**KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.**  
**GREEN RIVER GENERATING STATION, CENTRAL CITY, KY**  
**ASH TREATMENT BASIN #2 SITE PHOTOS**

**CHK'D BY:**  
**MGS**

**REV. NO.:**

**PROJECT NO:**  
**3-2106-0177-0002**

**PROJECTION:**

**SCALE:**

**PAGE NO.:**  
**B-21**







**2-5**  
NEW PZ ON ROAD, SOUTH DIKE



**2-6**  
LOOKING SE FROM SOUTHEAST CORNER OF POND, ELEVATED PIPE LINES TO SCRUBBER POND,  
SITE DISCHARGE DITCH ON LEFT, PORTION OF FORMER ASH POND 3 ON RIGHT

<b>AMEC Earth &amp; Environmental</b> 690 Commonwealth Center 11003 Bluegrass Parkway Louisville, Ky 40299 (502) 267-0700			CLIENT LOGO 	CLIENT <b>UNITED STATES ENVIRONMENTAL PROTECTION AGENCY</b>	
PROJECT ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS		DWN BY: CAE	DATUM:	DATE: 8/19/10	
TITLE KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S. GREEN RIVER GENERATING STATION, CENTRAL CITY, KY ASH TREATMENT BASIN #2 SITE PHOTOS		CHK'D BY: MGS	REV. NO.:	PROJECT NO: 3-2106-0177-0002	
		PROJECTION:	SCALE:	PAGE NO.: B-22	



**2-7**

**LOOKING S FROM PHOTO 2-6 AT FORMER ASH POND 3**



**2-8**

**LOOKING N AT CREST AND UPSTREAM SLOPE OF EAST DIKE**

**AMEC Earth & Environmental**

690 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40299  
(502) 267-0700



**CLIENT LOGO**



**CLIENT**

**UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY**

**PROJECT**  
**ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS**

**DWN BY:**  
**CAE**

**DATUM:**

**DATE:**  
**8/19/10**

**TITLE**  
**KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.**  
**GREEN RIVER GENERATING STATION, CENTRAL CITY, KY**  
**ASH TREATMENT BASIN #2 SITE PHOTOS**

**CHK'D BY:**  
**MGS**

**REV. NO.:**

**PROJECT NO:**  
**3-2106-0177-0002**

**PROJECTION:**

**SCALE:**

**PAGE NO.:**  
**B-23**





**2-9**

**LOOKING N AT DOWNSTREAM SLOPE OF EAST DIKE**



**2-10**

**LOOKING N AT CREST OF EAST DIKE, FOREGROUND: NEW PZ IN ROAD  
BACKGROUND: OUTLET WORKS AND TIE-IN TO NATURAL GROUND**

**AMEC Earth & Environmental**

690 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40299  
(502) 267-0700



CLIENT LOGO



CLIENT

**UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY**

PROJECT  
**ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS**

DWN BY: CAE

DATUM:

DATE: 8/19/10

TITLE  
**KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.  
GREEN RIVER GENERATING STATION, CENTRAL CITY, KY  
ASH TREATMENT BASIN #2 SITE PHOTOS**

CHK'D BY: MGS

REV. NO.:

PROJECT NO: 3-2106-0177-0002

PROJECTION:

SCALE:

PAGE NO.

**B-24**





**2-11**

**LOOKING SW FROM NORTHEAST CORNER OF POND AT OUTLET STRUCTURE, CONTROLS AND POND INTERIOR**



**2-12**

**METAL AND RUBBER SKIMMER AND INTAKE, SILT CLEANED APPROX. EVERY 5 YEARS**



2-13

LOOKING SW AT NPDES OUTFALL 001, BACKGROUND: SPARSE GRASS ON DOWNSTREAM SLOPE OF SCRUBBER POND WEST DIKE



2-14

LOOKING NE AT NPDES OUTFALL 001, OVERFLOW AND GROUTED CHANNEL

**AMEC Earth & Environmental**

690 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40299  
(502) 267-0700



CLIENT LOGO



CLIENT

**UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY**

PROJECT  
ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

DWN BY: CAE

DATUM:

