

Emergency Action Plan for the
Fly Ash Dams I and II and
Bottom Ash/Reclaim Dikes

Cardinal Operating Company
306 County Road 7E
Brilliant, Ohio 43913

June 2021

EMERGENCY ACTION PLAN
FOR THE FLY ASH DAMS I AND II
AND BOTTOM ASH/RECLAIM DIKES
CARDINAL OPERATING COMPANY

ODNR File Nos. 0205-009, 0205-010 & 0105-004

I certify to the best of my knowledge, information, and belief that the information contained in this Emergency Action Plan meets the requirements of 40 CFR 257.73(a)(3).

June 2021



Francis S. Brezny
June 1, 2021

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C	Site-Specific Data
D	Preparation and Approval of the EAP
E	Distribution List/Acknowledgement

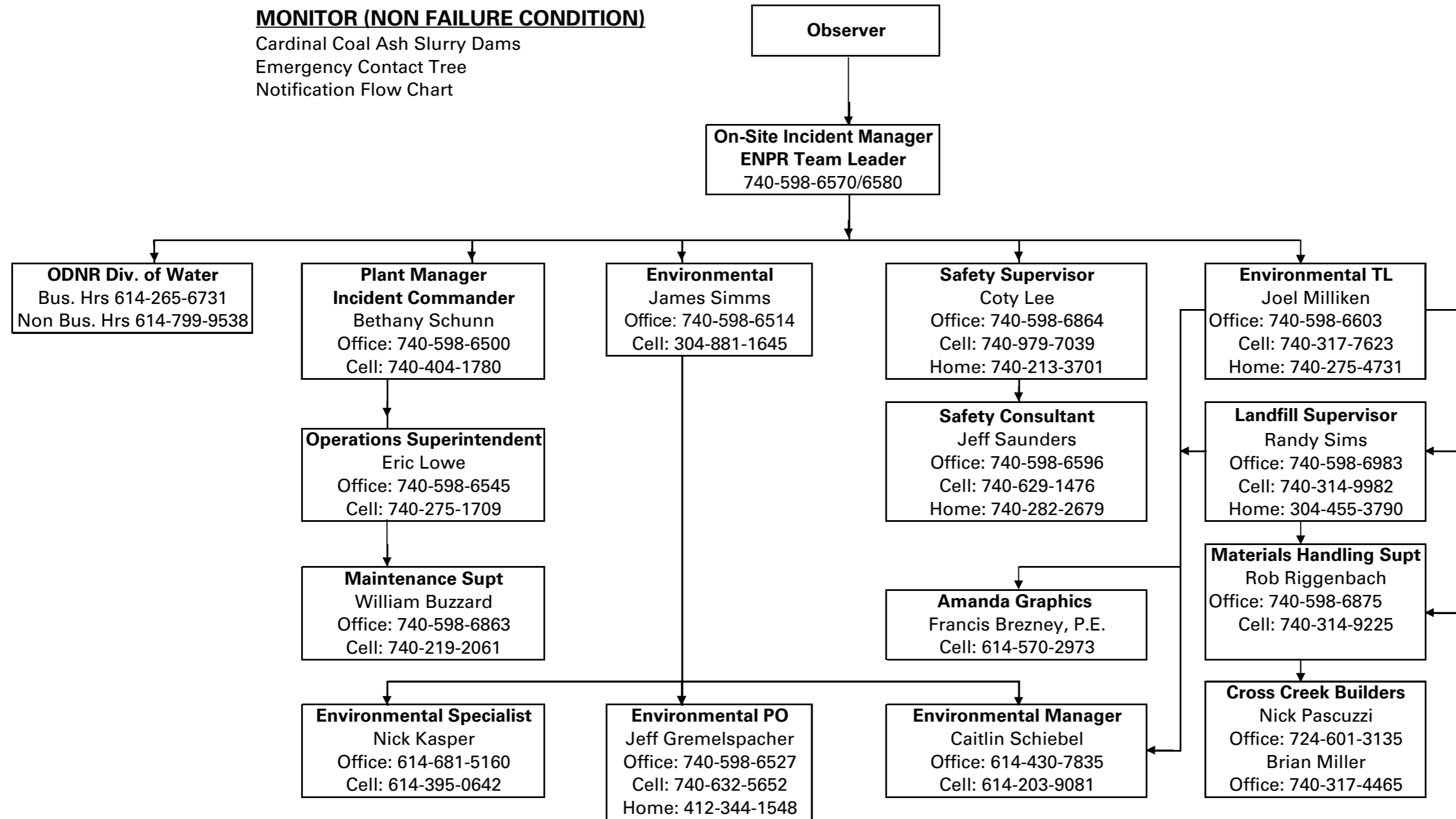
EXHIBIT 1: Monitor Notification Flowchart (Applies to all Cardinal dams & dikes)

CARDINAL PLANT EMERGENCY NOTIFICATION FLOWCHART

EXHIBIT - 1

MONITOR (NON FAILURE CONDITION)

Cardinal Coal Ash Slurry Dams
Emergency Contact Tree
Notification Flow Chart



NOTES:

EMERGENCY CONDITIONS

MONITOR: NON-FAILURE EMERGENCY

WATCH: POTENTIAL FAILURE EMERGENCY

WARNING: IMMINENT FAILURE OR FAILURE HAS OCCURRED EMERGENCY

Section 4.0 of this EAP provides further descriptions of these conditions

*SERC - State Emergency Response Commission

** EMA - Emergency Management Agency

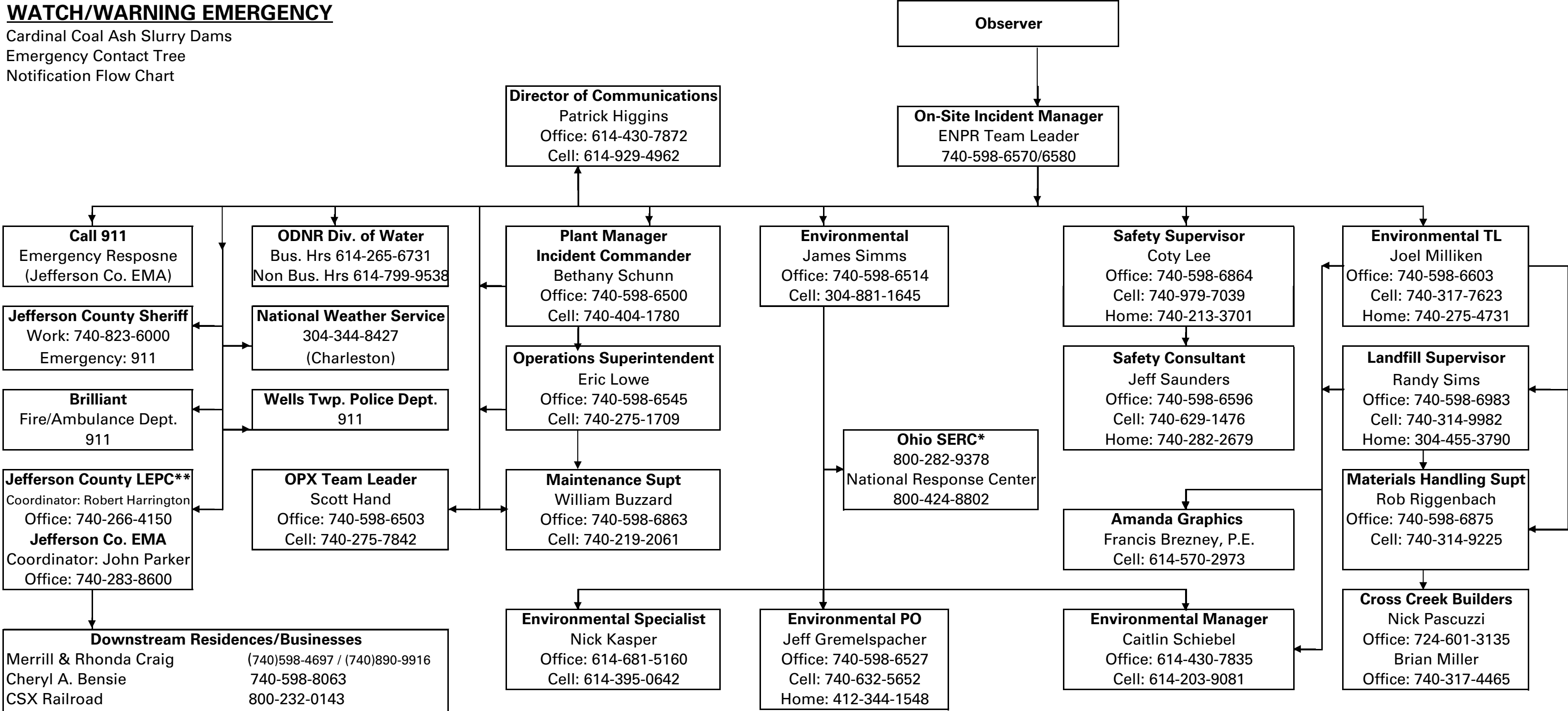
LEPC - Local Emergency Planning Committee

EXHIBIT 2: Watch and Warning Notification Flowchart (Applies to all Cardinal dams & dikes)

CARDINAL PLANT EMERGENCY NOTIFICATION FLOWCHART

EXHIBIT - 2
WATCH/WARNING EMERGENCY

Cardinal Coal Ash Slurry Dams
 Emergency Contact Tree
 Notification Flow Chart



Downstream Residences/Businesses	
Merrill & Rhonda Craig	(740)598-4697 / (740)890-9916
Cheryl A. Bensie	740-598-8063
CSX Railroad	800-232-0143
Katmai Corp.	740-598-8220
M. L. Lebane	740-598-3149
Coen Oil Company	740-223-5500
Ohio American Energy, Inc.	740-598-4325
Ohio Education Association	740-598-3561
Richard Devore	740-314-2000
Steel Valley Tank Welding	740-598-4994
Wheeling & Lake Erie Railroad	Yardmaster (330) 767-3364 (24hrs)
Norfolk Southern Railroad	800-453-2530

Estimated time of flood arrival 5 mintues.
 Estimated time of peak flood flow 20-25 minutes.

NOTES:
 EMERGENCY CONDITIONS
 MONITOR: NON-FAILURE EMERGENCY
 WATCH: POTENTIAL FAILURE EMERGENCY
 WARNING: IMMINENT FAILURE OR FAILURE HAS OCCURRED EMERGENCY
 Section 4.0 of this EAP provides further descriptions of these conditions

*SERC - State Emergency Response Commission
 ** EMA - Emergency Management Agency
 LEPC - Local Emergency Planning Committee

1.0 NOTIFICATION FLOWCHART

1.1 General

Exhibits 1 and 2 are the Notification Flowcharts for potential emergency conditions at the Cardinal Plant's fly ash and bottom ash dams located in Jefferson County, Ohio. The plant is co-owned by Buckeye Power and American Electric Power (AEP) and is operated by the Cardinal Operating Company. The Notification Flowchart provides the hierarchy for notification in the event of an emergency for the following conditions:

- Monitor: Non-failure Emergency Condition.
- Watch: Potential Failure Condition.
- Warning: Imminent Failure or Failure Has Occurred Condition.

Section 4.0 of this Emergency Action Plan (EAP) provides further descriptions of these conditions.

1.2 Sample Messages

In the event of an emergency condition at the dam, the following notifications shall be made. Sample messages are provided below to expedite transfer of accurate and timely information in the event of such a situation. Underlined items are provided to indicate where information specific to the caller or call must be given.

1.2.1 Monitor - Non-failure Emergency Condition

- A. Standby Alert Notification from Cardinal Operating Company to Ohio Department of Natural Resources (ODNR). "This is (your name) from Cardinal Operating Company. I am calling to advise you that we are starting constant surveillance of our Cardinal facility's (Fly Ash Dam [FAD] I or II, Bottom Ash Dike [pick one]) according to our EAP due to a non-failure emergency condition at the dam. At this time, we do not anticipate that the dam will fail, but are notifying you so you are aware of the situation. We will call you again if the condition worsens, if a decision to evacuate is made, or when cancellation of this standby alert has been made." *(Note, be prepared to provide additional information to ODNR regarding the nature of the emergency condition.)*

1.2.2 Watch – Potential Failure Condition

- A. Notification from Cardinal Operating Company to Jefferson County Emergency Management (911). “This is (your name) from Cardinal Operating Company. I am calling to notify you that we have a potential failure condition of our Cardinal facility’s (Fly Ash Dam [FAD] I or II, Bottom Ash Dike [pick one]). Please note that this is NOT presently an evacuation situation and we will call again if it becomes necessary to evacuate potential flood prone areas.”

