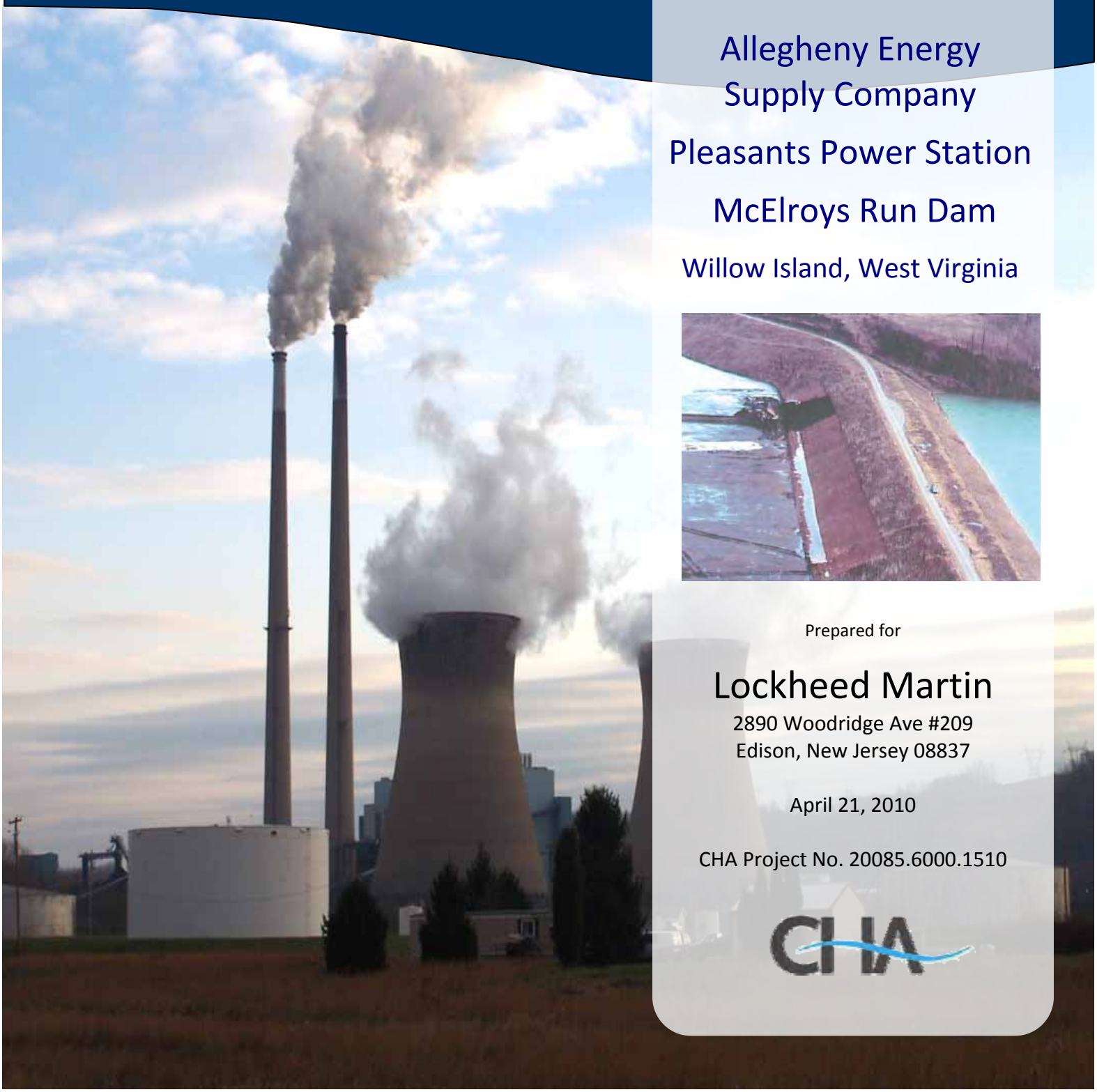
Assessment of Dam Safety
Coal Combustion Surface Impoundments (Task 3)
Final Report



Allegheny Energy Supply Company

Pleasants Power Station

McElroys Run Dam

Willow Island, West Virginia

Prepared for

Lockheed Martin

2890 Woodridge Ave #209
Edison, New Jersey 08837

April 21, 2010

CHA Project No. 20085.6000.1510

CHA

I acknowledge that the management unit referenced herein:

- McElroy's Run Dam

Has been assessed on October 13, 2009.

Signature: _____
Malcolm D. Hargraves, P.E.
Senior Geotechnical Engineer

Signature: _____
Katherine E. Adnams, P.E.
Senior Geotechnical Engineer

Reviewer: _____
Warren A. Harris, P.E.
Geotechnical Operations Manager

Reviewer: _____
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Principal Engineer
Registered in the State of West Virginia

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STATE OF WEST VIRGINIA
PROFESSIONAL ENGINEER
4/20/10

TABLE OF CONTENTS

SECTION **PAGE NUMBER**

1.0 INTRODUCTION & PROJECT DESCRIPTION 1
1.1 Introduction 1
1.2 Project Background 1
1.2.1 State Issued Permits 2
1.2.2 Independent Engineering Review 2
1.3 Site Description and Location 3
1.3.1 Other Impoundments 4
1.4 Previously Identified Safety Issues 4
1.5 Site Geology 5
1.6 Bibliography 5

2.0 FIELD ASSESSMENT 14
2.1 Visual Observations 14
2.2 Visual Observations – McElroy's Run Dam 15
2.2.1 Embankments and Crest 15
2.2.2 McElroy's Run Dam Outlet Control Structures 16
2.2.3 McElroy's Run Emergency Spillway 17
2.3 Monitoring Instrumentation 17

3.0 DATA EVALUATION 52
3.1 Design Assumptions 52
3.2 Hydrologic and Hydraulic Design 52
3.3 Structural Adequacy & Stability 54
3.3.1 Instrumentation Review Relative to Stability 57
3.4 Operations, Maintenance, and Inspections 57
3.4.1 Inspection Procedures 58
3.4.1.1 Allegheny Energy Weekly Inspections 59
3.4.1.2 Annual Inspections 60
3.4.1.3 Inspections by West Virginia Dam Safety 60
3.4.2 Operations Plan 61
3.4.3 Maintenance 61
3.5 Foundation Conditions 62

4.0 CONCLUSIONS/RECOMMENDATIONS 66
4.1 Acknowledgement of Management Unit Condition 66
4.2 Surface Degradation 66
4.3 McElroy's Run Dam Hydrologic and Hydraulic Analysis 67
4.4 McElroy's Run Dam Recommendations for Additional Stability Analyses 67
4.5 McElroy's Run Dam Recommendations for Additional Soil Behavior Analyses 68
4.6 McElroy's Run Dam Movement and Piezometer Data Changes 68
4.7 McElroy's Run Dam Routine Inspection Procedures 69

5.0 CLOSING 70

TABLES

Table 1 - Persons Involved in Coordination of the Task 2
Table 2 – Approximate Precipitation Prior to Site Visit 14
Table 3 - Engineering Comparison to Design Criteria 54
Table 4 – Soil Strength Properties Used in Stability Analyses 55
Table 5 - Engineering Comparison to Design Criteria 56

LIST OF FIGURES

Figure 1- Project Location Map 7
Figure 2 - Photo Plan 8
Figure 3 - Typical Cross Section 9
Figure 4 - Typical Cross Section with CCB Landfill Buttress 10
Figure 5 - Critical Infrastructure Map 11
Figure 6A - McElroy's Run Dam Geologic Cross Sections 12
Figure 6B - McElroy's Run Dam Geologic Cross Sections 13
Figure 7 - Photo Location Plan 18
Figure 8 - Instrument Location Plan 51
Figure 9 - McElroy's Run Dam Main Embankment Stability 63
Figure 10 - West Abutment Downstream Slope Stability Analysis 64
Figure 11 - West Abutment Downstream Slope Stability Analysis 65

APPENDIX

Appendix A - Completed EPA Coal Combustion Dam Inspection Checklist Forms & Completed EPA Coal Combustion Waste (CCW) Impoundment Inspection Forms

1.0 INTRODUCTION & PROJECT DESCRIPTION

1.1 Introduction

CHA was contracted by Lockheed Martin (a contractor to the United States Environmental Protection Agency) to perform site assessments of selected coal combustion surface impoundments (Project #0-381 Coal Combustion Surface Impoundments/Dam Safety Inspections). As part of this contract, CHA was assigned to perform a site assessment of Allegheny Energy's McElroy's Run Dam at the Pleasants Power Station, which is located in Willow Island, West Virginia as shown on Figure 1 – Project Location Map.

CHA made a site visit on October 13, 2009 to inventory coal combustion surface impoundments at the facility, perform visual observations of the containment dikes, and collect relevant information regarding the site assessment.

CHA Engineers Malcolm Hargraves, P.E., Khalid Abed, P.E., and Rebecca Filkins were accompanied by the following individuals:

Company or Organization	**Name and Title**
Allegheny Energy	Gary Haag, Environmental Manager
Allegheny Energy	Ralph Borsani, Engineer
Allegheny Energy	Eric Meyer, Manager Engineering
Allegheny Energy	Dennis Jones
GAI Consultants	Thomas Gower, Geologist

1.2 Project Background

The McElroy's Run Dam is under the jurisdiction of the State of West Virginia Department of Environmental Protection (WVDEP). According to the West Virginia Title 47 Legislative Rule, Series 34 Dam Safety Rule the dam has a Hazard Classification of Class 1 meaning the failure of

the dam may cause loss of human life or major damage to dwellings, buildings, railroads, or important utilities.

1.2.1 State Issued Permits

Allegheny Energy has received the following state issued permits for McElroy's Run Dam:

A Certificate of Approval signed February 7, 1978 for McElroy's Run Dam was provided to the EPA (and subsequently to CHA) as part of Allegheny Power's response to the EPA's March 2009 questionnaire.

A National Pollutant Discharge Elimination System (NPDES) permit, WV0023248 (State No. WV0000761), has been issued to Allegheny Energy authorizing discharge to the Ohio River in accordance with effluent limitations, monitoring requirements and other conditions set forth in the permit. The permit became effective August 15, 2009 and is set to expire July 15, 2014.

1.2.2 Independent Engineering Review

Prior to our site visit to the Pleasants Power Station, CHA was tasked with performing an independent engineering review (Task 2 of CHA's Scope or Work) of the McElroy's Run Dam. WV-DEP and Allegheny Energy, provided CHA with copies of the documents listed in Section 1.6 – Bibliography. Table 1 identifies professional personnel who participated in the review of the state inspection reports, in preparation of the Task 2 report and along with state and utility company representatives who were contacted by CHA to request documents. CHA prepared a draft report titled *Independent Engineering Review of Coal Combustion Surface Impoundments Draft Report*, dated August 13, 2009.

Table 1 - Persons Involved in Coordination of the Task

Company or Agency	Name and Title
CHA	Katherine Adnams, P.E., Senior Geotechnical Engineer
CHA	Warren Harris, P.E., Geotechnical Operations Manager
WV-DEP, Division of Dam Safety	Brian Long, P.E., Program Manager
Allegheny Energy	Gary Haag, Environmental Manager

1.3 Site Description and Location

Constructed in 1981, McElroy's Run Dam is located in Willow Island, West Virginia. The dam height is about 243 feet with a maximum storage volume of about 20,000 acre-feet. At the current water level the surface area is about 219 acres. The dam was constructed with a clay filled cutoff trench at the upstream toe, and a clay blanket on the upstream slope for a low permeability barrier. The downstream portion of the dam was constructed using compacted fly ash, and periodic layers of bottom ash for blanket/chimney drains.

The dam was constructed with a concrete discharge tower, which is outfitted with an operational sluice gate at Elevation 885 and a 24-inch square (former sluice gate) opening at El. 890. The discharge tower discharges under the dam via a 36-inch concrete pipe. Current primary discharge from the impoundment is via a 12-inch siphon with a maximum, 3,000 gallon per minute (GPM) operating discharge rate, although typical daily operations result in a flow of about 1,800 GPM. The siphon flow can either be diverted to the plant for make up water, or to an outfall in the Ohio River. A concrete, emergency spillway is located on the left (west) abutment.

The downstream face of the original dam is now covered by a landfill facility to about El. 860. The landfill is constructed with a bottom ash and/or sand filter blanket placed against the downstream slope of the dam. West Virginia DEP considers this a buttress to the dam. Seepage collection pipes, and the discharge tower outlet were extended beneath the landfill to discharge downstream of the complex.

Figure 2 – Photo Site Plan shows McElroy's Run Dam, the landfill, and displays its location in relation to the plant. McElroy's Run was a tributary to the Ohio River prior to the dam being constructed. Figure 3 shows a typical cross section of the dam. Figure 4 shows the landfill placement at the downstream side of the dam.

A map of the region indicating the location of the Pleasants Power Station and McElroy's Run Dam and identifying schools, hospitals, or other critical infrastructure located within approximately 5 miles down gradient of the ash pond is provided as Figure 5. The communities of Marietta, Ohio and Williamstown, West Virginia are about 12 miles downstream from the dam, and inundation mapping performed for McElroy's Run Dam extends about 18 miles downstream; the point at which a breach has little to no impact on the water level in the Ohio River.

