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

Duke Energy Corporation

Belews Creek
Steam Station

Walnut Cove, North Carolina

Prepared for

Lockheed Martin

2890 Woodridge Ave #209
Edison, New Jersey 08837

December 8, 2009

CHA Project No. 20085.1090.1510

I acknowledge that the management unit referenced herein:

- Ash Basin

Has been assessed on September 8, 2009 and September 9, 2009.

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1.0 INTRODUCTION & PROJECT DESCRIPTION

1.1 Introduction

CHA was contracted by Lockheed Martin (a contractor to the United State 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 Duke Energy's Belews Creek Steam Station, which is located 4.5 miles west of the town of Walnut Cove, North Carolina as shown on Figure 1 – Project Location Map.

CHA made a site visit on September 8, 2009 and September 9, 2009 to inventory coal combustion surface impoundments at the facility, to perform visual observations of the containment dike, and to collect relevant information regarding the site assessment. The majority of the inspection was completed on September 8, 2009.

CHA Engineers Malcolm Hargraves, P.E. and Richard M. Loewenstein Jr., P.E. were accompanied by the following individuals:

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Duke Energy	Melonie Martin
Duke Energy	Lawrence M. Cook
Duke Energy	Christopher D. Hallman
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1.2 Project Background

The Duke Energy Corporation Belews Creek Steam Station is located on the south side of the Dan River about 18 miles northeast of Winston-Salem, North Carolina as shown on the Project Location Plan in Figure 1. The Ash Basin Dike at the Belews Creek Steam Station is an approximate 2000 foot long and 140 foot high earthen dike that is located on a tributary to the Dan River locally referred to as Little Belews Creek and is identified in Figure 2A. The layout and typical cross section of the dam may be seen in Figures 3A and 3B, respectively. The dike forms an impoundment of approximately 350 acres. Coal combustion wastes are discharged into the southern reaches of the impoundment via sluice pipe lines as seen in Photo 37. Material recovery activities are underway at that location. Water within the basin is currently discharged through the Ash Basin Tower by two stop log weirs on the west side of the embankment as shown in Figure 2A and Photos 9 and 10.

The Ash Basin Dike is currently under the jurisdiction of the North Carolina Utilities Commission (NCUC). The Five-Year Independent Consultant Inspection Report dated February 2009 states that the impoundment is classified by the NCUC as an intermediate hazard (Class B) under North Carolina Dam Safety rules since risk of loss of life is low but extensive property damage is likely should a failure occur. The report also recommended that further evaluation be completed to determine the hazard classification considering the risks associated with operation of the facility. A breach analysis was also completed for the Ash Dam using the program DAMBRK and the 100 year flood event and is included in the Emergency Action Plan dated

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September 9, 1999. Duke has reported that the NCUC has requested that the ash basin dike be reclassified as “high Hazard” under the North Carolina Dam Safety Rules due to the potential environmental damage of an ash release in the event of failure

After January 1, 2010, regulatory oversight for the dam will be provided by the North Carolina Department of Environment and Natural Resources Division of Land Resources. Dam hazard classifications under their jurisdiction also consider the potential economic impact resulting from a failure. Under these guidelines, it is likely that the Ash Basin Dike would be given a High (Class C) rating and considered “Very Large” based upon its height for spillway design.

The EPA Coal Combustion Dam Inspection Checklist Forms provided in Appendix A note that this dike has a High Hazard Potential based on the National Inventory of Dams Criteria.

1.2.1 State Issued Permits

Duke Energy has been issued NPDES discharge permit NC0024406 from the North Carolina Division of Water Quality, which authorizes them to discharge wastewaters at two separate outfalls designated as 001 and 003. Outfall 001 discharges to West Belews Creek/Belews Lake and consists of once-through cooling water, intake screen backwash, recirculated cooling water and station equipment cooling water. Outfall 003 discharges to the Dan River and consists of the effluent from the ash basin, which itself is made up of several different waste streams from the power house and yard holding sumps, ash sluice lines chemical holding pond coal yard sumps, stormwater, remediated groundwater, domestic wastewater and flue gas desulphurization blowdown. The permit became effective on April 9, 2009 and will expire on February 28, 2012.

1.3 Site Description and Location

Figure 2A depicts the overall view of the Belews Creek Steam Station. The main features identified on the overall site map include the generating station, the Ash Basin, and Belews Lake

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which serve as the cooling water supply. Belews Lake, shown on the east side of generating plant is a 3,700 acre lake on Belews Creek, East Belews Creek and West Belews Creek. The water body is impounded by an earthen embankment on Belews Creek that is 170 feet high. A saddle dike is also incorporated into the reservoir containment from the west side of the gated spillway that is 65 feet high at its maximum section. The outlet of the reservoir discharges flows into the Belews Creek, approximately 0.5 miles from the confluence with the Dan River. The normal pool elevation is reported to be at Elev. 725.0 feet however it was stated to be at Elev. 720.0 feet at the time of the five year inspection in November, 2008. Please note that this dam is not the subject of this report or the September 8 and 9, 2009 site visit by CHA as it does not impound a form of coal combustion residuals.

The primary focus of this report is the Ash Basin and Dam located to northwest of the generating station. The 350 acre basin was constructed in 1970-1972 by Clement Brothers Contracting. Figures 3A and 3B illustrate the typical cross section of the 140 foot high dike with a 20 foot wide crest at Elev. 770 feet. Figure 8A depicts a plan view of the embankment along with the spillway tower structure which was relocated to the western side of the dike in about 1985 according to the as-built date noted on the design drawings. The spillway discharges over opposing stop log weirs and through a 21 inch conduit through an embankment. The pipeline extends over 1600 feet underground as shown on Figure 4 and Photo 32 to an exit point and discharges through a flume (Photo 33).

The original spillway may be seen on Figure 2A and Photo 35. It is located within the northeast corner of the impoundment and discharged via a 42 inch pipeline and open channel to Belews Lake. The spillway was relocated due to potential environmental impacts associated with the discharge through a channel directly into Belews Lake (Photo 2). The outlet pipe has been plugged with concrete and flowable fill (Photo 1).

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The Ash Basin impoundment is reported to have a storage capacity of about 12,600 acre-feet with the pool at Elev. 760 feet. The drainage area is reported to be 711 acres as reported in the 1978 Independent Consultant Inspection Report.

