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Report of Geotechnical Investigation
Dam Safety Assessment of Coal Combustion Surface Impoundments
Kentucky Utilities, a Subsidiary of E.ON U.S.
Tyrone Generating Station, Tyrone, KY

AMEC Project No. 3-2106-0177.0004

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I certify that the management units referenced herein:

Kentucky Utilities a Subsidiary of E.ON U.S, Tyrone Generating Station: Tyrone Ash Pond and the Former Secondary Pond were assessed on August 3, 2010.

Signature _____

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Project Engineer

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DRAFT

US EPA ARCHIVE DOCUMENT

TABLE OF CONTENTS

SECTION **PAGE NO.**

1.0 INTRODUCTION AND PROJECT DESCRIPTION 1
- 1.1 Introduction 1
- 1.2 Project Background 1
  - 1.2.1 State Issued Permits 2
- 1.3 Site Description and Location 3
- 1.4 Process Ponds 3
  - 1.4.1 Ash Handling and Flow Summary 3
  - 1.4.2 Tyrone Ash Pond 3
  - 1.4.3 Former Secondary Pond 5
- 1.5 Previously Identified Safety Issues 5
- 1.6 Site Geology 5
- 1.7 Inventory of Provided Materials 6

2.0 FIELD ASSESSMENT 7
- 2.1 Visual Observations 7
- 2.2 Visual Observations - Tyrone Ash Pond 7
  - 2.2.1 Tyrone Ash Pond - Embankments and Crest 7
  - 2.2.2 Tyrone Ash Pond - Outlet Control Structure 8
- 2.3 Visual Observations - Former Secondary Pond 8
- 2.4 Monitoring Instrumentation 8

3.0 DATA EVALUATION 9
- 3.1 Design Assumptions 9
- 3.2 Hydrologic and Hydraulic Design 9
  - 3.2.1 Tyrone Ash Pond 12
  - 3.2.2 Former Secondary Pond 14
- 3.3 Structural Adequacy & Stability 14
  - 3.3.1 Tyrone Ash Pond - Structural Adequacy & Stability 15
  - 3.3.2 Former Secondary Pond - Structural Adequacy & Stability 17
- 3.4 Foundation Conditions 17
- 3.5 Operations and Maintenance 17
  - 3.5.1 Instrumentation 18
  - 3.5.2 Inspections 18

4.0 COMMENTS AND RECOMMENDATIONS 22
- 4.1 Acknowledgement of Management Unit Conditions 22
- 4.2 Tyrone Ash Pond 23
  - 4.2.1 Hydrologic and Hydraulic Recommendations 23
  - 4.2.2 Geotechnical and Stability Recommendations 23
  - 4.2.3 Monitoring and Instrumentation Recommendations 24
  - 4.2.4 Inspection Recommendations 24
- 4.3 Former Secondary Pond 24

5.0 CLOSING 25

TABLES

Table 1. Site Visit Attendees 1
Table 2. MSHA* Minimum Long Term Hydrologic Design Criteria 11

US EPA ARCHIVE DOCUMENT
DRAFT

Table 3. Summary of 1998 DAMS2 Analysis 13
Table 4. Minimum Required Dam Safety Factors 15
Table 5. Soil Parameters 16
Table 6. Slope Stability Analyses Calculated Safety Factors 17
Table 7. Piezometer Information 18

FIGURES

Site Location & Vicinity Map ..... Figure 1
Site Plan ..... Figure 2
Critical Infrastructure Map ..... Figure 3
Topographic Map ..... Figure 4
Tyrone Ash Pond Plan View ..... Figure 5
Tyrone Ash Pond Typical Cross-Sections ..... Figure 6
Tyrone Ash Pond Piezometer Locations and 2010 Stability Analysis Cross-Sections ..... Figure 7

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

DRAFT

US EPA ARCHIVE DOCUMENT

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.) Tyrone Generating Station, which is located in Woodford County, Kentucky, approximately 7 miles west of Versailles, Kentucky. A Project Location Map is provided as Figure 1.

A site visit to Tyrone Generating Station was made by AMEC on August 3, 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 Mary Swiderski, EIT 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.	Barry Currens, Tyrone Generating Station Manager
E.ON U.S.	Roger J. Medina, Senior Chemical Engineer
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) Tyrone Generating Station. Impoundments (dams) are designed and constructed to provide storage and disposal for the CCW that are produced. KU refers to the two CCW impoundments at the Tyrone Generating Station as “Tyrone (or Main) Ash Pond” and the “Former Secondary 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. The Tyrone Ash Pond and Former Secondary Pond are not listed in the database.

The Kentucky Department for Natural Resources and Environmental Protection’s (KDEP) 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

US EPA ARCHIVE DOCUMENT
DRAFT

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 (Class B) hazard classifications occur every two years, while dams with a low (Class A) hazard classification 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 Tyrone Ash Pond (ID 956) as a low hazard dam (Class A). However, according to the KDOW inspection on June 9, 2005, the Former Secondary Pond "does 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 this lower impoundment would feasibly create any hydraulic (flooding) hazard downstream."

As part of the observations and evaluations performed at Tyrone Generating 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 Tyrone Ash Pond. As defined on the Inspection Form, dams assigned a "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. No classification was assigned to the Former Secondary Pond since the dikes of the Former Secondary Pond have been graded and the contained material has been removed.

1.2.1 State Issued Permits

KDOW has issued Kentucky Pollutant Discharge Elimination System (KPDES) Permit No. KY 0001899 to Kentucky Utilities Company. The most recent permit provided by KDOW authorizes Kentucky Utilities Company to discharge from Tyrone Generating Station to the Kentucky River at mile point 82.9 and 83.1. The permit became effective on February 1, 2002 and expired on

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February 1, 2007. At the time of writing this report, KDOW stated the KPDES permit for Tyrone Generating Station was under review.

KDOW issues construction permits for proposed ash ponds. Construction permit number 1502 dated April 21, 1978 for the "new ash pond at site of existing ash pond" was provided; however, the pond location could not be confirmed based on the latitude and longitude coordinates listed on the permit.

1.3 Site Description and Location

Kentucky Utilities Tyrone Generating Station is located approximately 7 miles west of Versailles, Kentucky. The area surrounding the plant boundary is primarily rural. The Site Location and Vicinity Map, included as Figure 1, illustrates the location of Tyrone Generating Station relative to Versailles. The Kentucky River is located to the west of the plant facilities. The Site Plan, included as Figure 2, shows the location of the Ash Ponds and their proximity to the Kentucky River. The distances between the closest point of the ash ponds and the Kentucky River are approximately 200 feet and 225 feet for the Tyrone Ash Pond and Former Secondary Pond, respectively.

An aerial photograph of the region indicating the location of Tyrone Generating 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.

1.4 Process Ponds

1.4.1 Ash Handling and Flow Summary

Tyrone Generating Station utilizes coal in the production of electricity. In this process, two types of CCW ash are generated: bottom ash and fly ash. The Tyrone Ash Pond is an active ash pond that receives process flows discharged from Unit 3 and rainfall runoff. Discharge from the Ash Pond is via a concrete decant structure to a KPDES monitoring and sampling point. From this monitoring/sampling point, discharge is conveyed to a rip-rap lined channel which directs the discharge to the Kentucky River via KPDES permitted outfalls.

Historically, the Former Secondary Pond received discharge from the main pond. At present, this pond no longer receives liquid-borne material; the dikes of this pond have been graded; and, the contained material has been removed.

1.4.2 Tyrone Ash Pond

Current Pond Conditions

The Tyrone Ash Pond was commissioned circa 1977 with a 13-acre surface area and a maximum embankment height of 19.6 feet. Information provided in response to the EPA Request for Information under Section 104(e) dated March 25, 2009 indicated that KU was unable to determine the total storage capacity and volume of materials stored in the ash pond. Design drawings indicate the pond storage capacity is approximately 162,000 cubic yards. Drawings indicate a design embankment crest width of 12 feet and exterior and interior slopes of 2.5:1 (H:V). A drainage ditch is located 10 feet from the toe of the downstream slope on the

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north and south embankments and was designed to provide drainage for non-pond site surface runoff. KU 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. A topographic plan view of the Tyrone Ash Pond is included as Figure 4. This figure is based on a ground control survey dated December 23, 2009 completed by Kimball Associates, Inc to provide KU with more accurate embankment elevations and other useful information regarding the facilities. Figures 5 and 6 illustrate the Tyrone Ash Pond Plan View and Typical Cross Sections.

Process flows to the ash basin primarily result from the operation of Unit 3 and management of residuals formed by the combustion of coal including the following:

- 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;
- Plant substation runoff flows pumped to ash basin; and,
- Coal pile runoff flows.

The basin receives process flows from the plant operations and rainfall flow from several areas. The rainfall runoff areas to the ash basin include:

- Two substations immediately to the east of the boiler-turbine building;
- The coal pile runoff area (runoff is collected in an approximately 1 acre pond and pumped to the ash basin); and
- Rainfall runoff flows associated with the watershed basin of the pond including runoff from stockpiled ash directly uphill (east) of the basin.

Material from the ash pond is periodically excavated based on beneficial reuse and operational need. From year 2000 to 2008, the pond was excavated twice per year. Tyrone Generating Station was placed on reserve shutdown in February 2009 and returned to service in June of 2010. From 2009 to 2010, the pond was not excavated. When dredging occurs, the dredged ash is placed in an ash stack located immediately adjacent to the eastern portion of the pond.

Previous Pond Issues

During a February 2009 site inspection, ATC Associates, Inc. noted seeps below the west embankment and recommended an evaluation of the area as a High priority item (see Section 3.5.2). KU commissioned ATC to perform an investigation. ATC's report, entitled *Ash Pond Seep Evaluation Report Tyrone Power Station* dated September 11, 2009, discussed the water seeps and slope erosion of the earth slopes between the cooling water canal and the west embankment of the Tyrone Ash Pond. The report also addressed the dry stacking of ash and the excavation of ash from the pond. KU did not provide the entire ATC report to AMEC; therefore, AMEC's comments regarding these issues are limited.

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The study scope included drilling four soil test borings, installing three temporary piezometers, pressure testing of the rock in the boreholes, water level readings, limited water quality testing and an electrical resistivity survey. ATC determined that the "seepage areas noted in the cooling water canal most likely reflect seepage of groundwater rather than seepage from the Main Ash Pond and at this time do not appear to represent a significant threat to the integrity of the Main Ash Pond". Referring to the seepage and bank erosion, the report recommends "future site assessments include monitoring of these areas".

1.4.3 Former Secondary Pond

According to provided documentation from KU's response to EPA, the Former Secondary Pond was commissioned in 1977 (estimated) with a total storage area of 0.5 acres. Documentation indicated that Kentucky Utilities was unable to determine the pond height or volume of materials stored in the ash pond. The pond was located to the north of the Tyrone Ash Pond and previously served as a finishing pond. Discharge from the Tyrone Ash Pond entered the Secondary Pond at its southeast corner. The principal spillway for the Secondary Pond was located on the northwest corner. Documentation could not be located to indicate whether the dam was designed and constructed under the supervision of a Professional Engineer. Prior to removal, the Former Secondary Pond was inspected by a professional engineer.

During April to May 2010, the pond was taken out of service, material was excavated, and the embankments were re-graded. Following the Former Secondary Pond's removal from service, decanted flow from the Ash Pond was routed north through a rock lined channel to a natural ravine that discharges to the Kentucky River.

1.5 Previously Identified Safety Issues

Discussions with plant personnel and review of provided documentation indicate that except for the seepage and erosion issue previously mentioned, there are no other current or previously identified safety issues, from the previous 5 years, at Tyrone Generating Station.

