Report of Dam Safety Assessment of Coal Combustion Surface Impoundments
Westar Energy
Tecumseh Energy Center, Tecumseh, KS

AMEC Project No. 3-2106-0183.0001

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May 2011

I certify that the management units referenced herein:

Westar Energy's Tecumseh Energy Center's Area 1 and Area 2 (ash ponds) were assessed on October 26, 2010.

Signature _____

Don W. Dotson, PE
Senior Geotechnical Engineer

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

- Chris Eger
  CADD Technician
- Daniel Conn
  GIS Specialist
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  Civil/Environmental Engineer

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1.0 INTRODUCTION AND PROJECT DESCRIPTION

1.1 Introduction

AMEC was contracted by the United States Environmental Protection Agency (EPA) contract BPA EP09W001702, to perform assessments of selected coal combustion byproducts surface impoundments. AMEC was directed by EPA, through the provided scope of work and verbal communications, to utilize the following resources and guidelines to conduct a site assessment and produce a written assessment report for the coal combustion waste facilities and impoundments.

- Coal Combustion Waste (CCW) Impoundment Inspection forms (hazard rating, found in Report Appendix A)
- Coal Combustion Dam Inspection Checklist (found in Report Appendix A)
- Impoundment Design Guidelines of the Mining Safety and Health Administration (MSHA) Coal Mine Impoundment Inspection and Plan Review Handbook (hydrologic, hydraulic, and stability conditions)
- National Dam Safety Review Board Condition Assessment Definitions (condition rating)

As part of this contract with EPA, AMEC was assigned to perform an assessment of Westar Energy's Tecumseh Energy Center (Tecumseh), which is located in Shawnee County, Kansas, just east of the city of Topeka, as shown on Figure 1, the Site Location and Vicinity Map.

A site visit to Tecumseh Energy Center was made by AMEC on October 26, 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, Don Dotson, P.E. and Mary Sawitzki, P.E., were accompanied during the site visit by the individuals listed on Table 1.

Table 1. Site Visit Attendees

Company or Organization	Name and Title
Westar Energy	Paul Wallen, Plant Director
Westar Energy	Andy Rietcheck, Senior Engineer
Westar Energy	David Walter, Mgr., Plant Support Engineering
Westar Energy	Kirk Wiscombe, Supervisor of Fuels
Westar Energy	Jared Morrison, Mgr., Water Programs
Westar Energy	Craig Swartzendruber, Mgr., Env. Compliance Systems

1.2 Project Background

Coal fired power plants, like Westar Energy's Tecumseh Energy Center, produce CCW as a result of the power production process. At Tecumseh, impoundments (dams) were designed

and constructed to provide storage and disposal for the CCW that is produced. Westar Energy refers to the CCW impoundments at the Tecumseh facility as the Area 1 and Area 2 temporary staging ponds. Westar Energy estimates the Area 1 pond was constructed and placed into service in 1968. Later, in 1984, the Area 2 pond, also referred to as the Clear Pond, was placed into service.

The National Inventory of Dams (NID), administered by the U.S. Army Corps of Engineers (USACE), provides a hazard rating for many dams within the United States. The Area 1 and Area 2 Ponds at Tecumseh Energy Center are not included in the NID.

As part of the observations and evaluations performed at Tecumseh, AMEC completed EPA's Coal Combustion Dam Inspection Checklists and CCW Impoundment Inspection Forms. Inspection forms for each pond are presented 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." As defined on the Inspection Form, dams assigned a "Significant Hazard Potential" 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." "Low Hazard Potential" classification definition is reserved for dams 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." "Less than Low Hazard Potential" classification is reserved for dams where "failure or misoperation results in no probable loss of human life and no economic or environmental losses." Based on the site visit evaluation of the impoundments, AMEC engineers assigned a "Significant Hazard" potential to the Area 1 pond and a "Low Hazard" potential to the Area 2 pond. The Area 1 pond was assigned a "Significant Hazard" rating due to the proximity of residences directly across SE 2nd Street from the pond's southern embankment. Additionally, the pond's northern embankment is located directly on Tecumseh Creek, within approximately 700 feet of the Kansas River.

1.2.1 State Issued Permits

The Kansas Division of Environment, Department of Health and Environment issued a Kansas Water Pollution Control Permit and Authorization to Discharge under the National Pollutant Discharge Elimination System (NPDES) to Westar Energy. The current permit identification number is KS0079731. This NPDES Permit authorizes Westar Energy to discharge decant from the Area 2 Ash Pond (Clear Pond) to the Tecumseh Creek. The effective date of the permit is October 1, 2008. The permit will expire on November 30, 2010. On June 2, 2010, Westar Energy submitted a permit renewal request to the Kansas Division of Environment. Renewed permit dates have not yet been provided to Westar Energy.

No other state issued permits were provided. Dam Safety Laws are contained in Kansas Statutes KSA 82a-301 through 305a. Based on the following excerpt from the Dam Safety Law regarding the definition of a „dam',

> *any artificial barrier including appurtenant works with the ability to impound water, waste water or other liquids that has a height of 25 feet or more; or has a height of six feet or greater and also has the capacity to impound 50 or more acre-feet. The height of a dam or barrier shall be determined as follows: (1) a barrier or*

> *dam that extends across the natural bed of a stream or watercourse shall be measured from the downstream toe of the barrier or dam to the top of the barrier or dam; or (2) a barrier or dam that does not extend across a stream or watercourse shall be measured from the lowest elevation of the outside limit of the barrier or dam to the top of the barrier or dam,*

it appears that the state of Kansas has not permitted the CCW impoundments at Tecumseh Energy Center as the size of the impoundments do not meet the minimum dam size criteria given in the law.

The Kansas Department of Health and Environment, in February 2011 comments to the Draft[1] Report, noted that:

> *According to the Kansas Department of Agriculture, Division of Water Resources, prior to 2002 a jurisdictional dam was defined as having the ability to impound 30 acre feet or greater volume at the tip of the dam. Both structures assessed by AMEC at Tecumseh Energy Center impound less volume, were built before 2002 and thus fall below the above definition and do not require a permit as long as they have not been modified.*

1.3 Site Description and Location

The Tecumseh Energy Center is located just east of the city of Topeka, Kansas. Areas to the west and south of the facility are primarily mixed use. The Kansas River flows west to east on the northern facility boundary. Areas to the east of the facility are primarily rural. Discharges from the facility flow directly into Tecumseh Creek, which flows into the Kansas River within approximately 700 feet. The Aerial Site Plan, included as Figure 2, provides a view of the two pond areas and their proximity to the creek and river.

Figure 3, the Critical Infrastructure Map, provides an aerial view of the region and indicates the location of the Tecumseh ash ponds in relation to schools, hospitals, and other critical infrastructure that is located within approximately 5 miles down gradient of the impoundments. A table that provides names and coordinate data for the infrastructure is included on the map.

1.4 Ash Ponds

Tecumseh utilizes coal in the production of electricity. In this process, two types of ash are generated: fly ash and bottom ash. Bottom ash, the heavier and coarser of the two, is sluiced into the Area 1 Ash Pond. While a small amount of the fly ash generated at the site is sluiced to the Area 1 Ash Pond, the majority is sold or land-filled in dry form. Decant water from the Area 1 Ash Pond is gravity discharged into the Area 2 Ash Pond. Flow from the Area 2 Ash Pond (Clear Pond) is gravity discharged to Tecumseh Creek via the permitted KPDES Outfall 002X1.

The Ash Ponds are used for staging only; there is no permanent disposal of CCW material in the ponds. Bottom ash, fly ash, and other CCW materials are dredged from the Area 1 Ash Pond and disposed of in the on-site dry landfill. According to Westar Energy, the Area 2 Ash Pond (Clear Pond) "is not used for temporary or permanent disposal of CCW." The ash handling summary detailed above was based on review of provided documentation as well as

[1] Draft Report submitted to EPA by AMEC in November 2010.

communication with Westar personnel who are knowledgeable concerning the facility's operational processes.
A May 18, 2009 document, written by Westar Energy in response to EPA's Request for Information under Section 104(e) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C 9604(e), provided the following general background for the ash ponds.

- The Area 1 pond is used for staging only. Materials that are discharged into the pond include bottom ash, fly ash, and boiler slag. Additionally, sediment from incoming river water that was collected in the settlement basins and cooling tower is placed into the ponds.
- The Area 2 pond (Clear Pond) was noted to contain only water removed from the Area 1 pond.
- The Area 1 and Area 2 ponds were noted to have been constructed based on engineered designs. However, Westar is not in possession of design drawings that were stamped by a professional engineer.
- It is not known whether the Area 1 and Area 2 ponds were constructed under the supervision of a professional engineer.
- The Area 1 and Area 2 ponds are not presently inspected or monitored by a professional engineer.

Westar Energy's March 18, 2009 response to EPA's Request for Information, as well as recent communications with Westar Energy personnel, provided the following additional information that is specific to each ash pond. Current descriptive information resulting from the site visit, as well as photographic references, are provided in Section 2, which is entitled Field Assessment.

1.4.1 Area 1 Pond

The Area 1 Pond is located on the western boundary of the facility. Tecumseh Creek is located to the west and directly to the north of this pond. Figure 4, provided by Westar Energy, illustrates the site contours circa 1968 and the location of Tecumseh Creek with respect to the Area 1 Pond. Westar has described the pond as being "excavated from grade" and finished with "a minimal height berm" constructed around the perimeter. Documentation was not provided that indicated original embankment slope values. The 1968 site contours indicate the crest of the original northern embankment slope may have been close to an elevation of 870 feet. The existing pond crest elevation is 885 feet. Provided documentation indicates the elevation of the downstream toe of the northern embankment slope (Tecumseh Creek) is approximately 846 feet. These values indicate a total berm height of 39 feet, of which approximately 24 feet comprises the original, natural creek embankment, while approximately 15 feet comprises the portion of the embankment that was added following pond excavation activity. Provided topography also indicates the total height of the southern embankment varies from approximately 10 to 20 feet above SE 2nd Street, the public roadway that is located adjacent and parallel to the southern embankment.

In 1980, the Area 1 Pond interior was modified as shown on Figure 5. Portions of the pond were deepened and a separation berm was added to create two, approximately equal regions (northern and southern).

The total surface area of the pond is 2 acres and the storage capacity is 20 acre-feet. The volume of material stored in the unit was not provided. The response noted that "Storage in this

area is temporary in nature and varies from no storage to total capacity dependent on current plant operations."

1.4.2 Area 2 Pond

The Area 2 Pond is also located on the western boundary of the facility, directly north of the Area 1 Pond and Tecumseh Creek. Westar has also described this pond as being "excavated from grade" and finished with "a minimal height berm" constructed around the perimeter. Figure 6 illustrates the pond's grading and location with respect to Tecumseh Creek and the Area 1 Pond. The pond was commissioned in 1984 to receive decant flow from the Area 1 Pond. Crest elevation is shown as 872 feet and the pond's surface area and storage volume are equal to 1 acre and 12 acre-feet, respectively.

Figure 7 illustrates typical pond cross sections including a section illustrating the decant pipe route from the Area 1 Pond. The typical cross section representing the pond's southern embankment, which is against Tecumseh Creek, indicates that the berm placed above existing grade was constructed with upstream and downstream slopes of 2:1 (H:V) and 3:1 (H:V), respectively. Like the natural northern embankment of the Area 1 Pond, the natural portion of the southern embankment of the Area 2 Pond is steep and its toe is located at Tecumseh Creek. Provided documentation indicates the total height of the southern embankment, from crest to toe, is approximately 26 feet, including approximately 4 to 5 feet added during the construction of the Area 2 Pond.

1.5 Previously Identified Safety Issues

Discussions with plant personnel and review of provided documentation indicate that there are no current or previously identified safety issues from the previous 5 years at the Tecumseh Energy Center facility.

1.6 Site Geology

The Tecumseh Energy Center is located south of the Kansas River in Shawnee County. This area is part of the glaciated region of Kansas. The soils consist of glacial drift and loess which consists of varying mixture of silts, clays, sands and gravels. The underlying bedrock in the Glaciated Region is of the Pennsylvanian Age Scranton Formation. The Scranton Formation consists of limestone and shale which predominately dip down to the north and northwest. Glacial erratics are also common in this area commonly consisting of quartzite boulders, known as Sioux quartzite, but also includes sandstone, basalt and granite. The depth to bedrock varies greatly throughout this area from exposed bedrock outcrops to over 100 feet in thickness.

1.7 Inventory of Provided Materials

Westar Energy AMEC with several documents pertaining to the design and operation of the Tecumseh Energy Center. These documents were used in the preparation of this report and are listed in Appendix C, Inventory of Provided Materials.

2.0 FIELD ASSESSMENT

2.1 Visual Observations

AMEC performed visual assessments of Tecumseh Ash Pond 1 and Ash Pond 2 on October 26, 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 Form were completed for each ash pond during the site visit and provided to the EPA via email within five business days following the site visit. Appendix A contains copies of the completed checklist forms. Photo location site maps for each ash pond, as well as descriptive photos, can be found in Appendix B. Rainfall data for the Topeka, Kansas area, located five miles east of Tecumseh Energy Center, was collected for thirty days prior to the date of the site visit. Table 2, below, summarizes the rainfall data for the days and month immediately preceding AMEC's site visit.

Table 2. Tecumseh Energy Center Rainfall Data

Rainfall Prior to Site Visit	
Date	**Rainfall (in.)**
October 18, 2010	0.00
October 19, 2010	0.00
October 20, 2010	0.00
October 21, 2010	0.00
October 22, 2010	0.24
October 23, 2010	0.34
October 24, 2010	0.00
October 25, 2010	0.00
October 26, 2010	0.24
Total (9 days prior to visit)	0.82
October Rainfall	1.30
Total (30 days prior to visit)	1.30

The Area 1 and Area 2 ponds are located west of the main facility buildings with Area 1 located to the south of Area 2. The site layout is illustrated on Figure 2 and Figure B-1 (Photo Log Map in Appendix B). The ponds are separated from one another by Tecumseh Creek which flows between the bases of the steep embankments located on the north and south sides of Area 1 and Area 2, respectively.

2.2 Area 1 - Visual Observations

A divider dike separates the Area 1 pond into north and south regions (Photo 1-10). These regions allow for alternating ash sluicing and dredging operations. Sluiced CCW materials are delivered to the northeast side of the Area 1 pond by pipe, where flow either directly enters the northern section of Area 1 or is routed through a small, open concrete channel to the southern portion of Area 1 (Photo 1-5). Photos 1-8 through 1-11 provide a panorama from the west side of the Area1 pond looking north to south.

2.2.1 Area 1 - Embankments and Crest

The eastern portions of the Area 1 pond are incised. An embankment exists on the other three sides. A chain link fence sits atop the entire outer crest edge. The south embankment toe of slope is located directly adjacent and parallel to SE 2nd Street (Photo 1-18). A series of widely spaced, modest homes sits across SE 2nd Street at this location. Although trees and vegetation exist at the southwest slope (Photo 1-17), the south slope had been cleared and contained just a few stumps (Photos 1-19, 1-20 and 1-22). A roadway swale was also visible (Photo 1-21). The west embankment slopes toward the floodplain of Tecumseh Creek. This embankment was not assessed as it was covered with trees and vegetation and was not readily accessible (Photo 1-12). Tecumseh Creek is located at the base of the north embankment. This embankment is very steep, contains some trees and vegetation, and was noted to have been recently groomed (Photos 1-13, 1-14, 1-16, 2-1, and 2-2). The crest of the Area 1 pond was noted to be in good condition, free of erosion or rutting (Photo 1-8 and 1-11).