This paragraph (section 1.2.2.e) is included here for immediate reference: Notification from “911” to Jefferson County Sheriff/ Brilliant Fire Department. “This is (your name) of “Jefferson County Emergency Management Agency (EMA). I am calling to notify you that there is a potential failure condition at the Cardinal Plant’s (Fly Ash Dam [FAD]I or II, Bottom Ash Dike [pick one]). We have been directed to notify you that “a potential failure condition exists at the dam so that you can be prepared if an evacuation notice is issued. Please note this is NOT presently an evacuation situation and we will call again if it becomes necessary to evacuate potential flood prone areas. *Please check your agency’s copy of the dam’s EAP, specifically Appendix A, for a map of potential flooded areas in case an evacuation order is given. This map indicates areas which may be flooded and would require evacuation should it become necessary. Again, this is NOT an evacuation condition at this time.*

In case this develops to an Imminent Failure or Failure Has Occurred Condition (Warning)” *I am calling to notify you that an evacuation order for the Cardinal Plant’s (Fly Ash Dam [FAD] II, Bottom Ash Dike [pick one]) downstream flooding area was given by Cardinal Operating Company at (time). Please mobilize the emergency response services according to the EAP. A map of potentially flooded areas is in Appendix A of the dam’s EAP. You can use the map to determine areas from which people should be evacuated. Again, we are asking you to begin the evacuations immediately.”*

- B. Notification from Cardinal Operating Company to ODNR. “This is (your name) at Cardinal Operating Company. I am calling to notify you that a potential failure condition exists at the Cardinal facility’s (Fly Ash Dam [FAD] II, Bottom Ash Dike [pick one]). We have initiated notifications according to our EAP. We will call you again to inform you if the condition worsens, if a decision to evacuate is made, or

when cancellation of this standby alert has been made.” *(Note, be prepared to provide additional information to ODNR regarding the nature of the emergency condition.)*

- C. National Weather Service (NWS) Forecast Center. If the emergency is related to a precipitation event, contact the NWS to determine NWS’s forecast of total rainfall. The telephone number for the NWS Forecast Office in Pittsburgh, Pennsylvania is (412) 262-1882 and it is answered 24 hours per day, 7 days per week.

If conditions at the dam worsen and the emergency changes to a Warning, NWS should be contacted again because they can rapidly issue warnings for downstream evacuation over public broadcast stations.

- D. Potential Evacuation Notification from Cardinal Operating Company to Contractors. “This is (your name) at the Cardinal Plant. I am calling to notify you that a potential failure condition exists at our (Fly Ash Dam [FAD] I or II, Bottom Ash Dike [pick one]), which may require your assistance. I am calling to notify you so that you are aware of the potential failure condition of the dam so preparation measures can be taken. Please note this is NOT presently a failure situation and we will call again if the situation worsens.” *As needed, please add “Your services are needed at this time.” (Note, be prepared to provide additional information to the contractors regarding the nature of the emergency condition and the types of equipment and materials that may be needed.)*
- E. Notification from “911” to Jefferson County Sheriff/ Brilliant Fire Department. “This is (your name) of “Jefferson County Emergency Management Agency (EMA). I am calling to notify you that there is a potential failure condition at the Cardinal (Fly Ash Dam [FAD] II, Bottom Ash Dike [pick one]). We have been directed to notify you that a potential failure condition exists at the dam so that you can be prepared if an evacuation notice is issued. Please note this is NOT presently an evacuation situation and we will call again if it becomes necessary to evacuate potential flood prone areas. Please check your agency’s copy of the dam’s EAP, specifically Appendix A, for a map of potential flooded areas in case an evacuation order is given. This map indicates areas which may be flooded and would require evacuation should it become necessary. Again, this is NOT an evacuation condition at this time.”

1.2.3 Warning - Imminent Failure or Failure Has Occurred Condition

- A. Notification from Cardinal Operating Company to "911." "This is (your name) at the Cardinal Plant in Jefferson County. I am calling to notify you that failure of our (Fly Ash Dam [FAD] II, Bottom Ash Dike [pick one]) is imminent/has occurred. Please notify all available emergency personnel according to the EAP for the dam. Specific details can be found in the Notification Flowchart, Exhibit 2 in the EAP. Evacuation of flood prone areas downstream of the dam as shown in the EAP should be started immediately."
- B. Notification from Team Manager to Energy Production Manager. "This is (your name) at the plant. I am calling to notify you that failure of the (Fly Ash Dam [FAD] II, Bottom Ash Dike [pick one]) is imminent/has occurred. Please get your staff out of the potentially flooded areas and come to (state location) to assist us." *(Be prepared to indicate the personnel and equipment that may be needed.)*
- C. Notification from Cardinal Operating Company to ODNR. "This is (your name) at the Cardinal Plant. I am calling to notify you that failure of our (Fly Ash Dam [FAD] II, Bottom Ash Dike [pick one]) is imminent/has occurred. We have already notified "911" according to the EAP for the dam. We have told them that evacuation of flood prone areas (as shown in the EAP) should be started immediately." *(Note, be prepared to provide additional information to ODNR regarding the nature of the emergency condition.)*
- D. National Weather Service in Pittsburgh. Contact the NWS to notify them of the emergency condition at the dam. Request that the NWS issue warnings over public broadcast stations (i.e., television, radio, weather radio) alerting the public to the failure condition and to immediately evacuate the area downstream and to beware of rapidly rising water levels in the Blockhouse Run and/or Ohio River.
- E. Notification from Cardinal Operating Company to Local Contractors. "This is (your name) at the Cardinal plant. I am calling to notify you that an evacuation order for the Cardinal Plant's (Fly Ash Dam [FAD] II, Bottom Ash Dike [pick one]) downstream flooding area was given by Cardinal Operating Company at (time). Your services are needed at this time. Please respond as quickly as possible." *(Note, be prepared to provide additional information to the contractors regarding the nature of the emergency*
-

condition, the types of equipment and materials that may be needed, and where they should assemble.)

- F. Notification from “911” to the Jefferson County Sheriff/Brilliant Fire Department. “This is (your name) of “the Jefferson County EMA. I am calling to notify you that an evacuation order for Cardinal’s (Fly Ash Dam [FAD] II, Bottom Ash Dike [pick one]) downstream flooding area was given by Cardinal Operating Company at (time). Please mobilize the emergency response services according to the EAP. A map of potentially flooded areas is in Appendix A of the dam’s EAP. You can use the map to determine areas from which people should be evacuated. Again, we are asking you to begin the evacuations immediately.”
- G. Evacuation Notification by Sheriff and Fire Department to Residents. “An evacuation order for the (Fly Ash Dam [FAD] II, Bottom Ash Dike [pick one]) flood prone area has been given. Please evacuate this area to higher ground immediately. This is an emergency. Please leave now!”

1.3 Resident Notification List

The dam break flood inundation evaluation provides a conservative estimate of the flooding in the event of a failure of the fly ash reservoir (FAR) II dam. The flood inundation map in Appendix A delineates the flooding limits based upon the peak elevations at the respective locations below fly ash dam II. The floodplain consists of Blockhouse Hollow, State Route 7, County Road 7E, two railroads and Cardinal Plant Property. Also contained within the floodplain are four houses and six other businesses. Shallow flooding may be expected outside the limits shown on the inundation map due to the expansion of the water as it loses momentum after the peak elevations have been obtained. The flood inundation notification list below provides the plant and local authorities with information that will assist evacuation and the anticipated road closures.

Resident Evacuation

Name	Address	Telephone No.
Mr. & Mrs. Richard Devore	1641 Hukill Street Brilliant, OH 43913	(740) 314-2000
Ms. Mary. L. Leblanc	1638 Gilchrist Street Brilliant, OH 43913	(740) 598-3149
Merrill & Rhonda Craig	1635 Gilchrist Street Brilliant, OH 43913	(740) 598-4697 (740) 890-9916
Ms. Cheryl A. Bencie	1535 Gilchrist Street Brilliant, OH 43913	(740) 598-8063
Katmai Corp.	34 Kelley Way Brilliant, OH 43913	(740) 598-8220
Ohio American Energy, Inc.	34 Kelley Way Brilliant, OH 43913	(740) 598-4325
Steel Valley Tank Welding	24 County Road 7E Brilliant, OH 43913	(740) 598-4994
Coen Oil Company	1499 Third Street Brilliant, OH 43913	Store: 740-598-1400 Corporate: (724) 223-5500
CSX Railroad		(800) 232-0143
Wheeling & Lake Erie Railroad		Yardmaster (330) 767-3364 (24 hrs)
Norfolk and Southern		800-453-2530

Estimated time of flood arrival 5 minutes

Estimated time of peak flood flow 20-25 minutes

*These listings are current 5/3/2021

2.0 STATEMENT OF PURPOSE

The purpose of this document is to establish the notification procedures for the rapid implementation of emergency action to be taken prior to and/or following a failure of fly ash dam II and the bottom ash pond complex at the Cardinal Generating Plant. This document also provides for monitoring of the dams under various conditions so that an emergency situation at the complex will be observed promptly and reported to the appropriate personnel and agencies.

The objective of this EAP is to safeguard lives and to reduce damage to the property of the citizens of Jefferson County who live or are traveling in close proximity to the fly ash and bottom ash dams and the Cardinal Generating Plant in the Brilliant, Ohio vicinity in the event of failure of the Cardinal Plant's coal ash slurry dams, or flooding caused by large flow releases from the dams. The EAP was prepared to meet the requirements of CCR Rule 40.257.73(a)(3) and Ohio Administrative Code (OAC) 1501:21-15-07 and 1501:21-21-04 and as further detailed in ODNR's EAP Guidelines.

This EAP supersedes any and all EAPs previously utilized by the plant.

3.0 PROJECT DESCRIPTION

3.1 General

Fly Ash Dam I (FAD I), Fly Ash Dam II (FAD II), and the bottom ash pond complex are owned by Buckeye Power and AEP and operated by Cardinal Operating Company. They are located near the Cardinal Power Plant in Wells Township, Jefferson County, near Brilliant, Ohio. The Cardinal FAD I and FAD II are located approximately 1 mile northwest of the Cardinal Power Plant. The bottom ash pond complex is located at the southern end of the Cardinal power plant. The ponds were constructed for the settling/sedimentation and collection/storage of coal combustion byproducts. Exhibit 3 shows the FAD II and bottom ash pond complex in relation to the Cardinal Plant and Exhibit 4 shows FAD I and FAD II.

3.2 Fly Ash Dam I

Cardinal Fly Ash Dam I (FAD I) is the plant's original fly ash retention dam constructed in the early 1970s. The dam is an earth and rockfill dam having a final design crest elevation of 1001.5 feet. The dam has upstream (u/s) and downstream (d/s) slopes of approximately 2.5 Horizontal to 1 Vertical (2.5H:1V). As ash placement behind FAD I reached its maximum allowed level, Cardinal FAD II was constructed and began operation in the late 1980s. Fly Ash Dam I reservoir is closed, no longer receives fly ash slurry, and has no permanent pool. This area has been permitted by the Ohio Environmental Protection Agency (OEPA) as a solid waste landfill (Permit to Install [PTI] Permit No. 06-07993, dated May 11, 2007) for the disposal of synthetic gypsum generated by the air pollution control equipment constructed at the Cardinal plant that captures sulfur dioxide emissions. Flow through FAR I is conveyed to FAR II via the emergency spillway.

3.3 Fly Ash Dam II

Cardinal Fly Ash Dam II (FAD II) is located on Blockhouse Run, which flows directly into the Ohio River. Blockhouse Run splits into two branches, designated as the East Branch and the West Branch. The split in Blockhouse Run is approximately one mile upstream of the Ohio River. Runoff from both the east and west branch watersheds drains into the reservoir. The reservoir would cover approximately 168 acres at Elevation 974, the maximum operating pool elevation.

Fly Ash Reservoir II (FAR II), created by FAD II, is utilized for the storage of fly ash, which is discharged as slurry from discharge pipes located at the upstream (north) end of the reservoir as shown on Exhibit 4. The fly ash settles out within the reservoir as the water flows toward the dam where the effluent overflows through the service spillway (overflow structure). Stop logs are placed in the discharge shaft of the overflow structure raising the pool level as necessary to maintain settling action or to limit discharge.

The dam consists of a 250-foot high arched embankment with a 13 ft high mechanically stabilized earth (MSE) Wall on top of the roller compacted concrete (RCC) cap on the upper 50 feet of the upstream face of the dam. An emergency spillway on the left abutment is an open channel cut through rock. The dam has a crest elevation of 983 feet, a width of 22 feet and a length of 1,600 feet. The dam is designed for a storage capacity of 11,868 acre-feet with stop logs at elevation 972.5 feet MSL and with a corresponding maximum operating pond elevation of 974 feet. Table 1 summarizes pertinent information for FAD II.