1.3.1 Other Impoundments

CHA also observed two connected sedimentation impoundments downstream of the dam and landfill. Allegheny Energy reported that these ponds collect storm water runoff and leachate from the landfill. These impoundments were primarily constructed below the existing grade with the exception of the west embankment of the western pond which is about 16 feet high and 130 feet long with a crest width of about 40 feet. During a 2009 site survey, provided to CHA by Allegheny Energy, the dike had 10.5 feet of freeboard. CHA did not perform an inspection of these impoundments, but did note that they appear to be lined with fabric formed concrete.

1.4 Previously Identified Safety Issues

Based on our review of the information provided to CHA and as reported by Allegheny Energy, there have been no identified safety issues at McElroy's Run Dam in the last 10 years.

In 1999, a landslide in the west abutment slope downstream of the toe of the dam was stabilized using a grid of grout columns. GAI Consultants (GAI) performed investigations related to the stability of this slope and found that within the dam and landfill area, the factor of safety was less than desirable. Therefore, modifications to the landfill grading plan were made to ensure recommended factors of safety were met.

1.5 Site Geology

According to the *Geologic Map of West Virginia*, by Cardwell, D.H., Erwin, R.B., and Woodward, H.P., the geology of the area of McElroy's Run Dam derives from the Paleozoic Era, is part of the Permian or Pennsylvanian System and includes sequences from the Dunkard and Monongahela Groups. These groups consist of non-marine cyclic sequences of sandstone, siltstone, red and gray shale, limestone and coal. Subsurface investigations at the site have confirmed the presence of these bedrock sequences and indicate that weathering and movement of the upper layers of bedrock have resulted in residual colluvial type soils overlying competent bedrock.

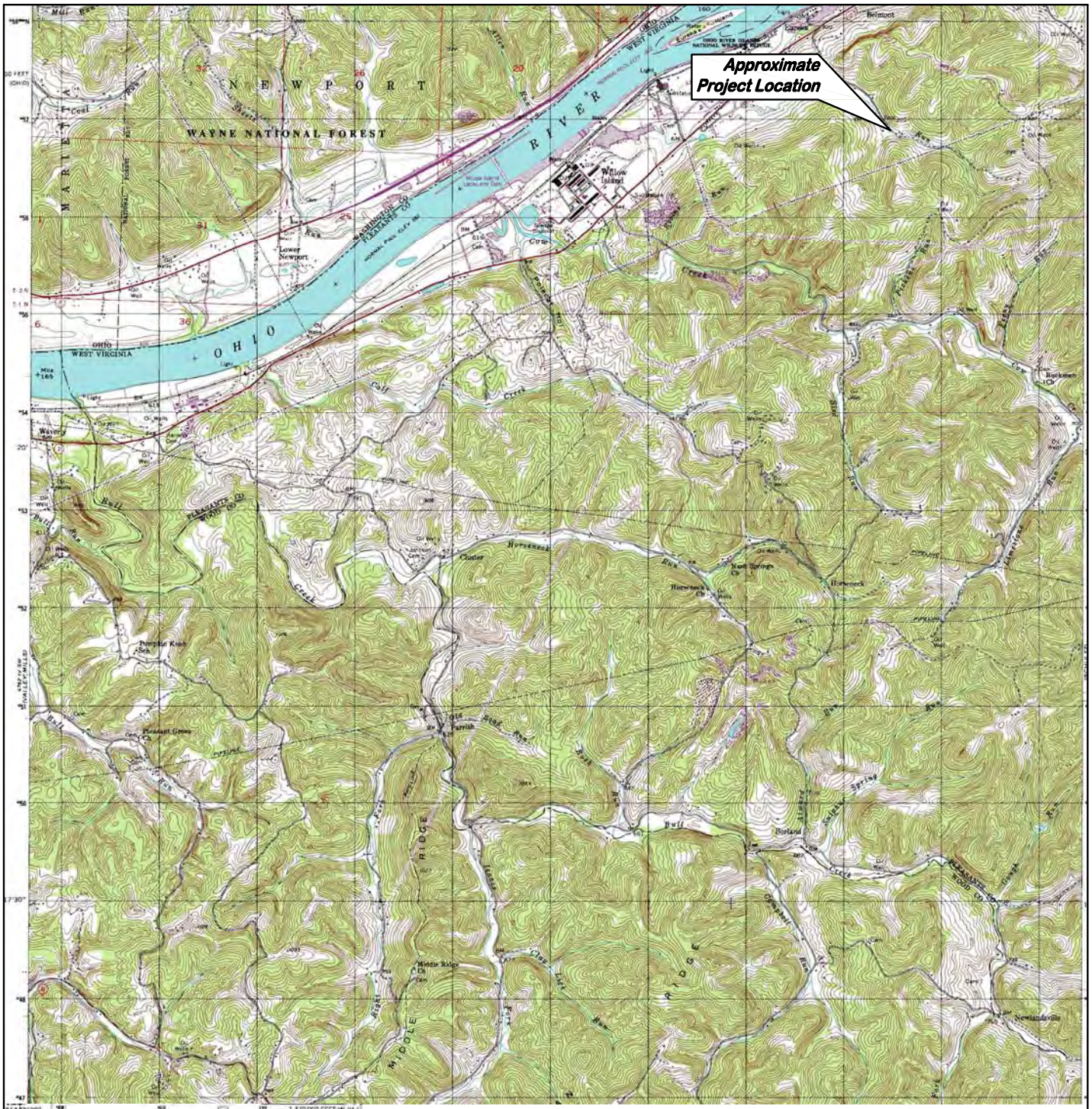
The west abutment area at the McElroy's Run Dam reportedly has a history of geologic instability. This instability is reportedly the result of the plunge of the Burning Springs Anticline, which contributes abundant groundwater. Allegheny Energy performed stabilizing work on the left slope downstream of the dam with a grid of concrete columns in about 2001. To confirm the dam's stability, GAI performed stability analyses in this left section of the dam following subsurface explorations and laboratory testing of soils. GAI noted that slickensides were observed within the colluvial soils overlying intact bedrock, and therefore residual shear strength friction angles were used in the analyses. Figures 6A and 6B show geologic sections of the dam in this area. Original design sections for the dam show a much thinner layer of soil overlying intact bedrock in the mid section of the dam than toward the abutments (see Figure 9).

1.6 Bibliography

CHA reviewed the following documents provided by WVDEP and Allegheny Energy in preparing this report:

- *Order of Compliance*, issued by West Virginia Department of Environmental Protection, January 30, 2009.

- *Findings Regarding Underground Mines in Proximity to the Dam*, GAI Consultants, March 3, 2009.
- *2005 Annual Embankment Inspection Report, McElroy's Run CCB Management Facility* GAI Consultants, September 29, 2005.
- *2006 Annual Embankment Inspection Report, McElroy's Run CCB Management Facility* GAI Consultants, December 6, 2006.
- *2007 Annual Embankment Inspection Report, McElroy's Run CCB Management Facility* GAI Consultants, September 4, 2007.
- *2008 Annual Embankment Inspection Report, McElroy's Run CCB Management Facility* GAI Consultants, September 10, 2008.
- *McElroy's Run Dam, Willow Island, Pleasants County, ID #07302, Routine Inspection of Dam*, West Virginia Department of Environmental Protection, June 30, 2005.
- *McElroy's Run Dam, Willow Island, Pleasants County, ID #07302, Inspection by Dam Safety*, West Virginia Department of Environmental Protection, June 10, 2008.
- *McElroy's Run Dam, Willow Island, Pleasants County, ID #07302, Inspection Report*, West Virginia Department of Environmental Protection, May 13, 2009.
- *Response to the US Environmental Protection Agency CERCLA 104(e) Information Request*, Allegheny Energy, March 24, 2009.
- *Stability Analysis of the West Abutment Downstream Slope of Embankment, McElroy's Run CCB Disposal Site*, GAI Consultants, January 2001.
- *McElroy's Run Embankment and Impoundment Area Monitoring and Emergency Action Plan and Operations Plan*, Revised September 2009.



SOURCE: USGS WILLOW ISLAND (WV) QUADRANGLE, 7.5 MIN SERIES

0 5000 10000

Scale in feet

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PROJECT LOCATION MAP

PLEASANTS POWER STATION
PLEASANTS COUNTY, WEST VIRGINIA

PROJECT NO. 20085.6000

DATE: AUG 2009

FIGURE 1

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IMAGE REFERENCE: GOOGLE EARTH, IMAGE DATED AUGUST 25, 2007.

0 1273 2546
Scale in feet

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PHOTO SITE PLAN

PLEASANTS POWER STATION
PLEASANTS COUNTY, WEST VIRGINIA

PROJECT NO. 20085.6000

DATE: AUG 2009

FIGURE 2

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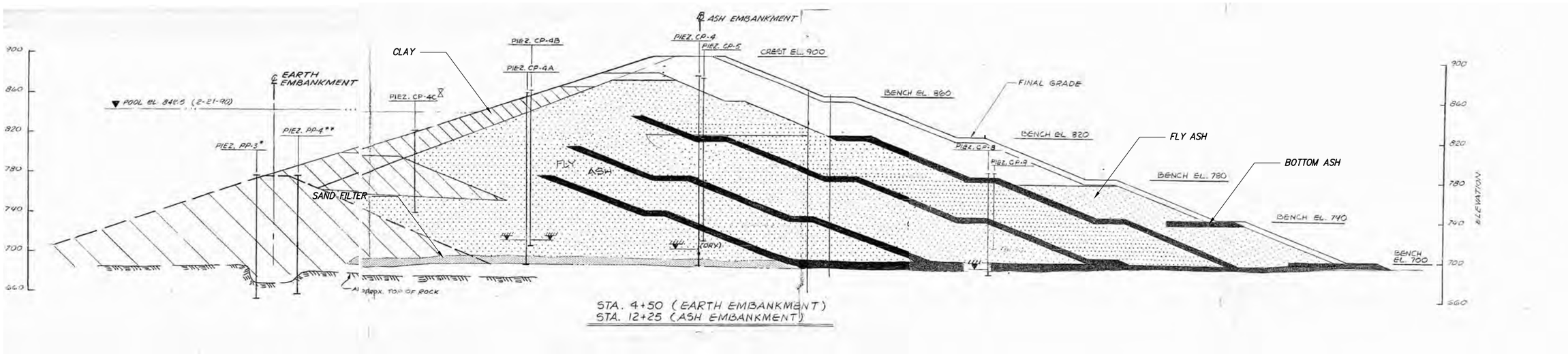

IMAGE REFERENCE: STABILITY ANALYSES OF MCELROY'S RUN EMBANKMENT, GAI CONSULTANTS, MARCH 12, 2009

0 80 160
Scale in feet

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TYPICAL CROSS SECTION

PLEASANTS POWER STATION
PLEASANTS COUNTY, WEST VIRGINIA

PROJECT NO. 20085.6000

DATE: AUG 09

FIGURE 3

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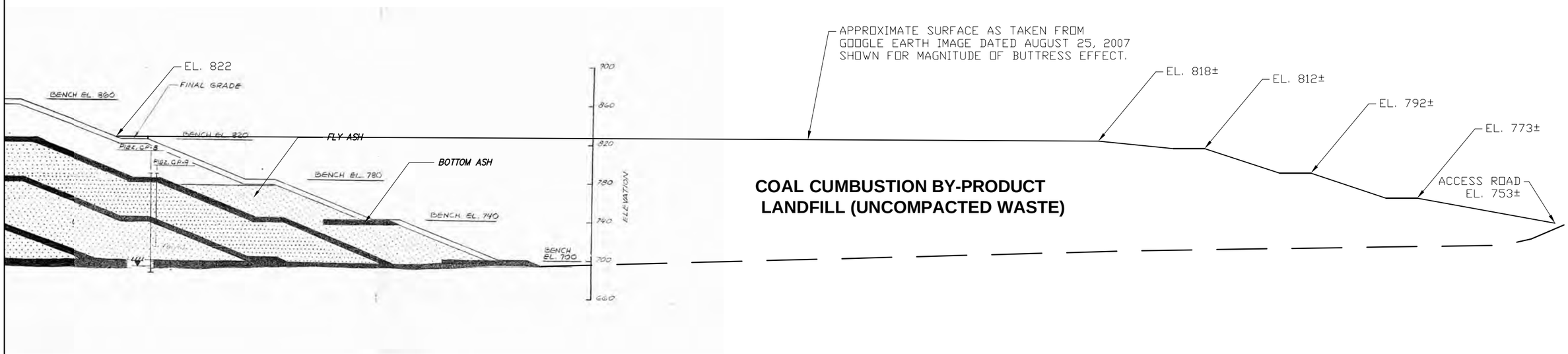