1.6 Site Geology

FMSM Engineers completed an Ash Pond Modification Study, dated April 1998. Within the report the site geology was described as follows;

> *The geologic map of the Tyrone Quadrangle, Anderson and Woodford Counties, Kentucky (USGS 1964) indicates the site is partially underlain by alluvial deposits representing the Pleistocene geologic period. The alluvium consists of sand, silt, clay and gravel material deposited by the Kentucky River, and varies in thickness from 10 to 70 feet in the area.*

The report further describes the irregularity of the bedrock formation. The report states that:

> *Underlying the alluvium in the project area is bedrock associated with the Tyrone Limestone Formation. This bedrock was deposited during the Middle Ordovician geologic period and consists of limestone. The limestone is described as light brownish gray, thin to thick bedded with some interbeds of yellowish-white limestone and shaley limestone.*

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Structural controls drawn on the base of the Brannon Limestone Member of Cynthiana Formation indicate a rock strata dip of 30 feet per mile to the west. The Brannon Limestone is located topographically above the Tyrone Limestone Formation. The mapping shows no faults or other structural features in the immediate vicinity of the site.

1.7 Inventory of Provided Materials

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

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2.0 FIELD ASSESSMENT

2.1 Visual Observations

AMEC performed visual assessments of Plant Tyrone's two ash pond units on August 3, 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 four business 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.

2.2 Visual Observations - Tyrone Ash Pond

The Tyrone Ash Pond is currently active and receives/contains fly ash, bottom ash, boiler slag, and other low volume wastes including coal fines, process water drainage, pyrites, and treated sanitary wastewater. The area to the east of the pond was being used to stack ash (photos 1-17, 1-18, 1-19, and 1-21) which is dredged from the active pond periodically based on beneficial reuse opportunities and operational needs. The ash pond receives storm water drainage from the ash stack, coal pile, two substations located to the east of the boiler-turbine building, and from farmland located to the east of the pond.

2.2.1 Tyrone Ash Pond - Embankments and Crest

The ash pond has a side-hill configuration, with the north, south and west dikes consisting of construction embankments. A freeboard of approximately 3 to 4 feet between the top of water and top of dike was observed at the outlet structure during the site visit (photo 1-10). Freeboard based on reported water elevation (532.3 feet) and the lowest dam crest elevation in the area of the outlet structure obtained from recent survey data dated 2010 (533.5 feet) was 1.2 feet. Photo 1-10 clearly shows one of these elevations to be incorrect. The crest of the dam was primarily surfaced with grass, however sections along the western dike were covered with crushed stone (photos 1-16, 1-18 and 1-20). The surface of the downstream embankment was covered with grass (photos 1-4, 1-5, 1-9, and 1-14). The dikes appeared to be maintained and were mowed at the time of the site visit. The upstream slopes were covered with grass and vegetation (photos 1-3, 1-17 and 1-19). Slopes thought to be over-steepened and/or uneven were noted on the downstream slope areas of the southwest and northern dikes (photos 1-4, 1-9 and 1-12). A low and sloping crest was noted in the center area of the west dike (photo 1-8). A cut was noted at the bottom of the downstream toe of the north dike (photo 1-9). Repaired surface areas on the downstream embankment were observed on the southwest, north and south dikes (photos 1-2, 1-5, and 1-14). A seep is located at the toe of the natural slope and above the cooling water canal below the toe of the center area of the west dike (photo 1-6). An ATC report dated September 2009 determined the seep was due to groundwater. KU has installed a monitoring and sampling point at the seep and has placed large rock in the channel above the seep (photo 1-7).

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2.2.2 Tyrone Ash Pond - Outlet Control Structure

The primary outlet for the Tyrone Ash Pond is a concrete structure connected to an 18-inch diameter corrugated metal discharge pipe (photo 1-10). The concrete structure supports an adjustable skimmer and stop log unit which allows the water level/discharge rate to be adjustment by facility personnel as facility operations require (photo 1-11). The inlet is located along the northern edge of the pond. Flow from this primary outlet structure is conveyed through the discharge point which is located at the toe of the downstream embankment (photos 1-12 and 1-13). The discharge channel is lined with a geotextile fabric beneath 12 inches of crushed limestone that is four to six inches in diameter. The channel connects to a natural ravine, which routes flow into the Kentucky River (photo 1-15).

2.3 Visual Observations - Former Secondary Pond

The Former Secondary Pond was located to the north of the Tyrone Ash Pond. During April and May 2010 the pond was taken out of service, material was excavated, and embankments were re-graded. At the time of the site visit, the pond dikes had been removed (re-graded) and the area was sparsely covered with grass (photos 1-9 and 1-14).

2.4 Monitoring Instrumentation

At the time of AMEC's site visit, no permanent impoundment monitoring equipment was installed at the Tyrone Generating Station.

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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

Class (A) Low Hazard Structure	$P_A = P_{100}$	(1)
Class (B) Moderate Hazard Structure	$P_B = P_{100} + [0.12 \times (PMP - P_{100})]$	(2)
Class (C) High Hazard Structure	$P_c = P_{100} + [0.26 \times (PMP - P_{100})]$	(3)

Freeboard Hydrograph

Class (A) Low Hazard Structure	$P_A = P_{100} + [0.12 \times (PMP - P_{100})]$	(4)
Class (B) Moderate Hazard Structure	$P_B = P_{100} + [0.40 \times (PMP - P_{100})]$	(5)
Class (C) High Hazard Structure	$P_c = PMP$	(6)

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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.

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.

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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 probably 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 inflow 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*

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DRAFT

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."

3.2.1 Tyrone Ash Pond

FMSM Engineers completed a hydrologic analysis of the Tyrone Ash Pond as part of their April 1998 report entitled *Ash Pond Modification Study Tyrone Generating Station Woodford County, Kentucky*. In order to provide KU with an additional 5 to 8 years of capacity, FMSM proposed two options for expansion of the east dike of the pond. Hydrologic analyses were completed for both the existing condition, as well as for both proposed option conditions. On-site observations by AMEC and correspondence with personnel indicate that neither of FMSM's options was pursued. As such, with the exception of an ash stack which is currently present and located to the east of the pond, current pond and tributary area conditions today are the same as the „existing conditions' in FMSM's hydrologic analysis. The ash stack is graded to direct flow to the ash pond and is not expected to contribute a significant amount of runoff to the pond.

According to the FMSM report, existing conditions were hydrologically analyzed using the DAMS2 computer program. FMSM 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 FMSM. Curve numbers and times of concentration were developed to characterize the watershed. The report continued by noting that:

Because the dam is „Class A', current regulations dictate it be designed to safely pass both emergency spillway (100-year, 6-hour rainfall) and freeboard (7.2 inches of rainfall) hydrographs in accordance with DOW Engineering Memorandum No. 5…The emergency spillway hydrograph

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was analyzed, even though this structure does not have an emergency spillway, in order to evaluate the performance of the existing principal spillway pipe. It is FMSM's experience that DOW will permit facilities such as this, with relatively small watersheds, to operate without an emergency spillway, provided the principal spillway is adequate to safely pass both hydrographs without overtopping the pond. It should be noted that the above statement is based only on FMSM's experience and is subject to interpretation by the DOW.

The DAMS2 program provides the option of routing a storm distribution through an outlet structure located within a defined stage storage impoundment relationship. FMSM routed the design storm though the vertical discharge riser and the 18-inch discharge pipe to determine the rate that the outlet structure could discharge design storm and return the water surface elevation to normal operating levels. Table 3, shown below, provides a summary of the DAMS2 hydrological analysis input and output values for the existing conditions at the Tyrone Generating Station.

Table 3. Summary of 1998 DAMS2 Analysis

	EMERGENCY SPILLWAY HYDROGRAPH	FREEBOARD HYDROGRAPH
	EXISTING CONDITIONS	
Normal Pool Elevation (feet)	534	534
Watershed Area (acres)	61.9	61.9
Reservoir Area (acres)	10.0	10.0
Runoff Curve Number	73	73
Volume at Normal Pool (acre/feet)	81.0	81.0
Precipitation (inches)	4.4	7.2
Time of Concentration (hours)	0.14	0.14
Runoff (inches)	1.82	4.11
Peak Inflow (cfs)	96.5	225.2
Peak Outflow (cfs)	17.2	25.2
Maximum Water Surface Elevation (feet)	534.54	535.40

Table 3 indicates the results of routing the freeboard hydrograph precipitation of 7.2 inches, calculated from KDOW freeboard hydrograph equation (4). Freeboard hydrograph precipitation would produce a peak water surface elevation of 535.4 feet in the Tyrone Ash Pond. That is 1.40 feet greater than the normal water surface elevation of 534.0 feet, and results in a freeboard of 0.6 feet using the design crest elevation of 536.0 feet. Additionally, the DAMS2 analysis of this design storm indicated that the principal spillway structure would be capable of discharging the runoff volume within approximately 16 hours.

The Ash Pond at the Tyrone Generating Station does not have an emergency spillway. However, Table 2 indicates the results of routing the emergency hydrograph precipitation from KDOW emergency hydrograph equation (1) produces a water surface elevation 0.54 feet above the normal operating elevation of 534.0 feet. The routing results indicated runoff volumes resulting from the emergency hydrograph would pass through the pond in approximately 12 hours.

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The Tyrone Generating Station discharges at river mile 82.9 and 83.1, the facility is in close proximity to Kentucky River Lock Number 5, which is located at mile point 82.2. The Kentucky River Navigation Charts indicate the typical river level at Lock No. 5 varies from 470 feet along the lower section to 485 feet at the upper section. A maximum high water elevation of 523 feet was observed in 1937. The topographic study performed in January 2010 indicate crest elevations of 533.5 feet at the south portion of the west dike to 535.4 feet at the west portion of the south dike.

It is AMEC's position that hydrologic design or assessment of an impounding dam or structure, including the determination of an acceptable freeboard, should be based on the minimum criteria set forth in 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, as described previously in Section 3.2.

Although according to KDOW the Tyrone Ash Pond is currently considered a low hazard dam, AMEC chose to assign a "Significant Hazard" classification" to the Tyrone Ash Pond on the EPA's CCW Impoundment Inspection form that was completed based on the August 3, 2010 facility site visit. The "Significant Hazard" classification was chosen for the Ash Pond due to its proximity to the Kentucky River and the potential for environmental impacts following any failure of the dam structure.

With respect to minimum hydrologic criteria, MSHA requires that an impoundment must 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." According to Table 2, MSHA specifies a design storm equal to ½ PMF (Peak Maximum Flood) for dams assigned a significant hazard classification and crest heights less than 40 feet and impoundment volumes less than 1,000 acre-feet. Details regarding what MSHA specifies as acceptable criteria for use in determining the PMF were provided previously in Section 3.2 of this Assessment Report. Time required to pass the design storm through the impoundment is also important and is described within MSHA documents.

3.2.2 Former Secondary Pond

There was no information provided regarding hydrologic and hydraulic design of the Former Secondary Pond.

It is AMEC's position that the Former Secondary Pond does not require a hydrologic evaluation based on its current removed condition and inability to store any storm runoff.

3.3 Structural Adequacy & Stability

The Commonwealth of Kentucky Department of Natural Resources Environmental Protection, Bureau of Environmental Protection, Division of Water, provided the June 1, 1980 document entitled, *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 to determine safety factors using the methods, guidelines, and procedures of the agencies listed in the guidelines may be considered, by the State of Kentucky, to have acceptable stability if the analyses yield at least the minimum safety factors shown in Table 3.