The Service spillway is a vertical concrete shaft structure with a 4-foot wide opening on one side. The spillway shaft is connected to the existing inclined spillway structure. The spillway structure drains into a 54-inch diameter Prestressed Concrete Cylinder Pipe (P.C.C.P.), which then ties into a 42-inch steel pipe extending down the dam. The existing energy dissipator (Impact Basin) at the outlet of the steel pipe is utilized. During most of the operating conditions, discharge through the service spillway is controlled by weir flow over the stop logs in the opening of the shaft. The discharge through the service spillway is measured via a Parshall Flume located to the south of the FAD II. Fly Ash Reservoir II is expected to initiate closure and start dewatering in June 2021.

Table 1
FAD II Data

Parameter	FAD II
Embankment Crest Elevation (feet)	983
Emergency Spillway Crest Elevation (feet)	975.5
Maximum Operating Pool Level (feet)	974.0
Operating Pool Freeboard (feet)	9
Maximum Stop Log Elevation (feet)	972.5
Surface Area (acres) at Pool Level	161

3.3.1 Fly Ash Dam II Emergency Spillway

The emergency spillway is located on the left abutment and is an open channel cut through rock. The flow capacity of the emergency spillway is designed to pass the Probable Maximum Flood when the reservoir reaches its maximum pond elevation, without overtopping the dam. At intermediate pool levels, floods of lesser magnitude will be discharged through the service spillway.

The fly ash dam is normally unattended and the service spillway structure has no remote controlled system to regulate the flow. Because of the nature of the pond and the design of the dam and service spillway structure, there exists sufficient freeboard to mitigate concerns of overtopping during a rainfall event.

3.3.2 Downstream Effects

There are no dams or residences located above the dam or in the east or west watershed boundaries. There are no dams located downstream that could be operated during an emergency to store flood flows. The Ohio River, Cardinal Plant, State Route 7 and the Tidd-dale subdivision of Brilliant, Ohio, all lie directly downstream of the dam. Therefore, a sudden failure of the dam will likely result in loss of human life and damage to homes, high value utility installations and both a railroad and a public road. The phone numbers for all of the residences with published phone service and the commercial/industrial establishments are included in Section 1.3.

3.4 Bottom Ash Pond Complex

The Bottom Ash Pond Complex is located along the west bank of the Ohio River just to the south of the main plant area. The Bottom Ash Complex at the Cardinal Plant consists of a Bottom Ash Pond (BAP) and a Recirculation Pond (RCP). The bottom ash pond is located north of the recirculation pond, separated by an earthen embankment. Perimeter dikes surround the bottom ash pond complex and are referred to as the bottom ash dike. Flow from the Bottom Ash Pond is directed to the RCP. The exterior dike crest elevation is 670 ft MSL and an overflow conduit with an inlet elevation of approximately 666.5 feet controls the maximum Recirculation Pond water level. In 2008, plastic sheet piling was driven across the recirculation pond to modify its flow pattern in preparation of allowing the

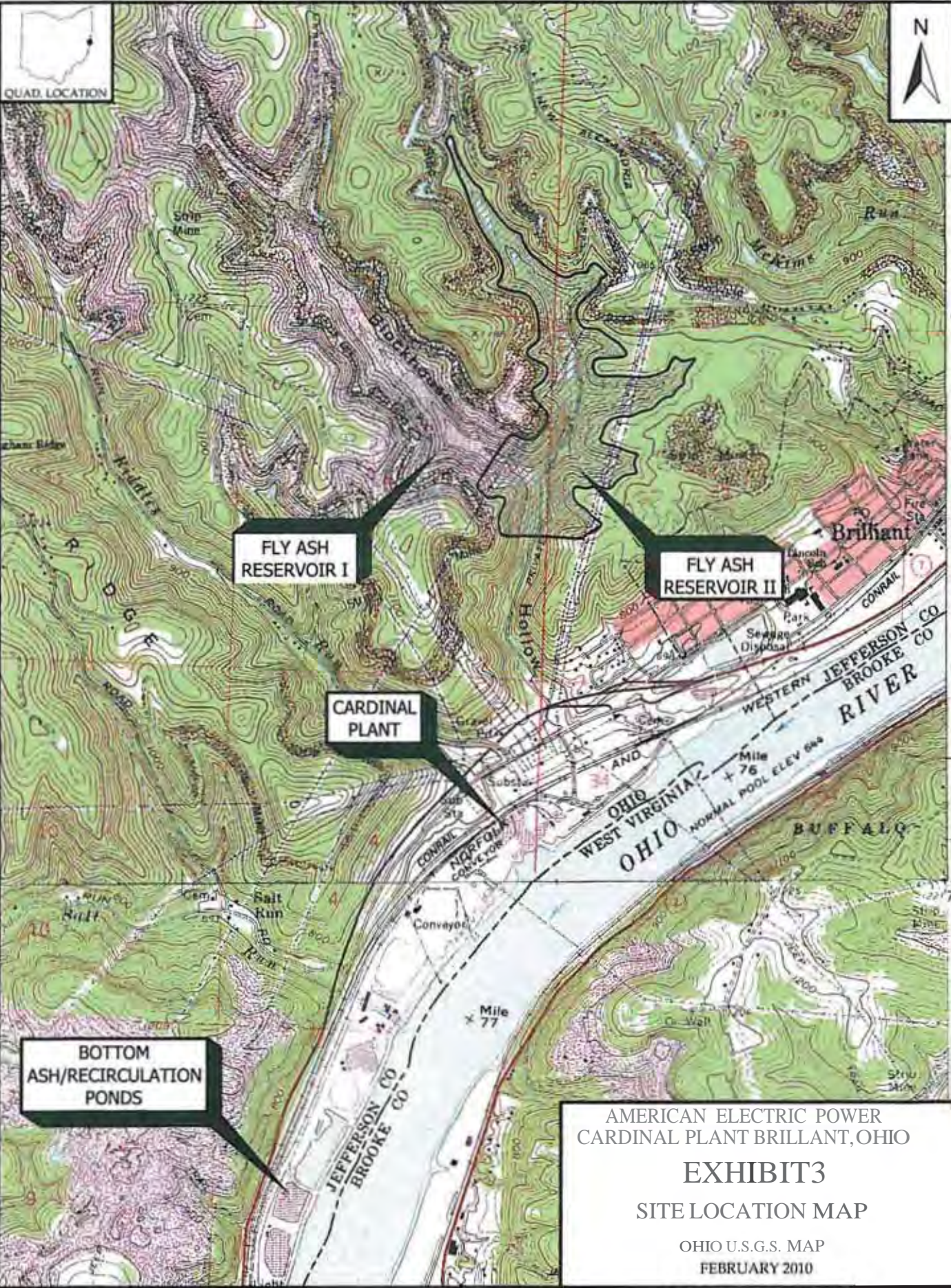
present overflow structure to discharge from the basin. The arrangement of the Bottom Ash Complex is shown in Exhibit 5.

The total length of the exterior dike along the Ohio River is approximately 2,000 feet. For comparison, the normal pool for this stretch of the Ohio River is El. 644. Both ponds are isolated from exterior surface water inflow.

The Bottom Ash Pond is expected to dewater and initiate retrofit, in June 2021. Retrofit activities are expected to be completed prior to the end of 2022, the size of the impoundment will remain unchanged.

Exhibit 3 - Site Location Map

PLOTTED: 2/5/2010 10:02:18 AM



P:\PR48249\cadd\Figure 1.dwg 12/10/2009 8:34:37 AM VicZanett, Ryan

BOTTOM ASH/RECIRCULATION PONDS

FLY ASH RESERVOIR I

FLY ASH RESERVOIR II

CARDINAL PLANT

AMERICAN ELECTRIC POWER
 CARDINAL PLANT BRILLANT, OHIO

EXHIBIT 3

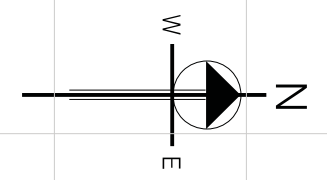
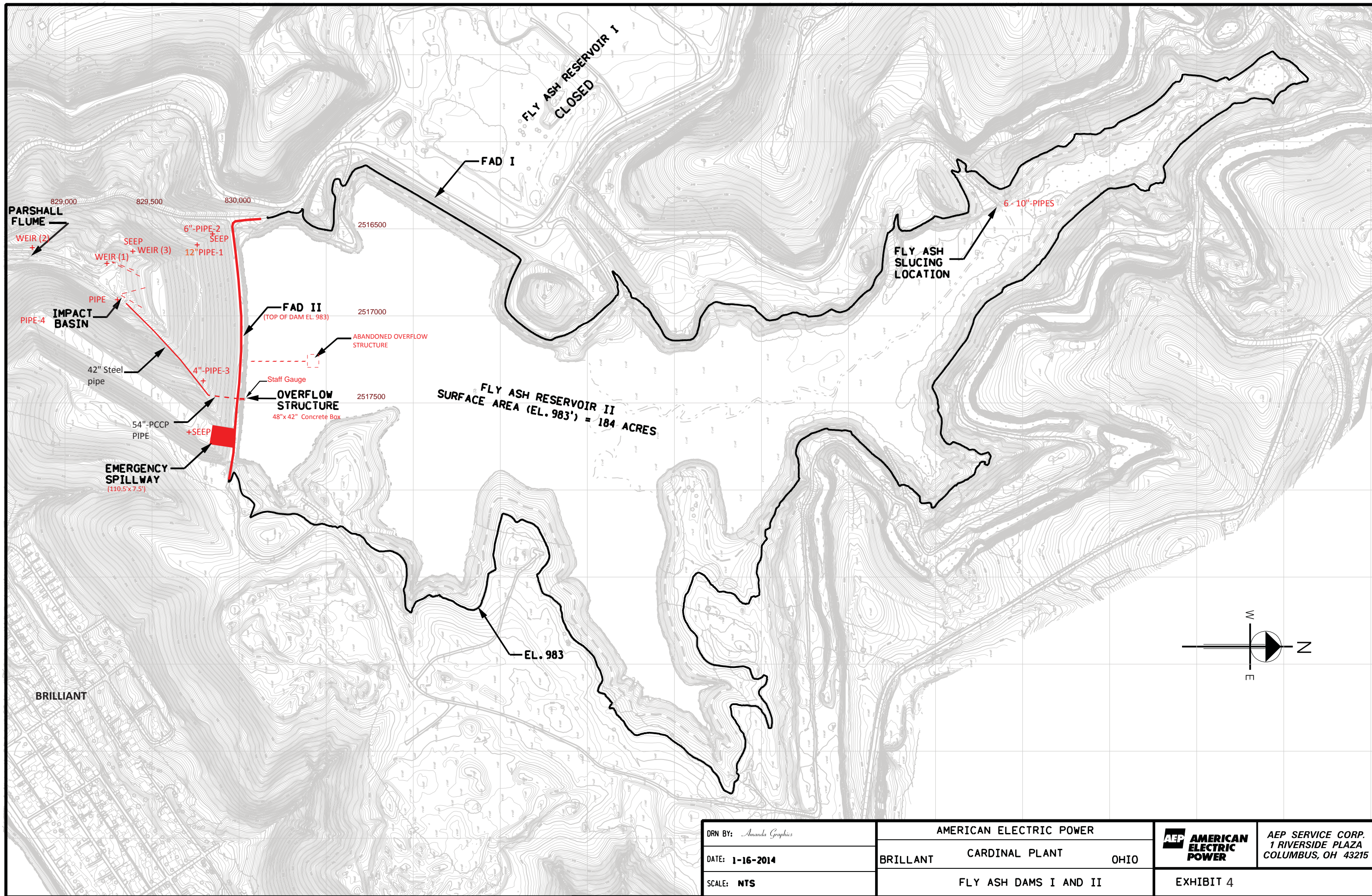
SITE LOCATION MAP