DATE: 8/19/10

TITLE  
KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.  
GREEN RIVER GENERATING STATION, CENTRAL CITY, KY  
ASH TREATMENT BASIN #2 SITE PHOTOS

CHK'D BY: MGS

REV. NO.:

PROJECT NO: 3-2106-0177-0002

PROJECTION:

SCALE:

PAGE NO. B-26





**2-15**

**LOOKING N AT EAST TIE-IN TO NATURAL GROUND, BACKGROUND: EAST BUTTRESS ON MAIN POND SOUTH DIKE**



**2-16**

**LOOKING SOUTH AT LEFT: DOWNSTREAM SLOPE WEST DIKE SCRUBBER POND, CENTER: SITE OUTLET DITCH, RIGHT: DOWNSTREAM SLOPE EAST DIKE ASH POND 2**

## AMEC Earth & Environmental

890 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40299  
(502) 267-0700



### CLIENT LOGO



### CLIENT

**UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY**

**PROJECT**  
**ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS**

**DWN BY:**  
**CAE**

**DATUM:**

**DATE:** 8/19/10

**TITLE**  
**KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.**  
**GREEN RIVER GENERATING STATION, CENTRAL CITY, KY**  
**ASH TREATMENT BASIN #2 SITE PHOTOS**

**CHK'D BY:**  
**MGS**

**REV. NO.:**

**PROJECT NO:**  
**3-2106-0177-0002**

**PROJECTION:**

**SCALE:**

**PAGE NO.:**

**B-27**





**SP-1**

**LOOKING S AT CREST AND UPSTREAM SLOPE OF WEST DIKE, HEIGHT OF INTERIOR AREAS OF ASH UP TO WITHIN 1-FOOT OF CREST**



**SP-2**

**LOOKING W AT CREST AND UPSTREAM SLOPE OF NORTH DIKE, INTERIOR AREAS OF ASH AND PILED MATERIAL ABOVE CREST**

**AMEC Earth & Environmental**

690 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40289  
(502) 267-0700



**CLIENT LOGO**



**CLIENT**

**UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY**

**PROJECT**  
**ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS**

**DWN BY:**  
**CAE**

**DATUM:**

**DATE:**  
**8/19/10**

**TITLE**  
**KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.**  
**GREEN RIVER GENERATING STATION, CENTRAL CITY, KY**  
**SCRUBBER POND SITE PHOTOS**

**CHK'D BY:**  
**MGS**

**REV. NO.:**

**PROJECT NO:**  
**3-2106-0177-0002**

**PROJECTION:**

**SCALE:**

**PAGE NO.:**  
**B-28**



**SP-3**

LOOKING S AT CREST AND UPSTREAM SLOPE OF WEST DIKE, PUMP STATION AT SOUTHWEST CORNER



**SP-4**

LOOKING NE FROM SOUTHWEST CORNER AT POND INTERIOR, APPROXIMATELY 50% WATER

**AMEC Earth & Environmental**

690 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40299  
(502) 267-0700



**CLIENT LOGO**



**CLIENT**

**UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY**

**PROJECT**  
ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

**DWN BY:**  
CAE

**DATUM:**

**DATE:** 8/19/10

**TITLE**  
KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.  
GREEN RIVER GENERATING STATION, CENTRAL CITY, KY  
SCRUBBER POND SITE PHOTOS

**CHK'D BY:**  
MGS

**REV. NO.:**

**PROJECT NO:**  
3-2106-0177-0002

**PROJECTION:**

**SCALE:**

**PAGE NO.:**  
B-29





**SP-5**

LOOKING E AT CREST AND UPSTREAM SLOPE OF SOUTH DIKE, NEW PZ IN CREST,  
AREAS WITH UNEVEN TO NEAR VERTICAL SLOPES ON UPSTREAM SLOPE ON SOUTH AND EAST DIKE



**SP-6**

LOOKING N FROM SOUTHEAST CORNER AT CREST AND UPSTREAM SLOPE OF EAST DIKE,  
AREAS WITH UNEVEN TO NEAR VERTICAL SLOPES ON UPSTREAM SLOPE