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Two well regarded 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 (MHSA). Minimum recommended factors of safety for various loading conditions can be found in those agency publications, as shown in Table 4 below.

Table 4. Minimum Required Dam Safety Factors

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

[1] Guidelines for the Geotechnical Investigation and Analysis of Existing Earth Dams, 1980, Kentucky Division of Water
[2] Coal Mine Impoundment Inspection and Plan Review Handbook, 2007, US Mine Safety and Health Administration
[3] Slope Stability Publication, EM1110-2-1902, 2003, US Army Corps of Engineers, Table 3-1: New Earth and Rock-Fill Dams
[4] Applies to drawdown from maximum surcharge pool
[5] Applies to drawdown from maximum storage pool
[6] Referred to USACE Engineer Circular "Dynamic Analysis of Embankment Dams" document that is still in preparation

AMEC reviewed the August 27, 2010 report entitled *Geotechnical Exploration and Slope Stability Analyses Data Package for the Tyrone Ash Pond* prepared by MACTEC Engineering and Consulting, Inc. The recently completed stability analysis is summarized in Section 3.3.1. To analyze the structural adequacy and stability of the Tyrone Ash Pond at Tyrone Generating Station, AMEC reviewed the material provided by Kentucky Utilities with respect to the load cases shown in Table 3. Factors of safety documented in the provided material were compared with those factors outlined in Table 3 to help determine whether the impoundments meet requirements for acceptable stability.

3.3.1 Tyrone Ash Pond - Structural Adequacy & Stability

MACTEC Engineering and Consulting, Inc developed a geotechnical exploratory drilling program, piezometer installation program and a geotechnical laboratory testing program. The geotechnical exploration program was conducted in August, 2010 and included a total of 12 borings at six cross-sections along the dam in areas judged to be "critical" based on the topography and nature of the exposed slope. Figure 7 illustrates the location of the six cross sections. Six of the borings were located along the embankment crest and were extended to a depth of up to 50 feet. The remaining six borings were located at corresponding locations along the toe of the embankment, and were extended to depths of up to 20 feet. A total of three piezometers were installed in crest Borings B-1, B-3, and B-5 to monitor pieziometeric levels within the dam.

The geotechnical laboratory testing program consisted of classification tests including Atterberg limits, grain-size analyses, specific gravity and unit weight determinations. Consolidated undrained triaxial shear tests with pore pressure measurements were performed on undisturbed samples in order to determine total stress and effective stress parameters. Additional strength testing was ongoing at the time this report was written. In addition to laboratory testing, Standard Penetration Test results were statistically analyzed to *"delineate the general subsurface conditions and estimate anticipated soil properties based on correlations and published data."* Regarding soil conditions and strength parameters, MACTEC stated:

> *In general, the dike was constructed of silty to sandy clay fill reportedly excavated from the incised portion of the pond. The clay fill was placed*

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overlying existing alluvial soils comprised of clay and sandy soils. Soil parameters selected for the slope stability analyses were based on various resources including the preliminary results of the extensive laboratory testing described above, field testing and observations, published information on similar soil types and our experience on similar projects.

Soil parameters selected by MACTEC for the analyses are shown in Table 5.

Table 5. Soil Parameters

SOIL TYPE NO.	SOIL DESCRIPTION	UNIT WEIGHT		EFFECTIVE STRESS	
		TOTAL (PCF)	SATURATED (PCF)	COHESION C' (PSF)	FRICTION ANGLE Φ' (DEGREES)
1	SC (fill)	134	139	100	32
2	CL (fill)	130	135	160	30
3	SC (alluvium)	130	135	100	30
4	CL (alluvium)	120	125	300	28
5	ML (alluvium)	118	123	200	28
6	CCW	90	95	0	30

Slope stability analyses were conducted using the computer program PCSTABL, developed by Purdue University. The program utilizes a "*two-dimensional limit equilibrium method of analysis and calculates the factor of safety based on the Modified Bishop Method of Slice*s." The stability of the existing dike was analyzed under steady-state/maximum flooding conditions, rapid drawdown and seismic (dynamic) conditions. Two of the six cross-section locations (sections 5 and 6) located along the north and east sides of the dike had been analyzed at the time of writing this report; however, the remaining four cross-section slope stability analyses (cross sections 1 through 4) and corresponding laboratory testing is currently ongoing. Cross-sections 5 and 6 were selected as the most critical based on the length of the exterior slopes.

The geometry used in the analyses was based on construction drawings provided by KU and a topographic survey map dated December 2009. The report noted that:

The upstream slopes for Sections 5 and 6 were observed to range from 2.2H:1V to 2.4H:1V and the downstream slopes ranged from 1.6H:1V to 2.2H:1V. The upstream slopes below the current water or ash levels were projected from the topographic data obtained in the field at each cross-section location from the portion of the upstream slope above the water/CCW level. Seismic conditions for this site were modeled under dynamic loading conditions using a peak ground accelerating value of 0.060 g (horizontally) for a 2 percent probability of exceedance in 50 years. The value was obtained from published guidance based on the site location.

The maximum pool level was modeled as the top of the surveyed crest. Based on topographic mapping, the crest elevation ranged from 533.0 to 534.7 feet National Geodetic Vertical Datum. Water level readings were obtained at the time of drilling and from piezometers installed in the crest borings.

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MACTEC's report stated *"our analysis, performed using the parameters and geometry described above, indicated that the cross-sections analyzed to date provide factors of safety that exceed the published factors of safety for the cases analyzed."* MACTEC commented that *"based on our initial review of the data, the material properties and embankment characteristics, it is expected that further analysis will result in factors of safety that meet regulatory guidelines."*

Results of the slope stability analyses are presented in Table 6.

Table 6. Slope Stability Analyses Calculated Safety Factors

CRITICAL SECTION	UPSTREAM SLOPE (H:V)	DOWNSTREAM SLOPE (H:V)	LONG-TERM STEADY STATE/MAX SURCHARGE POOL		RAPID DRAWDOWN		SEISMIC	
			TARGET FOS	FOS	TARGET FOS	FOS	TARGET FOS	FOS
5 Upstream	2.2 : 1.0	-	1.5	2.9	1.2	1.6	1.2	2.2
5 Downstream	-	2.2 : 1.0	1.5	2.2	1.2	2.2	1.2	1.9
6 Upstream	2.4: 1.0	-	1.5	3.6	1.2	1.9	1.2	2.6
6 Downstream	-	1.6: 1.0	1.5	2.1	1.2	2.1	1.2	1.8

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

3.3.2 Former Secondary Pond - Structural Adequacy & Stability

Information regarding structural adequacy and stability was not provided for the Former Secondary Pond.

3.4 Foundation Conditions

Geotechnical borings performed in 1998 by FMSM indicate the natural soils on the east dike consist primarily of fat clays with sand. The 2009 ATC seep evaluation report included two historic borings designated KU-11 and KU-12. These borings indicated the foundation materials consisted of "sandy soil" to "clay" overlying alluvial "sand and gravel".

MACTEC's report entitled *Geotechnical Exploration and Slope Stability Analyses Data Package for the Tyrone Ash Pond* prepared by MACTEC Engineering and Consulting, Inc dated August 27, 2010 briefly describes foundation conditions. The report states, "In general, the dike was constructed of silty to sandy clay fill reportedly excavated from the incised portion of the pond. The clay fill was placed overlying existing alluvial soils comprised of clay and sandy soils."

3.5 Operations and Maintenance

Kentucky Utilities personnel perform daily safety and surveillance inspections for the ash ponds at the Tyrone Generating Station. Inspections are documented during the times the plant is out-of-service; however, they are not documented when the plant is in service. No record of inspection dates or observations were provided. Furthermore, no information was provided to

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indicate the general inspection procedures or extent of the inspected area(s). ATC Associates performed inspections on the ash ponds in February 2009, and January 2010. The reports indicated areas of surface erosion, animal burrows, ash build-up on crest, low areas on crest, steep slopes, and un-vegetated areas. Additional details regarding the ATC inspections are provided in Section 3.5.2. Several of the issues noted in the 2010 ATC inspection report appeared to be addressed at the time of the site visit; however, no documentation was provided to indicate KU had proceeded with ATC's recommendations. No safety issues were reported in the reports that were reviewed by AMEC. 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

Historically, impoundment monitoring equipment has not been used at the Tyrone Generating Station. However, MACTEC Engineering installed three piezometers in support of the August 2010 slope stability analyses (subsequent to AMEC's site inspection). The piezometers were installed in crest Borings B-1C, B-3C, and B-5C. Each piezometer contained a 10-foot well screen that was placed from 20 feet to 30 feet below ground surface in Boring B-1C, and from 25 feet to 35 feet in Borings B-3C and B-5C. Due to the recent installation of the instrumentation, a trend in the phreatic surface cannot be noted at this time. Piezometer information was summarized by AMEC and is provided in Table 7.

Table 7. Piezometer Information

PIEZOMETER ID	BORING ELEVATION	BOTTOM OF BOREHOLE	WATER ELEVATION 8/25/10
B-1C	534.7	502.7	520.0
B-3C	534.3	499.3	505.4
B-5C	534.4	488.9	DRY

3.5.2 Inspections

State Inspections

The Tyrone Ash Pond is classified as a Low Hazard, or Class (A), dam by the KDOW, which means that, according to state regulations, the dam should be scheduled for inspected every 5 years. The most recent inspection performed by KDOW at Tyrone Generating Station was June 9, 2005. Review of the inspection indicates the following items for the Former Secondary Pond were to be addressed: removal of saplings, protection of the concrete apron below the outlet, filling in of low areas and re-grading the crest. Additionally, mowing of the downstream slope of the Tyrone Ash Pond was necessary. A February 2009 inspection report prepared by ATC Associates Inc. lists previous inspections completed by KDOW in January 1983, June 1988, July 1993, and December 1999. Previous inspection deficiencies to be addressed included mowing, filling animal burrows, and removal of vegetation.

2009 Inspection

ATC Associates Inc. completed an assessment of the Tyrone Ash Pond and Former Secondary Pond in February 2009. ATC rated the overall condition of the Tyrone Ash Pond as conditionally poor, which is defined as:

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A potential safety deficiency is recognized for unusual loading conditions which may realistically occur during the expected life of the structure. This designation may also be used when uncertainties exist as to critical analysis parameters which identify a potential dam safety deficiency; further investigation and studies are necessary.

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

Current ash excavation practices and presence of seepage below toe of natural slope present hazard to loss of embankment particularly during plant operations when water level in pond would be elevated. Several minor conditions observed with embankments as described above. Inlet pipes to pond not encased and are buried in embankment without protection. Previous leaks in pipes have caused damage to embankment slopes.

The report noted a total of nine action items. Three items were regarded as „high' importance, which indicates the action item should be addressed as soon as possible. The „high' importance items included:

1. Evaluate seepage and bank erosion above the cooling water outflow canal, below toe of the west embankment;
2. Monitor seepage area above cooling water outflow channel for increased flow, soil fines in flow or erosion or natural slope above seepage; and,
3. Evaluate the current ash excavation operations to avoid removing limestone boulders and clay soil from the pond bottom;

The remaining six maintenance items were given a „normal' rating indicating the action item should be addressed as part of the ongoing maintenance of the structure. The „normal' items included:

4. Monitor areas of surface erosion, west and north embankments, repair if vegetative cover damaged;
5. Repair animal burrows below west embankment crest on upstream slope near north end;
6. Remove ash build-up on crest from ash excavation operations, re-establish stable road base;
7. Monitor wet area below south embankment for seepage;
8. Evaluate and modify dry stacking of excavated ash east of pond; evaluate stability and prevent water ponding; and,
9. Evaluate need for concrete cradle below pipes crossing through south embankment.