The upstream face of the embankment can be seen in Photos 11, 14 and 15. The design slope for the upstream face is approximately 2 horizontal to 1 vertical. In 1993, rip rap was added to the upstream face of the dam to prevent damage from wave action. The rip rap extends from a point starting about 7 feet below the crest (about Elev. 763) to about Elev. 745 feet as shown on Section D-D in Figure 6 as well as Section A-A in Figure 3A. Design drawings indicate this was completed between Stations 2+50 and 10+00. The rip rap can be seen in Photos 14 and 15.

An aerial photograph of the region indicating the location of the Belews Creek Steam Station and identifying schools, hospitals, or other critical infrastructure located within approximately five miles down gradient of the Ash Pond and Dike is provided as Figure 7.

1.3.1 Other Impoundments

A small impoundment used to collect chemical washdown water is located south of the Ash Basin as depicted on Figure 2A. This pond was reportedly constructed between 1972 and 1974. The pond is used every 3 to 4 years and was last used during the spring of 2009. The embankment is approximately 500 feet long, has a crest width of 24 feet and a maximum height of about 16 feet. The embankment is shown on Photos 3 through 8 which depict the current pool level, the concrete overflow structure (28 inches wide by 24 inches deep), the bridge to the gauging station, and the upstream and downstream faces of the dike.

The overflow from this pond discharges into the Ash Basin. The Ash Basin pool is located at the toe of the chemical washdown pond dike. The pond does not directly receive coal combustion waste, only chemical cleaning water and the subsequent rinses resulting from the washdown and maintenance of the condensate and steam side of the boiler tubes.

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The only other impoundment noted on this site was the main cooling water reservoir, Belews Lake which was previously discussed above. The dam is also the subject of Five-year Independent Consultant Inspections.

1.4 Previously Identified Safety Issues

Based on our review of the information provided to CHA and as reported by Duke Energy, several concerns have been reported with regards to the level of the phreatic surface and the stability of the downstream slope since the dam was constructed. This concern resulted in the completion of field investigations, slope stability analysis and remedial construction activities on several occasions. The following paragraphs briefly summarize these activities:

- December 13, 1978: Stability analysis by Law Engineering and Testing Company for the downstream slope of the Ash Dike under steady state conditions with the pond elevation at Elev. 760 feet (full pond) and Elev. 745 feet (current conditions). The analysis indicated factors of safety of 1.31 and 1.34 respectfully.
- May through July 1982: subsurface investigation completed through the embankment including the completion of soil test borings, undisturbed sampling, sampling of under drain materials, and soil laboratory testing. The testing program consisted of grain size analysis, Atterberg Limits, and triaxial compression testing with pore pressure measurements.
- October 31, 1983: Law Engineering and Testing Company Report reviewing the proposed horizontal drain installations intended to effect the lowering of the phreatic line of the Ash Dam.
- March 19, 1984: Additional analysis completed by Duke Energy considering slope stability and the proposed horizontal drain installation. Stability analyses were run under the steady state seepage condition using new soil strength parameters. Safety factors ranged from 1.37 to 1.46 depending on reservoir elevation and the variation in soil

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parameters used. The horizontal drain design is developed and is partially shown on Figure 5.

- Horizontal drains were installed along the downstream berms at the Elev. 720 and 670 levels as shown on Duke Drawing BC-1037-03. This construction took place in about 1986 according to the Seventh Five-year Independent Consultant Inspection dated February 2009. These drains were also reported to have been cleaned out in 2004.
- Slope stability calculations completed by Duke Energy in July 1988 resulted in factors of safety ranging from 1.28 to 1.6 depending upon the cross section evaluated, the pond elevation (Elev. 752 to 760) and whether pore pressure was considered in the analysis. The lower factors of safety were noted to be at Station 10+00 at the highest point of the embankment.
- The February 2009 Five-year Independent Consultant Inspection documented rising water surface levels at several points in the embankment. Recommendations are made for further evaluation.
- Wet surface soils on the downstream face have been replaced with rip rap at several locations including between Station 6+75 and 8+00. Photos 20 and 24 are representative of these repairs.
- The outlet structure was relocated as previously noted due to environmental concerns within Belews Lake.
- Rip rap placed on upstream slope for wave protection in 1993.

1.5 Site Geology

Based on a review of available surficial and bedrock geology maps, and reports by others, the Belews Creek Steam Station is located in the Milton Geologic Belt of the Piedmont Physiographic Province in North Carolina. The Milton Belt consists of a complex of plutonic and metamorphic rocks. Rock types in the area of the site include gneisses and schists of Paleozoic to Precambrian age, Paleozoic intrusive rocks and younger Mesozoic-age sedimentary

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rocks. The ash basin dike is underlain by gneiss and schist and includes units of quartzite. The soils at the site are comprised of silty to sandy saprolite overlying weathered rock.

1.6 Bibliography

CHA reviewed the following documents provided by Duke Energy in preparing this report:

- *Slope Stability Calculations by Duke Energy Corporation*, 1971, 1984, 1988
- *Subsurface Investigation Data*, May to July 1982
- *Letter from Law Engineering and Testing Company to Duke Power Company*, October 31, 1983
- *Emergency Action Plan Duke Power Company Belews Creek Steam Station*, September 9, 1999
- *Belews Creek Steam Station Sixth Independent Consultant Inspection Report*, January 13, 2004, MACTEC Engineering and Consulting, Inc.
- *Belews Creek Steam Station, Ash Basin Dike and Main Dam Slope Stability Evaluation*, July 28, 2004, Duke Engineering & Services
- *Seventh Five-year Independent Consultant Inspection Report*, February, 2009, S&ME Inc.
- Selected Original Construction Drawings, 1971, Duke Power Company
- Selected Construction Drawings for Dam Modifications, 1971-1993, Duke Power Company
- Letter from Duke Energy Corporation to US EPA (with appendices), March 25, 2009