**AMEC Earth & Environmental**

890 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40299  
(502) 267-0700



**CLIENT LOGO**



**CLIENT**

**UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY**

**PROJECT**  
ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

**DWN BY:**  
CAE

**DATUM:**

**DATE:** 8/19/10

**TITLE**  
KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.  
GREEN RIVER GENERATING STATION, CENTRAL CITY, KY  
SCRUBBER POND SITE PHOTOS

**CHK'D BY:**  
MGS

**REV. NO.:**

**PROJECT NO:**  
3-2106-0177-0002

**PROJECTION:**

**SCALE:**

**PAGE NO.:**  
B-30





**SP-7**

LOOKING W FROM NORTH DIKE AT NORTHWEST CORNER OF POND, NATURAL GROUND ON DOWNSTREAM SIDE



**SP-8**

LOOKING W AT EAST DIKE DOWNSTREAM SLOPE, STEEP AND AREAS WITH SPARSE VEGETATION

**AMEC Earth & Environmental**

690 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40299  
(502) 267-0700



**CLIENT LOGO**



**CLIENT**

**UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY**

**PROJECT**  
ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

**DWN BY:** CAE

**DATUM:**

**DATE:** 8/19/10

**TITLE**  
KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.  
GREEN RIVER GENERATING STATION, CENTRAL CITY, KY  
SCRUBBER POND SITE PHOTOS

**CHK'D BY:** MGS

**REV. NO.:**

**PROJECT NO:** 3-2106-0177-0002

**PROJECTION:**

**SCALE:**

**PAGE NO.:** B-31



**SP-9**

LOOKING SOUTH FROM NEAR SOUTHEAST CORNER TOWARD FORMER ASH POND 3



**SP-10**

LOOKING SE AT SOUTHWEST CORNER DOWNSTREAM SLOPE, SHALLOW SURFACE SLIDE REPAIR

**AMEC Earth & Environmental**

690 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40299  
(502) 267-0700



**CLIENT LOGO**



**CLIENT**

**UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY**

**PROJECT**  
ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

**DWN BY:**  
CAE

**DATUM:**

**DATE:** 8/19/10

**TITLE**  
KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.  
GREEN RIVER GENERATING STATION, CENTRAL CITY, KY  
SCRUBBER POND SITE PHOTOS

**CHK'D BY:**  
MGS

**REV. NO.:**

**PROJECT NO:**  
3-2106-0177-0002

**PROJECTION:**

**SCALE:**

**PAGE NO.:**  
B-32





**SP-11**

**LOOKING E AT DOWNSTREAM SLOPE OF SOUTH DIKE, WET AREA BELOW TOE,  
STEEP SLOPE, SPARSE GRASS**



**SP-12**

**LOOKING NE AT DOWNSTREAM SLOPE OF SOUTH DIKE, STEEP SLOPE, SPARSE GRASS**

**AMEC Earth & Environmental**

690 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40299  
(502) 267-0700



**CLIENT LOGO**



**CLIENT**

**UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY**

**PROJECT**  
**ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS**

**DWN BY:**  
**CAE**

**DATUM:**

**DATE:**  
**8/19/10**

**TITLE**  
**KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.**  
**GREEN RIVER GENERATING STATION, CENTRAL CITY, KY**  
**SCRUBBER POND SITE PHOTOS**

**CHK'D BY:**  
**MGS**

**REV. NO.:**

**PROJECT NO:**  
**3-2106-0177-0002**

**PROJECTION:**

**SCALE:**

**PAGE NO.:**  
**B-33**





**SP-13**

**LOOKING N AT DOWNSTREAM SLOPE EAST DIKE, STEEP SLOPE, AREAS OF SPARSE GRASS,  
TIE INTO ORIGINAL IN BACKGROUND**

**AMEC Earth & Environmental**

690 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40299  
(502) 267-0700



**CLIENT LOGO**



**CLIENT**

**UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY**

**PROJECT**  
**ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS**

**DWN BY:**  
**CAE**

**DATUM:**

**DATE:**  
**8/19/10**

**TITLE**  
**KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.**  
**GREEN RIVER GENERATING STATION, CENTRAL CITY, KY**  
**SCRUBBER POND SITE PHOTOS**