The September 11, 2009 report prepared by ATC entitled *Ash Pond Seep Evaluation Report Tyrone Power Station* states that based on their evaluations they consider recommendation items 1, 3, 6, and 8 above to be cleared.

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2010 Inspection

ATC Associates Inc. completed an assessment of the Tyrone Ash Pond and Former Secondary Pond in January 2010 (field date October 2009). ATC rated the overall condition of the Tyrone Ash 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:

> *Plant offline at time of inspection and minimal water in pond. Item numbers 1 to 4 in the attached findings and recommendations should be implemented prior to placing the station back on line.*

The report noted a total of 14 action items. Two items were regarded as „high' importance, which indicates that the action(s) should be addressed as soon as possible. The two „high' importance items included:

1. Record flow rate before water added to Main pond and one week after as per ATC Sept. 11, 2009 Report; and,
2. Perform analytical and physical testing of pond and seep water as per ATC Sept. 11, 2009 Report.

Of the 14 action items, nine items were considered of „moderate' importance, which indicates the action(s) should be addressed during the next construction season. These „moderate' importance items included:

3. Modify ash excavation procedures as per ATC Sept. 11, 2009 Report;
4. Install seep collection and monitoring system at outfall as per ATC Sept. 11, 2009 Report;
5. Perform elevation survey of dam crest and fill low areas to maintain consistent crest elevation and freeboard;
6. Repair erosion gullies along downstream slop of north embankment on east and west sides of principal spillway outlet;
7. Place fill against toe of slope in area of finishing pond to restore consistent slope angle;
8. Mow vegetation along north embankment west of principal spillway;
9. Place fill material to flatten slope to 2.5H:1V in area east of ramp to crest;
10. Repair animal burrow on west embankment, survey stake with flagging driven at burrow; and,
11. Re-establish vegetation on exterior slope where damaged by mowing;

The remaining three recommended action items were rated as a „normal' priority, which indicates the action(s) should be completed as part of ongoing maintenance of the structure. These three „normal' priority items included:

12. Add crushed stone to existing ravines at referenced points;
13. Evaluate need for concrete pipe cradle to contain pipe penetrations through slope; and,
14. Grout or remove abandoned pipe penetrating embankment @NE abutment.

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While onsite at the Tyrone Ash Pond in October 2009, ATC performed field measurements to determine crest width, upstream and downstream slopes, dam height, and free board at various locations along the pond. Crest width measurements ranged from 13 to 20.5 feet. Upstream slopes varied from 1.5:1 to 3.6:1. Downstream slopes ranged from 1.3:1 to 2.9:1. Dam height was determined at one location and was found to be 19.6 feet. Freeboard varied from 10.6 to 11.4 feet.

Note that AMEC was not provided with documentation to verify that items 1 to 4 listed previously for the 2010 ATC inspection were addressed before placing the station back on line in June of 2010.

In addition to inspecting the Tyrone Ash Pond in October 2009, ATC inspected the Former Secondary Pond; however, the pond was emptied and re-graded during April and May of 2010. Therefore, it will not be discussed.

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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 (Tyrone Ash Pond and the Former Secondary Pond) were personally assessed by me and were found to be in the following condition:

Tyrone Ash Pond: Poor

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

Former Secondary Pond: Not Rated

The Former Secondary Pond is not rated because it was removed in April and May, 2010.

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4.2 Tyrone Ash Pond

4.2.1 Hydrologic and Hydraulic Recommendations

The current ash pond configuration with lower crest heights and steepened slopes are not as designed. The recent topographic mapping of the site indicates crest elevations on the Tyrone Ash Pond range from 533.5 feet at south portion of west dike to 535.4 feet at the west portion of the south dike. The mapping shows crest elevations below 534 feet on the north and west dikes. Although FMSM performed a hydrologic study of existing conditions in their 1998 report, the results cannot be considered valid since they used a crest elevation of 536 feet and a water elevation of 534 feet. In order to confirm that the impoundment will not be overtopped during a design storm event, as well as determine whether acceptable freeboard conditions exist, the appropriate design storm rainfall (per MSHA guidelines), or ½ PMF, should be applied to the impoundment's entire tributary watershed to determine the resulting water surface elevation in the pond. Accurate impoundment volumes and embankment elevations must be utilized in any model that is used to determine the structure's storage and/or routing capabilities.

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.

The provided stability analysis by MACTEC dated August 27, 2010 analyzed two cross-sections, one on the northwest corner and one on the north dike. The stability analyses were performed using the existing over-steepened slopes, existing loading conditions, and a seismic acceleration. The minimum safety factors are generally in line with the recommended criteria as stated above. The results generally indicate safety factors well above the minimum target values. However, in the opinion of the assessing professional engineer, the analyses should be revised in accordance with the following 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 a phreatic surface through the embankment. The almost vertical phreatic surfaces shown in the analysis are not typical.

The friction angle value of 30 degrees used for the CCW (ash) in the analysis appears high for loose, saturated ash. More 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 exhibited lower strengths or inconsistencies within the fill or foundation materials. Lowering the friction value, by one or two degrees, or more for weaker soils would be conservative and more appropriate. More layering of the embankment materials is needed to model lower strength materials, such as the low strength material encountered in Boring 6T. In addition, it appears odd that the moisture content at a depth of about 5 feet in Boring 6T is 79.9 percent, this soil and the material below is described as wet, and yet no water was encountered in the boring. Consideration should also be given to allowing some time for water levels in the piezometers to develop and stabilize.

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Some of the analyses presented appear limited to a circular surface; different types of failure surfaces should be analyzed and optimized. We understand additional laboratory results and analyses of other sections are to be performed as part of this study. Considerations at other sections include elevated water levels and soft foundation soils encountered at Section 1 and steep natural slope conditions below the sections on the west dike. The study should be revised to address the recommendations in this report and reviewed when complete. The completed analyses should include data sheets to show all input parameters, discussion on how each parameter was derived and preferably an AutoCAD (or equivalent) section to facilitate review.

4.2.3 Monitoring and Instrumentation Recommendations

Three piezometers were installed as part of the stability analysis investigation in August 2010. It would be prudent for the Tyrone Generating Station to maintain and protect these instruments, and document monitoring frequently until base line phreatic readings are apparent. After that time, a regular monitoring 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 that, at minimum, additional instrumentation be installed at the crest and toe of critical slopes. Installation should occur as budgets allow, or immediately upon development of future problems.

4.2.4 Inspection Recommendations

Kentucky Utilities stated that plant personnel perform daily safety and surveillance inspections for the ash pond at the Tyrone Generating Station. Inspections are documented during the times the plant is out-of-service; however, they are not documented when the plant is in service. No documentation of the inspections was provided. Furthermore, no information was provided to indicate the general procedure or extent of the inspection area(s). AMEC recommends that the current inspection program by the plant be expanded to include at least monthly documented inspections which identify potential problems, areas inspected, instrumentation monitoring, and pond and river levels.

AMEC has reviewed the 2009 and 2010 annual inspection reports and determined KU 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 recommended monthly inspections by facility personnel.

4.3 Former Secondary Pond

The Former Secondary Pond has been removed.

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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 Tyrone Generating 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.

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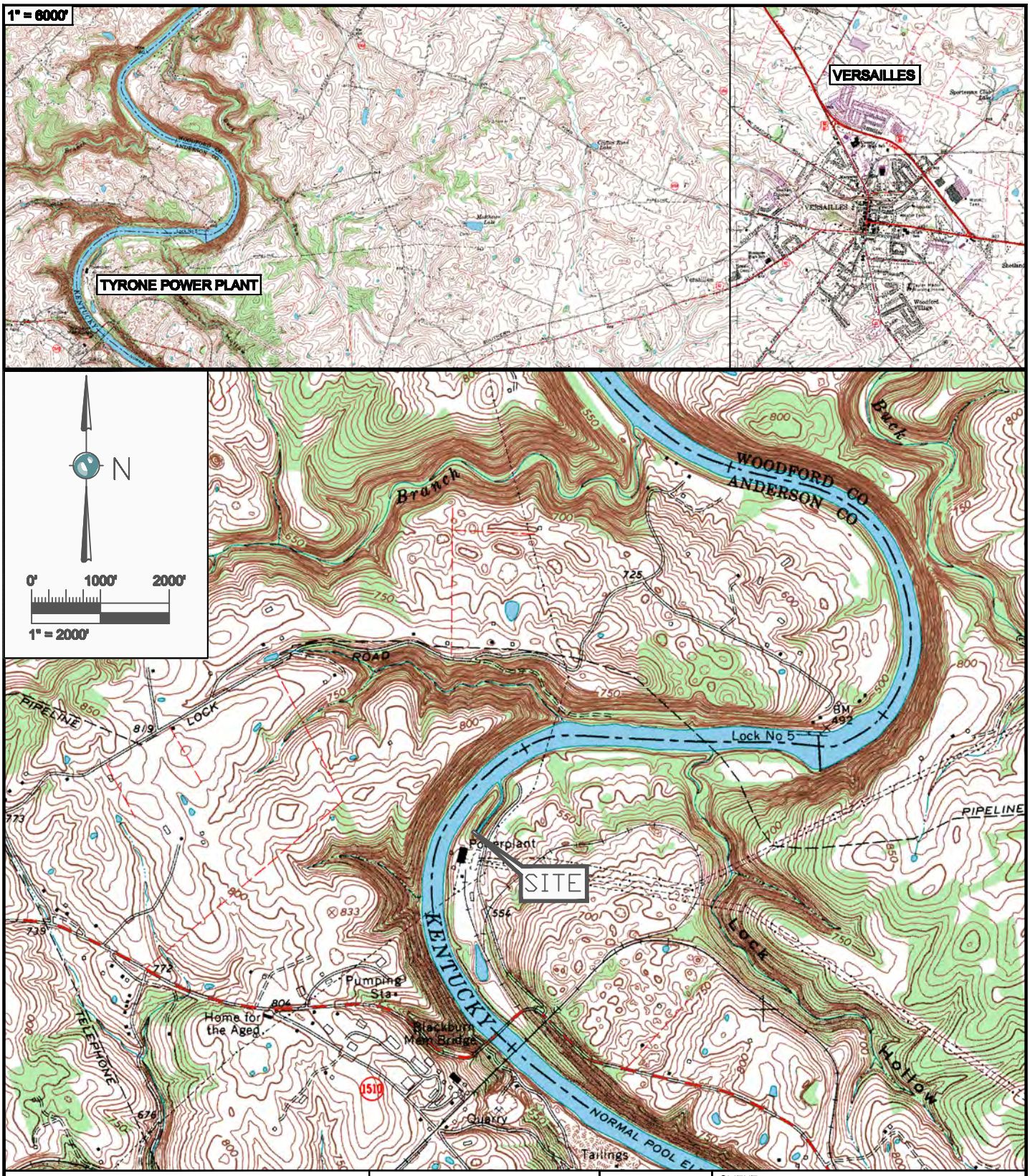
FIGURES



AMEC Earth & Environmental 690 Commonwealth Center 11003 Bluegrass Parkway Louisville, Ky 40299 (502) 267-0700	amec	CLIENT LOGO	CLIENT UNITED STATES ENVIRONMENTAL PROTECTION AGENCY	
PROJECT ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS		DWN BY: CAE	DATUM:	DATE: 8/16/10
TITLE KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S. TYRONE GENERATING STATION, TYRONE, KY SITE LOCATION & VICINITY MAP		CHK'D BY: MGS	REV. NO.:	PROJECT NO: 3-2106-0177-0004
		PROJECTION:	SCALE:	PAGE NO.. 1