OHIO U.S.G.S. MAP
 FEBRUARY 2010

SOURCE:
7.5 MINUTE TILTONSVILLE

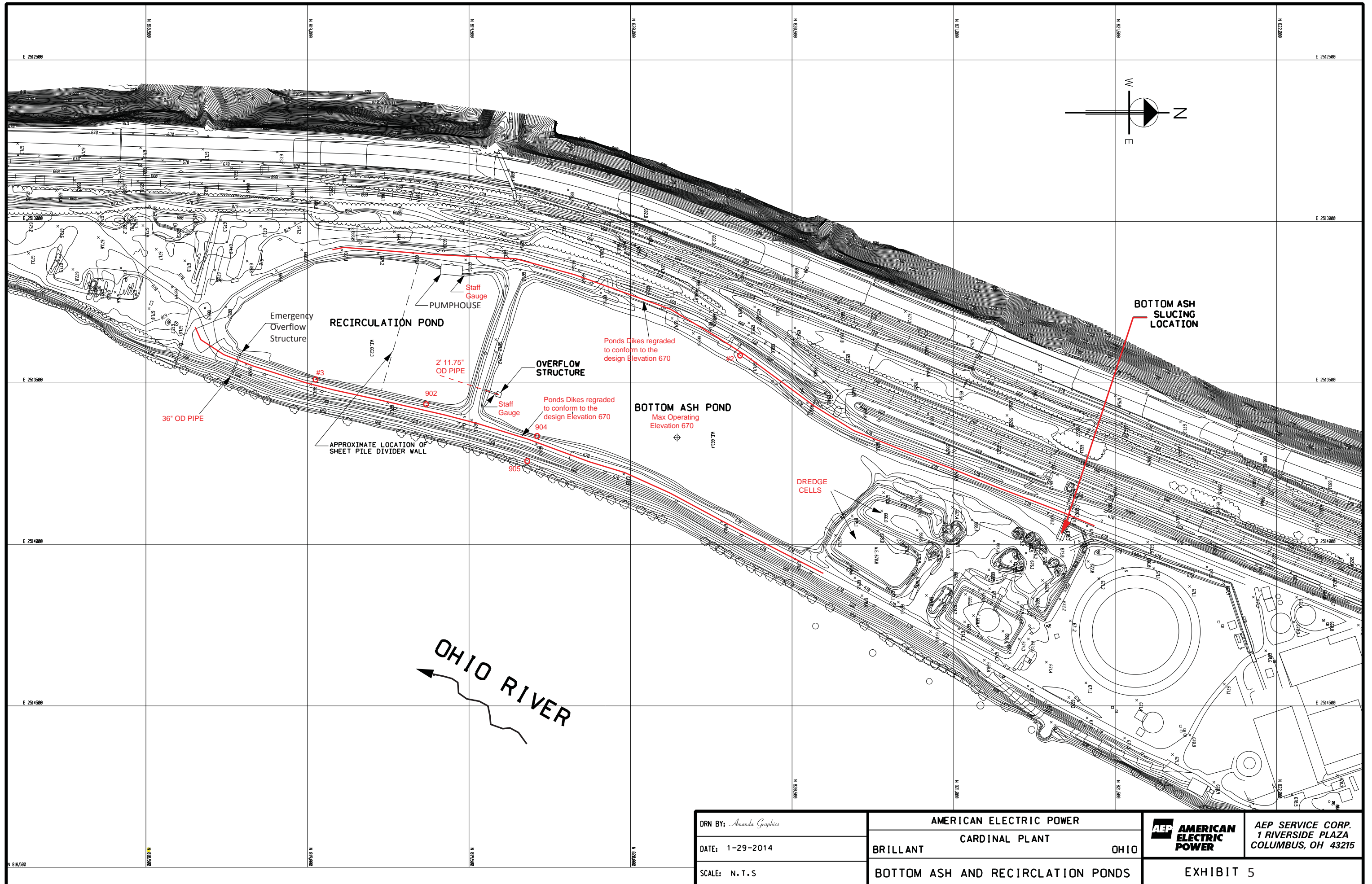
QUADRANGLE


Exhibit 4- Fly Ash Reservoirs I and II



DRN BY: <i>Amanda Graphics</i>	AMERICAN ELECTRIC POWER			AEP SERVICE CORP. 1 RIVERSIDE PLAZA COLUMBUS, OH 43215
DATE: 1-16-2014	BRILLIANT	CARDINAL PLANT		
SCALE: NTS	FLY ASH DAMS I AND II		EXHIBIT 4	

Exhibit 5 - Bottom Ash and Recirculating Ponds



DRN BY: <i>Amanda Graphics</i>	AMERICAN ELECTRIC POWER		 AMERICAN ELECTRIC POWER	AEP SERVICE CORP. 1 RIVERSIDE PLAZA COLUMBUS, OH 43215
DATE: 1-29-2014	BRILLANT CARDINAL PLANT OHIO			
SCALE: N.T.S	BOTTOM ASH AND RECIRCLATION PONDS		EXHIBIT 5	

4.0 EMERGENCY CONDITIONS AND CLASSIFICATION

4.1 Monitor: Non-failure Emergency Condition

Monitoring scenarios are generally maintenance and operational issues that may be dealt with by plant personnel and contractors and which do not threaten the integrity of the dam(s).

Conditions shall be classified as follows:

- A. General operational and maintenance conditions at the FAD II or bottom ash pond complex that do not require any notifications, such as:
 - 1. Rainfall equal to or less than 3 inches within 24 hours.
 - 2. Placement or removal of six or less stop logs in the overflow structure. The inspection checklist identifies instrumentation and features that should be inspected within 24 hours of the rainfall event and within 24 to 48 hours after the stop log operations.
 - 3. The following malfunctions or undesirable features should be noted on the inspection checklist. They should be repaired as time and budget permits. If not repaired, the noted items shall be specifically inspected for deterioration during the next scheduled inspection:
 - a. Damaged instrumentation.
 - b. Rodent burrows.
 - c. Surficial erosion.
 - d. Trees and tall vegetation.
 - e. Poor vegetal cover over a small area (less than or equal to a 5 foot radius).
- B. If any of the following conditions are developing, appear imminent, or have occurred, implement the Monitor notification plan immediately. Emergency conditions with

no immediate threat to the integrity of the dam(s), but requiring notification per Exhibit 1 are as follows.

1. The following malfunctions or undesirable features should be noted on the inspection checklist and reported to the Professional Engineer. Increased frequency of inspection may be necessary as determined by the Professional Engineer.
 - a. Minor sloughing of the embankment slopes, with no release of impounded fluids and solids.
 - b. Cracks parallel or transverse to the dam.
 - c. Soft zones in downstream face or toe area greater than a 5 foot radius.
 - d. Wet areas are observed on the downstream face of the dam.
 - e. Previously undetected springs with clear water and stable flow rates on the face of the dam or abutments.
 - f. Development of depressions or other settlement on the crest or slopes of the dam.
 - g. Deteriorated rip rap or other slope protection.
 - h. Obstructions are present at an outlet structure.
 - i. Poor vegetal cover over a large area (greater than 5 foot radius).

4.2 Watch: Potential Failure Condition – STANDBY ALERT

- A. Dam has specific problems that could lead to an evacuation condition. Failure could develop within hours to a couple of days if corrective measures are not initiated to prevent or mitigate failure.

Such problems or undesirable features are summarized below:

1. Springs on abutments or downstream face with muddy water but stable flow rate
 2. Pipes, cavities or holes which could be attributed to internal erosion even without evidence of seepage
 3. Severely clogged drains
 4. Slides with no seepage and that do not reach the dam crest
-

5. Noticeable increase in the amount of foundation or abutment seepage or piezometric level in the monitoring wells
6. Increasing water reservoir levels.
7. Significant blockage of outlet structures

4.3 Warning: Imminent Failure or Failure has Occurred Condition - EVACUATION REQUIRED

- A. Dam failure is imminent, there is no time for any corrective actions, or the dam has failed.

Highly undesirable features that would be major indications of an imminent failure are listed below:

1. Overtopping of the dam
2. Breach or slide below the waterline which reaches the dam crest and/or seeps water
3. Springs on the abutment or downstream slope with muddy water and progressively increasing flow rates
4. Unusual conditions of the water surface such as a whirlpool or bubbling.

Evacuation should be implemented if any of the above Warning criteria exist.

5.0 GENERAL RESPONSIBILITIES

5.1 Dam Owner Responsibilities

The personnel at the power plant are responsible for the periodic inspection of the ash pond complex. The complex is not a manned-facility but it is visited routinely during the week for maintenance and operations of the ash slurry piping and other plant operations. During these visits, personnel are instructed to report unusual conditions to their supervisors so that the appropriate engineers are notified and an inspection can be performed.

During implementation of the EAP, the power company and its personnel will be made available to the local emergency management agency for support and coordination efforts. Based on the concept of the ash pond complex and the physical facilities, the only operational role of the power plant will be to reduce the slurry being pumped into the ponds.

Buckeye Power has staff located at the Columbus, Ohio headquarters that are experienced in emergency procedures. These individuals will evaluate the data or descriptions supplied by the plant personnel to assess the appropriate emergency condition that should be declared.

The notification flowcharts, located on pages 1 and 2, illustrate the chain of command to initiate in the event of a potential or imminent failure of any of the dams or dikes associated with the bottom ash pond complex. Each individual who is designated to make follow-up phone calls shall specifically comment that the EAP for the FAD II and Bottom Ash Complex has been initiated and that there is a condition developing that may result in failure of a dam.

5.2 On-Site Emergency Personnel Responsibilities

5.2.1 Cardinal - Team Leader - Emergency Response Leader

An Energy Production Team Leader (Team Leader) is present at the facility at all times and has responsibility for plant operations. The Team Leader will have overall response authority in the event that an emergency condition occurs at any of the dams. The Team Leader can delegate responsibility to other personnel as appropriate.

The Team Leader should be notified that an emergency condition exists at the bottom ash pond complex or FAD II. This notification may be based on a passerby observing the dam condition or Cardinal Operating Company personnel who have been inspecting or evaluating specific malfunctions.

The Team Leader's duties (directly or through delegation) shall include:

- A. Assume responsibility for the emergency actions, determine initial emergency condition classification (Monitor, Watch or Warning), and continue to evaluate conditions.
- B. Provide for constant surveillance of the dam.
- C. Initiate additional emergency contacts according to the Notification Flowchart on page 1, as appropriate. See Section 1.2 of this EAP for sample notification messages.
- D. Determine the need for evacuation and initiate the evacuation plan. Evacuation must include Cardinal Operating Company and/or contractor personnel working in potentially flooded areas as well as the general public on non-Cardinal Operating Company potentially flooded land.
- E. Arrange for road closures downstream from the potentially failing embankment (e.g., close State Route 7 if the FAD II embankment is anticipated to fail).
- F. Initiate and direct corrective actions at the dam in consultation with Buckeye Power - Power Generation staff, Cardinal Operating Company Engineers and/or consulting Professional Engineers, and ODNR.
- G. Supervise Cardinal Operating Company personnel and contractors during response activities.
- H. Coordinate with coal yard superintendent, landfill staff, or outside contractor, as specified in Exhibits 1 and 2.
- I. Terminate emergency status at the dam.

5.3 Responsibility for Notification and Sample Messages

The Team Leader, Energy Production Manager, and Plant Manager, which are defined titles at the plant, shall be authorized to initiate contact with local individuals and outside agencies to begin emergency action to evacuate the downstream areas. The Energy Production Manager and/or Plant Manager may delegate the listed responsibilities of the Team Leader to other company personnel during the situation if deemed necessary. In addition, the Cardinal Operating Company Engineer who is evaluating the dam's condition shall have the authority to instruct the Team Leader to initiate notification based on his assessment of the conditions.

Once the notification procedures commence, the individuals listed on the appropriate Notification Flowchart shall make the necessary contacts as noted. If appropriate, the Plant Manager, Energy Production Manager, and/or Buckeye Power – Power Generation Staff may delegate additional personnel to make the necessary contacts.

The statements in Section 1.2 shall be read to each agency on the appropriate notification flowchart. The responsible person notifying the agencies should note the date and time of such notification.

5.4 Public Information/News Media

Buckeye Power's Corporate Director of Communications, Patrick Higgins, shall be responsible for disseminating information to the public and media. In the event, Mr. Higgins is unavailable, the Plant Manager will address the media.

5.5 Responsibility for Evacuation

5.5.1 Jefferson County EMA Director - Primary Responsibility

The Jefferson County EMA shall be responsible for the evacuation and notification of the general public, including personnel at the power plant. The power company personnel shall be made available to assist the Emergency Management personnel if requested.

5.5.2 Jefferson County Sheriff - Primary Responsibility

The Jefferson County Sheriff shall coordinate with the Jefferson County EMA to notify all residents of evacuation by loud-speaker-equipped squad cars while safety personnel are being deployed.

In addition, the Sheriff shall provide support personnel for road closures (if needed) and maintain communication with other emergency personnel.

5.5.3 Brilliant, Ohio Fire Department - Secondary Responsibility

Assist Sheriff with evacuation of residents as needed.

5.6 Responsibility for Duration, Security, Termination and Follow-Up

5.6.1 Duration

The Team Leader, unless delegated to another individual, shall be assigned as the Cardinal Operating Company contact for keeping local authorities advised of continuing conditions at the dam. The Team Leader shall also function as the on-site responsible individual for contact with ODNR Dam Safety and Buckeye Power – Power Generation Staff.