2.2.2 Area 1 - Outlet Control Structures

The pond's outlet control, an open-sided box weir structure, is located on the western pond edge, between the pond's north and south regions (Photo 1-6). Weir plates (Photo 1-7) are located on each side of the structure. Decant from the pond discharges though a pipeline into the Area 2 pond, which is located to the north.

2.3 Area 2 - Visual Observations

Decant flow from the Area 1 pond is conveyed to the Area 2 pond through a 16-inch pipe that discharges into the southwest corner of the Area 2 pond (Photo 2-10). The Area 2 pond is not divided, but serves as one settling area for decant from the Area 1 pond. Photos 2-7 through 2-9 provide a panorama, beginning with a western view across Area 2 and ending with an eastern view of the Coal Pile Runoff Pond.

2.3.1 Area 2 - Embankments and Crest

The north and east regions of the Area 2 pond are incised. A railroad track and berm is located parallel to and north of the north side of the pond (Photo 2-18). The ground slopes from the southern downstream toe of the railroad berm to the pond's edge. The Coal Pile Runoff Pond, located directly adjacent to and east of the pond, is separated from the Area 2 pond by an approximately 25-foot wide berm.

Based on provided site topography, the western edge of the pond is diked, with what appears to be a maximum height of between two and three feet. Access to this area was not attempted due to the presence of a fence and heavy trees and vegetation along the outer crest edge (Photo 2-17).

The southwest and southern portions of the pond are diked. Both downstream slopes were completely covered with trees and vegetation (Photos 2-1, 2-2, 2-11, 2-15, and 2-16). The southern downstream dike face appeared to be rather steep and without a uniform slope.

A roadway circles the pond atop an approximately 20-foot crest. The crest width appeared mostly uniform with some areas more well gravel covered than others (Photos 2-13 and 2-17).

2.3.2 Area 2 - Outlet Control Structure

The Area 2 pond outlet structure, a weir box with a pipe discharge, is located in the southeast corner of the pond (Photo 2-6). The 21-inch diameter corrugated metal pipe discharges into Tecumseh Creek through permitted KPDES Outfall 002X1. This outfall is located southwest of the weir box structure on the downstream embankment face (Photos 2-1 and 2-3). Although riprap is located below the discharge location, trees and vegetation surround the area and the ground surface is not uniformly graded (Photos 2-4 and 2-5). Parallel discharge pipes from the Coal Pile Runoff Pond (permitted KPDES Outfall 004A1) are located directly east of the Area 2 pond permitted KPDES Outfall. Discharge was not visible from the Coal Pile Runoff Pond at the time of the site visit. Comments from Westar personnel indicate that the high level overflow pipe from the Coal Pile Runoff Pond is not valved, while the normal discharge pipe is valved and normally closed.

2.4 Monitoring Instrumentation

Two piezometers were installed as part of the *2010 Evaluation of Ash Pond Berm Stability*, as prepared by Golder Associates. These piezometers, known as P-1 and P-2, were located on the crest of the northern embankment of the Area 1 Pond and installed to “better define piezometric levels at those locations.” The piezometers were registered with KDHE; however, they were removed upon completion of the subsequent berm reconstruction project.

3.0 DATA EVALUATION

3.1 Design Assumptions

AMEC has reviewed provided documentation related to design assumptions regarding both hydraulic adequacy and dike stability. However, some design assumptions were not available in the documentation, and have been listed as not provided where necessary.

3.2 Hydrologic and Hydraulic Design

3.2.1 Long Term Hydrologic Design Criteria

The Mine Safety and Health Administration provides minimum hydrologic criteria relevant to CCW impoundments in 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.

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 3, MSHA Minimum Long Term Hydrologic Design Criteria.

Table 3. 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 influent drawdown criteria, MSHA Impoundment Design Guidelines noted that:

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

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

The definition of design freeboard, according to the MSHA Guidelines, is "the vertical distance between the lowest point on the crest of the embankment and the maximum water surface elevation resulting from the design storm." Additionally, the Handbook states that "Sufficient documentation should be provided in impoundment plans to verify the adequacy of the freeboard." Recommended items to consider when determining freeboard include "potential wave run-up on the upstream slope, ability of the embankment to resist erosion, and potential for embankment foundation settlement." Lastly, the Handbook states, "Without documentation,

and absent unusual conditions, a minimum freeboard of 3 feet is generally accepted for impoundments with a fetch of less than 1 mile."

The CCW impoundments at the Tecumseh Energy Center fall within the smallest storm event designation category on Table 3. Using MSHA long term hydrologic criteria, design for the 100-year, 24-hour rainfall event would be recommended.

3.2.1 Documented Hydrologic Design Criteria

A specific hydrologic and hydraulic study was not provided. However, AMEC compiled pertinent information from other provided documentation and conversations with Westar Energy personnel.

Both the Area 1 and Area 2 Ponds were designed to collect only stormwater tributary to their surface areas. The eastern portion of the Area 1 pond is incised, but a stormwater berm on the northeast side and channelized area on the east and southeast side redirect stormwater runoff away from this pond. A small channelized area exists to the north of the Area 2 pond that redirects stormwater from north of the pond to areas to the west. The Coal Pile Runoff Pond intercepts any other stormwater flowing toward the Area 2 Pond from the east.

Drawings that were provided specify crest and discharge structure weir elevations for both the Area 1 and Area 2 Ponds. The Area 1 discharge weir and crest elevations appear to be 882 feet and 885 feet, respectively (three feet of typical operating freeboard), while the Area 2 discharge weir and crest elevations appear to be 868 feet and 872 feet (four feet of typical operating freeboard), respectively.

3.2.2 Pond Storage Capacity

Westar Energy did not provide any additional information regarding the hydrologic and hydraulic design of Ash Pond 1 and Ash Pond 2 in their comments to the November 2010 Draft Report.

To provide some insight into design storm hydrologic impacts on the facility, AMEC reviewed the U.S. Department of Agriculture Soil Conservation Service 1961 *Technical Paper No. 40 Rainfall Frequency Atlas of the United States* (*Atlas*). *Atlas* data was reviewed to determine the 100-year 24-hour and PMP event precipitation values for the Tecumseh, Kansas area. The *Atlas* detailed a factor relationship between the 100-year 6-hour rainfall and the PMP 6-hour event. For the Tecumseh Kansas area, the ratio of these two storms was indicated to be approximately 4 to 4.5. Lacking other input, that ratio was applied to approximate the relationship between the 100-year 24-hour storm event and the PMP. Table 4 summarizes the rainfall values for the Tecumseh, KS area determined from review of the *Atlas*.

Table 4. Rainfall Frequency Values for Tecumseh, KS Area

Storm Event	Precipitation[1] (inches)
100-year 24-hour	7.5
PMP	30[2]

[1] From Technical Paper No. 40 Rainfall Frequency Atlas of the United States (1961)
[2] Approximated from *Atlas* factor relationship between 100-year 6-hour storm and the PMP 6-hour storm

It appears that Ash Pond 2, based on the reported normal operating freeboard of 4 feet, would maintain a clear freeboard of greater than three feet above the 100-year 24-hour design storm rainfall amount of 7.5 inches.

Ash Pond 1, however, was noted to normally operate with three feet of freeboard separating the normal water surface and crest elevations. This pond would fair less well when impacted with the MSHA specified design storm for a dam with a significant hazard classification, the ½ PMF. AMEC assigned Ash Pond 1 the significant hazard classification due to the occupied homes that are located immediately adjacent to the southern boundary of the pond. MSHA recommends a freeboard of three feet exist between the water surface elevation that results from the design storm routing and the crest of the dam. A hydrologic and hydraulic investigation should be performed to determine the impact the ½ PMF design storm would have on Ash Pond 1, specifically its ability to store and or pass runoff. The resulting peak water surface elevation should be used to determine the normal operating water surface elevation that would facilitate a more acceptable design storm freeboard condition.

3.3 Structural Adequacy & Stability

3.3.1 Comparative Stability Factor of Safety Standards

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 (MSHA). Minimum recommended factors of safety for different loading conditions can be found in those agency publications, as shown in Table 5 below.

Table 5. Minimum Stability Factors of Safety

Loading Condition	MSHA[1]	USACE[2]
Rapid Drawdown	1.3	1.1[3] - 1.3[4]
Long-Term Steady Seepage	1.5	1.5
Earthquake Loading	1.2	---[5]

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

To consider the structural adequacy and stability of the ash ponds at Tecumseh Energy Center, AMEC reviewed stability analysis material provided by Westar Energy with respect to the load cases shown in Table 5. Factors of safety documented in the provided material were compared with those factors outlined in the table to help determine whether the impoundments meet the requirements for acceptable stability.

3.3.2 2009 Evaluation of Ash Pond Berm Stability

Golder Associates completed the report entitled *Evaluation of Ash Pond Berm Stability*, Westar Energy - Tecumseh Energy Center, dated December 2009 (2009 Report). Golder reported on site observations and stability evaluations of the CCW storage facilities at Tecumseh in response to the EPA's request for information under Section 104(e) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

Golder Associates advanced four soil borings, TEC-1, TEC-3, TEC-4, and TEC-5, in October 2009. The borings were drilled between the center and the downstream edge of the berm crests and located in areas with downstream embankment heights of 12 feet or more. Figure 8, from Golder's 2009 Report, illustrates the boring locations as well as the berm areas with heights noted to be greater than 12 feet. A truck mounted CME drill rig and 6-inch diameter hollow stem continuous flight augers were used to collect relatively undisturbed soil samples. "Borehole depths ranged from 15 to 25 feet" and Golder reported that "berm stratigraphy was fairly consistent between boreholes and generally consisted of 1 foot of gravel road surface underlain by low-plasticity clay (CL) and high-plasticity clay (CH) layers." Groundwater, Golder noted, was "observed only in TEC-1, which was drilled on the south side of Area 2, at an elevation of 853 feet above mean sea level." The Area 1 Pond and Area 2 Pond had respective, reported crest elevations of 885 feet and 870 feet above mean sea level.

Two cross sections, Section 1 and Section 2, were located to represent critical slope conditions with respect to stability. Figure 9 illustrates the cross section locations as chosen by Golder for the 2009 stability analyses as well as site topographic information provided by Westar Energy. Golder "conservatively assumed that the staging areas were filled with CCP's to an elevation two feet below the berm crests and that ponded water reached the same elevation as the berm crests." Further, based on their visual observation of the drained and cleaned north pool of the Area 1 pond, Golder assumed the depth of the CCP storage facility to be 20 feet. A 0.5 to 1.0 (H:V) slope ratio was chosen for the upstream embankment slopes, apparently based on the same visual assessment by Golder.

Table 6 summarizes the engineering parameters presented by Golder, based on the relatively undisturbed soil samples.

Table 6. Laboratory Geotechnical Test Data

Borehole	Sample	Depth	USCS	Dry Unit Weight (pcf)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Friction Angle (deg)	Cohesion (psf)
TEC-1	1	3-5'		94	28					
TEC-1	2	13-15'	CL	98	26	44	19	25	31	110
TEC-1	3	23-25'			24					
TEC-3	2	13-15'	CH	100	24	50	17	33		
TEC-4	2	13-15'	CL	102	23	42	18	24	29	170
TEC-5	1	3-5'	CL	104	22	48	18	30		

The report notes that for "purposes of the stability analyses, Golder represented distinct soil layers and assigned engineering parameters based on proximity to sampling locations, field soil classification and laboratory test data." Figure 10 illustrates the 2009 stability analyses Section 1 (Area 1 Pond) and Section 2 (Area 2 Pond), including assigned engineering parameters. Unit weights were assigned to each soil layer based on "density testing of undisturbed soil samples collected at TEC." The boring identification appears to have been inadvertently left out of the document. Further, the report noted with regard to parameters,

> *For CL materials, Golder assigned effective stress strength parameters based on the results of the consolidated-undrained triaxial testing of undisturbed samples collected at TEC. Since consolidated-undrained triaxial testing was not performed on samples of CH materials collected at TEC, Golder assigned effective stress strength parameters to CH layers based on the results of*

consolidated-undrained triaxial testing of undisturbed samples of similar CH material collected at Lawrence Energy Center on October 26, 2009. Golder assigned a unit weight to CCPs based on previous experience and assumed that CCPs within the staging areas contribute no strength.

Table 7 provides a summary of the assigned engineering parameters.

Table 7. Summary of Engineering Parameters

Material	Unit Weight (pcf)	Strength Parameters	
		Friction Angle (deg)	Cohesion (psf)
TEC-1 Sample 2 (PI=25, Section 2)	123	31	110
TEC-4 Sample 2 (PI=24, Section 1)	126	29	170
TEC-3 Sample 2 (PI=33)/TEC-2 Sample 1 (PI=39)	124	26	260
Coal Combustion Products (CCPs)	85	No Strength	

Groundwater was reportedly not observed in any boreholes near Section 1; therefore, Golder assumed a groundwater surface located just below the bottom of borehole TEC-3, which is located closest to Section 1. Therefore, the groundwater elevation at Section 1 was identified as "860 feet above mean sea level, 7 feet higher that the groundwater at TEC-1." The phreatic surface was assumed to be a straight line between the "upstream edge of the berm crest and the assumed static groundwater level" at the borehole. Groundwater was located at 853 feet above mean sea level at boring TEC-1. Therefore, since TEC-1 is near Section 2, "the phreatic surface in the center of the berm was set to that elevation." The phreatic surface alignment in Section 2 was located as described for Section 1.

A two-dimensional computer program developed by Rocscience Inc. (2009), entitled SLIDE, was used to analyze embankment stability. Golder noted that "Factors of safety for static conditions were computed for circular failure surfaces using Spencer's method for force and moment equilibrium." A seismic coefficient of 0.05, based on a two percent chance of reoccurrence in a 50 year period, and Spencer's method, as described above, were used to compute factors of safety for seismic loading conditions. Table 8 illustrates the computed factors of safety.

Table 8. Summary of 2009 Stability Analysis

Cross Section and Analysis Condition	Computed Factor of Safety	Minimum Factor of Safety*
Section 1 - Static	1.0	1.5
Section 1 - Seismic	0.9	1.1
Section 2 - Static	1.6	1.5
Section 2 - Seismic	1.4	1.1

*Golder noted minimum factor of safety values.

Golder noted that, "Based on the factors of safety computed using SLIDE, some portions of the CCP storage facilities at TEC [1] may be only stable under static conditions and may become

unstable during a seismic event or if loaded beyond the assumed conditions." Computed static and seismic factors of safety for Section1 do not meet minimum acceptable factor of safety criteria. The stability of Section 2 was found to be acceptable, with factors of safety exceeding accepted minimums.

Following the initial stability calculations, Golder performed additional analysis and determined that acceptable factors of safety would be obtained for Section 1 if the existing slope was decreased (flattened), specifically to 1.7:1 (H:V). Calculated factor of safety values for the flattened slope section were determined to be 1.5 and 1.3 for static and seismic conditions, respectively. Figure 11 illustrates the boundaries of the over steep slope area of the Area 1 Pond's north embankment that would require repair.