**CHK'D BY:**  
**MGS**

**REV. NO.:**

**PROJECT NO:**  
**3-2106-0177-0002**

**PROJECTION:**

**SCALE:**

**PAGE NO.**  
**B-34**



**3-1**

**CULVERT AND OUTLET DITCH TO GREEN RIVER WEST OF ASH POND 3**



**3-2**

**LOOKING S FROM PHOTO 2-6 AT ASH POND 3**

**AMEC Earth & Environmental**

690 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40299  
(502) 267-0700



CLIENT LOGO



CLIENT

**UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY**

PROJECT  
ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

DWN BY: CAE

DATUM:

DATE: 8/19/10

TITLE  
KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.  
GREEN RIVER GENERATING STATION, CENTRAL CITY, KY  
ASH POND 3 SITE PHOTOS

CHK'D BY: MGS

REV. NO.:

PROJECT NO: 3-2106-0177-0002

PROJECTION:

SCALE:

PAGE NO. B-35





**3-3**

**REGRADED AND RIP-RAP ARMORED SOUTH AND ONLY DIKE OF ASH POND 3**

**AMEC Earth & Environmental**

690 Commonwealth Center  
11003 Bluegrass Parkway  
Louisville, Ky 40299  
(502) 267-0700



**CLIENT LOGO**



**CLIENT**

**UNITED STATES  
ENVIRONMENTAL  
PROTECTION AGENCY**

**PROJECT**  
**ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS**

**DWN BY:** CAE

**DATUM:**

**DATE:** 8/19/10

**TITLE**  
**KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.**  
**GREEN RIVER GENERATING STATION, CENTRAL CITY, KY**  
**SCRUBBER POND SITE PHOTOS**

**CHK'D BY:** MGS

**REV. NO.:**

**PROJECT NO:**  
3-2106-0177-0002

**PROJECTION:**

**SCALE:**

**PAGE NO.:**  
B-36



**APPENDIX C**  
**Inventory of Provided Materials**

**Kentucky Utilities, Subsidiary of E.ON U.S.  
Green River Power Station  
List of Provided Documents**

**8-18-10**

- 1 KU Green River Topographic Map.zip
- 2 KU Green River Main Ash Pond Slope Stability Analysis.pdf
- 3 KU Green River Scrubber Pond Drawings.zip
- 4 KU Green River Main Ash Pond Drawings.zip
- 5 KU Green River Appendix D Green River.pdf
- 6 KPDES Water Balance Diagrams.zip

**8-23-10**

- 1 H.C. Nutting Company – 1976 Report GEOTECH Investigation.pdf
- 2 H.C. Nutting Company – 1976 Report GEOTECH Investigation.pdf
- 3 H.C. Nutting Company – Retention Basin Tech Spec.zip
- 4 Sheet C-0001 General Site Plan – Water Pollution Control Facilities – RevC.pdf
- 5 Sheet C-0002 Plant and Switchyard Area Plan – Water Pollution Control Facilities – RevF.pdf
- 6 Sheet S-0416 Flow Measurement Structure – Plan and Sections-Water Pollution Control Facilities – RevC.pdf
- 7 Green River Ash Pond Slope Repair 2010.zip
- 8 Green River Spillways Report 12 August 2010.pdf
- 9 Sheet GRO-SK-00004-GR 30x42 DRAINAGE.pdf

**8-25-10**

- 1 Boring Location Plan – Sheet S0<sub>2</sub> Removal Pond.pdf
- 2 Dike Location Plan – Sheet S0<sub>2</sub> Removal Pond.pdf
- 3 Green River Station August 2010 Pond Inspection Reports.pdf
- 4 Soil Boring Logs – Sheet S0<sub>2</sub> Removal Pond.pdf

**8-27-10**

- 1 Green River ATBs and FGD Basin 08-27-10.pdf

**9-3-10**

- 1 2010-09-03 Green River Data Package.pdf – Geotechnical Exploration and Slope Stability Analyses Data Package for Green River Power Station Number 2 Pond & Scrubber Pond, prepared by MACTEC Engineering and Consulting, Inc. , September 3, 2010

**9-10-10**

- 1 Response of Louisville Gas and Electric Company and Kentucky Utilities Company to Request for Information under Section 104(e) of the CERCLA