IMAGE REFERENCE: STABILITY ANALYSES OF
MCELROY'S RUN EMBANKMENT, GAI CONSULTANTS,
MARCH 12, 2009

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Scale in feet

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TYPICAL CROSS SECTION
WITH CCB LANDFILL BUTTRESS

PLEASANTS POWER STATION
PLEASANTS COUNTY, WEST VIRGINIA

PROJECT NO.
20085.6000

DATE: AUG 09

FIGURE 4

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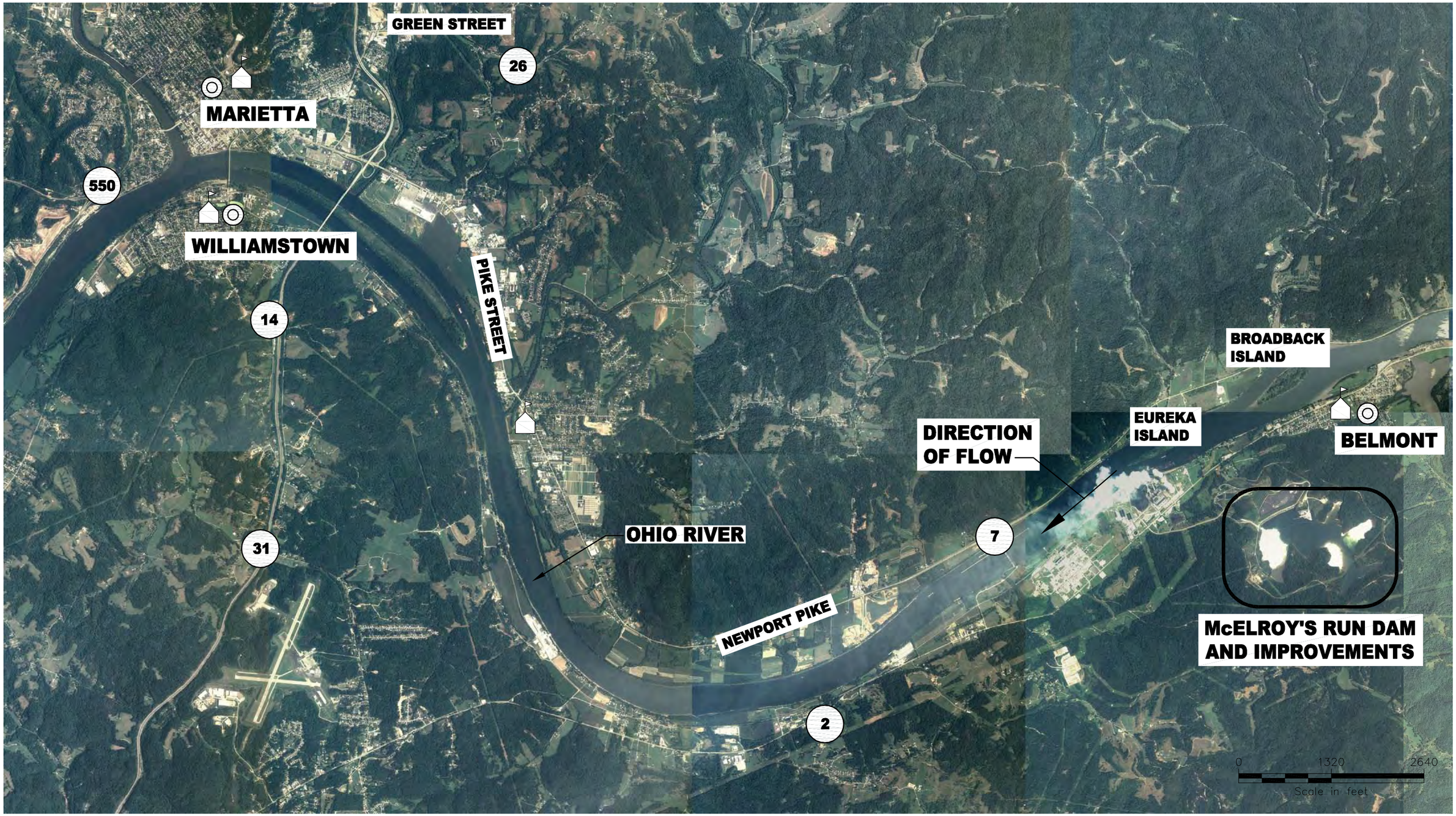

IMAGE REFERENCE: GAI CONSULTANTS, STABILITY ANALYSIS OF THE WEST ABUTMENT DOWNSTREAM SLOPE OF EMBANKMENT, MCELROY'S RUN CCB DISPOSAL SITE, PLEASANTS POWER STATION, WILLOW ISLAND, WV, JANUARY 2001

LEGEND

31 STREET, HIGHWAY

FIRE DEPARTMENT

SCHOOL

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MCELROY'S RUN DAM
CRITICAL INFRASTRUCTURE MAP

PLEASANTS POWER STATION
PLEASANTS COUNTY, WEST VIRGINIA

PROJECT NO. 20085.6000

DATE: NOV 09

FIGURE 5

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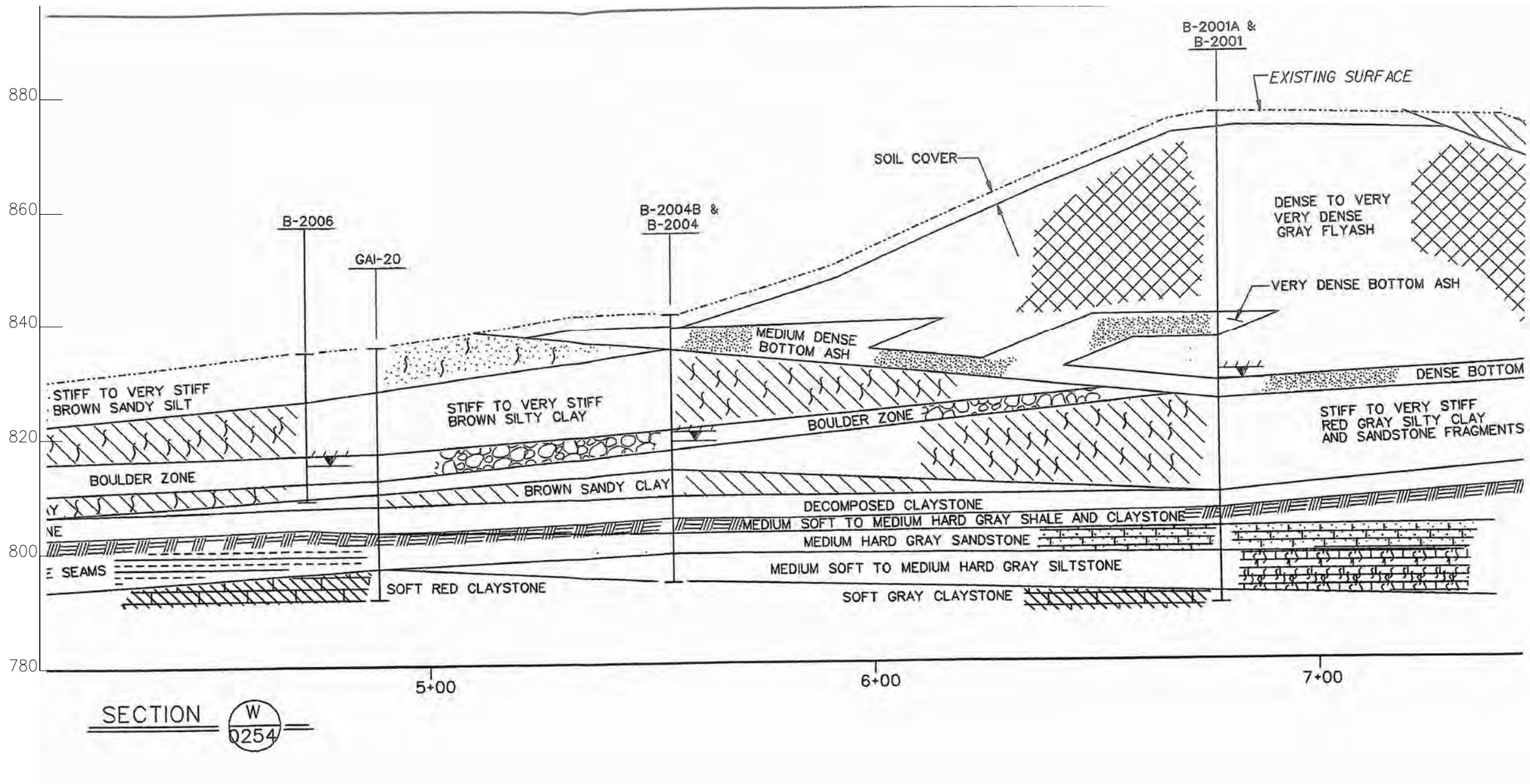

IMAGE REFERENCE: GAI CONSULTANTS, STABILITY ANALYSIS OF THE WEST ABUTMENT DOWNSTREAM SLOPE OF EMBANKMENT, MCELROY'S RUN CCB DISPOSAL SITE, PLEASANTS POWER STATION, WILLOW ISLAND, WV, JANUARY 2001

0 20 40
Scale in feet

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MCELROY'S RUN DAM
GEOLOGIC CROSS SECTIONS

PLEASANTS POWER STATION
PLEASANTS COUNTY, WEST VIRGINIA

PROJECT NO. 20085.6000

DATE: AUG 09

FIGURE 6A

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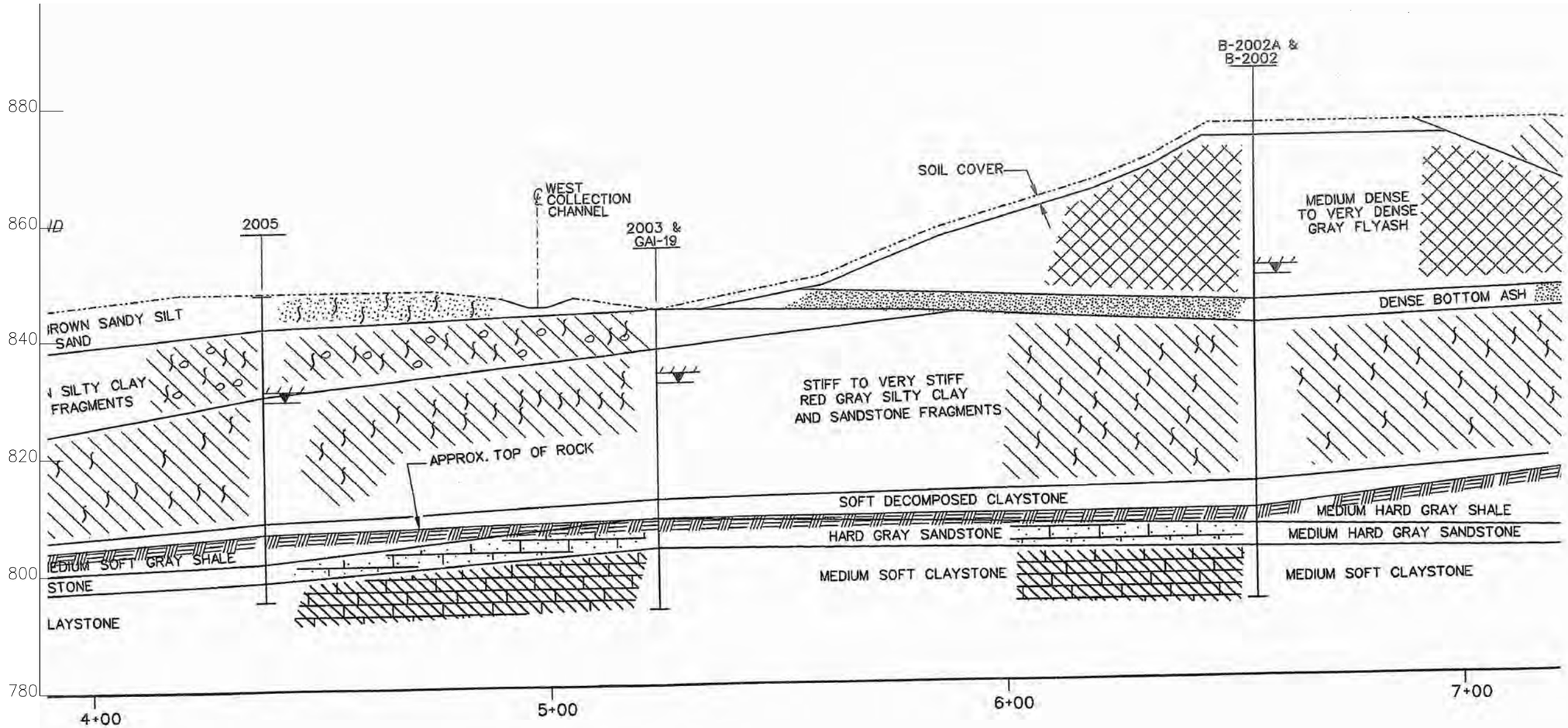

SECTION V/0254

IMAGE REFERENCE: GAI CONSULTANTS, STABILITY ANALYSIS OF THE WEST ABUTMENT DOWNSTREAM SLOPE OF EMBANKMENT, MCELROY'S RUN CCB DISPOSAL SITE, PLEASANTS POWER STATION, WILLOW ISLAND, WV, JANUARY 2001

0 20 40
Scale in feet

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MCELROY'S RUN DAM
GEOLOGIC CROSS SECTIONS

PLEASANTS POWER STATION
PLEASANTS COUNTY, WEST VIRGINIA

PROJECT NO. 20085.6000

DATE: AUG 09

FIGURE 6B

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2.0 FIELD ASSESSMENT

2.1 Visual Observations

CHA performed visual observations of McElroy's Run Dam following the general procedures and considerations contained in Federal Emergency Management Agency's (FEMA's) *Federal Guidelines for Dam Safety* (April 2004), and Federal Energy Regulatory Commission (FERC) Part 12 Subpart D to make observations concerning settlement, movement, erosion, seepage, leakage, cracking, and deterioration. A Coal Combustion Dam Inspection Checklist and Coal Combustion Waste (CCW) Impoundment Inspection Form, prepared by the US Environmental Protection Agency, were completed on-site during the site visit. Copies of the completed forms were submitted via email to a Lockheed Martin representative approximately three days following the site visit to the Pleasants Power Station. Copies of these completed forms are included in Appendix A. Photo logs and Site Photo Location Map (Figure 7) for McElroy's Run Dam are located at the end of Section 2.4.