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY

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

DWN BY:	DJC
CKD BY:	MS
Datum:	NAD 83
Projection:	Albers
Scale:	As Shown

ASSESSMENT OF DAM SAFETY OF
COAL COMBUSTION SURFACE IMPOUNDMENTS

KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S
TYRONE GENERATING STATION, TYRONE, KY
TYRONE ASH POND & FORMER SECONDARY POND
SITE PLAN

REV. No.:	A
Date:	8-19-10
Project No:	3-2106-0177-0004
Figure No:	2

Critical Infrastructure	ID Number	Latitude	Longitude
Margaret Hall	1	38.057298	-84.731335
Millville School	2	38.12063	-84.826893
Simmons High School	3	38.048132	-84.744947
Alton Church	4	38.080351	-84.926896
Glens Creek Church	5	38.095908	-84.792448
Griers Creek Church	6	38.03452	-84.793837
Macedonia Church	7	38.129518	-84.848839
Victory Chapel	8	38.124518	-84.886339
Blugrass Community Hospital	9	38.05511	-84.723759

amec
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690 Commonwealth Business Center
11003 Bluegrass Parkway
Louisville, KY 40299

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY

DRAWN BY: DJC
CHK'D BY: MS
DATUM: NAD83
PROJECTION: Albers
SCALE: AS SHOWN
DATE: 8/19/2010

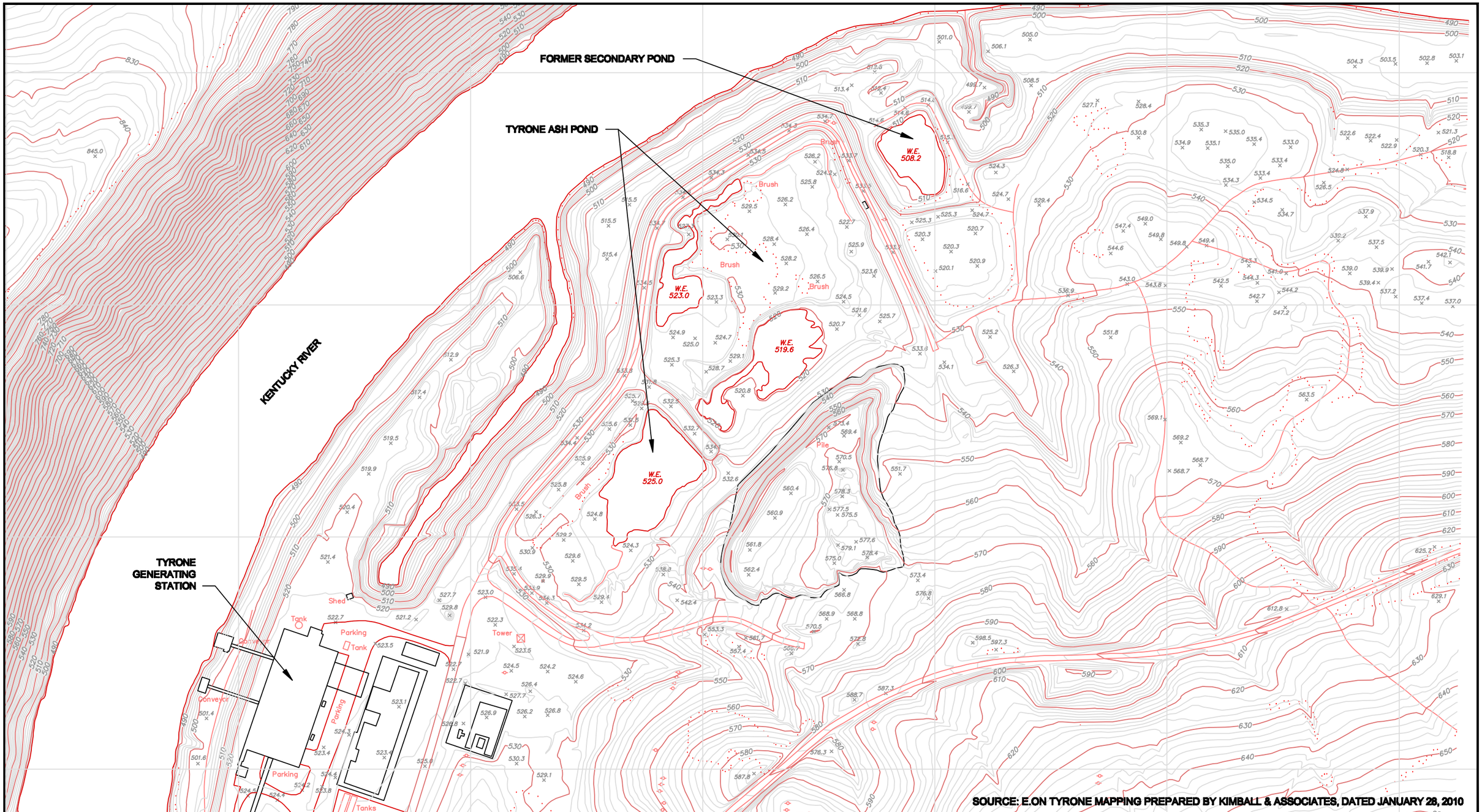
ASSESSMENT OF DAM SAFETY OF
COAL COMBUSTION SURFACE IMPOUNDMENTS

KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S
TYRONE GENERATING STATION, TYRONE, KY
CRITICAL INFRASTRUCTURE

N
0 1 Miles
0 1 Kilometers

Notes: Critical infrastructure data provided by ESRI

FIGURE 3



SOURCE: E.ON TYRONE MAPPING PREPARED BY KIMBALL & ASSOCIATES, DATED JANUARY 28, 2010

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

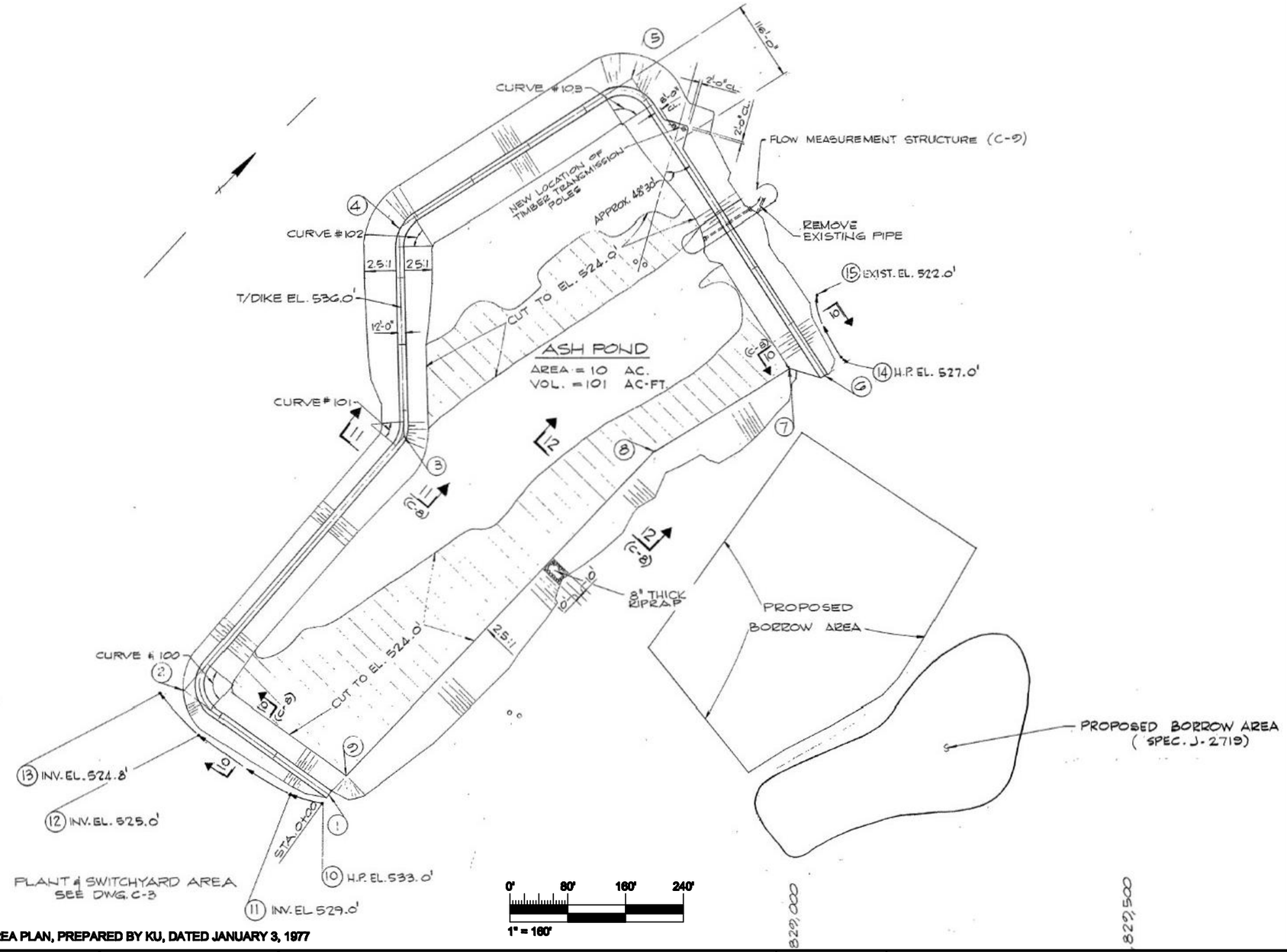
DWN BY:	CAE
CHK'D BY:	MGS
DATUM:	
PROJECTION:	
SCALE:	AS SHOWN

PROJECT: ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

TITLE: KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.
TYRONE GENERATING STATION, TYRONE, KY
TOPOGRAPHIC MAP

DATE:	8/16/10
PROJECT NO:	3-2106-1077.0004
REV. NO.:	
FIGURE No.	4

S:\Geosciences\Proposals\EPA Coal Impoundment Inspection\EPA CCW June Round 6\KU E-ON Tyrone\CAD and GIS\TYRONEFIG4.dwg – Layout2 – Aug. 18, 2010 7:56am – chris.eger