3.3.3 2010 Evaluation of Ash Pond Berm Stability

The 2010 Evaluation of Ash Pond Berm Stability report was written by Golder to provide analyses results for the proposed slope improvements and regrade of the Area 1 Pond's north embankment slope.

Although several borings had been advanced for the 2009 evaluation of berm stability, two additional borings, P-1 and P-2, were advanced in the northern crest of the Area 1 Pond for the 2010 study, as shown on Figure 12. Piezometers were installed in these borings at locations designed by Golder and Westar, "to better define piezometric levels" in the area. Figure 12 illustrates the piezometer locations. Both piezometers were removed upon completion of the slope regrading project.

Golder addressed phreatic surfaces for Section 1 by determining the groundwater elevation in the piezometers, P-1 and P-2, five months following installation. The observed elevation was noted as 859 feet above mean sea level. It was noted in the report that Golder assumed the phreatic surface would consist of two surfaces;

(1) A straight line between the upstream edge of the berm crest and the observed groundwater level in P-2 at a horizontal distance of 16 feet from the upstream edge of the berm crest, and

(2) A straight line from the observed groundwater level in P-2 at a horizontal distance of 16 feet from the upstream edge of the berm crest to the observed flow depth in Tecumseh Creek at the interface of the riprap (used in the slope repair) and the native soil.

Golder noted that the groundwater level in a test hole, which was excavated near Section 1 in September 2010, was at elevation 851 feet above mean sea level. This level was noted as "in agreement with the assumed phreatic surface." The phreatic surface for Section 2 was determined following a similar approach.

The same stability cross section locations were used for the 2010 evaluation; however, the downstream slope of Section 1 was flattened to 1.7: (H:V) as indicated by the additional analysis that followed the 2009 evaluation. Figure 12 illustrates the uniformly regraded north embankment slope of the Area 1 Pond. Figure 13 illustrates the 2010 stability analyses Section 1 (Area 1 Pond) and Section 2 (Area 2 Pond), including assigned engineering parameters. The engineering parameters for the 2010 study included an entry for riprap material, with parameter values as shown on Figure 13, due to the fact that the proposed regrade included riprap

placement at the base of the slope. Table 9 illustrates the computed factors of safety resulting from the flattened slope and riprap addition.

Table 9. Summary of 2010 Stability Analysis

Cross Section and Analysis Condition	Computed Factor of Safety	Minimum Factor of Safety*
Section 1 - Static	1.5	1.5
Section 1 - Seismic	1.3	1.1
Section 2 - Static**	1.5	1.5
Section 2 - Seismic**	1.4	1.1

*Golder noted minimum factor of safety values.
**2009 analysis result.

Golder noted that the results indicate that the Area 1 and Area 2 Ponds should "remain stable under maximum anticipated loading conditions."

3.4 Foundation Conditions

As stated by Westar Energy, both ponds were created through excavation from existing grade. Soil information for areas below the added berm height was determined through review of the boring logs. The logs indicate the original foundation in the Area 1 Pond to be stiff, brown to reddish-brown, SILTY CLAY, little to some sand, (CL to CH). The Area 2 Pond original foundation material was described as stiff, dark brown, SILTY CLAY, little sand (CL) with deeper portions as stiff, dark brown, CLAY, trace sand, (CH).

3.5 Operations and Maintenance

3.5.1 Safety Assessments

2009 Visual Observation

Golder performed a visual observation of the Tecumseh Energy Center on October 27, 2009 in conjunction with the 2009 Evaluation of Ash Pond Berm Stability report they were preparing. Inflow and outflow structures, upstream berm slopes, berm crests, downstream berm slopes, and berm toes were assessed. Subsequent site visits occurred on December 11 and December 16, 2009. Various recommendations given in that report lead Westar Energy to contract with Golder to complete the September 2010 *TCOM North Ash Pond Berm Redesign* project which addressed the slope stability concerns. Additional site visits were completed by Golder in February, March, August, and October, 2010. Golder provided a summary table regarding several recommended action items in the 2010 Evaluation of Ash Pond Berm Stability report. Table 10, from the 2010 report, summarizes the recommended action items, corrective action, and the status of each as of October 26, 2010.

Table 10. Corrective Actions to Address Recommendations

Recommendation[1]	Corrective Action(s)	Status
Implement measures to contain CCPs in the event of a leak or rupture of above-ground inflow piping	Relocate inflow piping to sturdier pipe rack	Complete
	Construct containment berm along downstream berm crest	Complete
Reshape slope to 1.7 (horizontal) to 1 (vertical) or flatter[2]	Reshape slope using an engineered design	Complete
Implement erosion control techniques on reshaped slope[2]	Install turf reinforcement mat in flattened areas	Complete
	Plant native vegetation in flattened areas	Complete
Install armoring at the berm toe[2]	Install riprap at the berm toe	Complete
Install armoring at the outfall location[3]	Install riprap at the outfall location	Complete

[1] From 2010 Evaluation of Ash Pond Berm Stability report, by Golder Inc.
[2] Refers to northern downstream embankment of Area 1.
[3] Refers to outfall located on southern embankment of Area 2.

2010 Technical Memo Regarding Vegetation

Golder Associates submitted a Technical Memorandum (TM) to Westar Energy on October 21, 2010 regarding Vegetation on Ash Pond Berm Slopes at Westar Energy's Lawrence and Tecumseh Energy Centers. In that TM, Golder's opinion was "that the overall effect of the vegetation at [Lawrence and Tecumseh Energy Centers] is beneficial and that removal of shrubs and trees is not likely to result in a slope stability improvement." This recommendation was primarily based on the work of Donald Gray and Robin Sotir and other authors. We note, however, that the primary emphasis of these references is regarding slope stability erosion control and not primarily the structural integrity of impoundments. Golder also stated that they were "not aware of any instances where the structural instability of an earthen structure was demonstrated to have been caused primarily by the presence of vegetation." FEMA 534, "Technical Manual for Dam Owners: Impacts of Plants on Earthen Dams" provides instances of dam breaching linked directed to woody vegetation. We understand that removal of vegetation may be an issue with various regulatory bodies and other stakeholders, but AMEC ultimately recommends a more aggressive vegetation management program.

3.5.2 Instrumentation

Two piezometers, P-1 AND P-2, were installed as part of the 2010 Evaluation of Ash Pond Berm Stability; however, they were removed upon completion of the subsequent berm reconstruction project. No other berm stability monitoring equipment/instrumentation exists at the facility.

3.5.3 State or Federal Inspections

State and federal inspections have not been performed at the Tecumseh Energy Center. No future inspections are anticipated.

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 hereinafter were personally assessed by me and was found to be in the following condition:

Area 1 Pond: Fair

Area 2 Pond: Satisfactory

4.2 Recommendations

The management units above were rated poor in the November 2010 Draft Report because of lack of documentation. Specifically, hydrologic and hydraulic documentation was not provided for either pond.

In comments to the Draft Report, the state of Kansas indicated they believed that the Poor rating assigned by AMEC to the ponds was misleading. They stated "the report should explicitly and more directly reflect a lack of proper documentation as the reason for the assessment." The Draft Report clearly stated the lack of documentation, specifically hydraulic and hydrologic, led to the Poor condition rating for the ponds. As the condition ratings clearly state, "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." Hydrologic Section 4.2.1 of the Draft Report clearly outlined the type of information that would be used to determine whether the ponds were designed and operated adequately with respect to hydrologic and hydraulic concerns.

4.2.1 Hydrologic and Hydraulic

Draft Report

AMEC recommends that an appropriate design storm rainfall and freeboard depth in accordance with MSHA guidelines be applied to watershed that is tributary to the Area 1 and Area 2 ponds to assess whether the dam and decant system can safely store, control, and discharge the design flow. Based on the size and rating for the ponds, the MSHA recommended design storm would be the ½ PMF for Ash Pond 1 and the 100-year, 24-hour event for Ash Pond 2. Hydraulic calculations should also be completed to determine the rate at which the discharge system could pass the design storm, if necessary, or draw down elevated water surfaces following such an event. The analysis should consider all critical stages over the life of the pond including full pond conditions.

Final Report

Based on the information that AMEC determined from internal review of *Technical Paper No. 40 Rainfall Frequency Atlas of the United States as well as* discharge weir and pond crest elevations provided by Westar Energy, design storm freeboard conditions were estimated. Ash Pond 2 appears to be capable of storing the 100-year 24-hour design storm while maintaining sufficient freeboard (≥ 3 feet) above the water surface elevation resulting from the design storm. Based on that information, AMEC has improved the rating for Ash Pond 2 to Satisfactory. Continued operation with a normal operating water surface elevation four feet below the impoundment crest is recommended.

Ash Pond 1, however, is subject to a larger design storm event because this pond carries a higher hazard rating due to nearby residences. With only three feet of freeboard available during typical operations, the design storm of ½ PMF would reduce the freeboard to much less than the MSHA recommended three feet. AMEC believes that a rating of Fair is appropriate for Ash Pond 1, as "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." Uncertainties exist as to how the pond would respond to the design storm of ½ PMF and if an acceptable freeboard condition would result based on the currently reported normal operating water surface elevations. Additionally, hydraulic information was not provided for the discharge weir and associated piping system.

AMEC recommends that Westar Energy performs and documents a complete hydrologic and hydraulic study for both Ash Ponds, as described in the Draft Report, and that the study be used

to properly and appropriately operate the ponds in anticipation of and response to future design storm events.

4.2.2 Geotechnical and Stability Recommendations

Based on the stability analyses provided to AMEC, the Area 1 and Area 2 ponds meet minimum factors of safety.

4.2.3 Monitoring and Instrumentation Recommendations

AMEC recommends that the installation and periodic monitoring of piezometers be considered by Westar Energy.

4.2.4 Inspection Recommendations

Annual visual inspections of each management unit should be performed by a Professional Engineer. These inspections should be documented reports and should be maintained by the facility.

Additionally, weekly visual inspections should be performed by facility O&M personnel and should be supported by an inspection checklist that would serve as documentation of these inspections.

AMEC recommends that vegetation on the impoundments be aggressively managed based on guidance in (a) Corps of Engineers EM 1110-2-301, *Guidelines for Landscape Planting and Vegetation Management at Floodwalls, Levees, and Embankment Dams* and (b) FEMA 534, *Technical Manual for Dam Owners: Impacts of Plants on Earthen Dams*. Additionally, any animal impact should be mitigated based on guidance in FEMA 473, *Technical Manual for Dam Owners: Impacts of Animals on Earthen Dams*.

Westar Energy staff noted to AMEC during the October 2010 site visit that, while they understood the importance of vegetation management they were receiving conflicting recommendations from various state and federal regulatory agencies regarding best vegetation management practices In AMEC's opinion, Westar Energy should coordinate with federal, state agencies, and any other stakeholders to reach a consensus agreement regarding vegetation management at the site.

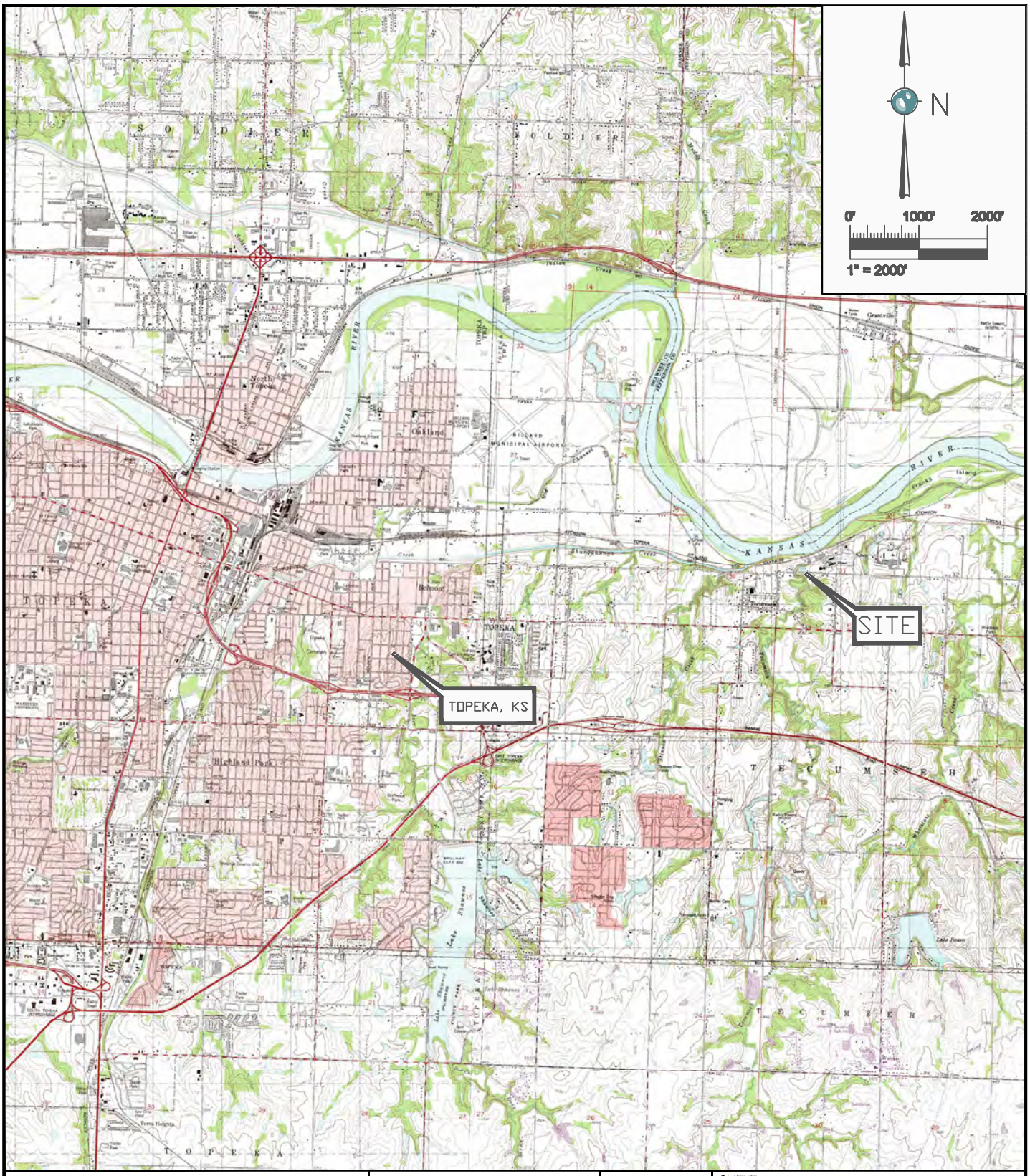
5.0 CLOSING

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 the Tecumseh Energy Center 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.