CHA's visual observations were made on October 13, 2009. The weather was sunny with temperatures between 40 and 60 degrees Fahrenheit. Prior to the days we made our visual observations, the following approximate rainfall amounts occurred (as reported by www.weather.com).

Table 2 – Approximate Precipitation Prior to Site Visit

Date of Site Visit – October 13, 2009		
Day	**Date**	**Precipitation (inches)**
Monday	October 5, 2009	0.00
Tuesday	October 6, 2009	0.23
Wednesday	October 7, 2009	0.00
Thursday	October 8, 2009	0.60
Friday	October 9, 2009	1.36
Saturday	October 10, 2009	0.00
Sunday	October 11, 2009	0.00
Monday	October 12, 2009	0.00
Tuesday	October 13, 2009	0.00
Total	**Week Prior to Site Visit**	**2.19**

Date of Site Visit – October 13, 2009		
Day	**Date**	**Precipitation (inches)**
Total	**30 Days Prior to Site Visit**	**4.07**

2.2 Visual Observations – McElroy's Run Dam

CHA performed visual observations of McElroy's Run Dam. The McElroy's Run Dam is about 1,900 feet long and about 243 feet high. The landfill extends about 1,350 feet north of the dam crest.

2.2.1 Embankments and Crest

In general, the alignment of the crest of McElroy's Run Dam does not show signs of change in horizontal alignment. The crest is about 70 feet wide and is partly grass covered and partly covered by an access road as shown in Photo 17. Both the northeast and southwest abutments contacts are against bedrock.

The upstream slope is grass covered with exposed soil near the water line where the water level has been lowered (Photos 4, 11, and 13) to evaluate the extent and magnitude of beach erosion at the water line. Photos 11 and 12 show the level of beach erosion. There were a few areas where the vegetation cover was thin and surface erosion was occurring, and a couple isolated small animal burrows. These types of features are shown in Photos 8 through 10.

The downstream slope is grass covered with an active landfill buttress being built up against it. Photos 21 and 22 show the upper portion of the downstream slope and the placement of a bottom ash blanket drain at the active landfill construction area. Similar to conditions on the upstream slope, Photos 23 through 25 show typical conditions with thin vegetation cover and erosion rills obscured by thicker vegetation on the downstream slope above the landfill.

Landfill benches below the bench currently under construction are grass covered with occasional isolated woody vegetation. Occasional loss of grass cover and rutting from mowing equipment, and occasional active and repaired rodent burrows were observed. There were some deep (6 to 10 inches) erosion rills in the area where recent re-grading for the recently constructed access road has occurred on the east side and in the recently placed bottom ash blanket drain as shown in Photos 37 and 26, respectively.

Fabriform®, a method of revetment construction, is the drainage swale armor of choice at McElroy's Run Dam. A fabriformed concrete drainage ditch runs along the southeast toe of the landfill buttress adjacent to an active haul road. There is also a fabric formed concrete drainage ditch that the bench drains connect to that runs along the west abutment groin (Photo 28).

The blanket drain seepage collection system discharges downstream of the landfill buttress. On the day of the inspection there was a flow of approximately 36 gallons per minute of clear seepage as shown in Photo 58.

2.2.2 McElroy's Run Dam Outlet Control Structures

Currently water from the McElroy's Run ash disposal pond is outlet at a siphon float located near the northwest corner of the pond. This 12-inch diameter siphon can convey water either back to the Pleasants Power Station for reuse, or discharge to the Ohio River. Photo 5 shows the siphon float within the impoundment.

The original intake tower in McElroy's Run Dam is an isolated concrete structure accessible only by boat. The intake structure is functional through the use of sluice gates, but is not routinely used. At the time of the inspection the pond water level was well below the intake elevation. Photos 1 through 3 show this spillway tower. The tower discharges to a farbiformed basin as shown in Photos 59 and 60.

2.2.3 McElroy's Run Emergency Spillway

To the west of the dam there is a concrete emergency spillway as shown in Photos 31 through 35. The approach to the concrete paving is lined with stone rip rap (Photo 31), and there is grouted riprap protection at the outlet of the emergency spillway as shown in Photo 35. Loose caulk was noted at some of the joints between concrete paving panels as shown in Photo 33.

2.3 Monitoring Instrumentation

There is monitoring instrumentation installed at McElroy's Run Dam. Figure 8 shows the approximate locations of instrumentation. The locations shown in Figure 8 represent what was provided to CHA although Allegheny Energy acknowledged that some of these locations have been closed and buried as the landfill has been built up. Therefore, this figure should not be considered an accurate depiction of currently operating instrumentation, but rather what has been installed and monitored at some point during the life of the facility.

A more complete discussion of the data collected from this instrumentation is contained in Section 3.4.

IMAGE REFERENCE: ALLEGHENY ENERGY 2009 TOPOGRAPHIC MAP, DRAWING C79503318, DATED 9-30-2009

0 300 600

Scale in feet

N

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PHOTO LOCATION PLAN

PLEASANTS POWER STATION
PLEASANTS COUNTY, WEST VIRGINIA

PROJECT NO. 20085.6000

DATE: NOV 2009

FIGURE 7

File: K:\20085\CADD\ACAD\FIGURES\6000 PLEASANT\6000 PLEASANT FIG 2.DWG Saved: 12/2/2009 2:14:57 PM Plotted: 12/2/2009 2:17:16 PM User: Gray, Timmolyn

1

Looking west at concrete spillway tower structure and floating skimmer.

2

Closer look at spillway tower and closed sluice gates.

CHA	**ALLEGHENY POWER** **PLEASANTS POWER STATION** **McELROY'S RUN DAM** **WILLOW ISLAND, WV**
CHA Project No.: 20085.6000.1510	October 13, 2009

3

A close-up of the gage staff showing lake elevation level below elevation 885.

4

Looking west along the upstream slope face.
Note exposed soil below grass line where water level has been lowered.

CHA	**ALLEGHENY POWER** **PLEASANTS POWER STATION** **McELROY'S RUN DAM** **WILLOW ISLAND, WV**
CHA Project No.: 20085.6000.1510	October 13, 2009

5

Siphon float (currently primary pond discharge).

6

Sluice lines and ash within the McElroy Run impoundment (looking south).

7

Looking west along upstream slope with emergency
spillway invert in background at left (west) abutment contact.

8

Small isolated animal (possibly reptile) burrow in upstream slope face.

9

Exposed soil at possible tire rut or surface erosion area on upstream slope.

10

Loss of ground cover and erosion on upstream slope.

11

Looking southwest along upstream slope at water level.
Note beaching erosion at both former water line and current water line.

12

Close up of beaching erosion on upstream slope.

13

Looking east along upstream slope face with another view of the soil exposed below the grass line.

14

Upstream slope at right (east) abutment contact, looking east. Break in tree line above slope is location of upstream core trench at the right abutment contact. Note Fabriform lined groin at abutment contact.

15

Close up view of the upstream slope right abutment groin looking toward crest.

16

Upstream slope right abutment groin looking toward toe and lake.
Note sediment build-up near end of groin and bedrock exposed to the left of the groin

17

Downstream slope face, looking west, showing part of crest and access drive.

18

Instrumentation on the dam crest, looking west.

19

Downstream slope face, looking east, showing part of crest and access drive.

20

Looking northeast from crest at active buttress landfill operations
on downstream face and landfill expansion area in the background.

21

Looking east along downstream slope face and
bottom ash being stockpiled for drainage blanket at slope toe.

22

Looking west along downstream slope face.
Note bottom ash drainage blanket on slope in landfill buttress area.

23

Close-up of thinning and lost grass cover area on downstream slope.

24

Vegetated, obscured erosion rill on downstream slope (beneath clipboard).

25

Another area of thinning grass cover and potential erosion above bottom ash drainage blanket.

26

Erosion gully at top of the bottom ash drainage blanket being placed on the active buttress landfill bench.

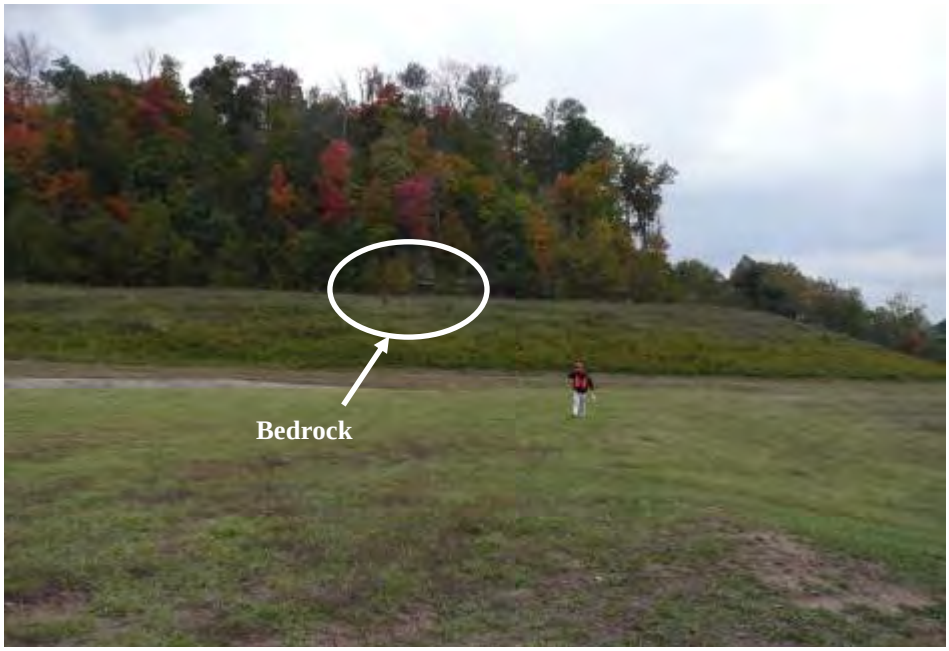
27

Looking east along the downstream slope face showing slope vegetation and present stage of the bottom ash drainage blanket placement.

28

Looking downstream (north) at Fabriform concrete lined groin near west (left) abutment.

29



West abutment contact at the emergency spillway. Bedrock exposed in natural hillside at tree line.

30

Looking west along upstream slope at emergency spillway entrance.

31

Looking northwest (downstream) from upstream slope at emergency spillway.
Note stone slope protection at entrance.

32

Emergency spillway, looking upstream at the control section.

33

Expansion and crack control joints in concrete spillway. Note loose sealant in joints.

34

Looking downstream at emergency spillway outlet.

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CHA Project No.: 20085.6000.1510	October 13, 2009

35

Grouted rip rap outlet protection at emergency spillway.

36

Looking west at downstream slope below emergency spillway.
Grassed erosion rills (slightly darker green areas in grass cover) can be seen in this area.

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CHA Project No.: 20085.6000.1510	October 13, 2009

37

Erosion rill in fly ash at edge of active bench in the buttress landfill.
Downstream slope of the actual embankment dam visible in distant background.

38

Looking northeast from right abutment contact along the downstream slope of
the buttress landfill. Note water deposited ash from working bench above this level.

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CHA Project No.: 20085.6000.1510	October 13, 2009

39

Fabric formed concrete lined tie-in from bench (Bench H) to left abutment groin.
Note vegetation beginning to become established in sediment deposited in ditch over time.

40

Looking west at the hillside above the left abutment contact with the buttress landfill slope.

41

Slope disturbance due to mowing activity and subsequent erosion, exposing ash beneath soil cover.

42

Rutting from mowing equipment on bench in water deposited ash along buttress landfill slope.

43

Another area of slope disturbance, erosion, and exposed ash due to mowing equipment.

44

Erosion rills in exposed ash where soil cover was too thin or ash was transported via sheet flow from the active working bench above this area.

45

Water deposited ash and loss of grass cover on inactive bench and slope.

46

Looking southeast along the landfill buttress slope adjacent to active haul road. Slope is steeper adjacent to road.

47

Erosion rill and loss of grass cover on landfill buttress slope facing haul road.

48

Repaired rodent burrow on landfill buttress slope.