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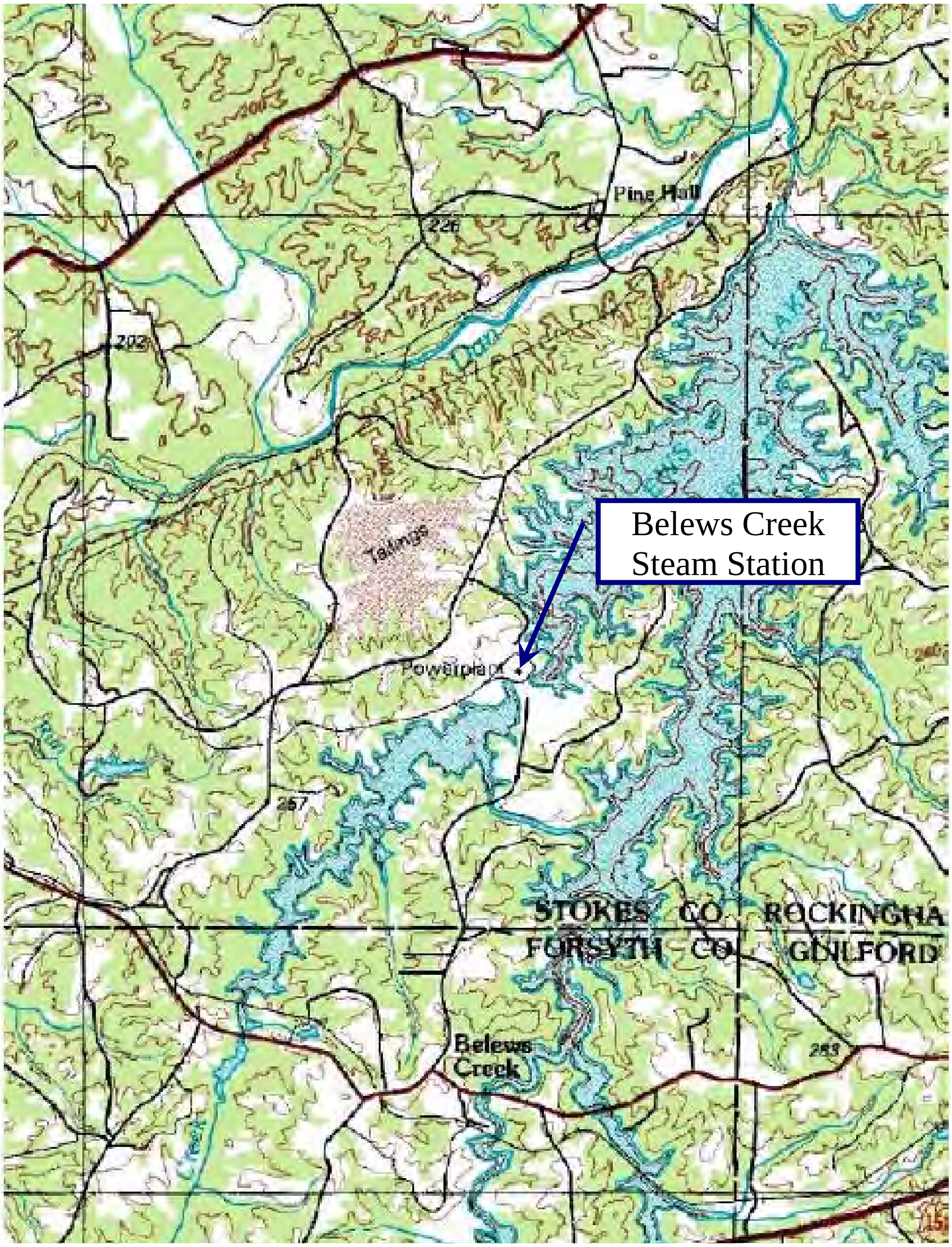

Image Date: 07/01/1979

N	CHA		**Figure 1** **Project Location Map**
	Scale: 1" = 2 miles	**Project No.:** **20085.1090.1510**	**Duke Energy** **Belews Creek Steam Station** **Walnut Cove, North Carolina**

DRAWING REFERENCE: S&ME, INC. DRAWING 1 OF 1, BELEWS CREEK ASH BASIN, 09/02/09
IMAGE REFERENCE: ORTHO-PHOTOGRAPHY WAS OBTAINED FROM NC AERIALS EXPRESS (FLY DATE, MARCH 2006).

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PHOTO SITE PLAN
DUKE ENERGY
BELEWS CREEK STEAM STATION
WALNUT COVE, NORTH CAROLINA

PROJECT NO. 20085
DATE: 10/2009
FIGURE 2A

File: K:\20085\CADD\ACAD_SHEET_FILES\2 FIGURE 2 – PHOTO SITE PLAN.DWG Saved: 10/9/2009 4:22:43 PM Plotted: 10/9/2009 5:25:38 PM User: Everleth, Jennifer

DRAWING REFERENCE: S&ME, INC. DRAWING 1 OF 1, BELEWS CREEK ASH BASIN, 09/02/09
IMAGE REFERENCE: ORTHO-PHOTOGRAPHY WAS OBTAINED FROM NC AERIALS EXPRESS (FLY DATE, MARCH 2006).