SOURCE: (TY-C-00001) PLANT & ASH POND AREA PLAN, PREPARED BY KU, DATED JANUARY 3, 1977

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

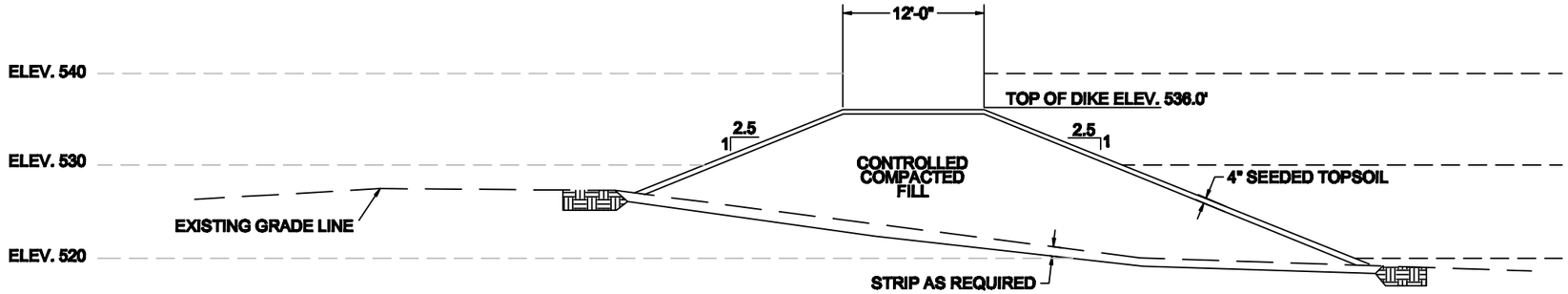
DWN BY:	CAE
CHK'D BY:	MGS
DATUM:	
PROJECTION:	
SCALE:	AS SHOWN

PROJECT: ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

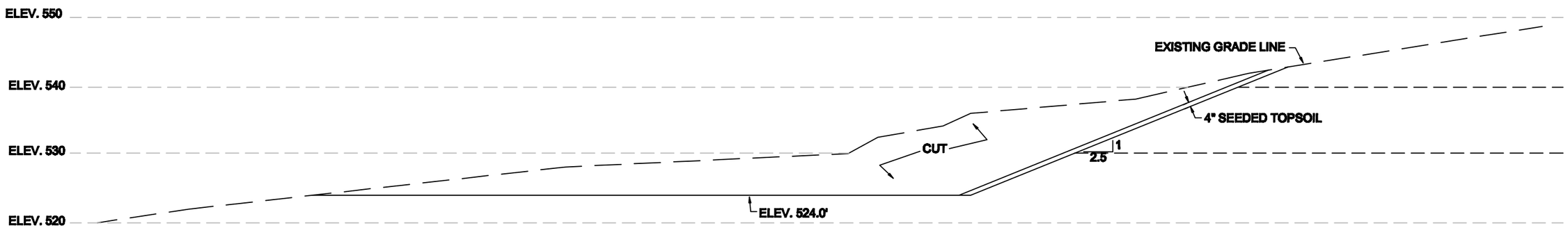
TITLE: KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.
TYRONE GENERATING STATION, TYRONE, KY
TYRONE ASH POND PLAN VIEW

DATE:	8/16/10
PROJECT NO:	3-2106-1077.0004
REV. NO.:	
FIGURE No.	5

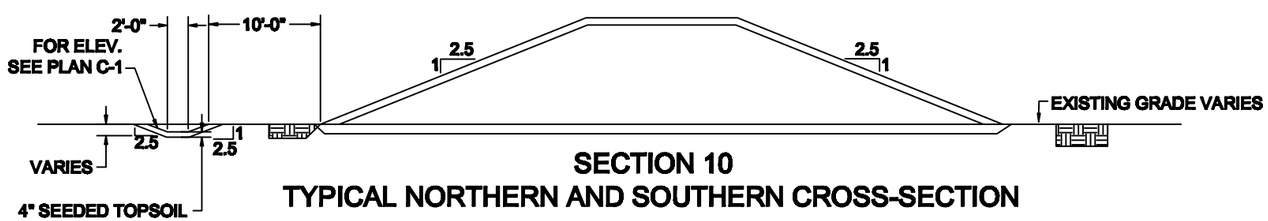
S:\Geosciences\Proposals\EPA Coal Impoundment Inspection\EPA CCW June Round 6\KU E-ON Tyrone\CAD and GIS\TYRONEFIG5.dwg – Layout1 – Aug. 18, 2010 7:54am – chris.eger



SECTION 11
TYPICAL WESTERN CROSS-SECTION



SECTION 12
TYPICAL EASTERN CROSS-SECTION



SECTION 10
TYPICAL NORTHERN AND SOUTHERN CROSS-SECTION

SOURCE: (TY-C-00008) ASH POND AREA - SECTION & DETAILS, PREPARED BY KU DATED JANUARY 3, 1977

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

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DWN BY:	CAE
CHK'D BY:	MGS
DATUM:	
PROJECTION:	
SCALE:	AS SHOWN

PROJECT: ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

TITLE: KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.
TYRONE GENERATING STATION, TYRONE, KY
TYRONE ASH POND TYPICAL CROSS-SECTIONS

DATE:	8/16/10
PROJECT NO:	3-2106-1077.0004
REV. NO.:	
FIGURE No.	6

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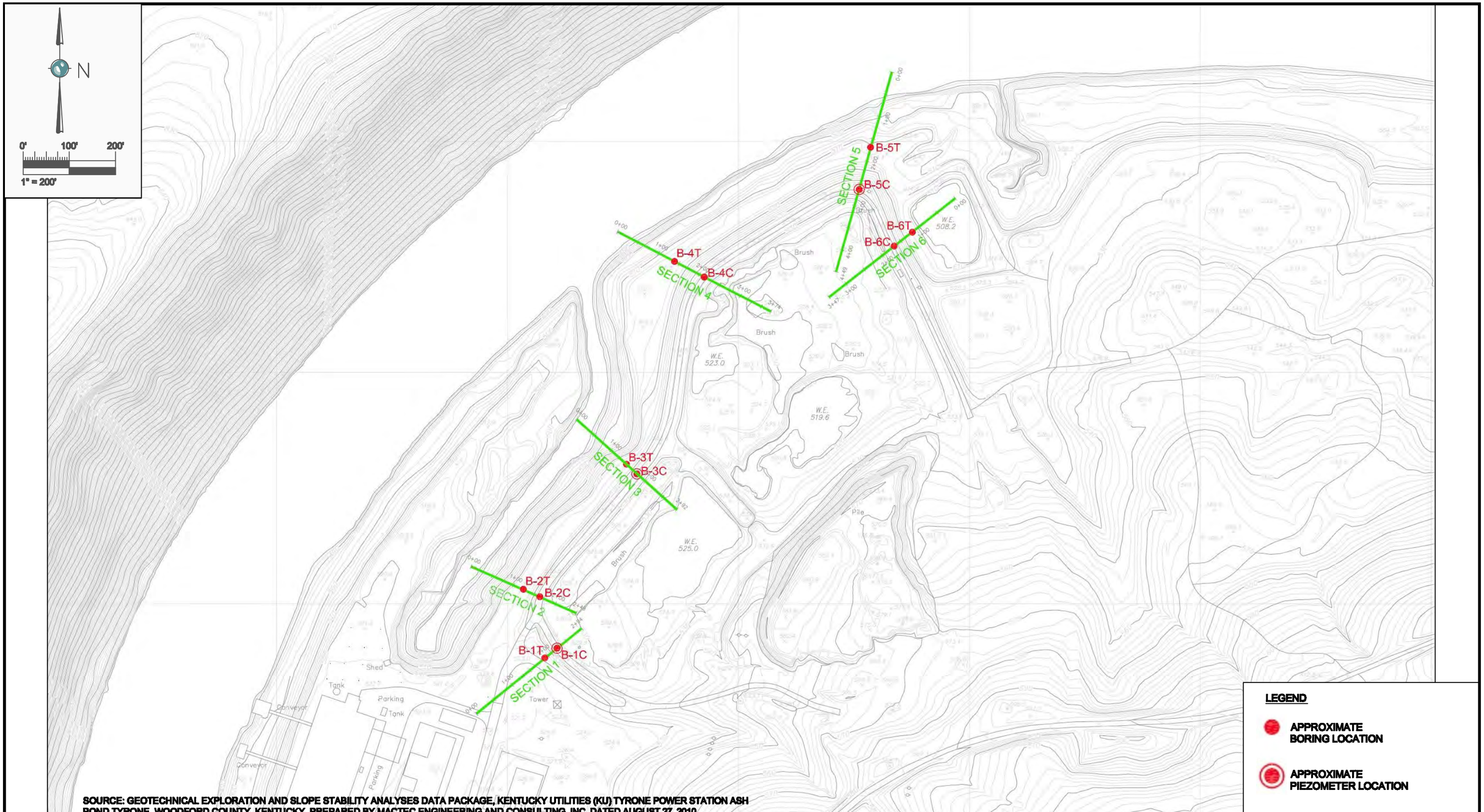


SOURCE: GEOTECHNICAL EXPLORATION AND SLOPE STABILITY ANALYSES DATA PACKAGE, KENTUCKY UTILITIES (KU) TYRONE POWER STATION ASH POND TYRONE, WOODFORD COUNTY, KENTUCKY. PREPARED BY MACTEC ENGINEERING AND CONSULTING, INC. DATED AUGUST 27, 2010

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

DWN BY:	CAE
CHK'D BY:	MGS
DATUM:	
PROJECTION:	
SCALE:	AS SHOWN

PROJECT: ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

TITLE: KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.
TYRONE GENERATING STATION, TYRONE, KY
TYRONE ASH POND PIEZOMETER LOCATIONS AND 2010 STABILITY ANALYSIS CROSS-SECTIONS

DATE:	8/30/10
PROJECT NO:	3-2106-1077.0004
REV. NO.:	
FIGURE No.	7

S:\Geosciences\Proposals\EPA Coal Impoundment Inspection\EPA CCW June Round 6\KU E-ON Tyrone\CAD and GIS\TYRONEFIG7.dwg – Layout2 – Aug. 30, 2010 11:13am – chris.eger

US EPA ARCHIVE DOCUMENT

APPENDICES

US EPA ARCHIVE DOCUMENT

APPENDIX A
Waste Impoundment Inspection Forms

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name: Tyrone Generating Station	Date: August 3, 2010
Unit Name: Tyrone Ash Pond	Operator's Name: KU (Subsidiary of EON)
Unit I.D.: Tyrone Ash Pond	Hazard Potential Classification: High **Significant** Low
Inspector's Name: James Black, Mary Swiderski	

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

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	Daily		18. Sloughing or bulging on slopes?		X
2. Pool elevation (operator records)?	532.3'		19. Major erosion or slope deterioration?		X
3. Decant inlet elevation (operator records)?	Varies		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	N/A		Is water entering inlet, but not exiting outlet?		X
5. Lowest dam crest elevation (operator records)?	533.5'		Is water exiting outlet, but not entering inlet?		X
6. If instrumentation is present, are readings recorded (operator records)?	X		Is water exiting outlet flowing clear?	X	
7. Is the embankment currently under construction?		X	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation,stumps, topsoil in area where embankment fill will be placed)?		X	From underdrain?		X
9. Trees growing on embankment? (If so, indicate largest diameter below)		X	At isolated points on embankment slopes?		X
10. Cracks or scarps on crest?		X	At natural hillside in the embankment area?		X
11. Is there significant settlement along the crest?		X	Over widespread areas?		X
12. Are decant trashracks clear and in place?		X	From downstream foundation area?		X
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		X	"Boils" beneath stream or ponded water?		X
14. Clogged spillways, groin or diversion ditches?		X	Around the outside of the decant pipe?		X
15. Are spillway or ditch linings deteriorated?		X	22. Surface movements in valley bottom or on hillside?		X
16. Are outlets of decant or underdrains blocked?		X	23. Water against downstream toe?		X
17. Cracks or scarps on slopes?		X	24. Were Photos taken during the dam inspection?	X	

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

Inspection Issue #	Comments
1	Daily inspection around pond, inspection is documented if the plant is out of service, not documented when plant is running. Two semi annual inspections were conducted in 2009.
3	Outlet controlled by stop logs, bottom elevation of structure is 520.5', top is 536'
6	Weir at outlet is only instrumentation
12	Skimmer present

US EPA ARCHIVE DOCUMENT

US EPA ARCHIVE DOCUMENT

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # KY 0001899 INSPECTOR Black/Swiderski

Date August 3, 2010

Impoundment Name Tyrone Generating Station – Tyrone Ash 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 Tyrone Ash Pond

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

New X Update _____

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

IMPOUNDMENT FUNCTION: Storage and management of coal combustion byproducts

Nearest Downstream Town : Name Frankfort, KY

Distance from the impoundment Approximately 14 miles

Impoundment Location:

Longitude -84 Degrees 50 Minutes 43 Seconds

Latitude 38 Degrees 2 Minutes 59 Seconds

State KY County Woodford

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

If So Which State Agency? KY 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.