49

Collapsed more recent rodent burrow area

50

Looking west across buttress landfill slope showing older construction benches. Grass and soil cover appears more stable and less susceptible to erosion on these lower benches.

51

Close up of bottom ash groin and blanket drain on right abutment contact. Note sporadic grass on groin.

52

6” diameter abutment drain outlet to west (left) abutment groin
below active bench; seepage clear. Groin dry above this level.

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CHA Project No.: 20085.6000.1510	October 13, 2009

53

Seepage pipe outlet to groin around Bench E in west groin; seepage clear.

54

Seepage from hillside near area of hillside slide repair.

55

Red bed shale residuum exposure in hillside at west (left) buttress landfill abutment contact where hillside slide was repaired.

56

Looking up-slope at fabric formed concrete groin on west (left) buttress landfill abutment.

57

Looking down-slope at fabric formed concrete groin on west (left) buttress landfill abutment.

58

Blanket drain seepage collection system outlet. Approximately 36 gallons per minute. Seepage was clear.

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CHA Project No.: 20085.6000.1510	October 13, 2009

59

Looking downstream at spillway outlet basin.

60

Concrete spillway outlet. Water does not normally flow through outlet.
Water leaves outlet via a siphon with an outfall in the Ohio River.

61

Sedimentation Basin No.1 for landfill and storm water runoff. Predominantly incised.

62

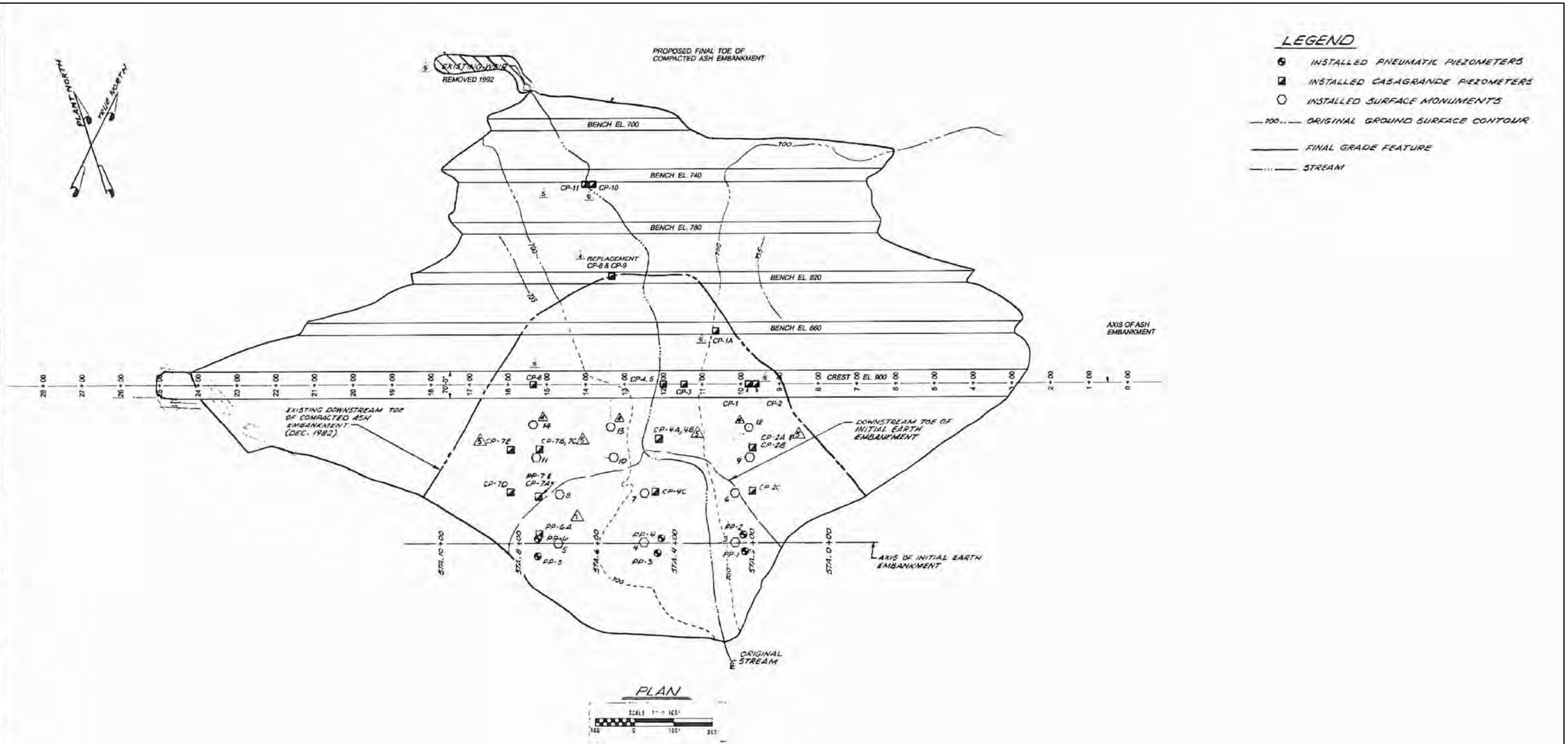
Separation dike between Sedimentation Basin No.1 and Sedimentation Basin No. 2.

63

Sedimentation Basin No. 2 for general site runoff and outfall from Sedimentation Basin No.1.

64

Downstream slope of Sedimentation Basin No. 2 showing pump house structure (right side of photo).
Pump house conveys effluent from Sedimentation Basin No. 2 back up to the McElroy's Run Impoundment.



NOTES:

1. SURFACE MONUMENTS 3, 4, 5, WERE INSTALLED IN JANUARY 1992
2. ALL PNEUMATIC PIEZOMETERS HAVE MALFUNCTIONED AS OF DECEMBER 1993
3. CASAGRANDE PIEZOMETER PP-6A ABANDONED JUNE 8, 1993.
4. CASAGRANDE PIEZOMETER CP-2C, 4C, 7A, 7B & PP-7 ABANDONED AND GROUTED MAY 4, 1987 AND SURFACE MONUMENTS 9,10 AND 11 WERE INSTALLED.
5. SURFACE MONUMENTS 12, 13 AND 14 WERE INSTALLED IN DECEMBER 1991.
6. REPLACEMENT PIEZOMETERS CP-8 AND CP-9 WERE INSTALLED IN FEBRUARY 1991.
7. CASAGRANDE PIEZOMETERS CP-2A 2B,4A,4B 7B,7C & 7E ABANDONED & GROUTED OCTOBER 29, 1992, AND CP-1B & CP-1C INSTALL ON NOVEMBER 4, 1992

IMAGE REFERENCE: DRAWING NUMBER 101-6514-191
REVISION 6

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INSTRUMENT LOCATION PLAN

PLEASANTS POWER STATION
PLEASANTS COUNTY, WEST VIRGINIA

PROJECT NO. 20085.6000

DATE: NOV 2009

FIGURE 8

File: K:\20085\CADD\ACAD\FIGURES\6000 PLEASANT\6000 PLEASANT FIG 2.DWG Saved: 12/2/2009 2:14:57 PM PLotted: 12/2/2009 2:17:36 PM User: Gray, Timmolyn

3.0 DATA EVALUATION

3.1 Design Assumptions

CHA has reviewed the design assumptions related to the design and analysis of the stability and hydraulic adequacy of the McElroy's Run Dam, which were available at the time of our site visits and provided to us by Allegheny Energy. The design assumptions are listed in the following sections.

3.2 Hydrologic and Hydraulic Design

Dams in West Virginia are governed by West Virginia Rule 47CSR34. Under this legislation the McElroy's Run Dam is classified as a Class 1, high hazard dam. This classification requires the dam to safely pass or store the inflow from the 6-hour duration Probable Maximum Precipitation (PMP), discharge 90% of the stored storm volume within 10 days after the storm event, and emergency spillway operation frequency shall be no more than once in 100 years.

When McElroy's Run Dam was permitted with the WVDEP, the regulations required a Class 1 (High Hazard) dam, such as McElroy's Run Dam, safely pass or store 80 percent of the PMP while leaving 3 feet of freeboard in the impoundment, which the Certificate of Approval for this dam indicates the spillways were designed for. In 1992 the regulations were revised to require Class 1 dams to safely pass or store 100 percent of the PMP and the freeboard requirement was removed. Mr. Brian Long, PE from WVDEP indicated that this change was insignificant for most dams and that due to the number of dams in the State meeting the pre-1992 requirement combined with the insignificant difference in the flood routed storm capacity, WVDEP did not reissue Certificates for existing dams that met the pre-1992 Rule requirement.

The hydrologic and hydraulic analyses for McElroy's Run Dam are included in engineering reports prepared by GAI engineers. Based on these engineering reports and 1978 Certificate of Approval reviewed by CHA, and our observation that recent aerial mapping does not show development within the drainage basin that could change inflow characteristics during the design storm, it appears that the McElroy's Run Dam will fully store 80 percent of the 6-hour PMP when operations maintain the reservoir water level at or below El. 888.45. The normal operating range is reported to be El. 886 to 888 although the reservoir level was below El. 885 at the time of CHA's site visit.

Reports reviewed for both operations and slope stability evaluations provide a slightly conflicting picture of whether the stored storm volume can be drained from the reservoir in 10 days. A discussion in GAI's March 12, 2009 response to WVDEP's Order for Compliance on whether rapid drawdown conditions could exist suggest that the rate of drawdown "…cannot reasonably drop faster than one foot per day…[which] is an unexceptional drawdown rate…and would not produce a rapid drawdown condition" and "Calculations by GAI indicate that drawdown of the pool from emergency spillway control El. 893.4 to the normal pool El. 885 could not be accomplished in less than 10 days assuming that both the El. 890 and El. 885 gates are open." The Monitoring and Emergency Action Plan and Operations Plan dated September 21, 2009 indicates on page 1 under *Brief Overview of Dam* that the sluice gate at El. 885 that is normally closed can be opened to drain 90 percent of the storm storage in 10 days. CHA evaluated reported maximum discharge rates (a design flow of 1,800 gpm and a hydraulic capacity of 3,000 gpm) from the siphon, and an estimated flow from the sluice gate at El. 885 in the spillway tower (90 cfs), and determined that the storm storage could be removed from the reservoir in between 9 and 10 days, thus meeting the State requirements.

We have summarized the results of several engineering reports and CHA's analyses in comparison to the design criteria required by Rule 47CSR34 in Table 3.

Table 3 - Engineering Comparison to Design Criteria

Design Consideration	Current Criteria[1]	Criteria when McElroy's Run Permitted (1978)[1]	Engineering Results
Hydrologic Considerations	Pass the 6-hour duration Probable Maximum Precipitation (PMP)	Pass 80% PMP with 3 feet of freeboard	Pass 80% PMP with 3.3 feet of freeboard[2]
	Discharge the portion of the PMP not capable of being stored in the reservoir Discharge 90% of the stored storm volume within 10 days after the storm event.		80% PMP peak flow routed through emergency spillway[2] Conflicting responses. CHA anticipates that with both the primary spillway and the siphon operating, this criterion will be met.
	Emergency Spillway Frequency of Operation shall be no more often than once in 100 years.		Normal water levels result in no discharge from the Emergency Spillway for storms of magnitude 0.8 PMP or less.

1. McElroy's Run Dam was constructed prior to implementation of the current hydrologic and hydraulic design criteria. WVDEP did not require dam owners to analyze their dams for the new criteria when the older criteria were met.
2. 1978 Certificate of Approval

3.3 Structural Adequacy & Stability

CHA has reviewed and concluded that engineering reports for slope stability indicate the following results in comparison to the criteria established by West Virginia Rule 47CSR34. We have summarized the soil properties used for these analyses and results of several engineering reports in comparison to these design criteria in Tables 4 and 5, respectively. While some laboratory testing was performed to develop soil properties for use in these analyses by D'Appolonia and GAI, some soil properties were assumed, as noted in footnotes to Table 4, based on the engineer's experience. Figures 9 through 11 show the results of slope stability analyses as summarized in this table. These factors of safety reflect pre-landfill construction

conditions and are, therefore, conservative because the landfill buttresses the downstream slope of the dam.

Table 4 – Soil Strength Properties Used in Stability Analyses

Soil Stratum	Unit Weight (pcf)	Friction Angle (φ)	Cohesion (psf)
March 12, 2009 Stability Analyses of McElroy's Run Dam Report by GAI			
Summary From D'Appolonia Design Drawings			
Compacted Silty Clay	134.4 (moist) 139.6 (saturated)	23	300
In Situ Silty Clay to Clayey Silt and Rock Fragments	130.7 (moist) 131.9 (saturated)	23	0
Soft Broken Claystone	135* (moist and saturated)	23*	300*
Interbedded Siltstone, Sandstone and Claystone	150*	45*	10,000*
Compacted Fly Ash and Bottom Ash	110 (moist and saturated)	0**	45**
Uncompacted Fly Ash *(as notated by D'Appolonia Consulting Engineers, Inc.)*	90 (moist) 100 (saturated)	0**	30**
January 2001 Stability Analysis of West Abutment Downstream Slope report by GAI* **			
Clay Seal	130	23	0
Fly Ash in Dam	110	32	0
Bottom Ash	100	35	0
Colluvium 1	128	26.2	0
Colluvium 2	133.5	22.2	0
Colluvium 3	132.5	23	0
Dec. Claystone	135	23	0
Boulders	120	30	0
Colluvium 4	117.5	8.5	0

* Assumed soil property.
** Assumed soil property based on previous experience by designer.
*** Soil properties of natural soils were developed from 7 soil samples selected for laboratory testing. No indication of where ash properties derived from.