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PHOTO SITE PLAN
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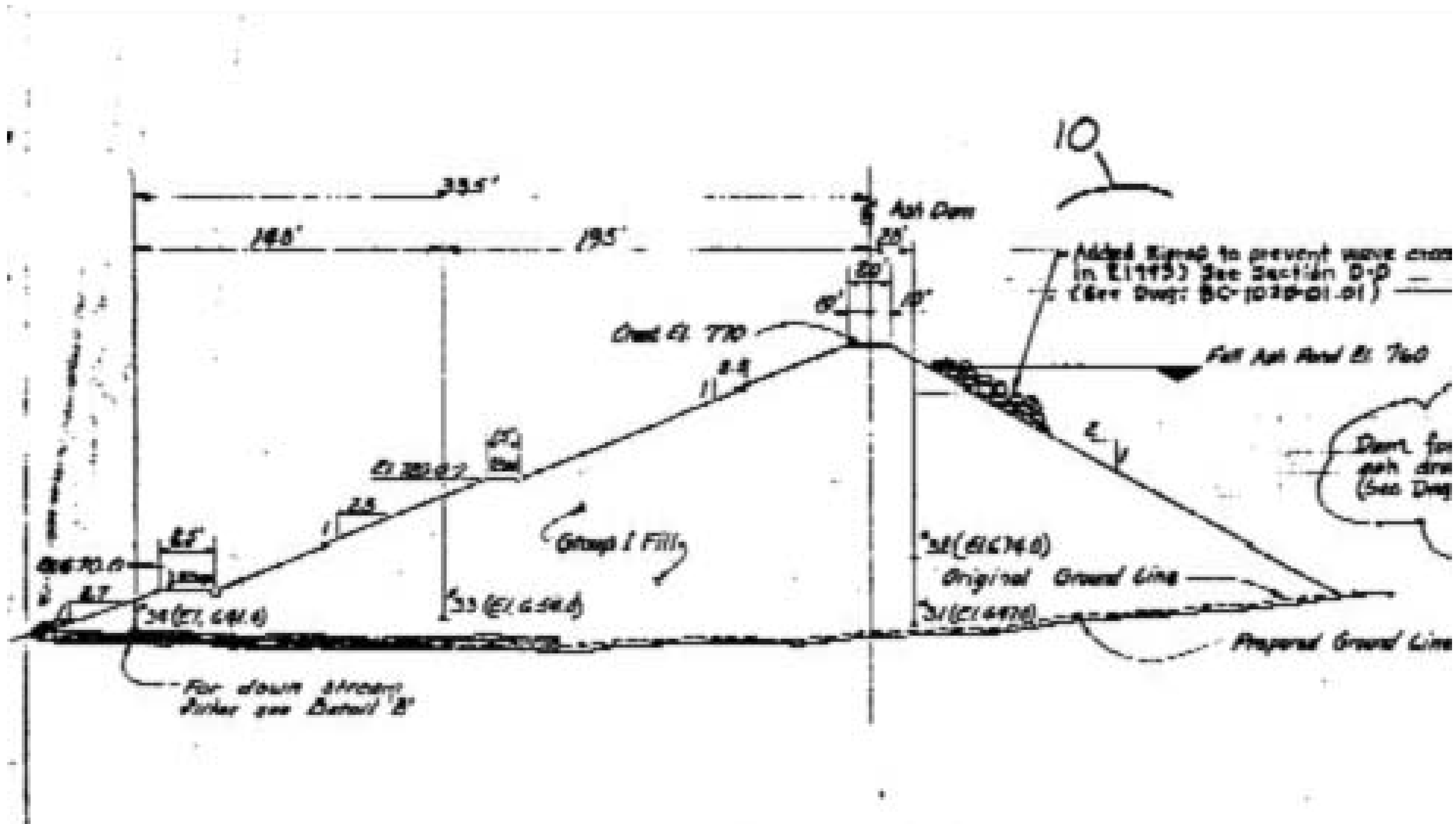
WALNUT COVE, NORTH CAROLINA

PROJECT NO. 20085
DATE: 10/2009
FIGURE 2B

File: K:\20085\CADD\ACAD_SHEET_FILES\2 FIGURE 2 - PHOTO SITE PLAN.DWG Saved: 10/9/2009 4:22:43 PM Plotted: 10/9/2009 5:30:12 PM User: Everleth, Jennifer



SECTION A-A Not To Scale

[redacted]

DRAWING REFERENCE: ASH DIKE PLAN, PROFILE & SECTIONS, DRAWING BC 1037-1, SECTION A-A'
ASH DIKE HORIZONTAL DRAIN PLACEMENT, DRAWING BC-1037-03, TYPICAL CROSS-SECTION LKG. WEST

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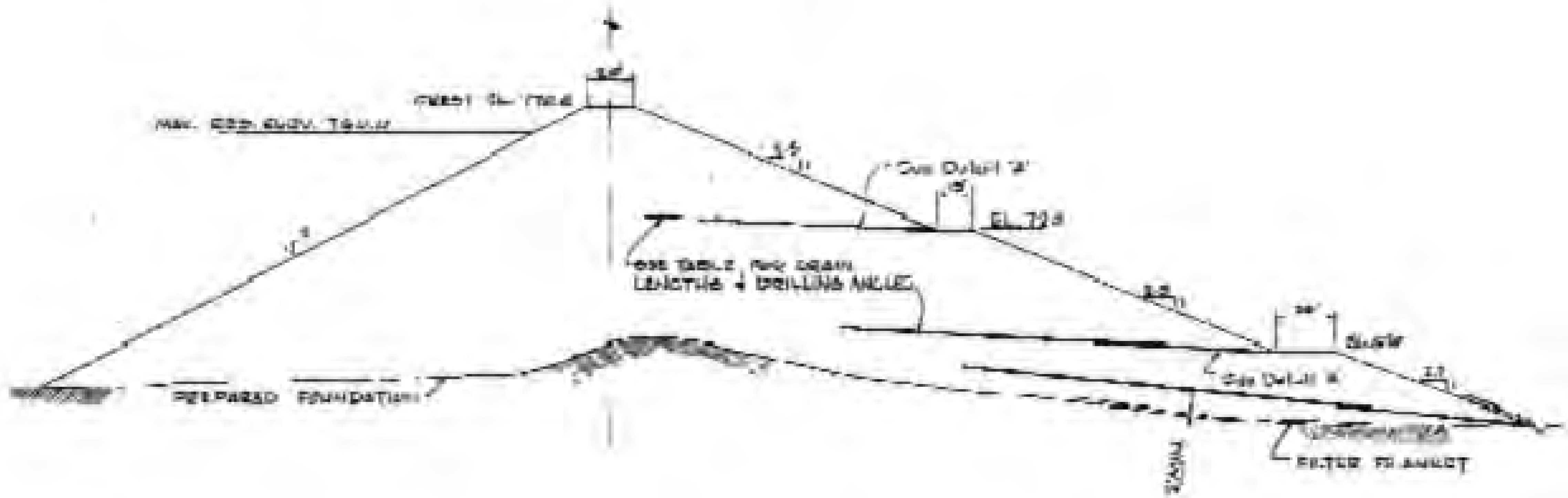
TYPICAL CROSS SECTIONS
DUKE ENERGY
BELEWS CREEK STEAM STATION
WALNUT COVE, NORTH CAROLINA

PROJECT NO. 20085	
DATE: 10/2009	
FIGURE 3A	

File: K:\20085\CADD\ACAD_SHEET_FILES\3 TYPICAL CROSS SECTIONS.DWG Saved: 10/9/2009 4:33:13 PM Plotted: 10/9/2009 5:32:03 PM User: Everleth, Jennifer



TYPICAL CROSS-SECTION LKG. WEST

Not To Scale

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ASH DIKE HORIZONTAL DRAIN PLACEMENT, DRAWING BC-1037-03, TYPICAL CROSS-SECTION LKG. WEST