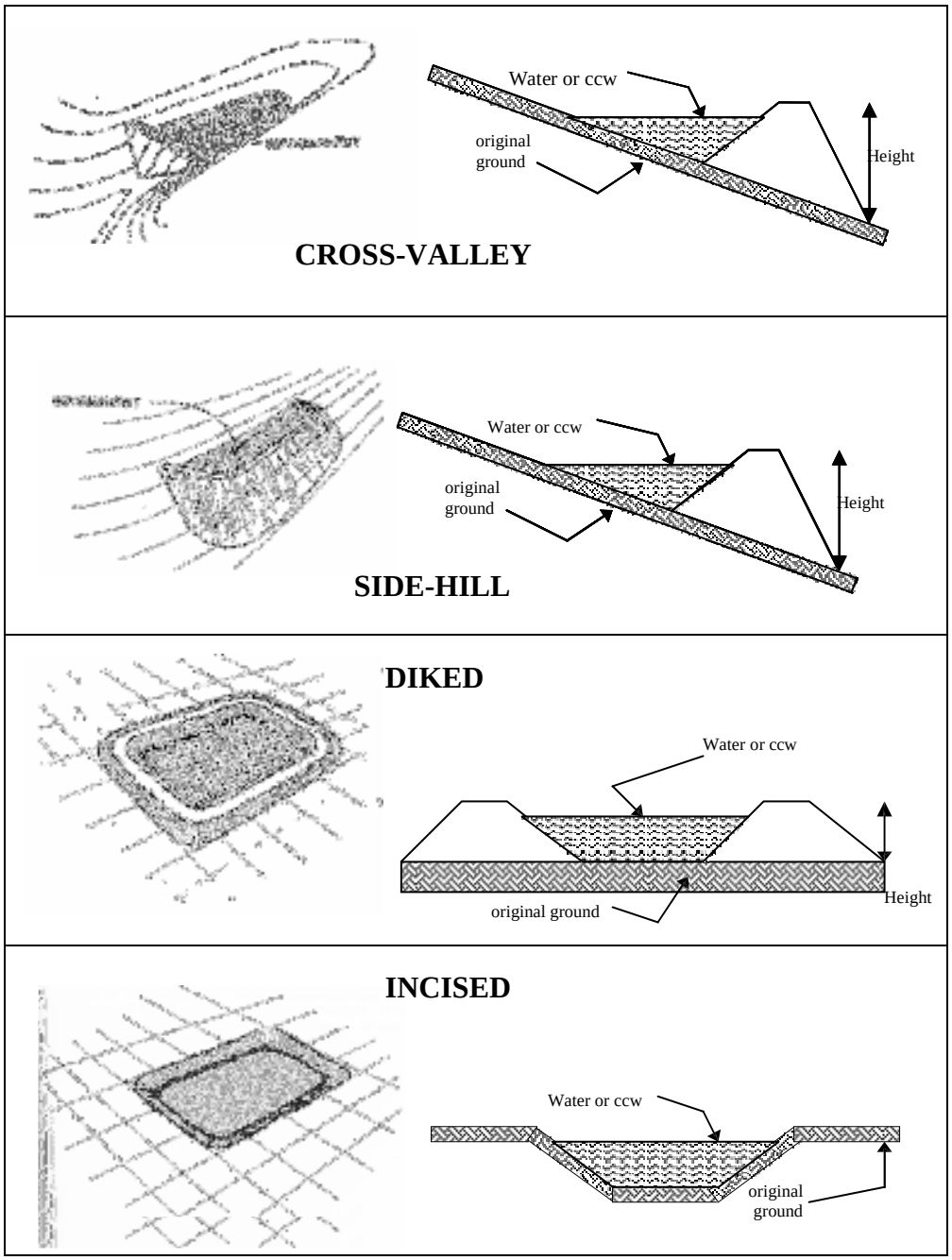
_____**HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

Failure may reach Kentucky River
Water Intakes are located downstream
Failure would not result in shutdown of Power Plant

US EPA ARCHIVE DOCUMENT

CONFIGURATION:



_____Cross-Valley
__X__Side-Hill
_____Diked
_____Incised (form completion optional)
_____Combination Incised/Diked

Embankment Height __19.6_____feet Embankment Material_Earthen Fill_____
Pool Area _____13_____ acres Liner _N/A_____
Current Freeboard ___3-4_____ feet Liner Permeability _N/A_____

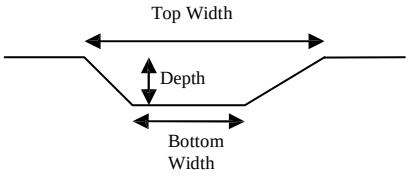
US EPA ARCHIVE DOCUMENT

TYPE OF OUTLET (Mark all that apply)

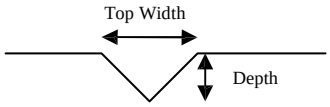
_N/A_ Open Channel Spillway
_____Trapezoidal
_____Triangular
_____Rectangular
_____Irregular

_____depth
_____bottom (or average) width
_____top width
_____

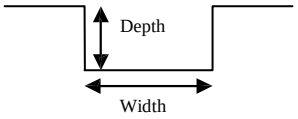
TRAPEZOIDAL



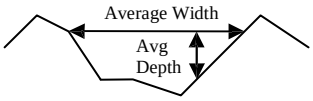
TRIANGULAR



RECTANGULAR

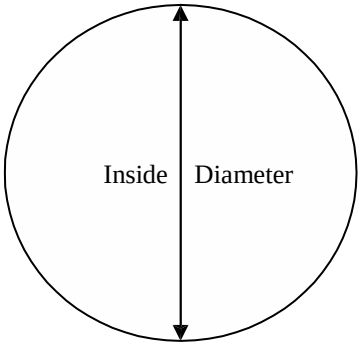


IRREGULAR



_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 _Sargent and Lundy – J.M McLaughlin KY # 9039_____

US EPA ARCHIVE DOCUMENT

Has there ever been a failure at this site? YES _____NO ____X_____

If So When? _____

If So Please Describe : _____

US EPA ARCHIVE DOCUMENT

Has there ever been significant seepages at this site? YES _____NO ___X___

If So When? _____

IF So Please Describe: _____

US EPA ARCHIVE DOCUMENT

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 : _____

US EPA ARCHIVE DOCUMENT

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name: Tyrone Generating Station	Date: August 3, 2010
Unit Name: Tyrone Secondary Ash Pond	Operator's Name: KU (Subsidiary of EON)
Unit I.D.:	Hazard Potential Classification: **N/A**
Inspector's Name: James Black, Mary Swiderski	

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

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

Comments: Decommissioned (removed ash and berms) Secondary Pond (Polish Pond) in May 2009, previously contained CCW material from Tyrone Ash Pond.

EPA FORM -XXXX

US EPA ARCHIVE DOCUMENT

US EPA ARCHIVE DOCUMENT

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # KY 0001899 INSPECTOR Black/Swiderski

Date August 3, 2010

Impoundment Name Tyrone Generating Station – Secondary Ash 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 Secondary Ash Pond

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

New X Update _____

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

IMPOUNDMENT FUNCTION: Decommissioned Secondary Pond (Polish Pond) in May 2009, previously contained CCW material from Tyrone Ash Pond.

Nearest Downstream Town : Name Frankfort, KY

Distance from the impoundment Approximately 14 miles

Impoundment Location: Longitude -84 Degrees 50 Minutes 37 Seconds

Latitude 38 Degrees 3 Minutes 5 Seconds

State KY County Woodford

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): **See comments below.**

_____**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.

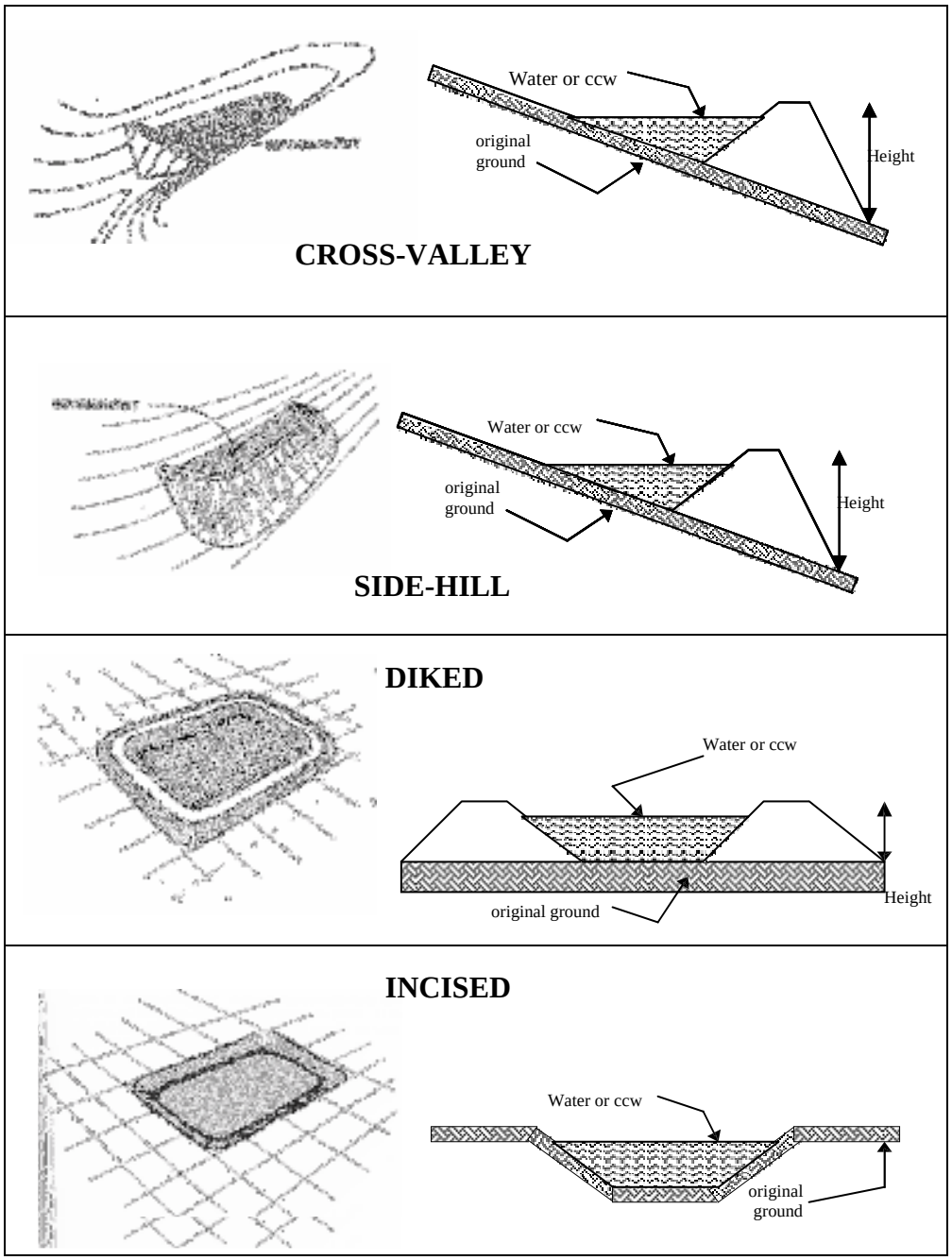
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