The Cardinal Operating Company Lead Engineer shall have the responsibility of the on-site technical personnel for assessing the conditions of the dam and its appurtenances. The Lead Engineer and the Team Leader shall be in constant communication to ensure that appropriate and consistent status updates are disseminated to the respective agencies.

5.6.2 Security

During the constant surveillance period of a Standby Alert and Evacuation conditions, Cardinal Operating Company shall have a minimum of two personnel assigned to on-site duties that would include monitoring of the conditions. Inspections and monitoring that would endanger the personnel should not be implemented.

Cardinal Operating Company shall coordinate with the appropriate local law enforcement agencies if traffic control or roadblocks are necessary to secure the area.

5.6.3 Termination

The following individuals shall have the authority to terminate the emergency condition at the dam should no failure occur or the hazard passes.

- Team Leader
- Lead Engineer
- ODNR Dam Safety representative

If all three of the individuals listed above are on site, there shall be a consensus that termination of the emergency is appropriate. In the event that a consensus is not met, ODNR's representative will have over-riding authority.

The Team Leader shall have the responsibility to inform the Jefferson County EMA and other emergency response agencies that the emergency at the dam has been terminated.

5.6.4 Follow-Up Evaluation

The EAP coordinator shall conduct a follow-up meeting with the individuals and agencies contacted during the notification conditions as soon as practical to assess the effectiveness of the EAP. If some participants cannot attend a meeting, they should be requested to provide written comments on the notification and coordination that their agency received during the emergency condition.

5.7 Responsibility of the EAP Coordinator

The Plant Process Owner/Landfill Operator, currently Mr. Randy Sims, shall be the EAP Coordinator, with assistance from Buckeye Power. The EAP Coordinator shall be responsible for:

- A. Distributing copies of the Plan to all recipients.

- B. Conducting orientation seminars so that all participants are aware of the Plan and know their responsibilities.
- C. Preparing an annual emergency preparedness exercise as described in Appendix B.
- D. Reviewing and revising the EAP as necessary. At a minimum, the EAP Coordinator shall review the flowcharts annually so that the contacts and phone numbers are current. If significant organizational changes occur, the entire Plan should be reviewed and revised as necessary to identify the roles and responsibilities of the appropriate personnel.
- E. Coordinate a follow-up evaluation of emergency response activities following any emergency condition at the dam.
- F. Serving as the EAP contact person.
- G. Assist the Team Leader to implement the EAP, as required, during an event.

5.8 Duties and Responsibilities

The following table lists potential duties that each organization may be called upon to perform should an emergency condition arise at the dam. The hierarchy of notification can be found in the Notification Flowcharts (Exhibits 1 and 2).

5.8.1 Duties and Responsibilities for Monitoring: Non-failure Emergency Condition

Organization	Monitoring Duties
Cardinal Operating Company	<ul style="list-style-type: none"> • Notify ODNR at beginning of emergency condition • Coordinate response activities at the dam • Mobilize local contractors if needed • Notify ODNR when emergency condition ends.
Buckeye Power - Power Generation	<ul style="list-style-type: none"> • Provide technical analysis and design support.
ODNR	<ul style="list-style-type: none"> • Monitor events at the dam • Offer technical advice to Cardinal Operating staff.

Coal Yard Personnel Local Contractors:	<ul style="list-style-type: none"> • Provide construction equipment, materials, and personnel to assist Cardinal Operating staff in responding to the emergency condition.
1. Coal Yard Personnel	<ul style="list-style-type: none"> • Provide supplies and materials.

5.8.2 Duties and Responsibilities for Watch: Potential Failure Condition

Organization	Watch Duties
Cardinal Operating Company	<ul style="list-style-type: none"> • Notify "911" emergency center and ODNR at beginning of emergency condition • Coordinate response activities at the dam • Mobilize local contractors if needed • Notify ODNR, EMA, and other agencies when emergency condition ends.
Buckeye Power – Power Generation	<ul style="list-style-type: none"> • Provide technical analysis and design support.
ODNR	<ul style="list-style-type: none"> • Monitor events at the dam • Offer technical advice to Cardinal Operating staff.
Coal Yard Personnel Local Contractors:	<ul style="list-style-type: none"> • Provide construction equipment, materials, and personnel to assist Cardinal Operating staff in responding to the emergency condition.
1. Coal Yard Personnel	
Jefferson County EMA "911" Emergency Center	<ul style="list-style-type: none"> • Notify the Jefferson County Sherriff of the emergency condition • Notify the Jefferson County Emergency Management Director and Brilliant and Wells Twp Fire Department of the emergency condition.
1. Jefferson County Sheriff 2. Brilliant and Wells Twp Fire Department	<ul style="list-style-type: none"> • Review the flood inundation map contained in Appendix A of the dam's EAP to be familiar with areas that may require evacuation if an evacuation order is given. • At this level, NO EVACUATION IS REQUIRED.

5.8.3 Duties and Responsibilities for Warning: Imminent Failure or Failure has Occurred Condition

Organization	Warning Duties
Cardinal Operating Company	<ul style="list-style-type: none"> • Notify "911" emergency center and ODNR at beginning of emergency condition • Coordinate response activities at the dam • Mobilize coal yard personnel and local contractors if needed • Notify ODNR, EMA, and other agencies when emergency condition ends • Complete follow-up reporting to ODNR.
Buckeye Power – Power Generation	<ul style="list-style-type: none"> • Provide technical analysis and design support.
ODNR	<ul style="list-style-type: none"> • Monitor events at the dam • Offer technical advice to Cardinal Operating staff.
Coal Yard Personnel Local Contractors 1. Coal Yard Personnel	<ul style="list-style-type: none"> • Provide construction equipment, materials, and personnel to assist Cardinal Operating staff in responding to the emergency condition.
Jefferson County EMA "911" Emergency Center	<ul style="list-style-type: none"> • Notify the Jefferson County Sherriff of the emergency condition • Notify the Jefferson County Emergency Management Director and the Brilliant and Wells Twp Fire Department of the emergency condition.
1. Jefferson County Sheriff 2. Brilliant and Wells Twp Fire Department	<ul style="list-style-type: none"> • IMMEDIATELY BEGIN EVACUATION of flood prone areas downstream of the dam as shown on the flood inundation map contained in Appendix A of the dam's EAP • Evacuation activities may include physical evacuation, calling, knocking on doors, announcements with bullhorns, etc. • Assist in rescue of stranded residents, placing sandbags, and other duties as required.

6.0 PREPAREDNESS

6.1 Access to the Site

The Cardinal FAD II can be accessed by turning northeast off Riddles Run Road onto a blacktop road, which is posted indicating Cardinal Operating Company property. The toe of the dam may be accessed by following the blacktop road and then taking the first gravel road north; the top of the dam can be accessed by continuing northwest on the blacktop road to a gravel road.

The road is gated and monitored by a security guard during daylight hours. In the event, the gate is locked and unattended, security at the Plant's main gate can unlock the gate and grant access.

The bottom ash/recirculation pond complex can be reached via plant roads.

6.2 Surveillance

Neither FAD II nor the bottom ash pond complex is a manned-facility but each is visited by security guards or plant staff, who makes 1 to 2 trips per shift for maintenance and operations of the ash slurry piping and other plant operations. During these visits, personnel are instructed to report unusual conditions to their supervisors so that the appropriate engineers are notified, and an inspection can be performed. All of the dams' instrumentation are manually read and recorded during routine daily, weekly and monthly scheduled dam inspections by qualified personnel.

Flow from the bottom ash pond is discharged into the recirculation pond whose outlet is an overflow conduit thereby controlling the maximum recirculation pond water level. There are no operations associated with the ponds except for the inflow of the ash sluice water. Runoff from storm events is passed through the ponds without any control. Typically, the runoff events are not a concern because the bottom ash/recirculation ponds have freeboard heights greater than 5 feet and the drainage area into the ponds is very small.

6.3 Emergency Corrective Measures

All work related to the following conditions shall be coordinated with Buckeye Power - Power Generation Staff, Cardinal Operating Company Engineers and consulting Professional Engineers, if necessary.

6.3.1 High Pool Levels/Overtopping Condition

- A. If acceptable to Buckeye Power - Power Generation Staff and Cardinal Operating Company Engineers, remove stop logs from the FAD II outlet structure to lower the pool level. Pumps and/or siphons may be necessary to provide additional capacity to drawdown the pool level. It may be necessary to excavate a hole in accumulated fly ash or bottom ash to enhance removal of water from the pond.

The drawdown rate of the pool should be limited to avoid potential slope stability concerns. Contact Buckeye Power - Power Generation Staff for an acceptable drawdown rate if pool level drawdown is required.

- B. Contact a Professional Engineer for permanent repair recommendations.

6.3.2 Leakage Condition

- A. If acceptable to Buckeye Power - Power Generation Staff and Cardinal Operating Company Engineers, remove stop logs from the FAD II outlet structure to lower the pool level. Pumps and/or siphons may be necessary if additional capacity is required for a faster drawdown or if the pool must be drawn down lower than the outlet structures allow. It may be necessary to excavate a hole in accumulated fly ash or bottom ash to enhance removal of water from the pond.
- B. Place straw bales, earth or rock fill over the leakage area. These materials may be located on site or available from the coal yard operation, or other contractor as listed on the Notification Flowcharts in Exhibits 1 and 2.
- C. Contact a Professional Engineer for mitigation techniques and permanent repair recommendations.

6.3.3 Slumping/Sliding of Embankment Condition

- A. Fill affected area with earth or rockfill. These materials are available on site or from coal yard operations, or other contractor as listed on the Notification Flowcharts in Exhibits 1 and 2. If sliding occurs, the toe of the slide should be stabilized by weighting it with earth, rock, or gravel.
- B. If the slump reduced the dam crest elevation, place sandbags at the slump to restore dam to its original elevation.
- C. Contact a Professional Engineer for permanent repair recommendations.

6.3.4 Sinkhole Condition

- A. Fill sinkhole with earth or rockfill. These materials may be available on site or from coal yard operations, or other contractor as listed on the Notification Flowcharts in Exhibits 1 and 2.
- B. Contact a Professional Engineer for permanent repair recommendations.

6.3.5 Severe Downstream Erosion or Minor Structural Damage

- A. Monitor and log condition of structures or downstream erosion.
- B. Contact a Professional Engineer for permanent repair recommendations.

6.4 Response During Periods of Darkness

There are no area lights at either the bottom ash pond complex or FAD II. The Cardinal plant has two portable light trailers with diesel generators that can be used for response during dark conditions. If necessary, additional portable lighting will be rented to illuminate areas of concern.

Normal operations of the power plant do not include site visits to these areas during hours of darkness.

6.5 Response During Weekends and Holidays

The power plant is manned 24 hours, 365 days a year. Personnel would be available to respond to an emergency situation at any time.

6.6 Response During Periods of Adverse Weather

The plant has four-wheel drive vehicles to be used for transportation to the ash pond complex or FAD II. The power plant also has track-mounted bulldozers that are used in the day-to-day operations of the coal yard that could be utilized to access the ponds during extreme weather conditions.

6.7 Alternative Systems of Communication

The primary means of external communications is through cellular telephones. A microwave telephone system for the Cardinal Operating Company system and its affiliates is also available for internal communications.

The secondary communication system is the use of two-way radios. Most plant vehicles are equipped with radios. The frequency can be changed to be in contact with the local emergency response agency.

6.8 Emergency Supplies and Resources

Materials necessary to repair earthen embankments are not normally stockpiled at the dams or the plant site. However, plant personnel have access to heavy equipment, such as bulldozers and backhoes, which could be utilized for temporary repairs. Equipment operators and laborers are available at the plant at all hours. Other equipment is available at a heavy equipment rental company located in Brilliant, Ohio. Construction materials such as soil, stone, gravel, and heavy equipment are available at the landfill construction site and will be available for the foreseeable future.

Since the bottom ash pond complex and FAD II are used as major sedimentation facilities, fill material is readily available. Additionally, the ash pond complex is surrounded by hill slopes that could be excavated to obtain other fill material.

The plant also stockpiles a limited number of concrete stop logs that are used in the outlet structures.

The table below lists emergency contacts and services/materials.

Name	Emergency Items	Address	Phone
Emergency Contact			
Rob Riggerbach	Heavy Equipment	Cardinal Plant Coal Yard	(740) 314-9925 (740) 598-6875
Team Leader	Initial Contact - Incident Command	Cardinal Plant	(740) 598-6570/ 6580/ 6530
Cross Creek Builder	Trucks and Heavy Equipment	1595 Smith Twp. Rd Atlasburg, PA	(724) 601-3135 (740) 317- 4456

6.9 Training and Updating of the EAP

The EAP shall be reviewed and updated by the Owner and all affected parties at least once a year or as necessary. When updating the EAP, check all contact names and phone numbers for verification. If there are significant changes to the plan, such as dam ownership or major modifications to the dam, the EAP shall be updated as soon as possible.