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TYPICAL CROSS SECTIONS

DUKE ENERGY
BELEWS CREEK STEAM STATION
WALNUT COVE, NORTH CAROLINA

PROJECT NO. 20085

DATE: 10/2009

FIGURE 3B

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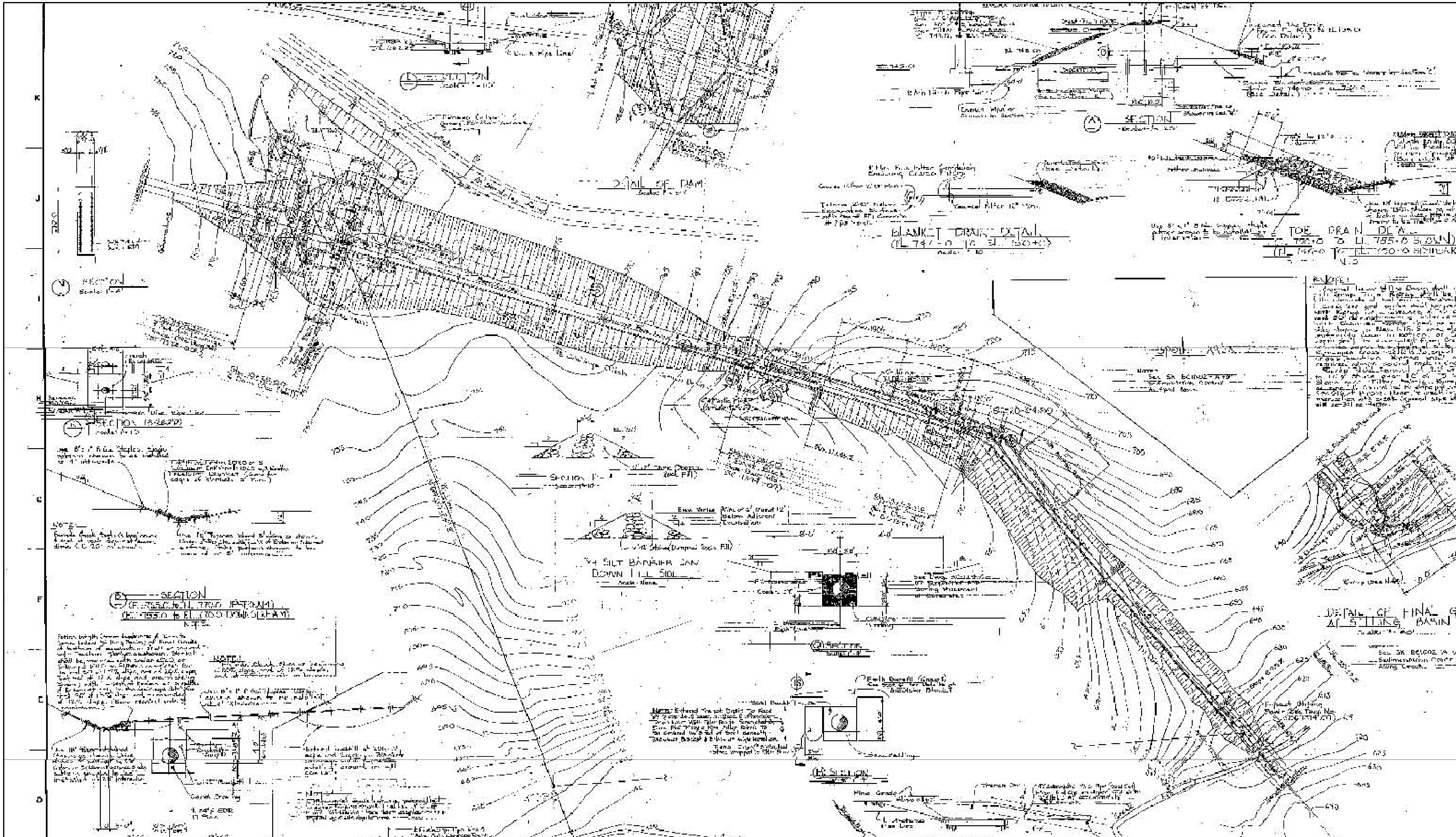

DRAWING REFERENCE: ADD. ASH DRAINAGE TOWER DISCHARGE SYSTEM, EARTHWORK PLAN, SECTIONS & DETAILS, DRAWING BC 1374-07, SECTION S