FIGURES



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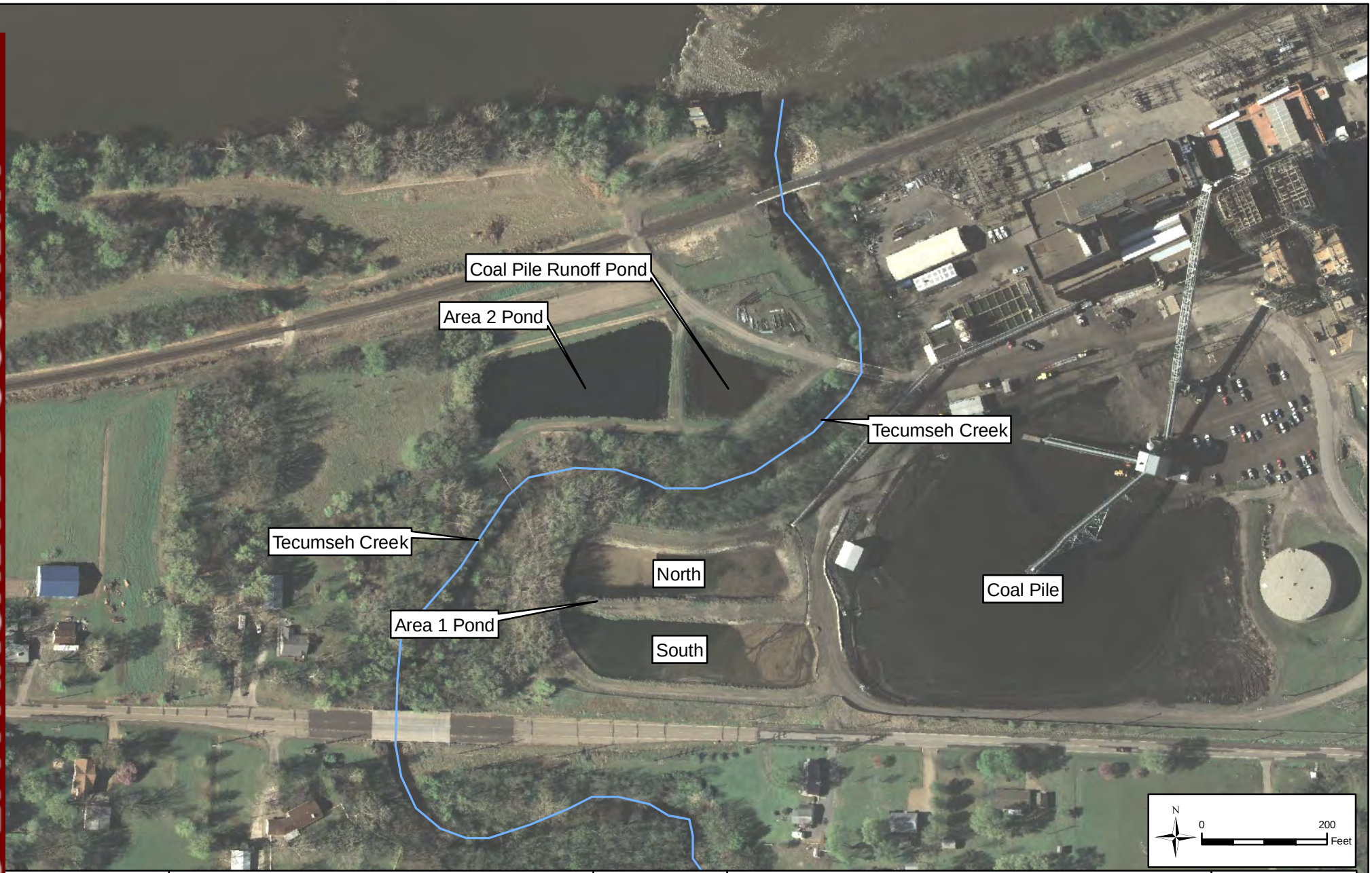
690 Commonwealth Center
11003 Bluegrass Parkway
Louisville, Ky 40299
(502) 267-0700

CLIENT LOGO

CLIENT: UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

PROJECT: ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS	DWN BY: CAE	DATUM:	DATE: 11/15/10
TITLE: WESTAR ENERGY TECUMSEH ENERGY CENTER, TECUMSEH, KS SITE LOCATION & VICINITY MAP	CHK'D BY: MOS	REV. NO.:	PROJECT NO: 3-2106-0183.0001
	PROJECTION:	SCALE: AS SHOWN	FIGURE No. 1



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DWN BY: DJC
CKD BY: MS
Datum: NAD 83
Projection: UTM 15
Scale: As Shown

ASSESSMENT OF DAM SAFETY OF
COAL COMBUSTION SURFACE IMPOUNDMENTS

TECUMSEH ENERGY CENTER,
TECUMSEH, KS
AERIAL SITE PLAN

REV. No.: A
Date: 11-9-10
Project No: 3-2106-0183-0001
Figure No: 2

ID	NAME	Longitude	Latitude
1	Grantville Elementary School	-95.55442225	39.08222205
2	Prairie Creek School	-95.50442067	39.10944387
3	Greenwood Valley School	-95.47858704	39.04388917

amec

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UNITED STATES
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DRAWN BY: DJC
CHK'D BY: MS
DATUM: NAD83
PROJECTION: UTM 15
SCALE: AS SHOWN
DATE: 11/9/2010

ASSESSMENT OF DAM SAFETY OF
COAL COMBUSTION SURFACE IMPOUNDMENTS

TECUMSEH ENERGY CENTER,
TECUMSEH, KS
CRITICAL INFRASTRUCTURE

N
0 1 Miles
0 1 Kilometers

Notes: Critical infrastructure data provided by ESRI

FIGURE
3

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

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CHK'D BY:	MOS
DATUM:	
PROJECTION:	
SCALE:	NTS

PROJECT: ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

TITLE: WESTAR ENERGY
TECUMSEH ENERGY CENTER, TECUMSEH, KS
1968 SITE CONTOUR MAP

DATE:	11/22/10
PROJECT NO:	3-2106-0183.0001
REV. NO.:	
FIGURE No.	4

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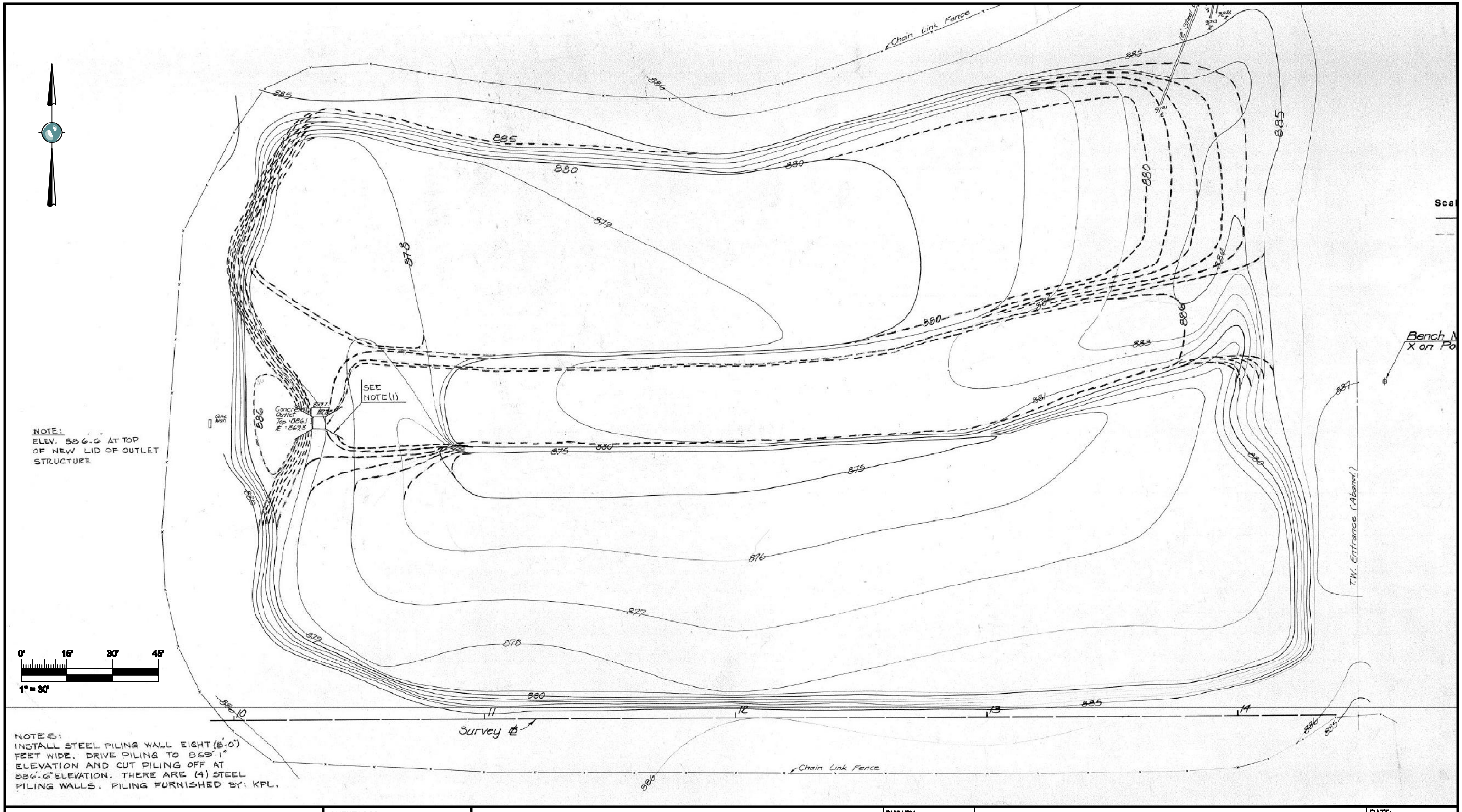

NOTE:
ELEV. 886.6' AT TOP OF NEW LID OF OUTLET STRUCTURE

NOTES:
INSTALL STEEL PILING WALL EIGHT (8'-0") FEET WIDE. DRIVE PILING TO 869.1' ELEVATION AND CUT PILING OFF AT 886.6' ELEVATION. THERE ARE (4) STEEL PILING WALLS. PILING FURNISHED BY: KPL.

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

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DATUM:	
PROJECTION:	
SCALE:	AS SHOWN

PROJECT
ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

TITLE
WESTAR ENERGY
TECUMSEH ENERGY CENTER, TECUMSEH, KS
AREA 1 POND - 1980 POND MODIFICATION PLAN

DATE:	11/22/10
PROJECT NO:	3-2106-0183.0001
REV. NO.:	
FIGURE No.	5

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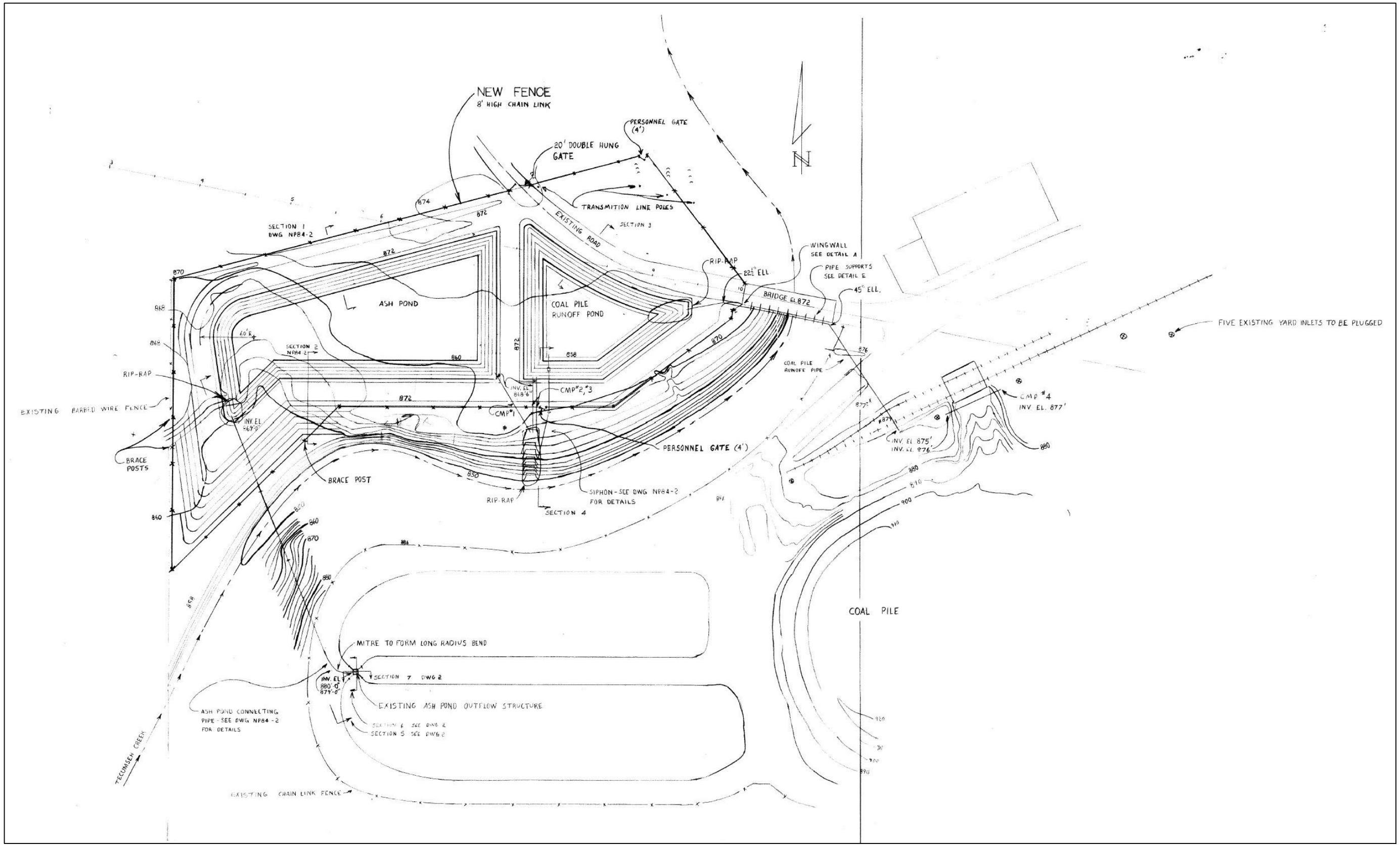

NOTE: THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE AMEC EARTH & ENVIRONMENTAL REPORT

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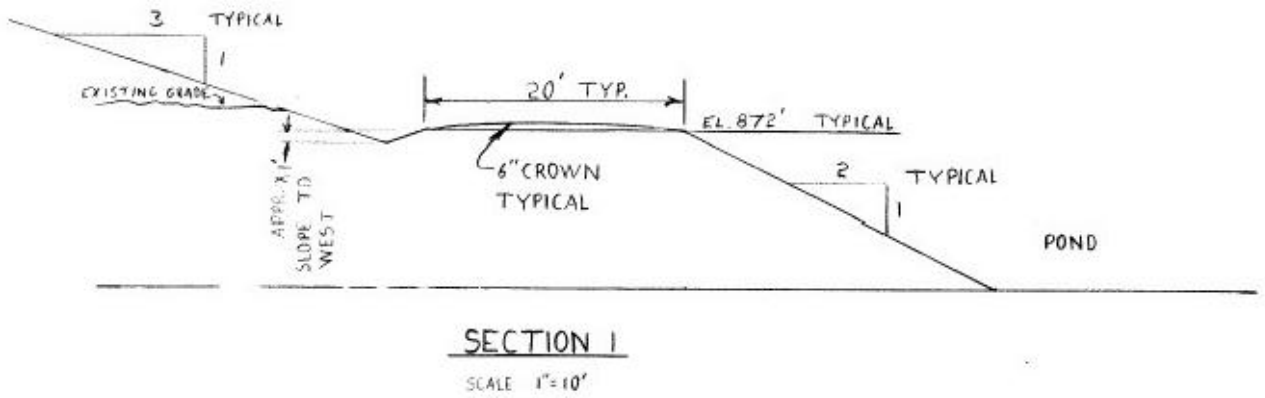
DATUM:	
PROJECTION:	
SCALE:	AS SHOWN