Table 5 - Engineering Comparison to Design Criteria

Design Consideration	Criteria		Engineering Results	
Embankment Stability			West Abutment Area*	Max. Main Embankment Section*
	Steady State Conditions Factor of Safety	1.5	1.6(2)	Upstream 1.8(1) Downstream 2.0(1)
	Upstream Slope Rapid Drawdown Factor of Safety	1.2	Not calculated	Not calculated(3)
	Steady State and Earthquake Loading Factor of Safety	1.2	Not calculated	Upstream 1.3(1) Downstream 1.4(1)
Liquefaction	Analyze potential and safeguard against if needed		No conclusion provided to CHA.	

1. March 12, 2009 Stability Analyses of McElroy's Run Dam report.
2 January 2001 Stability Analysis of West Abutment Downstream Slope report.
3. The March 12, 2009 Stability Report concludes that the impoundment can not be lowered by more than 1 foot per day, which GAI does not consider to be a rate at which rapid drawdown conditions exist.
* Before landfill construction.

GAI states in their March 12, 2009 Stability Report that the impoundment cannot be lowered by more than 1 foot per day, which is a rate not normally associated with inducing rapid drawdown conditions. However, as stated in Section 3.2 – Hydrologic and Hydraulic Design, there is some conflicting information in the engineering documents reviewed by CHA as to what is the time to drain storage from the design storm. Another consideration related to rapid drawdown is that low permeability material, which is normally in the middle of the dam structure, is an upstream blanket on McElroy's Run Dam by design. Low permeability soils are fine grained and drain very slowly which is the mechanism that can result in "locked in" pore pressures as the reservoir drains leading to rapid drawdown stability issues. Without a general fill buttress against the low permeability barrier at McElroy's Run Dam, CHA recommends consideration of this mechanism of failure.

Subsurface information provided does not appear to suggest liquefaction susceptible foundation soils are found at this site. However, the dam itself is constructed from fly ash, a material that can be liquefaction susceptible under certain circumstances. No evaluation of liquefaction of the foundation or dam materials was provided to CHA.

3.3.1 Instrumentation Review Relative to Stability

The recent instrumentation reports suggest that a couple of piezometers that formerly were dry have seen as much as 10 feet of water in them. During this same period the survey data indicates apparent movement of the dam has shifted from a trend of the instruments reading in a southwesterly (upstream and toward the left abutment) movement, to data collected in 2006 and 2007 suggesting a northeasterly trend (downstream and toward the right abutment). CHA recommends that in light of changing piezometer level readings, a further evaluation of the water levels and survey data be performed to confirm that these data are not indicating a change in the behavior of the embankment.

3.4 Operations, Maintenance, and Inspections

West Virginia Rule 47CSR34 15.4 requires periodic safety inspections of dams as follows for Class 1, high hazard dams:

- Monthly or more frequently by the Owner;
- At least every 2 years by the Owner's engineer; and
- At any time as desired by the State.

According to our conversations with WVDEP, these inspections are only required to be visual inspections. Inspection reports for those inspections performed by the Owner's engineer are to be submitted to WVDEP and are to include descriptions of maintenance work to be performed as

a result of the inspection findings. These reports are to be certified by an engineer to verify that the dam and its appurtenances are functioning as designed.

Special inspections are required following a storm event equal to or greater than a 50-year, 6 hour rainfall following the same reporting criteria, which at McElroy's Run Dam is about 3.6 inches according to National Weather Service's Technical Paper No. 40 - *Rainfall Frequency Atlas of the Eastern United States for Duration from 30 minutes to 24 hours and Return Periods from 1 to 100 years* (TP-40).

Class 1 dam owners are also required by West Virginia regulations to prepare a monitoring plan to be submitted to the State. This plan is to include at least the following:

- A description of the dam including drawings and location maps;
- A listing of problems and deficiencies and any implemented repairs;
- The inspection frequency under varying weather conditions;
- A description of areas or items to be inspected;
- Corrective actions to be taken;
- The responsible persons' names, addresses, and phone numbers;
- The method of notification of the State and County emergency service authorities; and
- Other site-specific items if required by the State.

3.4.1 Inspection Procedures

Allegheny Energy plant personnel perform weekly inspections and take weekly piezometer readings at the McElroy's Run Dam. The piezometer data along with corresponding pool elevations and cross valley drain volumes are then transmitted weekly internally within Allegheny Energy and to GAI Consultants (GAI) for review. GAI has been Allegheny Energy's consultant with regard to the McElroy's Run Dam for about 28 years.

GAI performs annual inspections of McElroy's Run Dam and compiles the piezometer readings, pool elevations and drain volumes into the annual inspection report. Annual survey monument measurements are also included in this report.

WVDEP coordinates their periodic inspections (every 2 to 3 years) with Allegheny Energy to coincide with an annual inspection by GAI. Over the last 5 years, WVDEP has performed inspections in 2005, 2008, and a special inspection in 2009 in response to the Tennessee Valley Authority (TVA) incident.

3.4.1.1 Allegheny Energy Weekly Inspections

Allegheny Energy provided CHA with a copy of their monitoring and inspection procedures. This plan applies to weekly inspections performed by Allegheny Energy personnel, and inspections during certain hydrometeorlogical events for which they have separated tasks by rain intensity of less than or greater than 4.42 inches in a 24 hour period. CHA found this rainfall intensity is approximately equal to a 25-year event based on the TP-40.

The monitoring plan and inspection schedule is part of the Emergency Action Plan (EAP) for the facility. A recent copy of a weekly inspection report was provided to CHA. This inspection report includes:

- Weekly piezometer readings as well as the plotted data for the previous two months (+/-),
- The reservoir elevation,
- Rainfall amounts,
- Flow rate related to plant operations,
- Flow through the foundation drain system, and
- Answers to three specific questions:
  - Are the decant gates at the 885 level and the 890 level openings free of debris so the maximum capacity of approximately 90 cfs can be discharged through the principal spillway system?

- All visible slopes of the embankment are free of erosion, cracks, seepage, bulges, animal holes, or other signs of instability?
- High visual quantity of sediment in foundation drain flow?

Each of these questions has a yes/no check off. There is also room for general comments to be recorded.

3.4.1.2 Annual Inspections

GAI performs annual inspections of the dam. The results of these inspections are summarized in a letter report which includes:

- Description of the conditions observed;
- A listing of participants in the inspection, including the signature of a licensed engineer;
- Certification that the embankment is functioning properly (i.e., no serious problems were identified in the reports reviewed by CHA); and
- Plotted settlement, horizontal movement, piezometer, drain flow and pool elevation data.

The inspections appear to have been performed under the direction of Mr. F. Barry Newman, PE, licensed in the state of West Virginia. The inspection reports are signed by the GAI staff who performed the inspection, and is certified by a Mr. F. Barry Newman, PE the Geotechnical/Structures Group Manager at GAI.

3.4.1.3 Inspections by West Virginia Dam Safety

WVDEP dam safety personnel make periodic inspections of McElroy's Run Dam. Although West Virginia regulations indicate the State can perform inspections at any time, with or without notice to the owner, CHA was told that they typically coordinate their inspections with the inspections being performed by GAI. Over the last 5 years, West Virginia Dam Safety personnel

have made inspections in 2005, 2008 and 2009. The most recent inspection in 2009 was performed in follow-up to the TVA incident, and was part of a West Virginia Dam Safety initiative to have current site visits to each of the coal waste impoundments at power plants in the State.

WVDEP sends Allegheny Energy a copy of their inspection report which includes a description of the dam, observations made, recommendations for maintenance work, a site map, and photographs documenting the observations.

Brian Long, PE (WVDEP) indicated to CHA that the recommendations are of maintenance needs only. They do not use the inspection report as a medium for transmitting more serious concerns or needs at the dam. More serious issues, not addressed in a timely manner by the Owner on their own accord would be addressed via the Civil Administrative Penalties section of 47CSR34.

3.4.2 Operations Plan

The operations plan for McElroy's Run Dam sets the normal reservoir levels so that the Emergency Spillway will only discharge during storms greater than 80 percent of the 6-hour PMP, and the Primary Spillway will only discharge from the sluice gate at El. 885 during a storm greater than a 25-year storm. Operation from the Primary Spillway requires accessing the outlet tower via a boat and opening the sluice gate. The maximum normal operating pool is established as El. 888.45, and the maximum operating pool with regard to dam safety is set at El. 893. During CHA's site visit the water level behind McElroy's Run Dam was below El. 885.

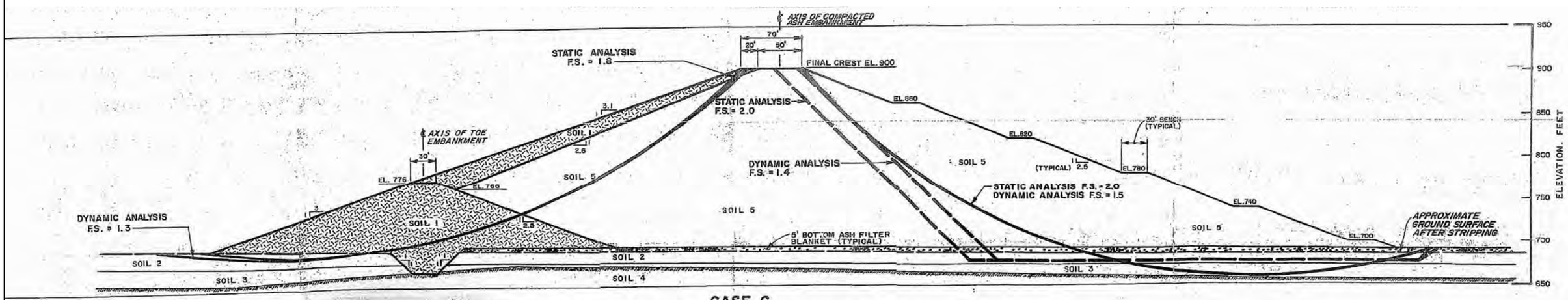
3.4.3 Maintenance

Routine maintenance is performed based on observations during the inspections. Plant personnel indicated reseeding was performed as necessary, and that mowing was performed when the

surface soils were dry enough to minimize rutting. CHA observed evidence of some maintenance with regard to filling of rodent burrows, and well maintained (cut) vegetation.

3.5 Foundation Conditions

Based on as-built drawings by D'Appolonia, it appears McElroy's Run Dam was constructed on native soils with a clay soil cut-off keyway installed through the soft broken claystone layer to the top of bedrock; an interbedded siltstone, sandstone and claystone formation. Investigations by GAI for the west abutment slope failure (downstream of the dam) suggest that the soil layer over the interbedded bedrock formation is thicker towards the abutments than at the mid point of the dam. A blanket drain, consisting of sand or bottom ash, was installed between natural soil and the embankment fill downstream of the cut-off keyway.



CASE C

COMPACTED EARTH TOE EMBANKMENT WITH FINAL-STAGE COMPACTED ASH EMBANKMENT-LONG TERM CONDITIONS

IMAGE REFERENCE: MCELROY'S RUN DISPOSAL SITE
SLOPE STABILITY ANALYSES – AS BUILT,
D'APPOLONIA CONSULTING ENGINEERS, INC.,
FEBRUARY 23, 1979.