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DISCHARGE PIPELINE

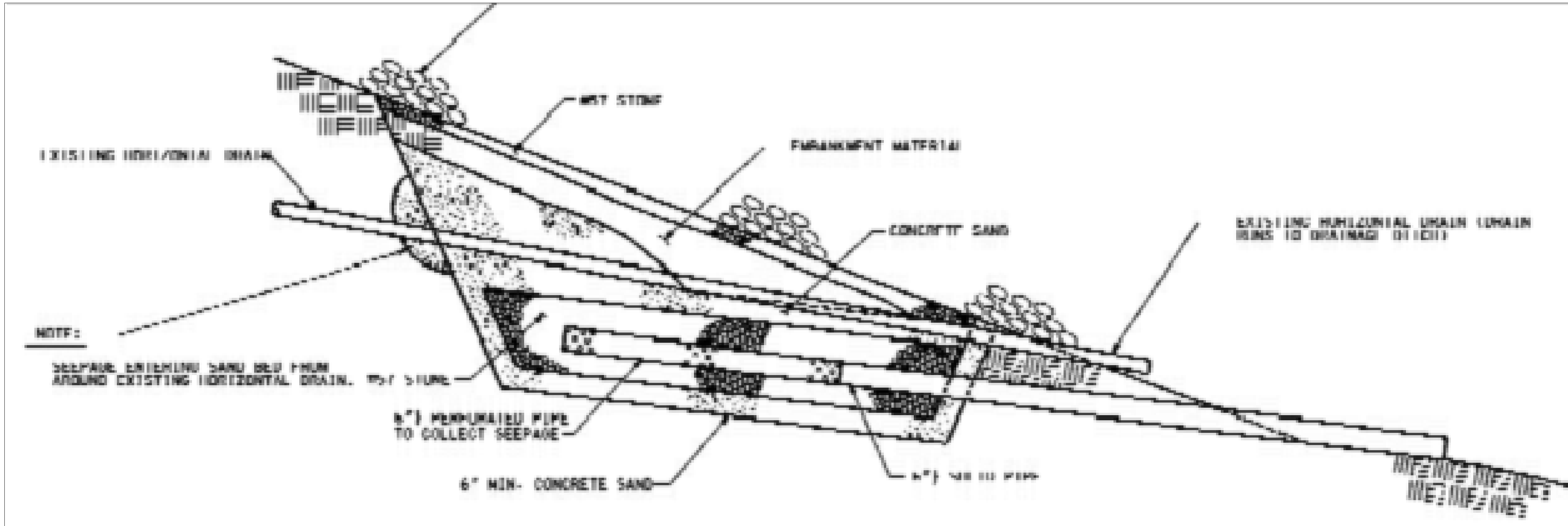
DUKE ENERGY
BELEWS CREEK STEAM STATION
WALNUT COVE, NORTH CAROLINA

PROJECT NO. 20085

DATE: 10/2009

FIGURE 4

File: K:\20085\CADD\ACAD_SHEET_FILES\4 DISCHARGE PIPELINE.DWG Saved: 10/9/2009 4:34:46 PM Plotted: 10/9/2009 5:34:41 PM User: Everleth, Jennifer



DETAIL B

(ASH DAM REPAIR AT DOWNSTREAM TOE)

Not To Scale

[redacted]

DRAWING REFERENCE: MAIN DAM, ASH DIKE & SADDLE DIKE, REPAIR WORK, SECTIONS & DETAILS, DRAWING BC-1025-01.01, SECTION D-D AND DETAIL B.

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ASH DIKE REPAIR WORK

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PROJECT NO. 20085

DATE: 10/2009

FIGURE 5

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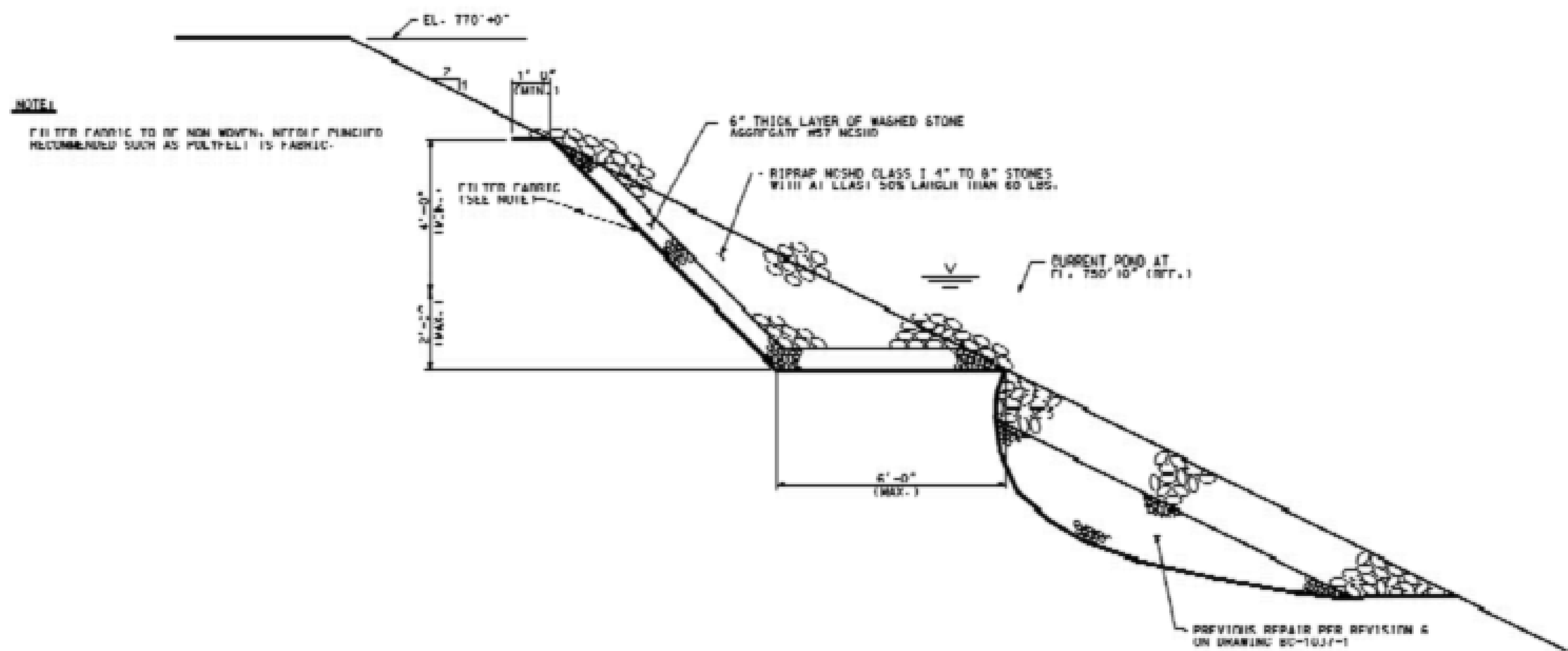

SECTION D-D
(ASH DIKE REPAIR AT UPSTREAM SIDE) Not To Scale

[redacted]

DRAWING REFERENCE: MAIN DAM, ASH DIKE & SADDLE DIKE, REPAIR WORK, SECTIONS & DETAILS, DRAWING BC-1025-01.01, SECTION D-D AND DETAIL B.