PROJECT: ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

TITLE: WESTAR ENERGY
TECUMSEH ENERGY CENTER, TECUMSEH, KS
AREA 2 POND - LOCATION AND GRADING PLAN

DATE:	11/22/10
PROJECT NO:	3-2106-0183.0001
REV. NO.:	
FIGURE No.	6

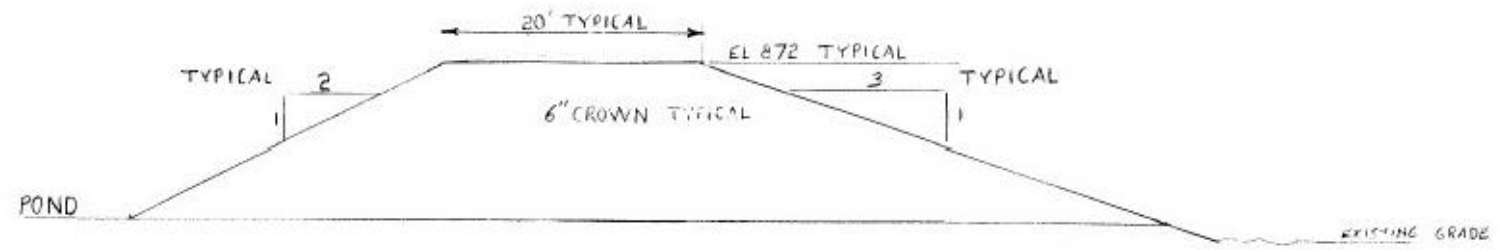
S:\Geosciences\Proposals\EPA Coal Impoundment Inspection\September Round 8\Tecumseh\Tecumseh Photos and CAD files\figures\tecumsehfig6-area2loc.dwg – Layout1 – Nov. 22, 2010 10:37am – chris.eger



SECTION 1

SCALE 1"=10'

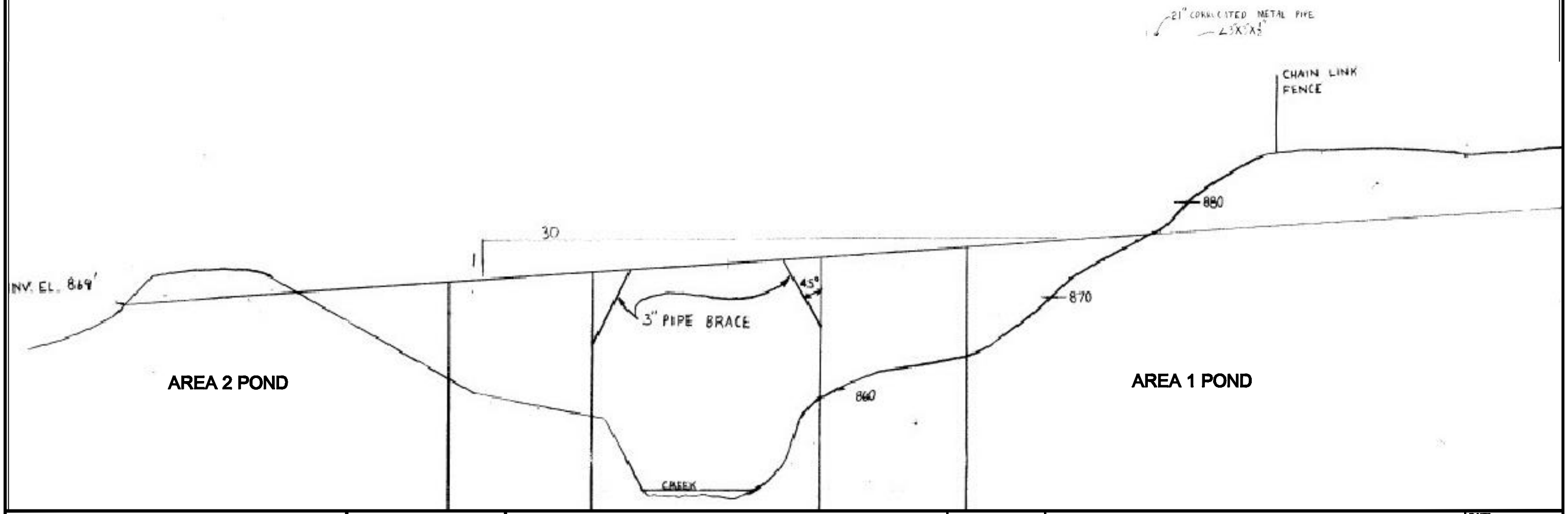
SECTION TYPICAL NORTH



SECTION 2

SCALE 1"=10'

SECTION TYPICAL SOUTH



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

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DWN BY:	CAE
CHK'D BY:	MOS
DATUM:	
PROJECTION:	
SCALE:	NOT TO SCALE

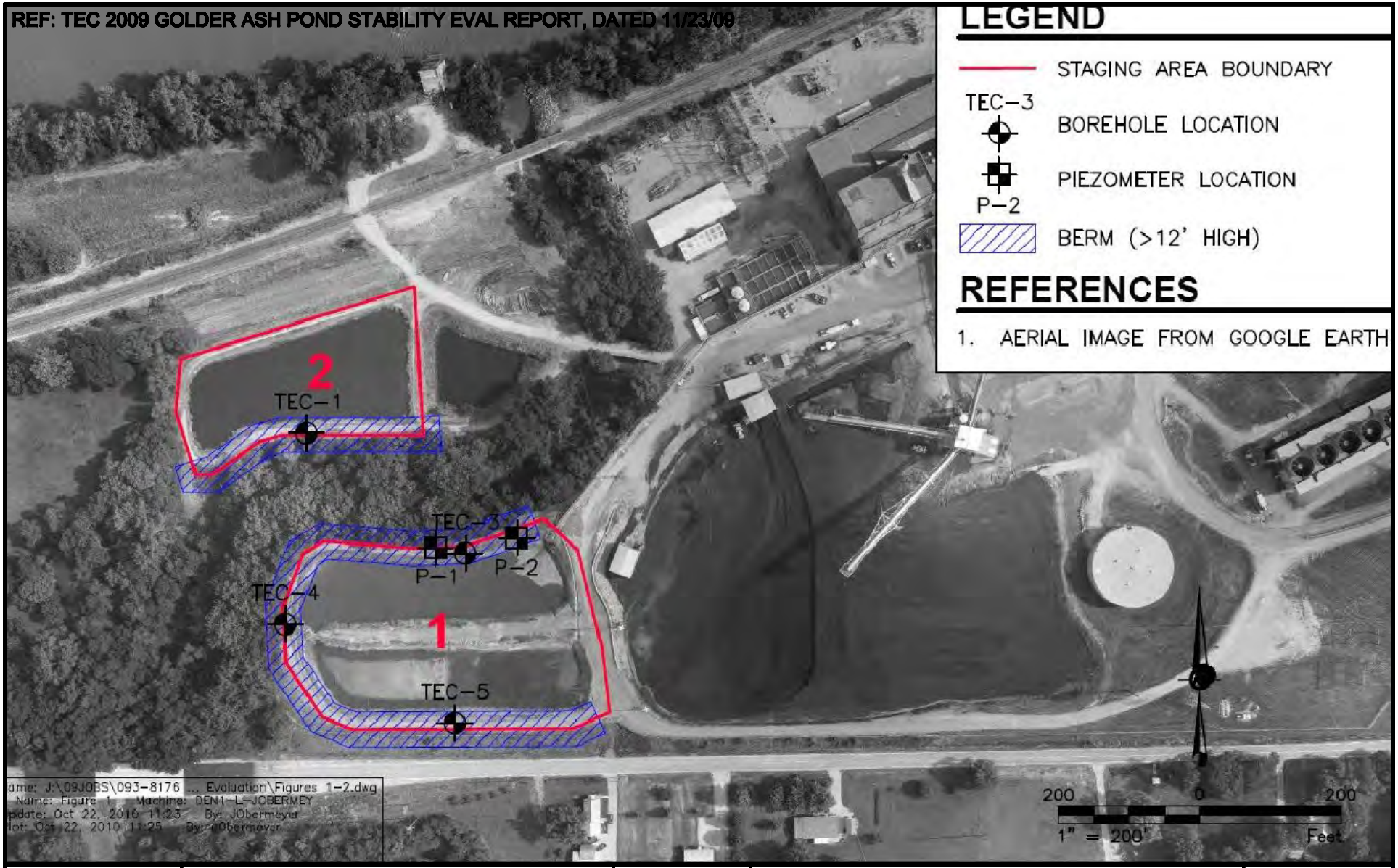
PROJECT: ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

TITLE: WESTAR ENERGY
TECUMSEH ENERGY CENTER, TECUMSEH, KS
AREA 2 POND - CROSS SECTIONS

DATE:	11/22/10
PROJECT NO:	3-2106-0183.0001
REV. NO.:	
FIGURE No.	7

S:\Geosciences\Proposals\EPA Coal Impoundment Inspection\September Round 8\Tecumseh\Tecumseh Photos and CAD files\figures\tecumsehfig7-arrea2crosssection.dwg – Layout1 – Nov. 29, 2010 9:48am – chris.eger

REF: TEC 2009 GOLDER ASH POND STABILITY EVAL REPORT, DATED 11/23/09



CLIENT LOGO	CLIENT: UNITED STATES ENVIRONMENTAL PROTECTION AGENCY	DWN BY: CAE	PROJECT: ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS	REV. NO.: A
		CHK'D BY: MOS		DATE: 11/22/10
AMEC Earth & Environmental, 690 Commonwealth Center, 11003 Bluegrass Parkway, Louisville, Ky 40299, (502) 267-0700		DATUM:	TITLE: WESTAR ENERGY TECUMSEH ENERGY CENTER, TECUMSEH, KS 2009 STABILITY ANALYSIS BERM HEIGHT AND BORING LOCATION PLAN	PROJECT NO: 3-2106-0183.0001
		PROJECTION:		FIGURE No. 8
		SCALE: AS SHOWN		

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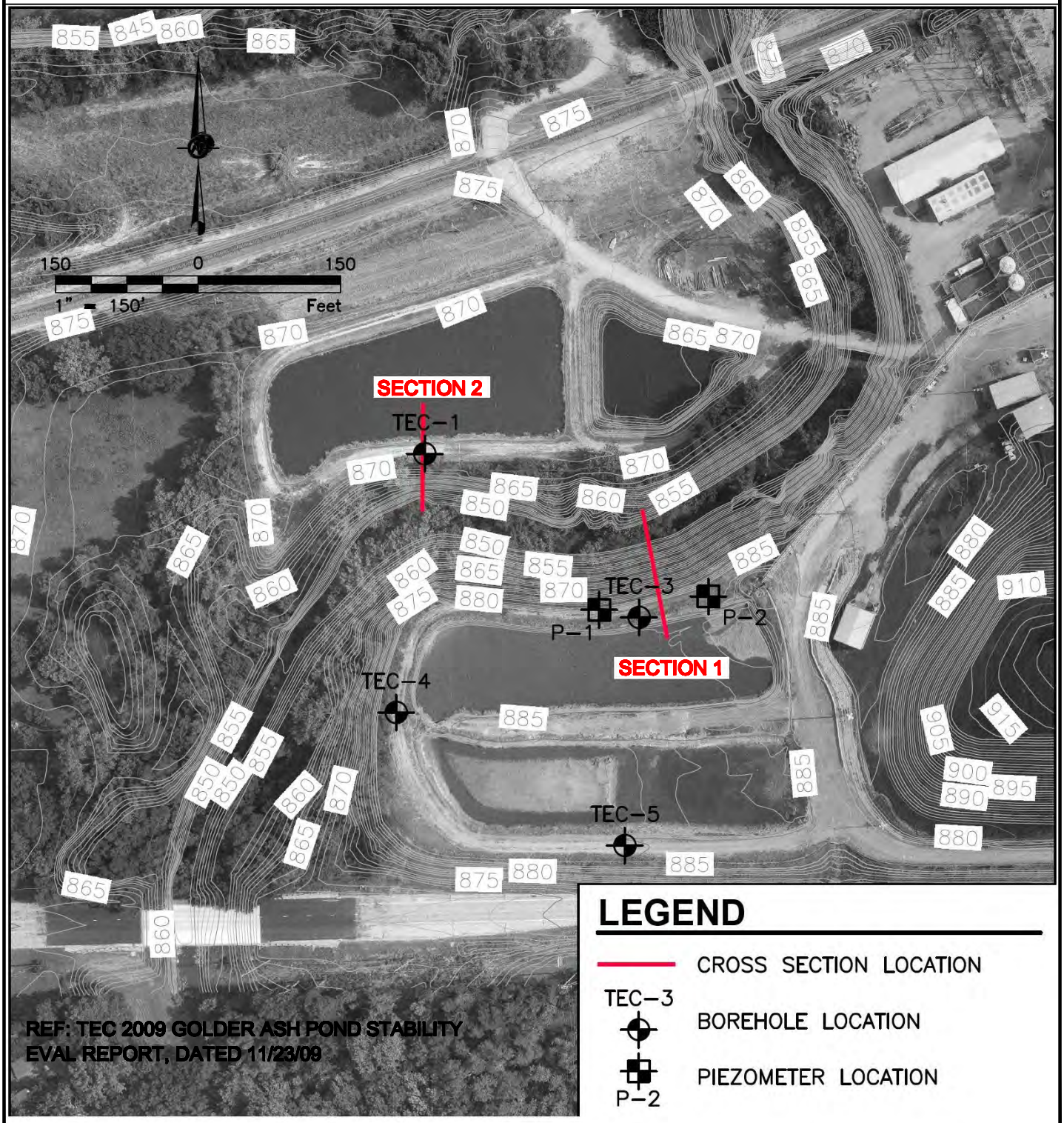