7.0 INUNDATION MAPS

Appendix A contains a Failure Inundation Mapping Report, which provides a brief description of the method and assumptions that were used to identify the potentially inundated areas from two potential dam failure scenarios for the FAD II - specifically, the Probable Maximum Flood (PMF) with failure of the dam, and normal pool ("sunny day") failure of the dam. Due to the low hazard potential from failure of the bottom ash/recirculation pond embankment, approximate impacted areas are shown on the map. Appendix A includes flood inundation map which is intended to delineate areas subject to flood waters in the event of a failure of one of the ash dams at the Cardinal Power Plant.

Shown on the map is the limit of flooding; the elevation and depth of flooding; and the peak time of the flood wave.

It should be noted that, because of the method and procedures used to develop the flooded area map, the limits of flooding shown are approximate and should be used solely as a guideline for establishing evacuation zones. Actual evacuation zones may be greater than the area covered by the flooded areas shown and should be established by local officials based on their judgment and knowledge of local conditions.

The study considers events of an extremely improbable nature. The results are not in any way intended to reflect on the integrity of any of the dams.

APPENDIX A
FLOOD INUNDATION MAPPING REPORT

**APPENDIX A
DAM FAILURE INUNDATION MAPPING REPORT
CARDINAL POWER PLANT DAMS**

PREPARED FOR

AEP Ohio

January 2014

PREPARED BY

**S&ME, INC.
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A-1.0 INTRODUCTION

In 2013, under ODNR Permit 2013-346, the Cardinal Fly Ash Dam II (FAD II) was raised 13 feet to crest El. 983. The Columbus, Ohio office of S&ME, Inc, designed the raising and served as the construction certification engineer. In accordance with Condition No. 7 of the construction permit, as well as OAC 1501:21-5-04, the existing Emergency Action Plan (EAP) has been revised to reflect the influence of the raised structure. As part of the EAP, new inundation mapping has been prepared depicting the probable area of the flooding if the dam were to fail. The analyses performed to develop this mapping are described in this section, which is Appendix A of the EAP.

In 2010, Burgess & Niple, Inc. (B&N), on behalf of AEP, prepared flood inundation mapping as part of an update to the EAP for FAD II. The inundation mapping was based on the results of a breach analysis with the reservoir at the pre-raising maximum operating pool (El. 960-“sunny day failure”) and under Probable Maximum Flood (PMF) conditions. In a February 23, 2011 letter, the ODNR Division of Soil and Water Resources provided comments on the EAP, which suggested that the department was generally comfortable with the dam break analyses, but wanted to see improvements to the inundation mapping including the use of color aerial photographs and additional labels.

This appendix includes an inundation map of downstream flooding locations should the fly ash dam fail. The flood inundation map is based upon a simulated failure of the Cardinal fly ash dam (FAD) II under PMF and normal pool conditions for the raised dam. The mathematical modeling provides an approximation of the flooded area. This report summarizes the analyses that were performed to develop the inundation map.

This document is intended to expedite rescue and mitigation efforts. The flood inundation map should be reviewed with all City and County personnel who are likely to direct and participate in the emergency response to a severe flood.

A-2.0 SCOPE OF STUDY

Breach analyses were performed for the raised dam to reflect the new maximum operating pool (El. 974) and new flood pool under PMF conditions. Recognizing that breach analyses and associated mapping had recently been prepared and reviewed by ODNR (submitted in 2010, ODNR review comments received in 2011), and also recognizing that the raised dam represents an increase of only 5% above the previous pool level, S&ME utilized the model previously developed by B&N as the basis of our analysis. It should be noted that the B&N model was initially developed by AEP to examine the Probable Maximum Flood (PMF) condition dam failure event.

The following discussion covers the information pertinent to the modeling of the normal pool failure of the fly ash dam, with limited information regarding the PMF with failure modeling; information on the PMF with failure is contained in AEP's write-up included in the previous version of EAP.

A-3.0 BASE INFORMATION

A-3.1 Dam Description

The Cardinal Power Plant is located in Jefferson County, Ohio near Brilliant, Ohio. There are no towns directly across the Ohio River from the power plant. The Cardinal fly ash reservoir (FAR) II dam is located approximately 1 mile northwest of the Cardinal Power Plant on Blockhouse Run, a tributary to the Ohio River. Blockhouse Run empties into the Ohio River at the power plant.

FAD II is located on Blockhouse Run, which drains directly into the Ohio River. Blockhouse Run splits into two branches, designated as the East Branch and the West Branch. The split in Blockhouse Run is approximately one mile upstream of the Ohio River. Runoff from both the East and West Branch watersheds drain into the reservoir. The reservoir is utilized for the storage of fly ash, which is sluiced from the plant and discharged at the upstream (north) end of the reservoir. The fly ash settles out within the reservoir as the water flows toward the dam where the effluent overflows through the service spillway. Stop logs are placed in the discharge shaft of the service spillway structure as necessary to maintain settling action or to limit discharge.

Relevant features for the FAD II are summarized in Table A-1. Under the design flood (PMF), the water level was projected to rise to El. 968.1 for the pre-raising configuration, while it is projected to rise to El. 981.9 for the post-raising configuration. Both of these flood pool projections assume that prior to the flood event, the reservoir is at the maximum operating pool level.

Table A-1

	Feature	Pre-Raising	Post-Raising
DAM	Classification	Class I	Class I
	Crest Elevation	970.0	983.0
	Maximum Height	225 feet	238 feet
	Crest Width	30 feet	22 feet

	Emergency Spillway El.	961.0	975.5
	Emergency Spillway Width	110 feet	108 feet
RESERVOIR	Max. Operating Pool El.	960.0	974.0
	Max. Operating Pool Area	138 ac.	161 ac.
	Max. Operating Pool Volume	9,800 ac-ft	11,868 ac-ft
	Emergency Spillway Area	137 ac.	184 ac.
	Emergency Spillway Volume	9,900 ac-ft	12,200 ac-ft
	Top of Dam Area	153 ac.	184 ac.
	Top of Dam Volume	11,350 ac-ft	13,500 ac-ft

A-3.2 Data Sources

As previously indicated, the dam break model for the FAD II was originally developed by AEP to examine the Probable Maximum Flood (PMF) dam failure event for the pre-raising dam configuration (crest at El. 970). This model was subsequently utilized by B&N as the basis for their sunny day analysis. Continuing along these lines, S&ME used the B&N model as the basis for our analyses of the raised dam.

Primary data sources include:

- DAMBRK input data from 2010 B&N sunny day model (note the data file for the original PMF analysis was not available).
- Reservoir elevation-area information provided by AEP as a part of the DAMBRK input for use in estimating reservoir volume.
- Reservoir elevation-area information developed by S&ME as a part of the design of the dam raising.
- U.S. Geological Survey (USGS) Quadrangle Maps (2013) for flood inundation mapping.
- Appendix A of the 2010 EAP for the dam.

A-3.3 Computer Software and Model Verification

S&ME used the computer software BOSS DAMBRK v. 3.00 to perform the breach analyses. This is an enhanced version of the National Weather Service (NWS) DAMBRK computer

program and is capable of using the same input files. Before moving forward with modeling the raised dam, S&ME first ran the provided input file (sunny day conditions) to confirm that similar results were obtained with the BOSS DAMBRK software as were obtained by B&N in 2010. Likewise, the model was adjusted to confirm that the PMF results could also be obtained for the pre-raise configuration. Table A-2 summarizes the results of this effort with respect to project flow rate and water surface elevation of four reference cross sections.

**Table A-2
 Confirmation of DAMBRK Model for Pre-Raising Conditions**

Pre-Raising Analysis Results			S&ME Recreation of Original Analysis	
Reference Cross Section Location (Miles downstream of dam)	AEP PMF Analysis - Dam Pre-Raise - Pool El: 968		PMF Analysis - Attempt to Re-Create AEP PMF Analysis - Pool El: 968	
	Maximum Flow (cfs)	Maximum Water Surface Elevation (feet)	Maximum Flow (cfs)	Maximum Water Surface Elevation (feet)
0.400	281,384	747.4	286,795	747.1
0.616	279,729	686.0	285,262	686.2
0.750	277,794	663.1	283,536	663.9
4.250	167,238	647.3	186,720	647.7
Reference Cross Section Location (Miles below dam)	B&N Sunny Day Analysis - Dam Pre-Raise - Pool El: 960		Rerun Program Using B&N DAMBRK Sunny Day Input File - Dam Pre-Raise - Pool El: 960	
	Maximum Flow (cfs)	Maximum Water Surface Elevation (feet)	Maximum Flow (cfs)	Maximum Water Surface Elevation (feet)
0.400	264,494	745.1	264,494	745.3
0.616	263,409	685.2	263,409	685.6
0.750	262,049	661.7	262,049	662.6
4.250	166,805	647.1	166,805	647.3

A review of the results summarized in Table A-2 suggests that the BOSS DAMBRK software yields substantially the same values as the version of the software employed by B&N in their analysis. Likewise, the recreated input file developed by S&ME for the PMF condition yielded similar results as obtained by AEP. Based on these results, S&ME moved

forward with modeling the raised dam using these two models as the starting point. The only changes subsequently made to the models were associated with the higher pool levels and the addition of higher elevations to some of the cross-sections where the new flows resulted in elevations exceeding the uppermost points on the cross-sections previously defined in the B&N model.

A-3.4 Breach Definition

A breach in a dam such as the Cardinal Power Plant fly ash dam is typically considered to be trapezoidal in cross-section and is defined by its bottom width, the elevation of the bottom of the breach, the side slopes of the breach, and the time period over which the breach forms. For consistency with the previous analyses completed by AEP and B&N, similar breach parameters were selected for both the normal pool and PMF failures. The elevation of the bottom of the breach was set at the same elevation as used in B&N's and AEP's failure analyses, which is approximately equal to the bottom of the reservoir.

For the sunny day failure condition, the pool was set as Elevation 974 at the initiation of failure, which corresponds to the maximum operating pool level post-raising. The pool was set at El. 983 for the PMF failure, corresponding to the crest of the dam post-raising. The Cardinal FAD II doesn't have any gates; thus there is no consideration for spill-gates or flashboards in the analysis. Table A-3 summarizes the breach parameters which were used for the Cardinal Power Plant dam for both the PMF with failure and the normal pool failure conditions.

Table A-3
Breach Parameters for the Cardinal Power Plant FAD II

Parameter	PMF	Normal Pool
Elevation of Bottom of Breach (feet)	750	750
Water Surface Elevation at which Breach Initiates (feet)	983	974
Bottom Width (feet)	200	200
Side Slopes Z (Z:1)	1:1	1:1
Breach Formation Time (hour)	1	1

In the above breach definitions, the elevation of the bottom of the breach was set at about the bottom of the reservoir storage pool.

A-3.5 Modeling Conditions

A-3.5.1 Probable Maximum Flood with Failure

The raised dam was designed to safely pass the PMF with around one foot of freeboard. Despite this, the PMF dam failure event is assumed to result from the overtopping of the dam resulting from precipitation exceeding the PMP or greater runoff than was assumed during design. To this end, the water surface in the reservoir just before failure was set at the crest elevation. This analysis routed the failure hydrograph from FAD II that occurs when the pool has reached its maximum non-failure condition stage with PMF inflow. The starting flow in Blockhouse Run downstream of the dam was set at the approximate flow from the dam spillway at the PMF pool, consistent with the previous analysis.

A-3.5.2 Normal Pool “Sunny Day” Failure

The sunny day dam failure is assumed to occur when the dam is at its normal pool elevation (i.e. Elevation 974) and failure of the embankment occurs. This would most likely result from a piping failure (i.e., water seeping through the embankment internally erodes soil from the embankment until it fails) or from a foundation failure. No rainfall event is associated with the normal pool failure condition. The outflow hydrograph from the dam reaches a sharp peak and recedes back to base flow. The peak is attenuated as it moves downstream.

A-4.0 STUDY RESULTS

A-4.1 Normal Pool Failure

Normal pool failure is defined as a failure of the dam under non-flood conditions. Peak flow and maximum water surface elevations are summarized in Table A-4. The extent of flooding is shown on the *Cardinal Plant Flood Inundation Map* exhibit.

A-4.2 Probable Maximum Flood with Failure

The PMF was modeled both without and with failure of the fly ash dam by AEP. This modeling was previously approved by ODNR. Table A-4 summarizes the results of the PMF with failure modeling at key locations. The extent of flooding is shown on the *Cardinal Plant Flood Inundation Map* exhibit.