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ASH DIKE REPAIR WORK
DUKE ENERGY
BELEWS CREEK STEAM STATION
WALNUT COVE, NORTH CAROLINA

PROJECT NO. 20085
DATE: 10/2009
FIGURE 6

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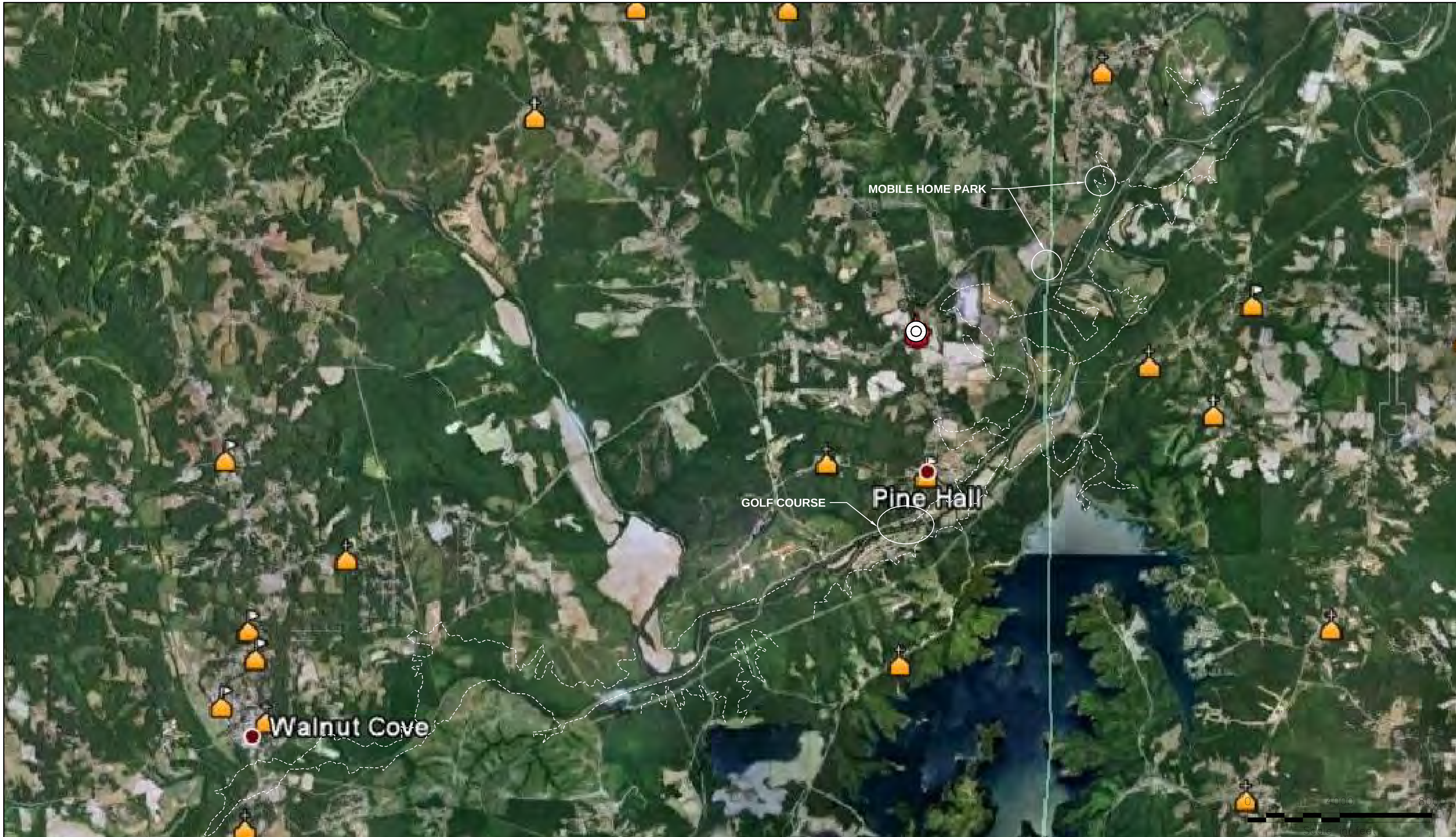

IMAGE REFERENCE: GOOGLE EARTH, USDA FARM SERVICE AGENCY, IMAGERY DATE: JUNE 30, 2006
INUNDATION LIMIT REFERENCE: BELEWS CREEK STEAM STATION DAM BREAK STUDY INUNDATION MAP OCT. 1992

INUNDATION LIMIT FOR ASH BASIN

LEGEND

CHURCH

SCHOOL

FIRE DEPARTMENT

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CRITICAL INFRASTRUCTURE MAP

DUKE ENERGY
BELEWS CREEK STEAM STATION
WALNUT COVE, NORTH CAROLINA

PROJECT NO. 20085

DATE: 10/2009

FIGURE 7

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2.0 FIELD ASSESSMENT

2.1 Visual Observations

CHA performed visual observations of the Ash Basin Dike, Chemical Washdown Pond Dike and the abandoned outlet structure 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 shortly after the site visit to the Belews Creek Steam Station. Copies of these completed forms are included in Appendix A. A photo log and Site Photo Location Maps (Figures 8A, 8B and 8C) are also located at the end of Sections 2.5.

CHA's visual observations were made on September 8, 2009 and September 9, 2009. The weather was sunny with temperatures between 62 and 80 degrees Fahrenheit. Prior to the days we made our visual observations, the following approximate rainfall amounts occurred (as reported by www.weather.com).

Table 1 - Approximate Precipitation Prior to Site Visit

Date of Site Visit – September 8, 2009 & September 9, 2009		
Day	**Date**	**Precipitation (inches)**
Tuesday	9/1/09	0.00
Wednesday	9/2/09	0.00
Thursday	9/3/09	0.00
Friday	9/4/09	0.00
Saturday	9/5/09	0.00
Sunday	9/6/09	0.00
Monday	9/7/09	0.00
Tuesday	9/8/09	0.00
Wednesday	9/9/09	0.00
Total	**Week Prior to Site Visit**	**0.00**

2.2 Visual Observation – Ash Basin Dike

CHA performed visual observations of the Ash Basin Dike which is about 2,000 feet long and about 140 feet high.

2.2.1 Ash Basin Dike Embankments and Crest

In general, the alignment of the crest of the Ash Basin Dike does not show signs of change in horizontal alignment, which arches slightly in the upstream direction as shown in Figure 2A and Photos 12 and 16. The crest exhibited minor loss of grass cover (near piezometer P-79) and localized rutting due to vehicular traffic. No evidence of prior releases, or failures on the dike was observed at the time of the site visit. Several areas were noted on the downstream face where rip rap was used to control seepage at the face of the dam as shown on Photos 20, 22, 23, 24 and 25. An area of seepage was also noted at the base of a slope repair below the lowest bench. This is shown on Photo 20. Horizontal drains were also used at several of these locations and evident in these photos as well as Photos 18 and 21.