- Ash Pond dikes have been removed and graded across pond site
- Previously contained CCW material has been removed and placed in Tyrone Ash Pond

US EPA ARCHIVE DOCUMENT

US EPA ARCHIVE DOCUMENT

CONFIGURATION:



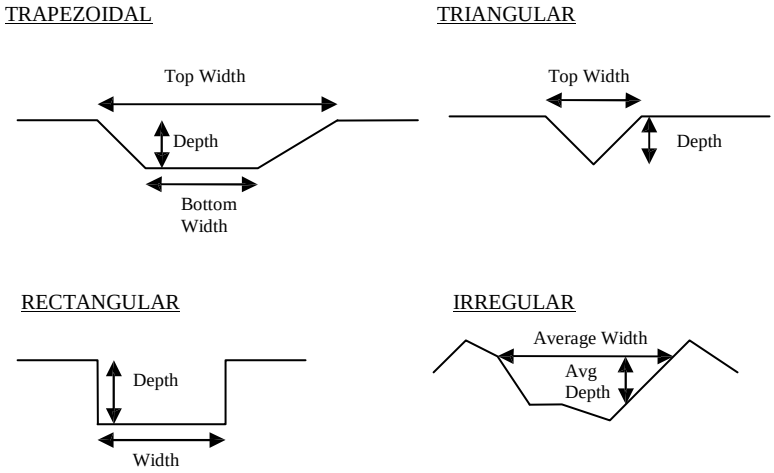
_____Cross-Valley
_____Side-Hill
_____Diked
_____Incised (form completion optional)
_____Combination Incised/Diked

Embankment Height __N/A_____feet Embankment Material_N/A_____
Pool Area _____N/A_____ acres Liner _N/A_____
Current Freeboard ___N/A_____ feet Liner Permeability _N/A_____

TYPE OF OUTLET (Mark all that apply)

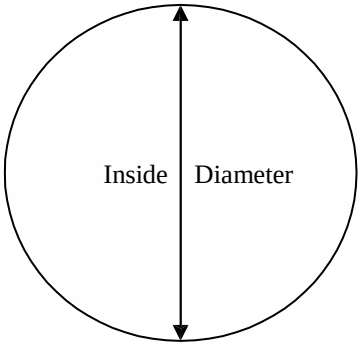
_N/A_ Open Channel Spillway
_____Trapezoidal
_____Triangular
_____Rectangular
_____Irregular

_____depth
_____bottom (or average) width
_____top width
_____



____Outlet

_____inside diameter



Material
_____corrugated metal
_____welded steel
_____concrete
_____plastic (hdpe, pvc, etc.)
_____other (specify) _____

_____
Is water flowing through the outlet? YES _____ NO _____

__X__No Outlet

_____

_____Other Type of Outlet (specify) _____

The Impoundment was Designed By Unknown
_____

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Has there ever been a failure at this site? YES _____NO ____X_____

If So When? _____

If So Please Describe : _____

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Has there ever been significant seepages at this site? YES _____NO ___X___

If So When? _____

IF So Please Describe: _____

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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 : _____

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APPENDIX B
Site Photo Log Map and Site Photos

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY

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

DWN BY:	DJC
CKD BY:	MS
Datum:	NAD 83
Projection:	Albers
Scale:	As Shown

ASSESSMENT OF DAM SAFETY OF
COAL COMBUSTION SURFACE IMPOUNDMENTS

KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S
TYRONE GENERATING STATION, TYRONE, KY
TYRONE ASH POND & FORMER SECONDARY POND
PHOTO LOCATION MAP

REV. No.:	A
Date:	8-19-10
Project No:	3-2106-0177-0004
Figure No:	B-1

US EPA ARCHIVE DOCUMENT

SITE PHOTOS

1-1

OIL AND WATER SEPARATOR, STEAM RELEASE, LOCATED 200 FEET SOUTHWEST OF ASH POND

1-2

RESEEDED AREA ALONG SOUTH DOWNSTREAM DIKE SLOPE

AMEC Earth & Environmental 690 Commonwealth Center 11003 Bluegrass Parkway Louisville, Ky 40299 (502) 267-0700	amec	CLIENT LOGO	CLIENT UNITED STATES ENVIRONMENTAL PROTECTION AGENCY	
PROJECT ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS		DWN BY: CAE	DATUM:	DATE: 8/4/10
TITLE KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S. TYRONE GENERATING STATION, TYRONE, KY ASH POND SITE PHOTOS		CHK'D BY: MGS	REV. NO.:	PROJECT NO: 3-2106-0177-0004
		PROJECTION:	SCALE:	PAGE NO.. B-2

1-3

INLET PIPES FROM UNIT 3, COAL PILE RUNOFF POND AND LIFT STATION

1-4

STEEP EMBANKMENTS ALONG SOUTHWESTERN DIKE

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		PROJECTION:	SCALE:	PAGE NO.. B-3

1-5

RESEEDED AREA ALONG WESTERN DIKE

1-6

AREA OF 2009 EARTH SLOPE REPAIR BETWEEN THE PLANT COOLING WATER CANAL AND THE TOE OF THE WESTERN DIKE OF THE ASH POND

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		PROJECTION:	SCALE:	PAGE NO.. B-4

1-7

AREA OF 2009 EARTH SLOPE REPAIR BETWEEN THE PLANT COOLING WATER CANAL AND THE TOE OF THE WESTERN DIKE OF THE ASH POND

1-8

STANDING IN LOW AREA OF WEST DIKE LOOKING EAST AT WORKING PLATFORM DIVIDING DIKE

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

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	PROJECTION:	SCALE:	PAGE NO.: B-5

1-9

LOOKING NORTHEAST AT LOCATION OF FORMER SECONDARY POND, RIGHT IS DOWNSTREAM SLOPE (UNEVEN) OF NORTH DIKE, CUT AT TOE OF SLOPE

1-10

PRIMARY OUTLET STRUCTURE

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

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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	PROJECTION:	SCALE:	PAGE NO.: B-6

1-11

SKIMMER ON OUTLET STRUCTURE

1-12

PRIMARY OUTLET/MONITORING POINT OF ASH POND AT TOE OF NORTHERN DIKE, NOTE STEEP/ERODED AREA TO RIGHT

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	PROJECTION:	SCALE:	PAGE NO.: B-7

1-13

PRIMARY OUTLET/MONITORING POINT OF ASH POND ALONG NORTHERN DIKE

1-14

LOOKING SOUTH FROM LOCATION OF FORMER SECONDARY POND, DOWNSTREAM SLOPE OF NORTH DIKE IN BACKGROUND

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	PROJECTION:	SCALE:	PAGE NO.: B-8

1-15

DISCHARGE POINT TO KENTUCKY RIVER

1-16

VIEW FROM NORTHERN DIKE LOOKING EAST, BACKGROUND AREA IS NORTH OF ASH STACK

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		PROJECTION:	SCALE:	PAGE NO.. B-9

1-17

VIEW FROM NORTHERN DIKE LOOKING SOUTHEAST TOWARDS ASH STACK

1-18

VIEW ALONG WESTERN DIKE AT TOE OF ASH STACK NOTE DRAINAGE DITCH ALONG BASE OF STACK

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Louisville, Ky 40299
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PROJECT: ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS	DWN BY: CAE	DATUM:	DATE: 8/4/10
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	PROJECTION:	SCALE:	PAGE NO.: B-10

1-19

VIEW ALONG WESTERN DIKE LOOKING SOUTH TOWARDS POWER PLANT

1-20

VIEW FROM SOUTHERN DIKE LOOKING EAST ACROSS CREST TO TIE-IN TO ORIGINAL GROUND, BACKGROUND IS AREA SOUTH OF ASH STACK

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PROJECT ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS		DWN BY: CAE	DATUM:	DATE: 8/4/10
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		PROJECTION:	SCALE:	PAGE NO.. B-11

1-21

VIEW FROM SOUTHERN DIKE LOOKING NORTHEAST TOWARDS ASH STACK

AMEC Earth & Environmental
690 Commonwealth Center
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Louisville, Ky 40299
(502) 267-0700

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APPENDIX C
Inventory of Provided Materials

Generation Engineering
220 West Main Street
Louisville, Kentucky 40202
T 1-502-627-2985

TRANSMITTAL LETTER

Date: August 11, 2010

To: James Black, AMEC Earth and Environmental
Mary Swiderski, AMEC Earth and Environmental

Re: Requested information for Tyrone Generating Station and Pineville Station

The following information you have requested has been provided on the CD included with this letter:

TYRONE

Item	Description/File Name
1	TY-C-00001 – Plant and Ash Pond Area Plan – Rev D.pdf *(included in July 30 2010 email transmittal)*
2	TY-C-00008 – Ash Pond Area Sections and Details – Rev C.pdf *(included in July 30 2010 email transmittal)*
3	TY-C-00009 – Flow Measurement Structure – Plan and Section – Rev D.pdf *(included in July 30 2010 email transmittal)*
4	Tyrone-MAP.dwg *(included in July 30 2010 email transmittal)*
5	TY-S-00017 – Ash Pond Outlet Structures – Rev D.pdf *(included in July 30 2010 email transmittal)*
6	Aerial Tyrone1 2009.pdf
7	Partial Tyrone Seep Report Sep 2009.pdf
8	Appendix F Tyrone.pdf – appendix from the 2009 Growing Season Visual Site Assessment Report, prepared by *ATC Associates Inc.*, March 19, 2010
9	Partial ATC Low Hazard Dams Assessment Report signed 20090319.pdf – portion of the Low Hazard Dams Assessment Report, prepared by *ATC Associates Inc.*, March 19, 2009
10	Folder contains 5 years of Discharge Monitoring Reports (DMRs) from 2006 through 2010
11	TY FMSM 1998 Ash Pond Modification Study.pdf – report was prepared by *FMSM Engineers*, April 1998

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Generation Engineering
220 West Main Street
Louisville, Kentucky 40202
T 1-502-627-2985

TRANSMITTAL LETTER

Date: August 17, 2010

To: James Black, AMEC Earth and Environmental
Mary Swiderski, AMEC Earth and Environmental

Re: Additional information for Tyrone Generating Station and Pineville Station

The following additional information has been provided on the CD included with this letter:

TYRONE

Item	Description/File Name
1	KU-Tyrone WB Diag-1-KPDES.jpg – Water Balance Diagram, 1-Day Max Rainfall
2	KU-Tyrone WB Diag-AVG-KPDES – Water Balance Diagram, Average Rainfall
3	Tyrone Process Flows Narrative.pdf - August 2010

PINEVILLE

Item	Description/File Name
1	B-66.pdf – Location Plan & Sections of Test Borings Unit No. 3
2	KU-Pineville WB Diagram.pdf – Water Balance Diagram, 30 Day Peak Monthly Average Process and 1-Day Max Rainfall Conditions
3	Pineville Process Flows Narrative.pdf – August 2010

If you have any questions, please call me.

David Millay
Civil Engineer
T 502-627-2468

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Generation Engineering
220 West Main Street
Louisville, Kentucky 40202
T 1-502-627-2985

TRANSMITTAL LETTER

Date: August 27, 2010

To: James Black, AMEC Earth and Environmental
Mary Swiderski, AMEC Earth and Environmental

Re: Information for Tyrone Generating Station

The following additional information has been provided on the CD included with this letter:

GREEN RIVER

Item	Description/File Name
1	2010-08-27 Tyrone Data Package.pdf

If you have any questions, please call me.

David Millay
Civil Engineer
T 502-627-2468

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