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MCELROY'S RUN DAM
MAIN EMBANKMENT STABILITY

PLEASANTS POWER STATION
PLEASANTS COUNTY, WEST VIRGINIA

PROJECT NO. 20085.6000

DATE: AUG 09

FIGURE 9

File: K:\20085\CADD\ACAD\FIGURES\6000 PLEASANT\6000 PLEASANTS FIGURES.DWG Saved: 12/2/2009 2:15:55 PM Plotted: 12/2/2009 2:21:57 PM User: Gray, Timmolyn

McElroy's Run West Liner Stability Analysis
Section W-W
81-237-85
Exisiting Embankment with lab values
and current water levels
TRG 1-31-01
FILE WWLABCST
Chkd By: CWS 1/31/01

Soil 3
flyash dam
Soil Model Mohr-Coulomb
Unit Weight 110
Cohesion 0
Phi 32
Unsaturated Phi B 0
Piezometric Line # 1
Pore-Air Pressure 0

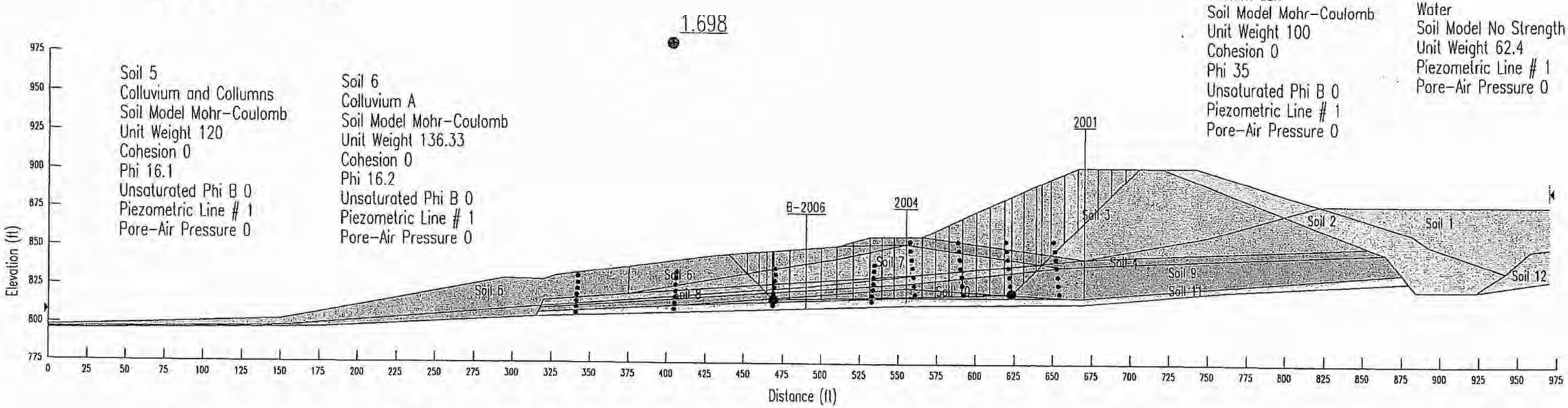
Soil 2
Clay Seal
Soil Model Mohr-Coulomb
Unit Weight 130
Cohesion 0
Phi 23
Unsaturated Phi B 0
Piezometric Line # 1
Pore-Air Pressure 0

Soil 4
bottom ash
Soil Model Mohr-Coulomb
Unit Weight 100
Cohesion 0
Phi 35
Unsaturated Phi B 0
Piezometric Line # 1
Pore-Air Pressure 0

Soil 1
Water
Soil Model No Strength
Unit Weight 62.4
Piezometric Line # 1
Pore-Air Pressure 0

Soil 5
Colluvium and Collumns
Soil Model Mohr-Coulomb
Unit Weight 120
Cohesion 0
Phi 16.1
Unsaturated Phi B 0
Piezometric Line # 1
Pore-Air Pressure 0

Soil 6
Colluvium A
Soil Model Mohr-Coulomb
Unit Weight 136.33
Cohesion 0
Phi 16.2
Unsaturated Phi B 0
Piezometric Line # 1
Pore-Air Pressure 0



Soil 7
Colluvium 2
Soil Model Mohr-Coulomb
Unit Weight 133.5
Cohesion 0
Phi 22.2
Unsaturated Phi B 0
Piezometric Line # 1
Pore-Air Pressure 0

Soil 8
Boulders
Soil Model Mohr-Coulomb
Unit Weight 120
Cohesion 0
Phi 30
Unsaturated Phi B 0
Piezometric Line # 1
Pore-Air Pressure 0

Soil 9
Colluvium 3
Soil Model Mohr-Coulomb
Unit Weight 132.55
Cohesion 0
Phi 23
Unsaturated Phi B 0
Piezometric Line # 1
Pore-Air Pressure 0

Soil 10
Colluvium 4
Soil Model Mohr-Coulomb
Unit Weight 117.5
Cohesion 0
Phi 8.5
Unsaturated Phi B 0
Piezometric Line # 1
Pore-Air Pressure 0

Soil 11
Dec. Claystone
Soil Model Mohr-Coulomb
Unit Weight 135
Cohesion 0
Phi 23
Unsaturated Phi B 0
Piezometric Line # 1
Pore-Air Pressure 0

Soil 12
Upstream Soil
Soil Model Mohr-Coulomb
Unit Weight 135
Cohesion 0
Phi 23
Unsaturated Phi B 0
Piezometric Line # 1
Pore-Air Pressure 0

IMAGE REFERENCE: GAI CONSULTANTS, STABILITY ANALYSIS OF THE WEST ABUTMENT DOWNSTREAM SLOPE OF EMBANKMENT, MCELROY'S RUN CCB DISPOSAL SITE, PLEASANTS POWER STATION, WILLOW ISLAND, WV, JANUARY 2001

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WEST ABUTMENT DOWNSTREAM SLOPE STABILITY ANALYSIS

PLEASANTS POWER STATION
PLEASANTS COUNTY, WEST VIRGINIA

PROJECT NO. 20085.6000

DATE: AUG 09

FIGURE 10

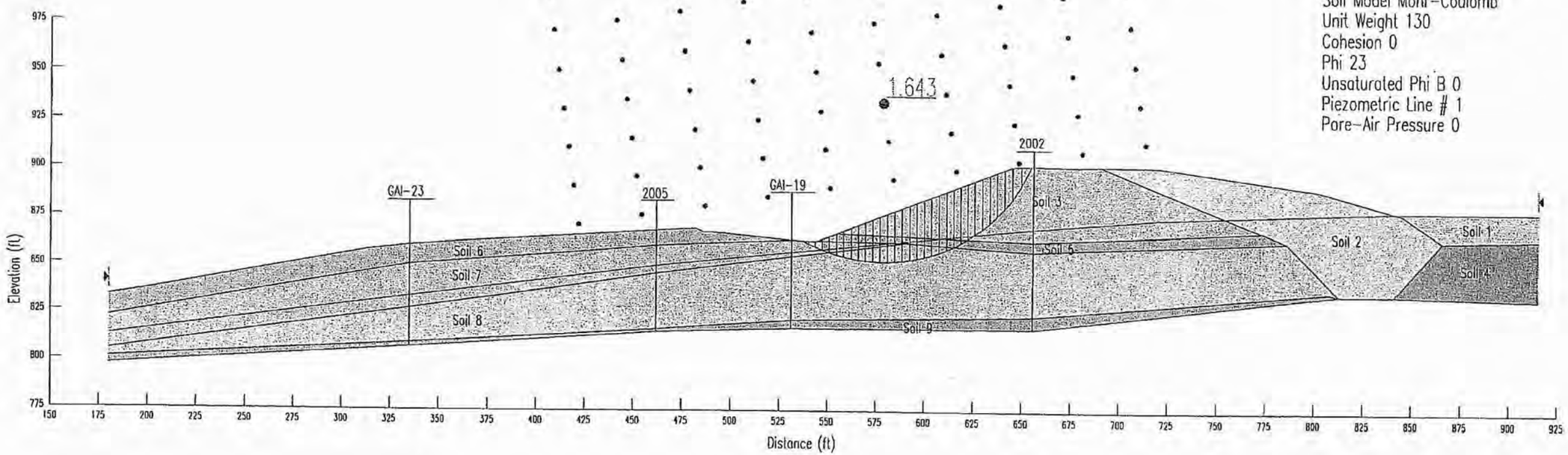
File: K:\20085\CADD\ACAD\FIGURES\6000 PLEASANT\6000 PLEASANTS FIGURES.DWG Saved: 12/2/2009 2:15:55 PM PLotted: 12/2/2009 2:22:19 PM User: Gray, Timmolyn

McElroy's Run West Liner Stability Analysis
Section V-V
81-237-85
Exisiting Embankment with lab values
and current water levels
TRG 1-29-01
FILE: WLABCWS
Chkd By: CWS 1/31/01

Soil 3
Fly Ash in Dam
Soil Model Mohr-Coulomb
Unit Weight 110
Cohesion 0
Phi 32
Unsaturated Phi B 0
Piezometric Line # 1
Pore-Air Pressure 0

Soil 1
Water
Soil Model No Strength
Unit Weight 62.4
Piezometric Line # 1
Pore-Air Pressure 0

Soil 2
Clay Seal
Soil Model Mohr-Coulomb
Unit Weight 130
Cohesion 0
Phi 23
Unsaturated Phi B 0
Piezometric Line # 1
Pore-Air Pressure 0



Soil 4
Upstream Soil
Soil Model Mohr-Coulomb
Unit Weight 135
Cohesion 0
Phi 23
Unsaturated Phi B 0
Piezometric Line # 1
Pore-Air Pressure 0

Soil 5
Bottom Ash
Soil Model Mohr-Coulomb
Unit Weight 100
Cohesion 0
Phi 35
Unsaturated Phi B 0
Piezometric Line # 1
Pore-Air Pressure 0

Soil 6
Colluvium 1
Soil Model Mohr-Coulomb
Unit Weight 128
Cohesion 0
Phi 26.2
Unsaturated Phi B 0
Piezometric Line # 1
Pore-Air Pressure 0

Soil 7
Colluvium 2
Soil Model Mohr-Coulomb
Unit Weight 133.5
Cohesion 0
Phi 22.2
Unsaturated Phi B 0
Piezometric Line # 1
Pore-Air Pressure 0

Soil 8
Colluvium 3
Soil Model Mohr-Coulomb
Unit Weight 132.55
Cohesion 0
Phi 23
Unsaturated Phi B 0
Piezometric Line # 1
Pore-Air Pressure 0

Soil 9
Dec. Claystone
Soil Model Mohr-Coulomb
Unit Weight 135
Cohesion 0
Phi 23
Unsaturated Phi B 0
Piezometric Line # 1
Pore-Air Pressure 0

IMAGE REFERENCE: GAI CONSULTANTS, STABILITY ANALYSIS OF THE WEST ABUTMENT DOWNSTREAM SLOPE OF EMBANKMENT, MCELROY'S RUN CCB DISPOSAL SITE, PLEASANTS POWER STATION, WILLOW ISLAND, WV, JANUARY 2001

Drawing Copyright © 2007 CHA

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FIGURE 11

File: K:\20085\CADD\ACAD\FIGURES\6000 PLEASANT\6000 PLEASANTS FIGURES.DWG Saved: 12/2/2009 2:15:55 PM Plotted: 12/2/2009 2:22:43 PM User: Gray, Timmolyn

4.0 CONCLUSIONS/RECOMMENDATIONS

4.1 Acknowledgement of Management Unit Condition

I acknowledge that the management unit referenced herein was personally inspected by me and was found to be in the following condition: **Fair.**

A management unit found to be in fair condition is defined as one in which acceptable performance is expected under all required loading conditions (static, hydrologic, seismic) in accordance with the applicable safety regulatory criteria. Minor deficiencies may exist that require remedial action and/or secondary studies or investigations.

CHA presents recommendations for maintenance and further studies to bring these facilities into Satisfactory in the following sections.

4.2 Surface Degradation

In general, the embankment slopes were in acceptable condition. However, several areas of thin vegetation, erosion rills and animal burrows were observed on both the upstream and downstream slopes of the dam. Continued vigilance to these types of issues is always warranted on an earthen embankment. CHA understands that the weekly inspections by Plant personnel include evaluating the surface condition and addressing conditions where necessary.

In addition, we recommend best management practices be implemented on the active work bench areas to minimize concentrated stormwater run-off when work ceases for more than a couple of days or when heavy rain is expected.

4.3 McElroy's Run Dam Hydrologic and Hydraulic Analysis

We recommend that confirmation of stormwater drawdown times be made. Currently there is conflicting statements in various reports reviewed by CHA as to what rate the primary spillway and siphon outlet can drain storm surcharges from the reservoir.

4.4 McElroy's Run Dam Recommendations for Additional Stability Analyses

Allegheny Energy's consultant, GAI, concluded that storm surcharges could not be removed from the reservoir quickly enough for a rapid drawdown condition to develop. As mentioned in Section 4.3, there is conflicting information on the rate of drawdown possible at this site. In addition, while CHA understands that rapid drawdown via pumping or other discharge methods may be undesirable for a waste disposal impoundment, CHA suggests that in the event of an emergency at the facility, rapid drawdown may be more desirable to reduce hydrostatic pressures on the dam, thereby preventing a more catastrophic collapse. There have also been documented case histories where other types of failure (such as a gate failure) have resulted in rapid drawdown conditions developing which have led to a domino effect and made the situation worse. For these reasons, CHA recommends that a rapid drawdown analysis be performed.

CHA was also not provided with a Flood Pool loading condition stability analysis, which while not specifically required under WVDEP regulations, US Army Corps of Engineers guidelines in EM-1110-2-1902 suggest a factor of safety under flood pool conditions of 1.4 is appropriate. Again, since there is the possibility that slow drainage of storm surcharge will occur, confirmation of drainage of the storm surcharge in the required time, and a stability analysis showing that the embankment is stable at the raised flood pool should be made.

4.5 McElroy's Run Dam Recommendations for Additional Soil Behavior Analyses

CHA was not provided with an evaluation of liquefaction susceptibility of the foundation or dam embankment soils.

The majority of the dam is constructed from fly ash. While reports suggest the fly ash was compacted during construction, soil properties used in stability analyses were reportedly based on the engineer of record's experience with no site specific backup of these properties. In addition, some of the soil strata defined in the slope stability analyses (as summarized in Table 4) were also reported to be assumed values. CHA recommends that soil strata having an impact on the overall stability of McElroy's Run Dam have site specific verification of in situ soil properties determined, and stability subsequently verified if properties vary from those used in previous analyses.