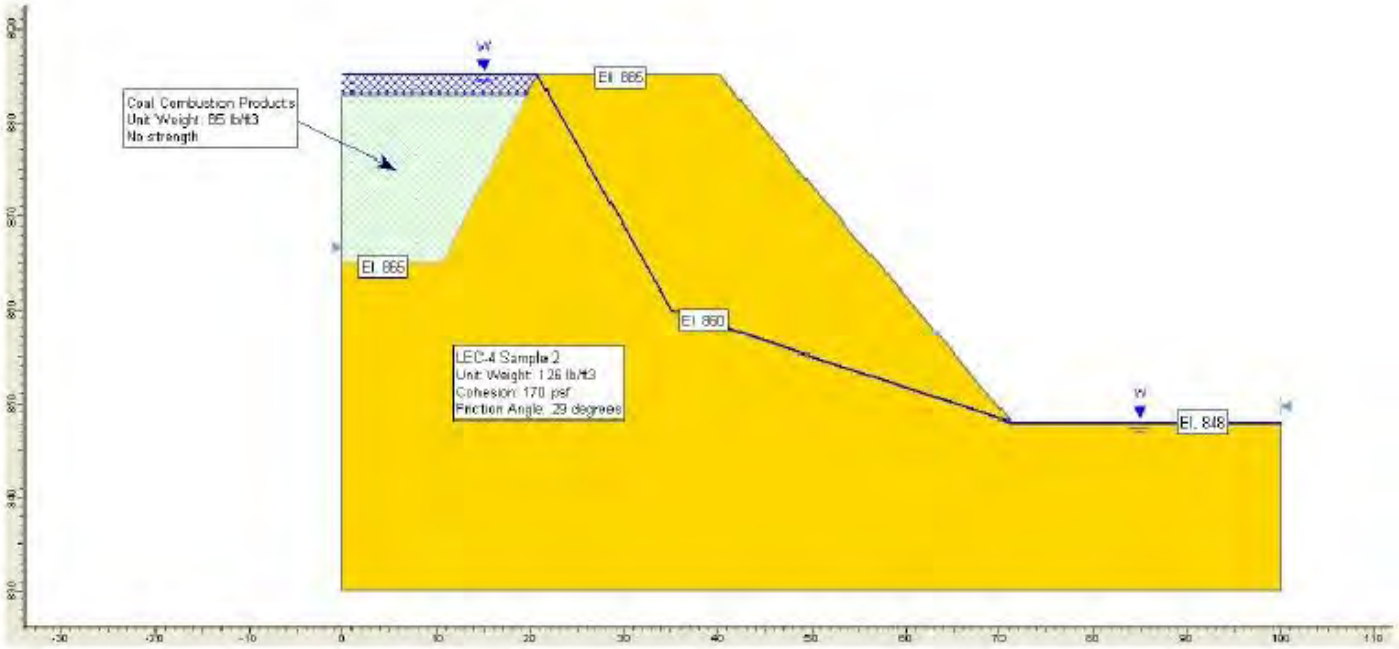
AMEC Earth & Environmental
690 Commonwealth Center
11003 Bluegrass Parkway
Louisville, Ky 40299
(502) 267-0700

CLIENT LOGO

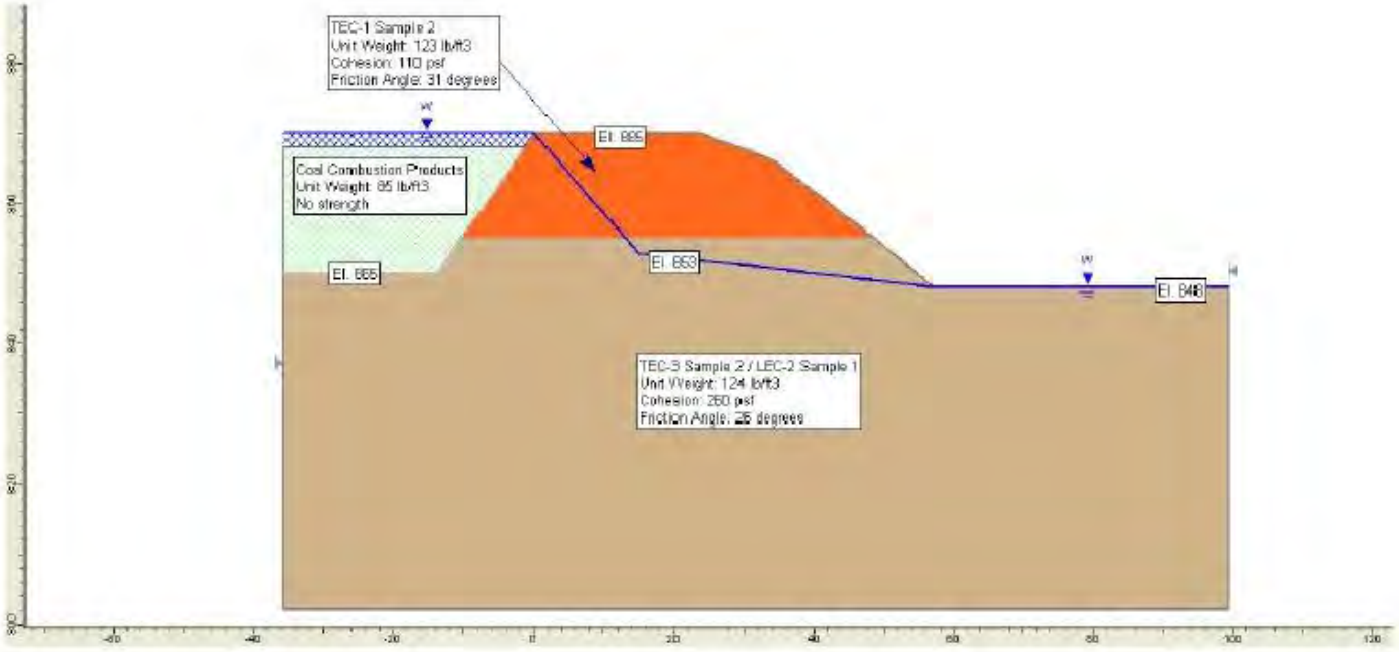
CLIENT: UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

PROJECT: ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS	DWN BY: CAE	DATUM:	DATE: 11/22/10
TITLE: WESTAR ENERGY TECUMSEH ENERGY CENTER, TECUMSEH, KS 2009 STABILITY ANALYSIS TOPOGRAPHY AND STABILITY CROSS SECTION LOCATIONS	CHK'D BY: MOS	REV. NO.:	PROJECT NO: 3-2106-0183.0001
	PROJECTION:	SCALE: AS SHOWN	FIGURE No. 9

SECTION 1
(AREA 1 POND)



SECTION 2
(AREA 2 POND)



REF: TEC 2009 GOLDER ASH POND STABILITY EVAL REPORT, DATED 11/23/09

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: 11/22/10
TITLE WESTAR ENERGY TECUMSEH ENERGY CENTER, TECUMSEH, KS 2009 STABILITY ANALYSIS CROSS SECTION		CHK'D BY: MOS	REV. NO.:	PROJECT NO: 3-2106-0183.0001
		PROJECTION:	SCALE: AS SHOWN	FIGURE No. 10

REF: TEC 2009 GOLDER ASH POND STABILITY EVAL REPORT, DATED 11/23/09

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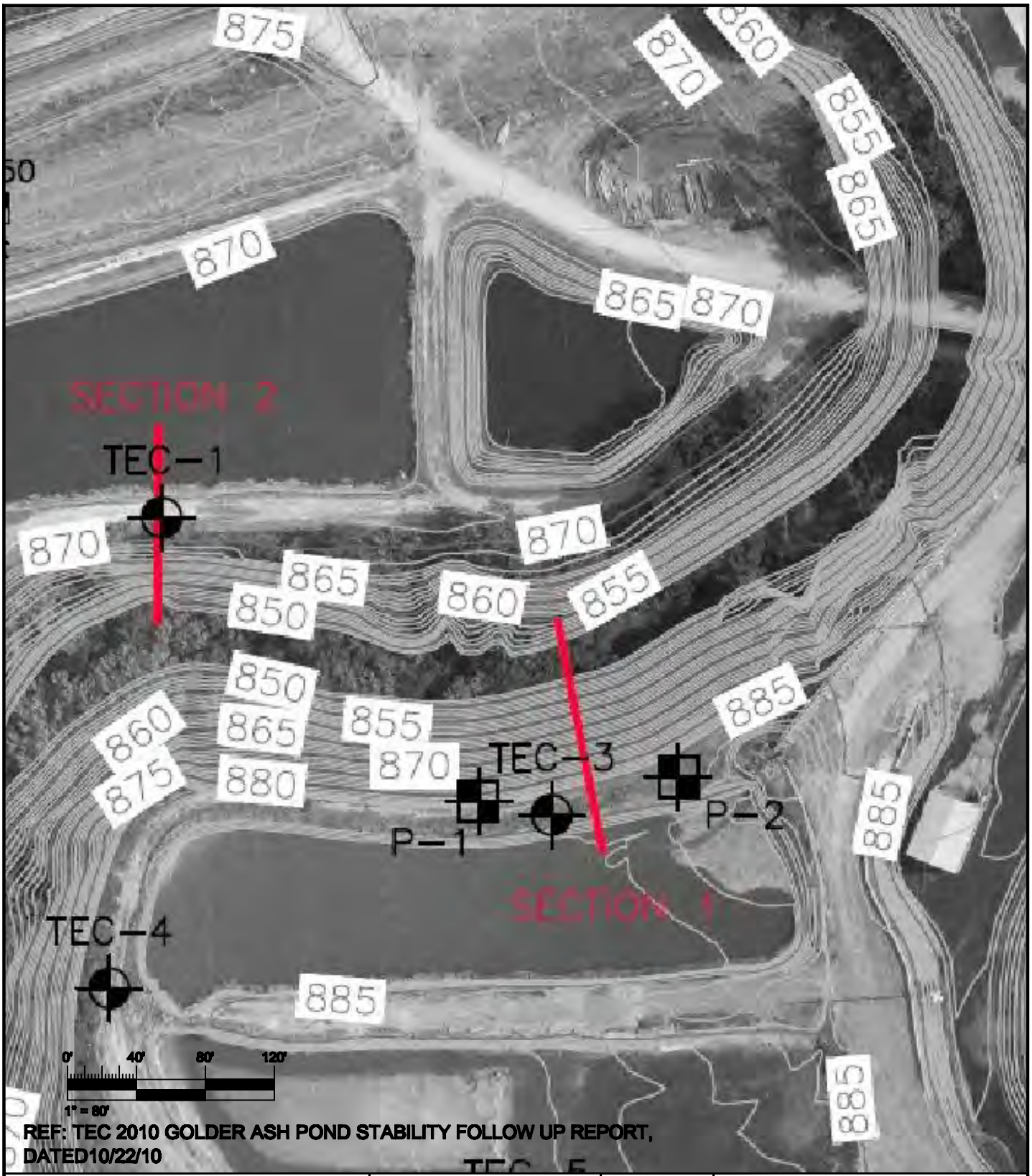
CLIENT LOGO

CLIENT: UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

PROJECT: ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS	DWN BY: CAE	DATUM:	DATE: 11/22/10
TITLE: WESTAR ENERGY TECUMSEH ENERGY CENTER, TECUMSEH, KS 2009 STABILITY ANALYSIS LOCATIONS OF OBSERVED DEFICIENCIES	CHK'D BY: MOS	REV. NO.:	PROJECT NO: 3-2106-0183.0001
	PROJECTION:	SCALE: AS SHOWN	FIGURE No. 11



REF: TEC 2010 GOLDER ASH POND STABILITY FOLLOW UP REPORT, DATED10/22/10

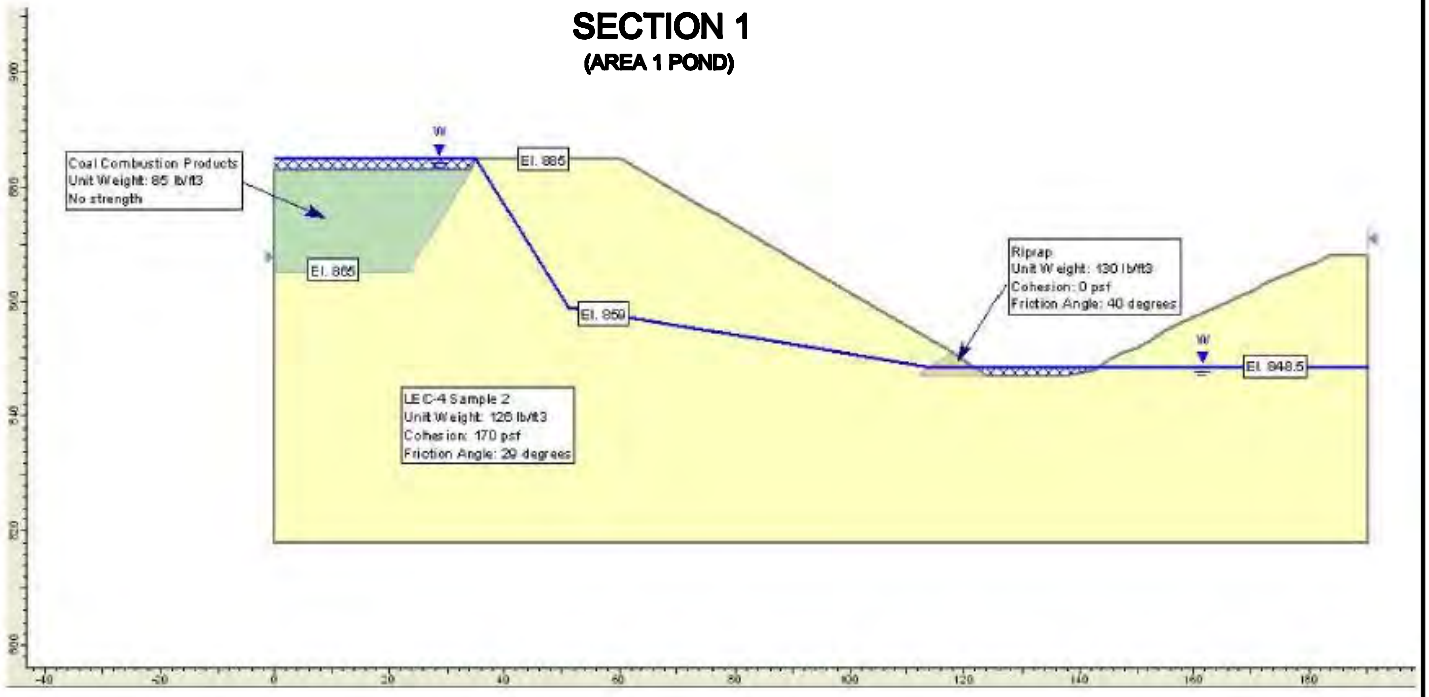
AMEC Earth & Environmental
690 Commonwealth Center
11003 Bluegrass Parkway
Louisville, Ky 40299
(502) 267-0700