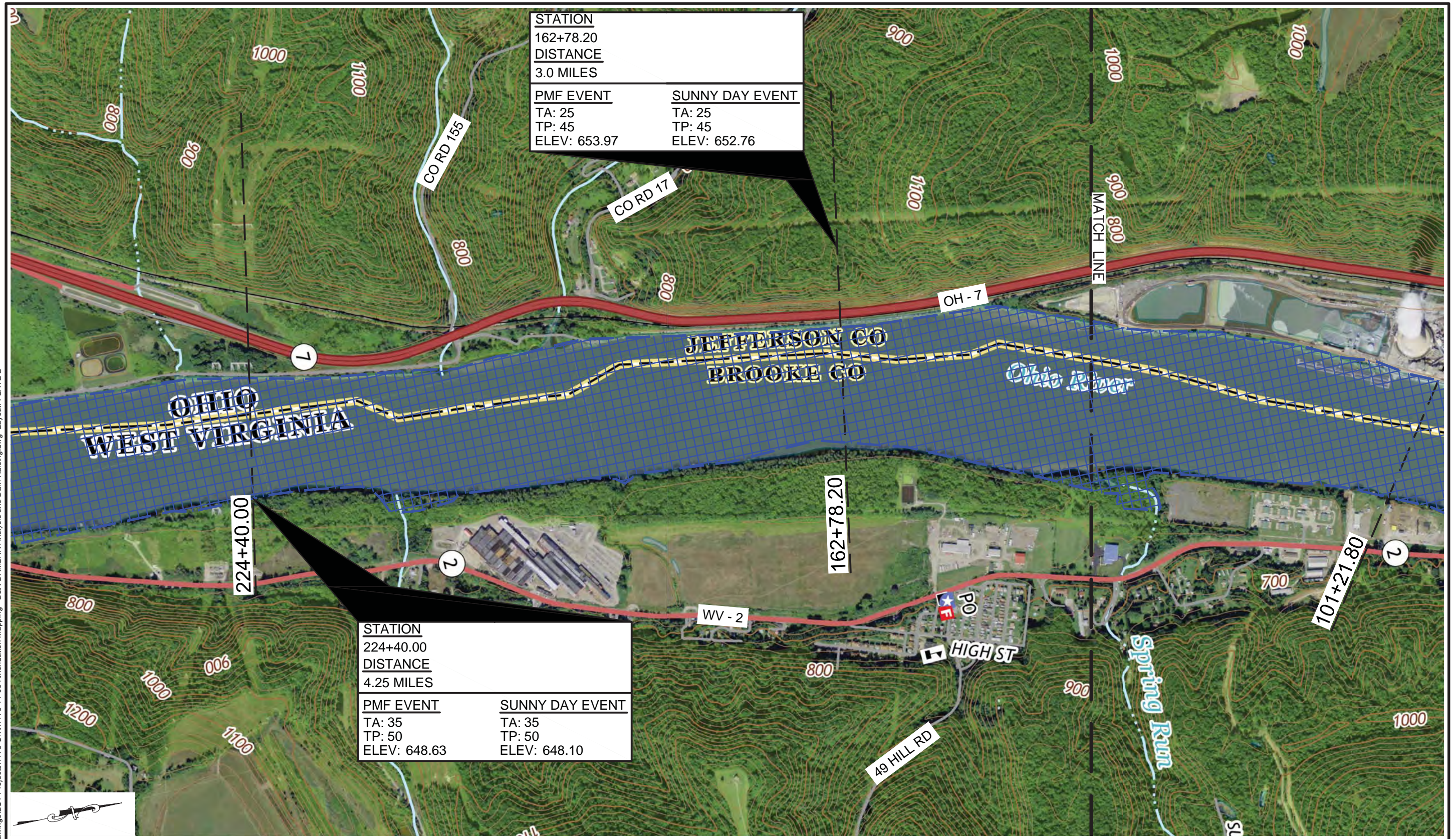
A-4.3 Mapping Flood Information

Flood information is provided at selected cross sections on the *Cardinal Plant Flood Inundation Map* exhibit at the end of this Appendix. S&ME used the USGS Steubenville West and Tiltonsville Quadrangles as base maps. Both of these quadrangles were published in 2013 and feature orthoimages taken in August 2011 in addition to conventional topographic data. The map shows the peak flood elevation, the flooding depth at the cross-sections shown, and the time from the dam failure until the peak elevation is reached. As the data in Table A-4 demonstrates, the modeled peak elevations for the PMF with failure and the normal pool failure are only about 2 feet (or less) different; a difference that cannot be indicated on mapping scale used for the *Flood Inundation Map* exhibit. Therefore, the *Cardinal Plant Flood Inundation Map* shows only one line for flood inundation limits. It should also be noted that the breach analyses suggest that once the flood wave passes beyond SR 7 and out into the Ohio River flood plain, the predicted water surface elevation is approximately the same as the FEMA base flood elevation (Ohio River Normal pool elevation is 644, and FEMA base flood elevation is 666).

Table A-4
Summary of Flood Routing Results

Reference Cross Section Location (Miles downstream of dam)	PMF - Pool at Top of Dam El. 983	
	Maximum Flow (cfs)	Maximum Water Surface Elevation (feet)
0.400	349,375	748.8
0.616	348,016	687.6
0.750	344,526	666.7
4.250	231,638	648.6
Reference Cross Section Location (Miles downstream of dam)	Sunny Day -Pool at El. 974	
	Maximum Flow (cfs)	Maximum Water Surface Elevation (feet)
0.400	318,315	748.7
0.616	316,871	687.0
0.750	313,415	665.2
4.250	204,951	648.1

Images: ~ 20131211144007443.tif ~ OH_Steubenville_West_20131028_TM_geo.tif ~ OH_Tiltonsville_20131028_TM_geo.tif
 Xrefs:
 File Last Updated: Jan 09, 2014
 Plot Info: 1-9-2014 @ 9:04am By: dverhulst
 S&ME Filename: I:\DEPT\SCADD\Drawings\BST Projects\1176-11-004\Inundation Mapping - B&N DAMBRK Analysis and Dam Raising.dwg Layout: PLATE 2




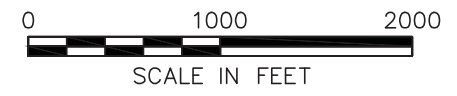
STATION	
162+78.20	
DISTANCE	
3.0 MILES	
PMF EVENT	SUNNY DAY EVENT
TA: 25	TA: 25
TP: 45	TP: 45
ELEV: 653.97	ELEV: 652.76

STATION	
224+40.00	
DISTANCE	
4.25 MILES	
PMF EVENT	SUNNY DAY EVENT
TA: 35	TA: 35
TP: 50	TP: 50
ELEV: 648.63	ELEV: 648.10


LEGEND

TA TIME OF FLOOD ARRIVAL (MIN)
 TP TIME OF FLOOD PEAK ARRIVAL (MIN)
 ELEV ELEVATION OF FLOOD PEAK (FEET)

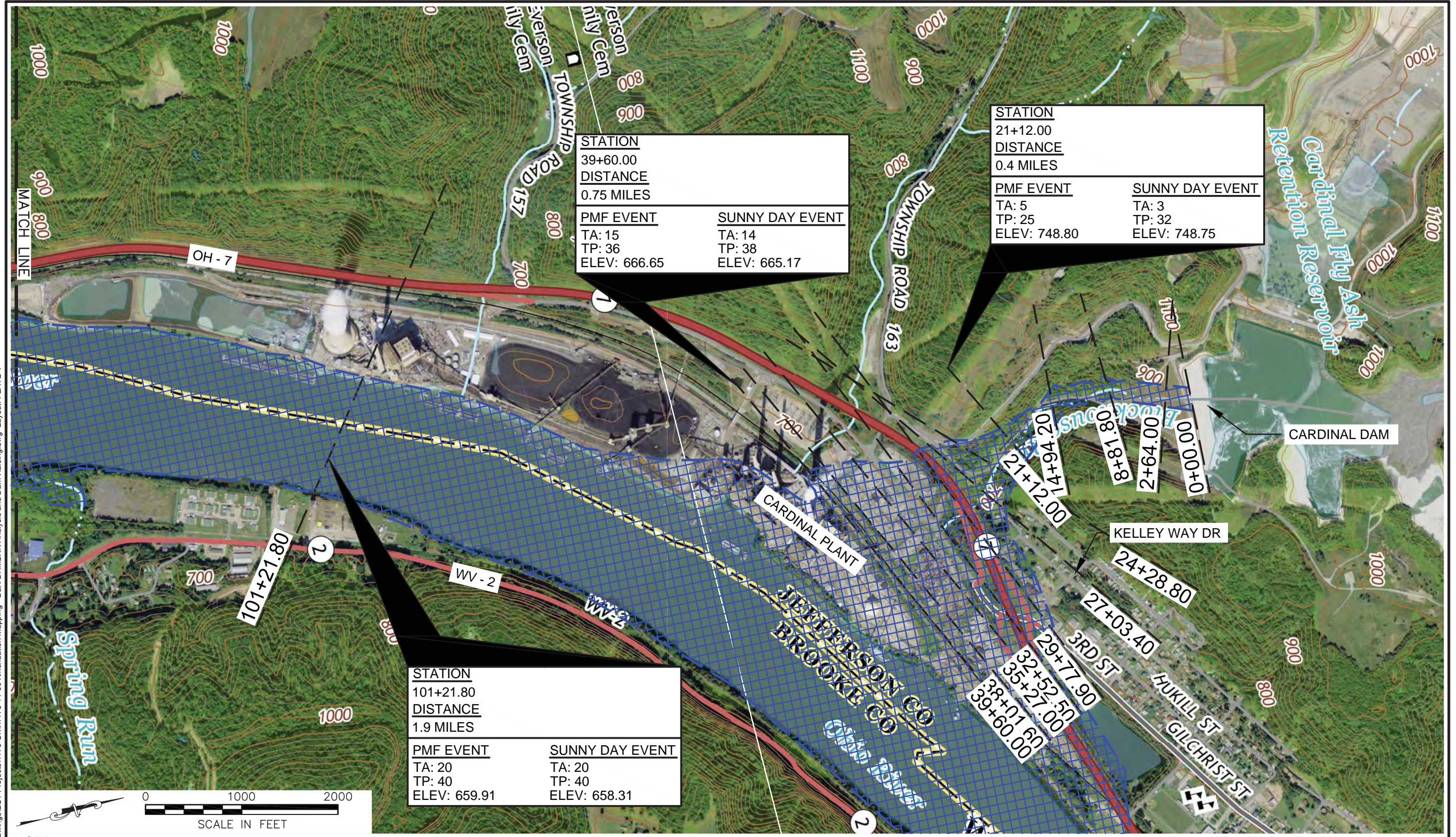
 LIMITS OF PMF STORM EVENT + BREACH INUNDATION



USGS MAPPING

INUNDATION MAP		
CARDINAL FAR2 DAM RAISING BRILLIANT, OHIO		
Project: 1176-11-004A	Drawn By: DCV	 WWW.SMEINC.COM ENGINEERING FIRM. 03530
Drawing Date: 12-11-2013	Approved By: MGR	
Last Updated: 1-9-2014	Scale: GRAPHIC 1:1	

Images: ~ 20131211144007443.tif ~ OH_Steubenville_West_20131028_TM_geo.tif ~ OH_Tiltonsville_20131028_TM_geo.tif
 Xrefs: File Last Updated: Jan 09, 2014
 Plot Info: 1-9-2014 @ 9:02am By: dverhulst
 S&ME Filename: I:\DEPTSCADD\Drawings\BST Projects\1176-11-004\Inundation Mapping - B&N DAMBRK Analysis and Dam Raising.dwg Layout: PLATE 1



STATION	
39+60.00	
DISTANCE	
0.75 MILES	
PMF EVENT	SUNNY DAY EVENT
TA: 15	TA: 14
TP: 36	TP: 38
ELEV: 666.65	ELEV: 665.17

STATION	
21+12.00	
DISTANCE	
0.4 MILES	
PMF EVENT	SUNNY DAY EVENT
TA: 5	TA: 3
TP: 25	TP: 32
ELEV: 748.80	ELEV: 748.75

STATION	
101+21.80	
DISTANCE	
1.9 MILES	
PMF EVENT	SUNNY DAY EVENT
TA: 20	TA: 20
TP: 40	TP: 40
ELEV: 659.91	ELEV: 658.31



NOTE:
 IN VICINITY OF PLANT.
 FEMA 100 YEAR FLOOD EL. 665.

SUNNY DAY INUNDATION NOT SHOWN DUE TO LIMITED DEVIATION FROM PMF EVENT LIMITS.