4.6 McElroy's Run Dam Movement and Piezometer Data Changes

The recent instrumentation reports suggest that a couple of piezometers that formerly were dry have seen as much as 10 feet of water in them. During this same period the apparent movement of the dam has shifted from a trend of the instruments reading southwesterly movement (i.e., upstream toward the left abutment), to a trend suggesting downstream northeasterly movement. CHA recommends that in light of changing piezometer level readings, a further evaluation of the water levels and survey data be performed to confirm that these data are not indicating a change in the behavior of the embankment.

We understand that some instruments have become inactive because of ongoing landfill operations but that in February 2009 previously non-functional piezometers (CP-2, CP-6, and CP-10) were replaced. An additional piezometer has become inactive at the time of this report, but replacement is planned.

4.7 McElroy's Run Dam Routine Inspection Procedures

West Virginia regulation require inspections be made following a storm event equal to or greater than a 50-year, 6-hour rainfall. The *Monitoring and Emergency Action Plan and Operations Plan* for McElroy's Run Dam indicates inspections are made following storm events equal to a 25-year, 24-hour storm event. Because these storm events are of different durations, it is difficult to directly compare which would have a greater likelihood of causing erosion or sloughing from saturation. CHA recommends the inspection procedures for McElroy's Run Dam be clarified to be consistent with West Virginia regulation, and include storm events as required now as well if deemed appropriate by Allegheny Energy and/or their consultant.

5.0 CLOSING

The information presented in this report is based on visual field observations, review of reports by others and this limited knowledge of the history of the Pleasants Power Station surface impoundments. The recommendations presented are based, in part, on project information available at the time of this report. No other warranty, expressed or implied is made. Should additional information or changes in field conditions occur, the conclusions and recommendations provided in this report should be re-evaluated by an experienced engineer.

APPENDIX A

Completed EPA Coal Combustion Dam Inspection Checklist Forms

&

Completed EPA Coal Combustion Waste (CCW) Impoundment Inspection Forms

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name:	Pleasants Power Station	Date:	October 14, 2009
Unit Name:	McElroy's Run Dam	Operator's Name:	Allegheny Energy
Unit I.D.:	07302	Hazard Potential Classification:	(High) Significant Low
Inspector's Name:	Malcolm D. Hargraves P.E./Rebecca Filkins		

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

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	weekly		18. Sloughing or bulging on slopes?		x
2. Pool elevation (operator records)?	app. 883.5		19. Major erosion or slope deterioration?		x
3. Decant inlet elevation (operator records)?	885		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	893		Is water entering inlet, but not exiting outlet?	see	note
5. Lowest dam crest elevation (operator records)?	900		Is water exiting outlet, but not entering inlet?	see	note
6. If instrumentation is present, are readings recorded (operator records)?	x		Is water exiting outlet flowing clear?	see	note
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)?	n/a		From underdrain?	x	
9. Trees growing on embankment? (If so, indicate largest diameter below)		x	At isolated points on embankment slopes?		x
10. Cracks or scarps on crest?		x	At natural hillside in the embankment area?	x	
11. Is there significant settlement along the crest?		x	Over widespread areas?		x
12. Are decant trashracks clear and in place?	x		From downstream foundation area?		x
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		x	"Boils" beneath stream or ponded water?		x
14. Clogged spillways, groin or diversion ditches?		x	Around the outside of the decant pipe?		x
15. Are spillway or ditch linings deteriorated?		x	22. Surface movements in valley bottom or on hillside?		x
16. Are outlets of decant or underdrains blocked?		x	23. Water against downstream toe?		x
17. Cracks or scarps on slopes?		x	24. Were Photos taken during the dam inspection?	x	

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

Inspection Issue # Comments

"n/a" = Not available

19. Isolated grassed erosion rills noted on upstream slope and downstream area around emergency spillway. More obvious erosion rills and rutting noted on active and recently completed working benches of downstream landfill. Intermittent slight beaching in exposed soil on upstream slope.

20. Primary outlet is a siphon with a submerged diffuser in the Ohio River; could not be directly observed.

21. Blanket drain seepage approximately 36 gallons per minute; clear. Seepage also noted from natural hillside at west (left) downstream landfill contact.

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # WV0023248 INSPECTOR Abed/Hargraves/Filkins

Date October 14, 2009

Impoundment Name McElroy's Run Dam

Impoundment Company Allegheny Energy

EPA Region 5

State Agency (Field Office) Addresss 2311 Ohio Avenue
Parkersburg, West Virginia 26101

Name of Impoundment McElroy's Run Dam

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

New _____ Update x

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

IMPOUNDMENT FUNCTION: FGD Sludge, site Drainage, site wastewater

Nearest Downstream Town : Name Eureka

Distance from the impoundment 2 miles

Impoundment Location:

Longitude 81 Degrees 16 Minutes 15 Seconds

Latitude 39 Degrees 22 Minutes 0 Seconds

State WV County Grant

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

If So Which State Agency? WVADEP - Div. of Water & Waste Management, Dam Safety

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.

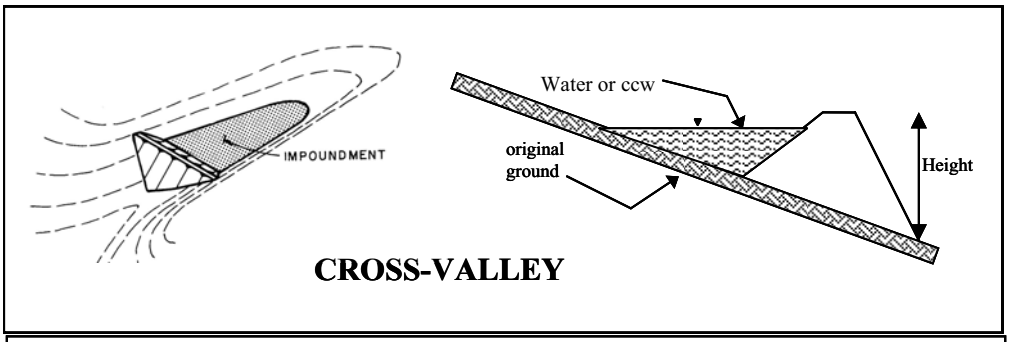
_____ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. 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.

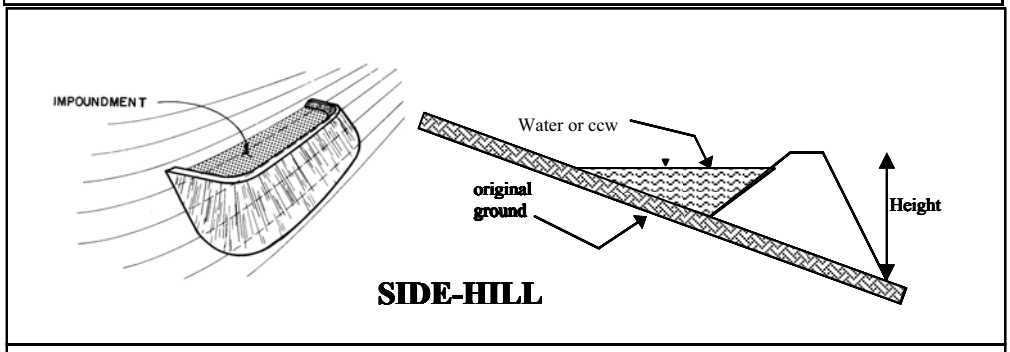
x_____ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

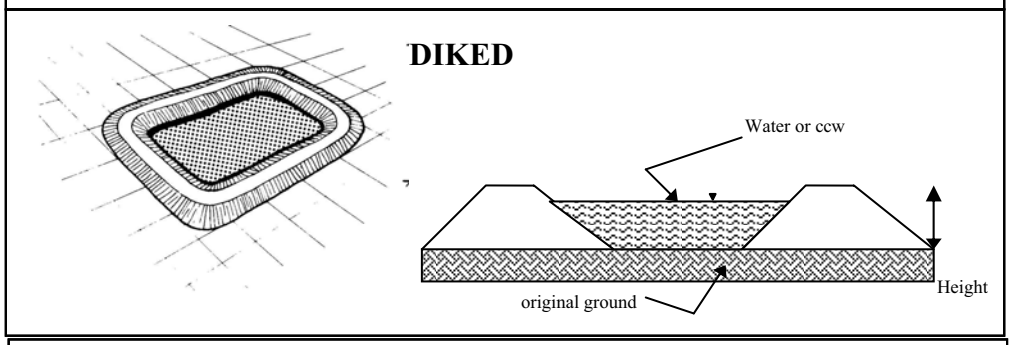
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

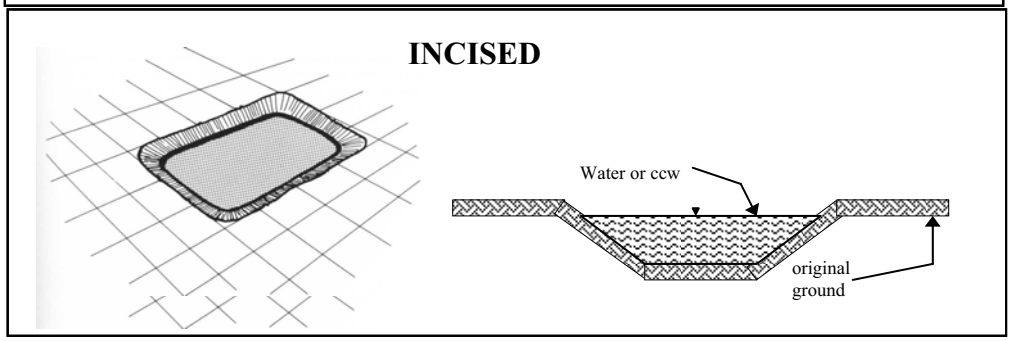
Failure of the dam would affect the community of Eureka, WV, Pleasants Power Station, WV Route 2, and eventually the Ohio River resulting in a probable loss of life, impacting critical infrastructure, and the environment.

CONFIGURATION:









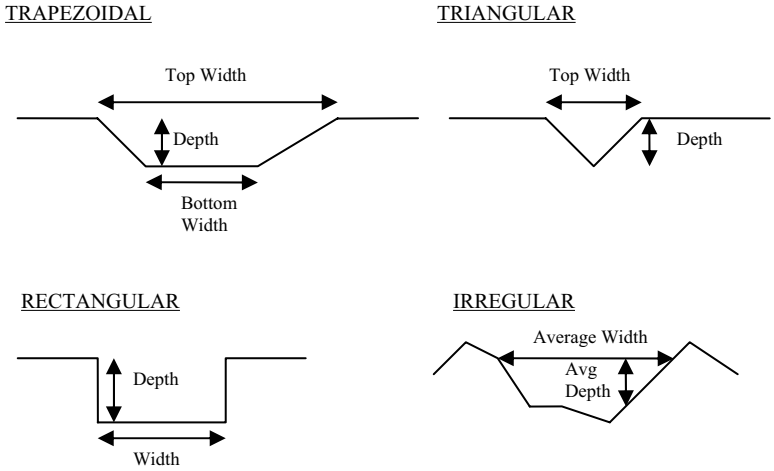
x_____ Cross-Valley
_____ Side-Hill
_____ Diked
_____ Incised (form completion optional)
_____ Combination Incised/Diked

Embankment Height 243 feet Embankment Material Earth and Ash
Pool Area 219 acres Liner none
Current Freeboard 16.5 feet Liner Permeability d/n/a

TYPE OF OUTLET (Mark all that apply)

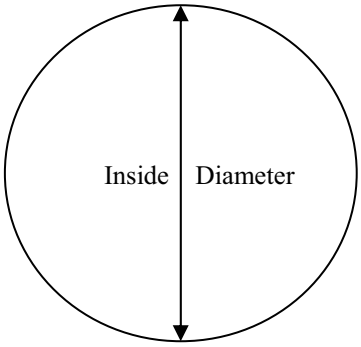
_____ **Open Channel Spillway**
X Trapezoidal
_____ Triangular
_____ Rectangular
_____ Irregular

6.5 depth
20 bottom (or average) width
35 top width



x **Outlet**

36 inside diameter



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

Is water flowing through the outlet? YES _____ NO x

_____ **No Outlet**

x **Other Type of Outlet** (specify) 16" Dia. Submerged siphon in Ohio River (water flowing)

The Impoundment was Designed By D'Appolonia

Has there ever been a failure at this site? YES _____ NO x (see note)

If So When? see note

If So Please Describe :

No failures resulting in a breach of the dike have been reported, however there is a history of slope instability due to a landslide in the natural hillside to the west (left) of the landfill buttress area. This landslide condition was stabilized in 2001 with 2' diameter cement/ash grout columns placed on 5' center to center spacings. This condition apparently developed prior to placing the present landfill stage, but did not affect the primary embankment. This area continues to seep and a series of drains intercept this seepage to convey it to the west (left) fabriform groin between the landfill and the natural hillside.

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

If So When? _____

IF So Please Describe:

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

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

If so Please Describe :