CLIENT LOGO

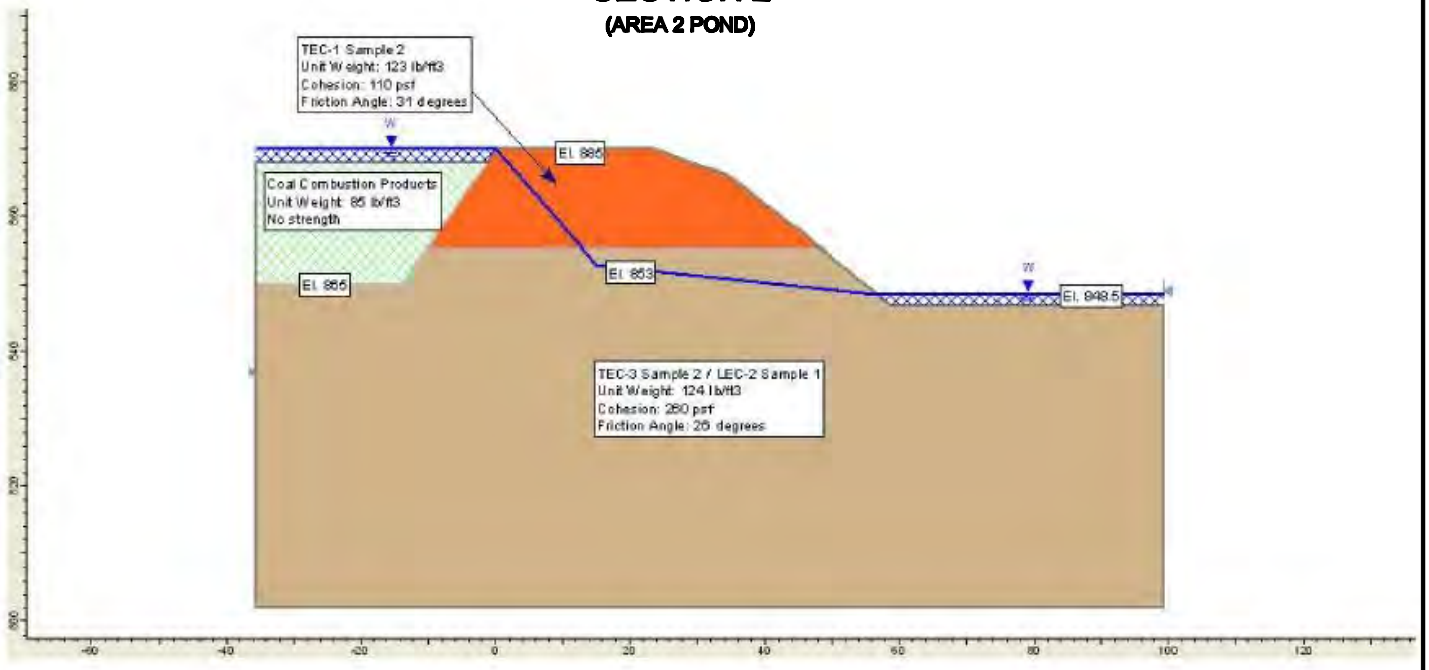
CLIENT: UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

PROJECT: ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS	DWN BY: CAE	DATUM:	DATE: 11/22/10
TITLE: WESTAR ENERGY TECUMSEH ENERGY CENTER, TECUMSEH, KS AREA 1 POND - 2010 NORTH EMBANKMENT REGRADE	CHK'D BY: MOS	REV. NO.:	PROJECT NO: 3-2106-0183.0001
	PROJECTION:	SCALE: AS SHOWN	FIGURE No. 12

SECTION 1
(AREA 1 POND)



SECTION 2
(AREA 2 POND)



REF: TEC 2010 GOLDER ASH POND STABILITY EVAL REPORT, DATED 10/22/10

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

PROJECT: ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS	DWN BY: CAE	DATUM:	DATE: 11/22/10
TITLE: WESTAR ENERGY TECUMSEH ENERGY CENTER, TECUMSEH, KS 2010 STABILITY ANALYSIS CROSS SECTION	CHK'D BY: MOS	REV. NO.:	PROJECT NO: 3-2106-0183.0001
	PROJECTION:	SCALE: AS SHOWN	FIGURE No. 13

CLIENT LOGO

CLIENT: UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

APPENDICES

APPENDIX A
Waste Impoundment Inspection Forms

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name: Tecumseh Energy Center	Date: October 26, 2010
Unit Name: Area 1	Operator's Name: Westar Energy, Inc.
Unit I.D.:	Hazard Potential Classification: High (Significant) Low
Inspector's Name: Don Dotson/AMEC and Mary Sawitzki/AMEC	

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?	See note		18. Sloughing or bulging on slopes?	See note	
2. Pool elevation (operator records)? See note	882.25 ft.		19. Major erosion or slope deterioration?	See note	
3. Decant inlet elevation (operator records)?	882.0 ft.		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)?	885 ft.		Is water exiting outlet, but not entering inlet?		X
6. If instrumentation is present, are readings recorded (operator records)?	N/A		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)?	See	note	From underdrain?	See Note	
9. Trees growing on embankment? (If so, indicate largest diameter below)	X		At isolated points on embankment slopes?	See Note	
10. Cracks or scarps on crest?		X	At natural hillside in the embankment area?	See Note	
11. Is there significant settlement along the crest?		X	Over widespread areas?	See Note	
12. Are decant trashracks clear and in place?	N/A		From downstream foundation area?	See Note	
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		X	"Boils" beneath stream or ponded water?	See Note	
14. Clogged spillways, groin or diversion ditches?		X	Around the outside of the decant pipe?	See Note	
15. Are spillway or ditch linings deteriorated?	N/A		22. Surface movements in valley bottom or on hillside?	See Note	
16. Are outlets of decant or underdrains blocked?		X	23. Water against downstream toe?	See Note	
17. Cracks or scarps on slopes?	See note		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.	Westar does not formally inspect ponds. Westar has plans to institute formal inspection program.
2.	High weir flow 6" (882.5 ft.) Low weir flow 3" (882.25 ft.)
5.	Topography and recent Golder Stability Report show minimum crest elevation between 885 ft. and 885.5 ft.
6.	None - but temporarily installed for Golder's Stability Analysis/Geotechnical Investigation
7.	Just finished bank repair (north) of Ash Pond 1 (Main) 2009 Report/DWGs and 2010 Follow up
8.	Majority of pond is incised, no information provided regarding preparation of any constructed embankment section.
9.	Trees on embankment 18" - 24" diameter
17. – 19. & 21 - 23.	Difficult to determine due to heavy vegetation on embankment and toe of slope.

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # KS0079731 INSPECTOR Don Dotson/Mary Sawitzki (AMEC)

Date October 26, 2010

Impoundment Name Area 1 Pond

Impoundment Company Westar Energy

EPA Region 7

State Agency (Field Office) Address

Name of Impoundment Area 1 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: Receives sluiced coal combustion waste; primarily bottom ash; minor fly ash amounts

Nearest Downstream Town : Name Lecompton, KS

Distance from the impoundment approx. 7 miles

Impoundment Location: Longitude -95 Degrees 34 Minutes 20.6 Seconds
Latitude 39 Degrees 3 Minutes 7.9 Seconds
State KS County Shawnee

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

If So Which State Agency?_____

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

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

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

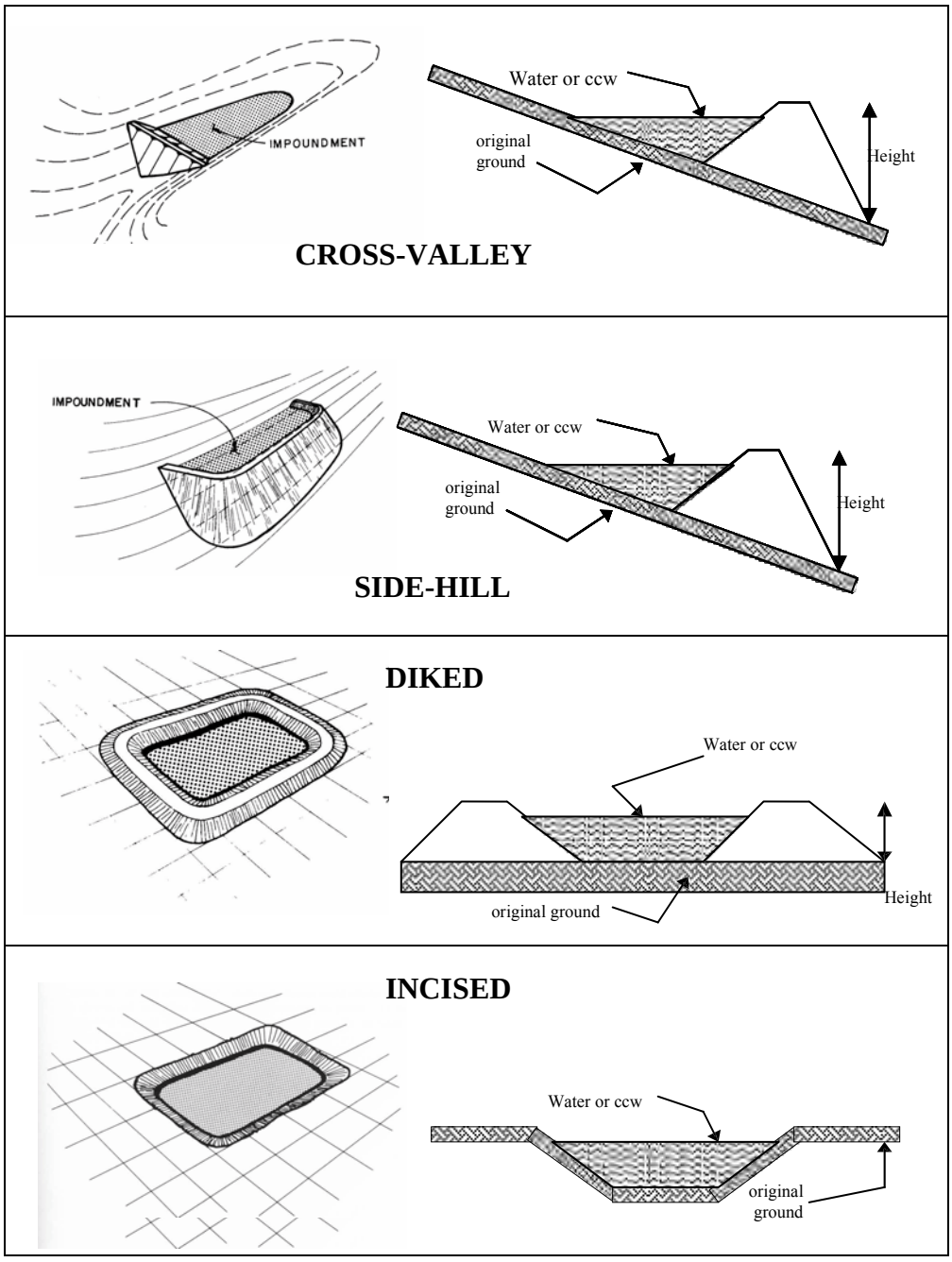
__X__**SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns.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

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

DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

Proximity to Kansas River; also rural homes adjacent to south embankment just outside facility property boundary

CONFIGURATION:



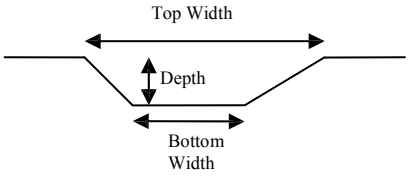
_____Cross-Valley
_____Side-Hill
_____Diked
_____Incised (form completion optional)
__X__Combination Incised/Diked

Embankment Height 36.5 feet Embankment Material Silty clay
Pool Area 2 acres Liner No
Current Freeboard 3 feet Liner Permeability N/A

TYPE OF OUTLET (Mark all that apply)

_____Open Channel Spillway
_____Trapezoidal
_____Triangular
_____Rectangular
_____Irregular

TRAPEZOIDAL



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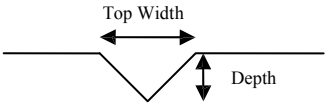
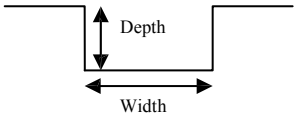
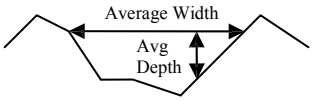


_____depth
_____bottom (or average) width
_____top width

RECTANGULAR

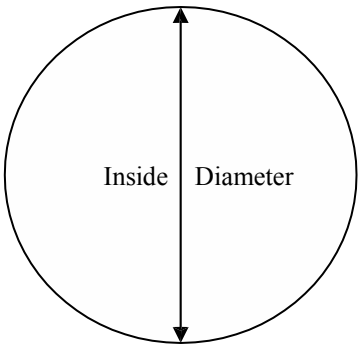


IRREGULAR



_____Outlet

_____inside diameter



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

Is water flowing through the outlet? YES __X__ NO _____

_____No Outlet

__X__**Other Type of Outlet** (specify) Box w/ weir inlet (L= 2 ft.) discharge through 16-inch outlet pipe

The Impoundment was Designed By Kansas Power and Light Company (now Westar Energy)

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

If So When? _____

If So Please Describe : _____

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

If So When? _____

IF So Please Describe: _____

Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site? N/A YES _____ NO _____

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

If so Please Describe : _____

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name: Tecumseh Energy Center	Date: October 26, 2010
Unit Name: Area 2	Operator's Name: Westar Energy, Inc.
Unit I.D.:	Hazard Potential Classification: High **Significant** Low
Inspector's Name: Don Dotson/AMEC and Mary Sawitzki/AMEC	

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?	See note		18. Sloughing or bulging on slopes?	See note	
2. Pool elevation (operator records)?	868.25 ft		19. Major erosion or slope deterioration?	See note	
3. Decant inlet elevation (operator records)?	868 ft		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)?	871 ft		Is water exiting outlet, but not entering inlet?		X
6. If instrumentation is present, are readings recorded (operator records)?	N/A		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)?	See	note	From underdrain?	See Note	
9. Trees growing on embankment? (If so, indicate largest diameter below)	X		At isolated points on embankment slopes?	See Note	
10. Cracks or scarps on crest?		X	At natural hillside in the embankment area?	See Note	
11. Is there significant settlement along the crest?		X	Over widespread areas?	See Note	
12. Are decant trashracks clear and in place?	N/A		From downstream foundation area?	See Note	
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		X	"Boils" beneath stream or ponded water?	See Note	
14. Clogged spillways, groin or diversion ditches?		X	Around the outside of the decant pipe?	See Note	
15. Are spillway or ditch linings deteriorated?	N/A		22. Surface movements in valley bottom or on hillside?	See Note	
16. Are outlets of decant or underdrains blocked?	No		23. Water against downstream toe?	See Note	
17. Cracks or scarps on slopes?	See note		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. Westar does not formally inspect ponds. Westar has plans to institute formal inspection program.

8. Majority of pond is incised, no information provided regarding preparation of any constructed embankment section

9. Trees present 18" - 24" diameter

17-19 & 21-23 Difficult to determine due to heavy vegetation on embankment and toe of slope.