MAPPING PROVIDED BY 2013 USGS

LEGEND

- TA TIME OF FLOOD ARRIVAL (MIN)
- TP TIME OF FLOOD PEAK ARRIVAL (MIN)
- ELEV ELEVATION OF FLOOD PEAK (FEET)

LIMITS OF PMF STORM EVENT + BREACH INUNDATION

INUNDATION MAP		
CARDINAL FAR2 DAM RAISING BRILLIANT, OHIO		
Project: 1176-11-004A	Drawn By: DCV	 WWW.SMEINC.COM <small>ENGINEERING FIRM. 03530</small>
Drawing Date: 12-11-2013	Approved By: MGR	
Last Updated: 1-9-2014	Scale: GRAPHIC 1:1	

APPENDIX B
TRAINING, EXERCISING, UPDATING,
AND POSTING THE EAP

APPENDIX B

TRAINING, EXERCISING, UPDATING AND POSTING THE EAP

A. Training

The Cardinal Operating Company Plant EAP Coordinator shall be thoroughly familiar with the Emergency Action Plan (EAP) and the actions that may be required under the EAP.

The EAP Coordinator with assistance from Buckeye Power shall be responsible for:

1. Conducting orientation seminars for plant personnel who are involved in the inspection and operations of the bottom ash pond complex and FAD II. The seminars will also include personnel who may respond to outside callers reporting an unusual condition at or near the ponds.
2. Conducting an initial coordination meeting with key plant personnel and appropriate local and state agencies will be conducted to review the EAP and discuss the responsibilities of each agency. Once the initial EAP has been presented and distributed to the authorities, annual office visits will be made to update their copies of the EAP. If there are significant changes to the initial EAP, a coordination meeting with all the participants will be conducted.
3. Training alternate Cardinal Operating Company staff to complete the Emergency Response Leader duties in the event the Team Leader is not available during a period of emergency as described in this EAP.
4. All attendees of such training session shall sign the EAP Training Record Form.

B. Exercising

The EAP Coordinator shall plan and convene an emergency exercise one time each year. The exercise shall include appropriate Cardinal Operating Company administrative, operations, and maintenance personnel. Response organizations shall be invited to participate, however, their unavailability shall not be cause for not completing the exercise. The exercise shall be performed to test the procedures and determine appropriate actions in the event of an emergency.

At the conclusion of the exercise, the personnel shall review the exercise and prepare a written summary of lessons learned and items that can be improved upon.

C. Updating the EAP

The EAP Coordinator with assistance from Buckeye Power, will be responsible for conducting an annual review of the Plan. The annual review shall include the following items:

1. Cardinal Operating Company personnel names, positions, and/or phone numbers shall be verified and revised as necessary.
2. All telephone numbers listed for external agencies shall be called and verified that they are the correct numbers to dial in the event of an emergency.
3. Descriptions of alterations to the dam embankments and/or outlet structures.
4. Additions or deletions to the list of Emergency Supplies and Resources.

Upon completion of each annual review, the EAP Coordinator shall complete the form on the following page to document the review and update.

Revised pages shall be distributed to all EAP recipients with a summary of the changes. If there are no revisions necessary within a given year, the EAP Coordinator shall document that the Plan has been reviewed.

Every 5 years Cardinal Operating Company shall retain a Professional Engineer to review the EAP to assure that it remains viable in the event that an emergency should occur at the dam. At a minimum, the Professional Engineer's activities should include:

- A site visit to inspect the dam and appurtenances and to review staffing and emergency responses by Cardinal Operating Company personnel
- Review of the written plan
- Confirm that Emergency Supplies and Resources are current
- Complete any necessary updates to the EAP and submit it to Cardinal Operating Company.

D. Posting of the Notification Flowcharts

An up-to-date copy of the Notification Flowcharts shall be posted in the control room and in the office of the Team Leader.

The EAP Coordinator shall maintain a minimum of one hard copy of the EAP at the Cardinal Plant.

See Appendix E for the distribution list of the EAP and the number of full copies/sets of inundation map each agency should receive as updates. The EAP Coordinator shall be responsible for distribution of the EAP and any updates.

EAP Training Record Form

Use this form to record training sessions. File the completed form in the EAP. A thorough review of all items in the EAP should be discussed during training. Appropriate employees and EAP team members should attend the training session, annually or participate in a simulated exercise.

Training Location: _____

Date: _____ Time: _____ Instructor: _____

CLASS SIGN-IN

**CARDINAL GENERATING PLANT
EMERGENCY ACTION PLAN
PLAN REVIEW AND UPDATE RECORD**

The EAP must be reviewed and updated (if necessary) annually for accuracy of information provided, particularly to keep contact names and telephone numbers up-to-date. At the conclusion of each review and update the changes shall be indicated in the following table.

Date Review Completed	Name and Title of Reviewer	Changes Made
11/16/2012	Randy Sims	Corrected Flow Charts for
3/21/2014	Mohammad Ajlouni	Respond to ODNR Comment letter dated February 23, 2011. Incorporate 2013 Dam raising changes.
3/2/2015	Mohammad Ajlouni	Respond to ODNR Final Comments. Incorporate changes to Notification Flow Charts
3/3/2017	Mohammad Ajlouni	Incorporate changes to Notification Flow Charts and Add Training Record Form.
6/5/2018	Nick Kasper	Incorporate changes to flow chart and engineering support.
5/15/19	Nick Kasper	Update Flow Chart contacts. Address ODNR Comments (Monitor, Watch, Warning)
9/20/19	Nick Kasper	Updated Contact information following Face to Face meeting.
5/14/2020	Nick Kasper	Updated notification flow charts, added Amanda Graphics P.E. into contact list.
5/3/2021	Nick Kasper	Updated notification flow charts

If changes to contact information are made, copies of the revised sheets shall be provided to all holders of copies of the EAP.

APPENDIX C

SITE-SPECIFIC DATA

APPENDIX C

SITE-SPECIFIC DATA

STUDIES/DESIGN REPORTS

All engineering studies and design reports related to the ash pond complex, including Appendix A - Dam Break Analysis, at the Cardinal Power Plant are stored at the corporate offices of Buckeye Power. These documents include design drawings and topographic mapping. Copies of most drawings are also available at the power plant. The power company will make discretionary availability of these documents. The following lists the contact and address for request of information.

Buckeye Power
Nick Kasper
6677 Busch Blvd.
Columbus, OH 432229
614-846-5757

Plant Manager
Cardinal Power Plant
306 County Road 7E
Brilliant, Ohio 43913
740-598-6500

APPENDIX C
EMERGENCY SUPPLIERS OF MATERIALS

*These listings are current 5/3/2021

Crushed Rock and Stone, Bottom Ash

- Bellaire Stone Company
55518 Trough Run Rd.
Bellaire, OH 43906
Office: (740) 676-3006

Diving Services

- Underwater Services, LTD
Nitro WV
Office: (304)759-2514
- United Diving Corporation
Belle, WV
Office: (304) 949-6392

Fabricators and Machine Shop Services

- Cardinal Operating Company
Plant's Fabrication and Machine Shops
Office: (740) 598-6604 or (740) 598-6575
After hours: (740) 598-6570 or (740) 598-6580
- Mull Machine Company
Wheeling, WV
Office: (304) 233-3369
- Croft & Sons Manufacturing, Inc.
Tiltonsville, OH
Office: (740) 859-2200
After hours: (304) 242-0819

Hauling

Cross Creek Builders
1595 Smith Twp. Rd. Atlasburg, PA 15004
(724) 601-3135

Concrete & Patching Materials

- Arrow Concrete Company
McMechen, WV
Office: (304) 232-6619
- Contractors Supply Corporation
Wheeling, WV
Office (304) 232-1040
- Tri-Son Concrete, Inc.
Bellaire, OH
Office: (740) 676-6606
- Weirton Construction Company (Starvaggi Industries)
Weirton, OH
Office: (304) 748-1400 or (304) 797-5230

Contractors

- Savage Construction Company
Wheeling, WV
Office: (304) 242-3100
After hours: (304) 242-0762 or (304) 243-1789
- James White Construction Company
Weirton, WV
Office: (304) 748-8181
- Cardinal Operating Company
Plant's Coal Yard
Office: (740) 598-6532 or (740) 598-6533
After hours: (740) 598-6570 or (740) 598-6580

Crane Service

- Howard L. Bowers Contracting Company
Wintersville, OH
Office: (740) 264-7731
After hours: (740) 264-0654
- Savage Construction Company
Wheeling, WV
Office: (304)242-3100
After hours: (304) 242-0762 or (304) 243-1789

Resident and Business Evacuation

Name	Address	Telephone No.
Mr. & Mrs. Richard Devore	1641 Hukill Street Brilliant, OH 43913	(740) 314-2000
Ms. Mary. L. Leblanc	1638 Gilchrist Street Brilliant, OH 43913	(740) 598-3149
Merrill & Rhonda Craig	1635 Gilchrist Street Brilliant, OH 43913	(740)-598-4697 740-890-9916
Ms. Cheryl A. Bencie	1535 Gilchrist Street Brilliant, OH 43913	(740) 598-8063
Katmai Corp.	34 Kelley Way Brilliant, OH 43913	(740) 598-8220
Ohio American Energy, Inc.	34 Kelley Way Brilliant, OH 43913	(740)598-4325
Steel Valley Tank Welding	24 County Road 7E Brilliant, OH 43913	(740) 598-4994
Coen Oil Company	1499 Third Street Brilliant, OH 43913	Store: 740-598-1400 Corporate: (724) 223-5500
CSX Railroad		(800) 232-0143
Wheeling & Lake Erie Railroad		Yardmaster (330) 767-3364 (24 hrs)
Norfolk and Southern		800-453-2530

Estimated time of flood arrival 5 minutes

Estimated time of peak flood flow 20-25 minutes

APPENDIX D

PREPARATION AND APPROVAL OF THE EAP

**APPENDIX D
PREPARATION AND APPROVAL OF THE EAP**

A. Plan Preparation

This Emergency Action Plan (EAP) was prepared by Buckeye Power for the Cardinal Plant bottom ash and FAD I & II dams. The EAP was prepared based on observations made during various site visits, information provided by plant personnel, information obtained from the Ohio Department of Natural Resources (ODNR) inspection reports, and modeling of flooding conditions.

B. Cardinal Operating Company Approval

This EAP was prepared for the Cardinal plant bottom ash and FAD II dams under my direction as the Plant Manager for the Cardinal Plant. By signing this Approval, I certify that I have read and understand the EAP and the actions that may be required under it and, to the best of my knowledge; the information contained herein is accurate as of the date of my signature.

 6/1/21
(Signature) (Date)

Bethany E. Schunn
Cardinal Plant Manager

C. ODNR Approval

This EAP shall be submitted to the ODNR for review and approval. Upon receipt of written approval from the ODNR, a copy of ODNR's approval letter shall be attached in this EAP following this page and a copy of the approval letter shall be forwarded to each holder of a copy of the EAP.

APPENDIX E

DISTRIBUTION LIST/ACKNOWLEDGEMENT

APPENDIX E

DISTRIBUTION LIST/ACKNOWLEDGEMENT

The following are copies of Receipt Signature Pages indicating that each agency on the distribution list has received, read, and understood the Plan and agree to their responsibilities. The list below provides the name, address, and phone number and number of copies to which the Emergency Action Plan has been distributed.

<u>Name/Address</u>	<u>Copies</u>
Cardinal Power Plant 306 Country Road 7E Brilliant, Ohio 43913-1089 (740) 598-4164	6
Buckeye Power Power Generation 6677 Busch Blvd. Columbus, Ohio 43229 (614) 846-5757	1
Jefferson County Emergency Operations Center P.O. Box 2039 Wintersville, OH 43953 (740) 266-4150	2
Brilliant Volunteer Fire Department 1001 3 rd Street Brilliant, OH 43913-1209 (740) 598-4151	1
Jefferson County Sheriff 16001 State Route 7 Steubenville, OH 43952 (740) 283-8600	1
Division of Water, Dam Safety Ohio Department of Natural Resources Fountain Square, Bldg., E-3 Columbus, Ohio 43224 (614) 265-6731	1

**CARDINAL POWER PLANT
ASH POND COMPLEX**

**EMERGENCY ACTION PLAN
RECEIPT SIGNATURE PAGE**

This is to acknowledge receipt of the appropriate number of copies of the Emergency Action Plan for the Ash Pond Complex at the Cardinal Power Plant. We have read and understood the Plan and agree to our responsibilities listed in the Plan.

NAME (Print)_____

SIGNATURE_____

DATE_____

AGENCY/COMPANY_____

Please return to: Cardinal Operating Company
Cardinal Power Plant
306 County Road 7E
Brilliant, OH 43913

Attn: EAP Coordinator