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # KS0079731 INSPECTOR Don Dotson/Mary Sawitzki

Date October 26, 2010

Impoundment Name Area 2

Impoundment Company Westar Energy

EPA Region 7

State Agency (Field Office) Address

Kansas Dept. of Health and Environmental	USEPA Region 7
1000 SW Jackson	901 N. 5th
Topeka, KS 66612	Kansas City, KS 66101

Name of Impoundment Area 2 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: Receives decant from Area 1 Pond, Discharges to NPDES outfall ID 002X1

Nearest Downstream Town : Name Lecompton, KS

Distance from the impoundment approx. 7 miles

Impoundment Location: Longitude -95 Degrees 34 Minutes 22.2 Seconds
Latitude 39 Degrees 3 Minutes 11.2 Seconds
State KS County Shawnee

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

If So Which State Agency? Only for NPDES standpoint

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

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

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

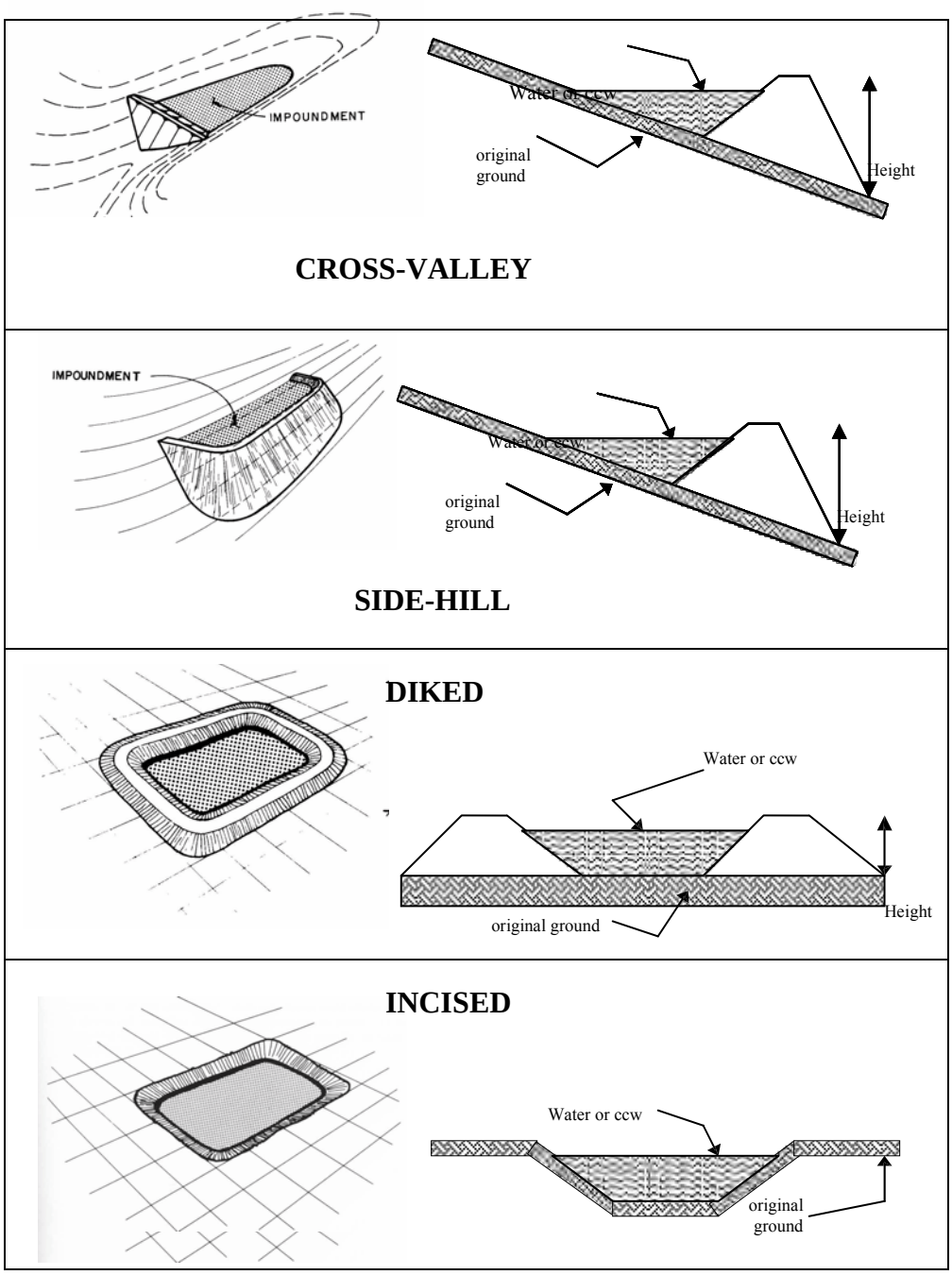
_____**SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns.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

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

DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

Area 2[1] Pond contains decant from Area 1 Pond; does not receive directly discharged CCW. Pond does not present hazard to rural homes that are located adjacent to Area 1 Pond.

[1]Corrected from originally submitted copy and copy submitted with November 2010 Draft Report. Previously read "Area 1 Pond contains…..



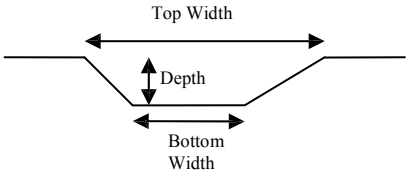
_____Cross-Valley
_____Side-Hill
_____Diked
_____Incised (form completion optional)
__X__Combination Incised/Diked

Embankment Height __22_____feet Embankment Material__Silty Clay_____
Pool Area _____1_____ acres Liner _____No_____
Current Freeboard _____3_____ feet Liner Permeability _____N/A_____

TYPE OF OUTLET (Mark all that apply)

_____Open Channel Spillway
_____Trapezoidal
_____Triangular
_____Rectangular
_____Irregular

TRAPEZOIDAL



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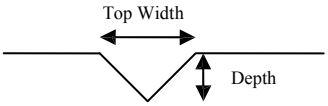

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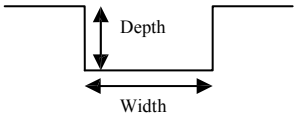

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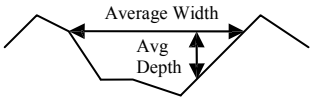
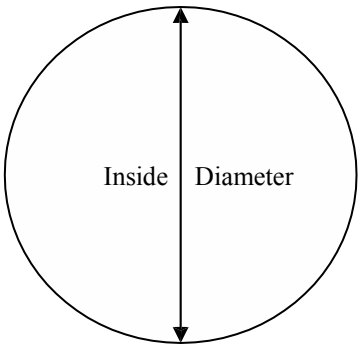


_____Outlet

_____inside diameter



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

Is water flowing through the outlet? YES __X__ NO _____

_____No Outlet

__X__**Other Type of Outlet** (specify) Box w/ weir inlet discharge through 21-inch outlet pipe

The Impoundment was Designed By Kansas Power and Light Company (now Westar Energy)

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

If So When? _____

If So Please Describe : _____

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

If So When? _____

IF So Please Describe: _____

Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site? N/A YES _____ NO _____

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

If so Please Describe : _____

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: UTM 15
Scale: As Shown

ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

TECUMSEH ENERGY CENTER, TECUMSEH, KS
PHOTO LOCATION MAP

REV. No.: A
Date: 11-9-10
Project No: 3-2106-0183-0001
Figure No: B-1

1-1
CENTRAL EAST SIDE LOOKING SOUTH

1-2
CENTRAL EAST SIDE LOOKING SOUTHWEST

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(502) 267-0700

CLIENT LOGO

CLIENT: UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

PROJECT: ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

TITLE: WESTAR ENERGY
TECUMSEH ENERGY CENTER, TECUMSEH, KS
AREA 1 PHOLO LOGS

DWN BY:	DATUM:	DATE:
CAE		11/15/10
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MOS		3-2106-0183.0001
PROJECTION:	SCALE:	APPENDIX:
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1-3

CENTRAL EAST SIDE LOOKING WEST ALONG DIVIDING DIKE

1-4

CENTRAL EAST SIDE LOOKING NORTHWEST

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1-5

CENTRAL EAST SIDE LOOKING NORTH (UPSTREAM) AT SLUICED ASH INFLUENT CHANNEL

1-6

LOOKING NORTH AT AREA 1 DISCHARGE STRUCTURE

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		PROJECTION:	SCALE: AS SHOWN	APPENDIX: B-4

1-7
OUTELT STRUCTURE WEIR PLATE

1-8
CENTRAL WEST SIDE LOOKING NORTH

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		PROJECTION:	SCALE: AS SHOWN	APPENDIX: B-5

1-9
CENTRAL WEST SIDE LOOKING NORTHEAST

1-10
CENTRAL WEST SIDE LOOKING EAST ALONG DIVIDING DIKE

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	PROJECTION:	SCALE: AS SHOWN	APPENDIX: B-6

1-11
CENTRAL WEST SIDE LOOKING SOUTH

1-12
CENTRAL WEST SIDE LOOKING WEST AT TREES ON UPSTREAM SLOPE OUTSIDE FENCE

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	PROJECTION:	SCALE: AS SHOWN	APPENDIX: B-7

1-13

LOOKING NORTHEAST FROM NORTH CREST AT TECUMSEH CREEK AND AREA OF TREE/VEGETATION REMOVAL AND REPAIR ON DOWNSTREAM SLOPE

1-14

LOOKING SOUTH AT AREA 1 NORTH EMBANKMENT DOWNSTREAM REPAIR

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		PROJECTION:	SCALE: AS SHOWN	APPENDIX: B-8

1-15

TREES AND VEGETATION ADJACENT TO KPDES
OUTFALL IN UPPER AREA OF SOUTH AREA 2 EMBANKMENT

1-16

LOOKING SOUTHWEST AT AREA 1 NORTH EMBANKMENT
DOWNSTREAM SLOPE REPAIR AREA

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TECUMSEH ENERGY CENTER, TECUMSEH, KS
AREA 1 PHOLO LOGS

DWN BY:	DATUM:	DATE:
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1-17

LOOKING NORTH AT TREES/VEGETATION ON DOWNSTREAM TOE OF SOUTHWEST EMBANKMENT

1-18

LOOKING EAST ALONG SE 2ND STREET AND DOWNSTREAM TOE OF SOUTHERN EMBANKMENT SLOPE

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TECUMSEH ENERGY CENTER, TECUMSEH, KS
AREA 1 PHOLO LOGS

DWN BY:	DATUM:	DATE:
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PROJECTION:	SCALE:	APPENDIX:
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1-19
STUMP ON DOWNSTREAM EMBANKMENT FACE

1-20
STUMP ON DOWNSTREAM EMBANKMENT FACE

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CHK'D BY:	REV. NO.:	PROJECT NO:
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PROJECTION:	SCALE:	APPENDIX:
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1-21
ROADWAY SWALE AT DOWNSTREAM EMBANKMENT TOE OF SLOPE

2-22
STUMP ON DOWNSTREAM EMBANKMENT FACE

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	PROJECTION:	SCALE: AS SHOWN	APPENDIX: B-12

2-1

LOOKING NORTH FROM NORTH CREST AT TECUMSEH CREEK AND AREA 2 SOUTHEMBANKMENT AND KPDES DISCHARGE OUTFALLS

2-2

LOOKING NORTH FROM NORTH CREST AT AREA 2 SOUTH EMBANKMENT AND EXISTING VEGETATION AND TREE COVER

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TITLE: WESTAR ENERGY
TECUMSEH ENERGY CENTER, TECUMSEH, KS
AREA 2 PHOLO LOGS

DWN BY:	DATUM:	DATE:
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2-3

LOOKING NORTH FROM AREA 1 NORTH CREST TO AREA 2 KPDES (DISCHARGING ON LEFT) AND COAL PILE RUNOFF POND (RIGHT) OUTFALLS

2-4

AREA 2 KPDES OUTFALL FROM ABOVE

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	PROJECTION:	SCALE: AS SHOWN	APPENDIX: B-14	

2-5
VEGETATION AND TREES ADJACENT TO KPDES OUTFALL

2-6
LOOKING WEST ALONG SOUTHERN EMBANKMENT CREST AT AREA 2 DECANT STRUCTURE

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AREA 2 PHOLO LOGS

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2-7
LOOKING NORTHWEST ACROSS POND

2-8
LOOKING NORTH AT DIVIDING DIKE BETWEEN AREA 2 AND COAL PILE RUNOFF POND

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	PROJECTION:	SCALE: AS SHOWN	APPENDIX: B-16

2-9

LOOKING NORTHEAST ALONG SOUTHERN EMBANKMENT OF COAL PILE RUNOFF POND-CONTINUATION OF AREA 2 SOUTHERN DOWNSTREAM EMBANKMENT

2-10

INFLUENT PIPE DISCHARGING DECANT FROM AREA 1 OUTFALL STRUCTURE

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		PROJECTION:	SCALE: AS SHOWN	APPENDIX: B-17

2-11

LOOKING WEST AT WESTERN EMBANKMENT, CREST, AND EXISTING TREES/VEGETATION

2-12

LOOKING NORTH ACROSS WESTERN AREA OF POND-CONCRETE CINDER PIT EMERGENCY OVERFLOW STRUCTURE VISIBLE AT BACK RIGHT

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2-13

LOOKING EAST ACROSS POND AND SOUTHERN EMBANKMENT CREST-TREES AND VEGETATION VISIBLE ON DOWNSTREAM EMBANKMENT

2-14

LOOKING SOUTHEAST TOWARD AREA 1 AT AREA 1 DECANT PIPE

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2-15
LOOKING EAST AT TREES/VEGETATION ON SOUTHERN DOWNSTREAM EMBANKMENT

2-16
LOOKING SOUTHWEST AT TREES/VEGETATION OUTSIDE DOWNSTREAM EMBANKMENT

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	PROJECTION:	SCALE: AS SHOWN	APPENDIX: B-20	

2-17
LOOKING SOUTHWEST FROM NORTH EMBANKMENT

2-18
LOOKING NORTH AT RAILROAD TRACKS AND EMBANKMENT THROUGH PROPERTY BOUNDARY FENCE

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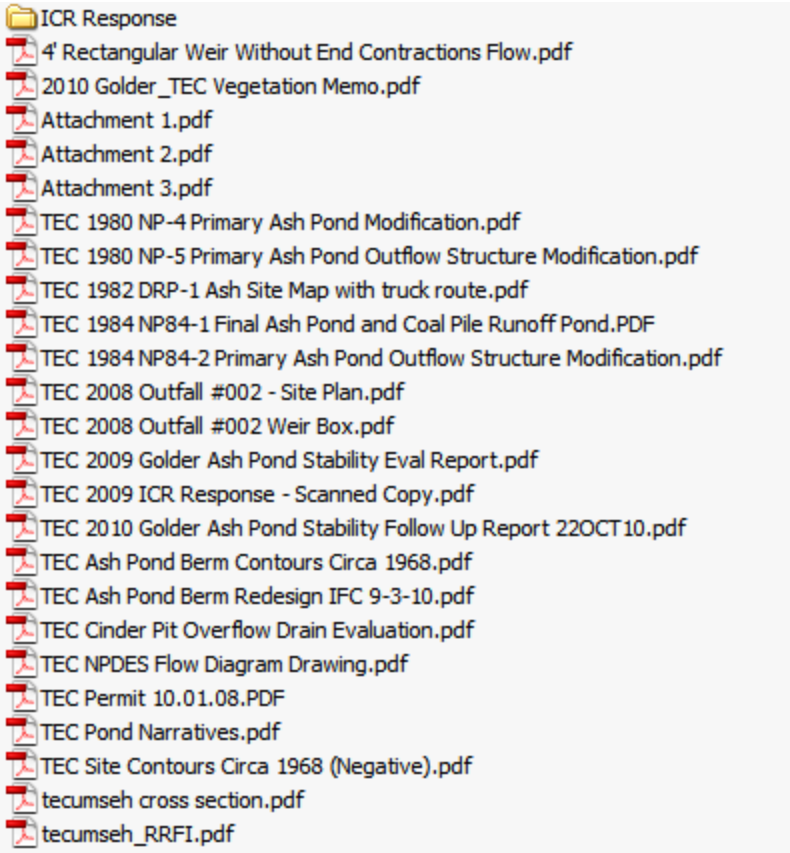
		PROJECTION:	SCALE: AS SHOWN	APPENDIX: B-21

APPENDIX C
Inventory of Provided Materials



Comments Regarding Draft Report of Dam Safety Assessment of Coal Combustion Surface Impoundments Tecumseh Energy Center, by Westar Energy, dated February 18, 2011

Comments on Draft Assessment Report, by EPA, and Kansas Dept. of Health and Environment, February 24, 2011