The downstream slope was reasonably uniformly graded at approximately 2.5 horizontal to 1 vertical as shown on Figures 3A and 3B and covered with appropriate grass vegetation, which had been recently mowed at the time of our site visit. Photos 12, 13, and 16 indicate the general condition of the downstream embankment. A damp area was noted at the toe of the slope in the vicinity of Station 10+00 which had soft soil and rutting caused by recent mowing activities. This area appeared to be related to the drainage from a horizontal drain and the removal of rip rap by maintenance staff. A localized area of instability was also noted adjacent to the drainage swale at the toe of the dam as shown in Photo 28. This area was also reported during the Seventh Five-year Independent Consultant Inspection.

The benches on the downstream face at Elev. 720 and 670 feet (Photos 16, 18, and 24) each have 4.5 foot wide concrete drainage channels. The horizontal drains are designed to daylight into

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these features and drain towards the groins along the east and west abutments. Water was noted to be flowing in the right (east) and left (west) abutments. Concrete drainage chutes at the intersection with the groins are noted to be moderately undermined at several locations (Photos 17 and 19).

The precipitation of iron oxide from the horizontal drains was noted in several areas of the embankment. This condition was noted in the vicinity of horizontal drains HD-18 through 22 however did not exist in the adjacent horizontal drains HD-23 through HD-27. It was also evident at the seepage monitoring point downstream of the embankment (Photo 26).

The upstream face of the dam is generally covered with heavier grass, light brush and small trees at the edge of the pond. The slope is generally at 2 horizontal to 1 vertical. As previously discussed, rip rap was placed on the downstream slope as wave protection in 1993. These conditions can be seen on Photos 11, 14 and 15. Minor erosion features were noted near the midpoint of the embankment however these were obscured by heavy grass. Photos 29 and 30 near piezometer P-43 depict this condition.

2.2.2 Ash Tower Control Structure and Discharge

The outlet control structure for the Ash Basin is located on the west side of the Ash Dike. The outlet control structure is a stop log controlled drop inlet at Elev. 745 feet, which discharges to the north around the west abutment of the dike and through a 1600 foot pipe to an outlet flume. The locations of these features may be seen on Figure 2B. Photos 9 and 10 show the outlet tower and a floating skimmer. Photo 32 shows the route of the underground outlet pipe and Photo 33 indicates the discharge flume.

The construction drawings as shown in the cross section in Figure 4 indicate that the discharge pipe around the dike is a 24-inch SDR 17 pipe (smooth wall HDPE, 21-inch I.D.) that was installed as part of upgrades in 1984. The downstream end of the pipe terminates at Elev. 616

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feet within a concrete impact basin which contains a Parshall flume (Photos 33 and 34). A rip rap stilling basin is present within the stream channel. The flume and stilling basin were observed to be clear of vegetation and unobstructed. The drainage course from the Ash Dike seepage controls joins the outfall watercourse below the stilling basin.

2.2.3 Abandoned Ash Tower Control Structure and Discharge

The abandoned outlet structure for the Ash Basin is located within a narrow sluice to the east of the Ash Dike as shown on Figure 2A and Photo 35. Stop logs have reportedly been placed within the weir to the highest pond level at Elev. 760 feet. The 36 inch drop inlet and 42 inch outlet structure where filled with flowable fill to Elev. 735 feet. The bridge to the outlet is in poor condition. The outlet tower is plugged with vegetation however it is not intended to be a functional discharge for the impoundment.

The outlet of the 42 inch pipe discharges on the east side of Pine Hall Road in a highly vegetated dry creek bed leading to Belews Lake. The outlet was inspected and the pipe was found to be a 39 inch CMP at the discharge point. The pipe was partially filled with flowable fill material. A minor seepage of water was observed exiting the pipe which could either be from groundwater infiltration through pipe joints or water leaking through the grout placed in 1984.

2.3 Visual Observations Chemical Washdown Pond

CHA performed visual observations of the chemical washdown pond. The dike is about 500 feet long and about 16 to 20 feet high with a crest width of 24 feet.

2.3.1 Washdown Pond Dike Embankment and Crest

In general, the washdown pond dike does not show signs of changes in horizontal alignment from the proposed alignment. No evidence of prior releases, failures or patchwork on the dike

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was observed at the time of the site visit. Photo 6 shows the dam crest and general alignment. The upstream slope of the dike was estimated to be between 1.5 and 2 horizontal to 1 vertical with a thick stand of high grass and weeds. Some erosion and localized sloughing was noted. The downstream slope can be viewed through the fence in Photo 7 and is heavily wooded with trees up to 12 inches in diameter.

The chemical washdown water inlet pipe is on the east side of the impoundment. A rip rap inlet and outlet is present (Photo 36). The concrete overflow structure was observed to be in good condition (Photo 5) however was silted in.

2.4 Monitoring Instrumentation

The monitoring program at the Ash Basin Dike consists of the following network as reported to CHA and observed in the field:

- Total Seepage is measured monthly at the Parshall flume located downstream of the embankment toe. The seepage from the 24 active Horizontal Drains was reported in the February 2009 Five Year Independent Consultant Inspection Report to be measured most recently at each drain outlet on a quarterly basis. Previously (2006-07) they had been read on a monthly basis. Observation wells to measure embankment saturation are installed in the embankment. Data from 9 wells are reported.
- Twenty-four piezometers were installed along 4 principal cross sections to measure piezometric pressure within the embankment.
- The most recent Five Year Report (February 2009) documents that 8 Settlement monitoring points exist on the embankment which were historically recorded from 1989 to 1997 and a most recent reading of 2002. December 2009 correspondence from Duke Energy indicates that the 2009 readings have been received. This information was not available to CHA at the time of this report.

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The piezometers and observation wells are monitored on a monthly basis. The data is presented and discussed in the Five Year Reports. The most recent 2009 document noted a rising trend in the water surface elevation in P-61 and P-59 which are located on the downstream toe just above the berm at Elev. 670 feet and at about Station 10+07. Several piezometers between the Elev. 620 and 720 berms were noted as not being monitored. All piezometers should be included in the next monitoring round.

CHA's review of the data also indicated similar trends for water levels in observation wells OW-56 at about Station 10 and OW-80 and OW-81 at about Station 7. These observation wells are all located just above the berm at Elev. 720 feet.

Measurements made at the horizontal drains have indicated an increase in flow at the toe (Drains 1, 2, 3, 4 and 5); the right abutment (drains 19, 26 and 27) and near the center of the embankment (Drains 10 and 11).

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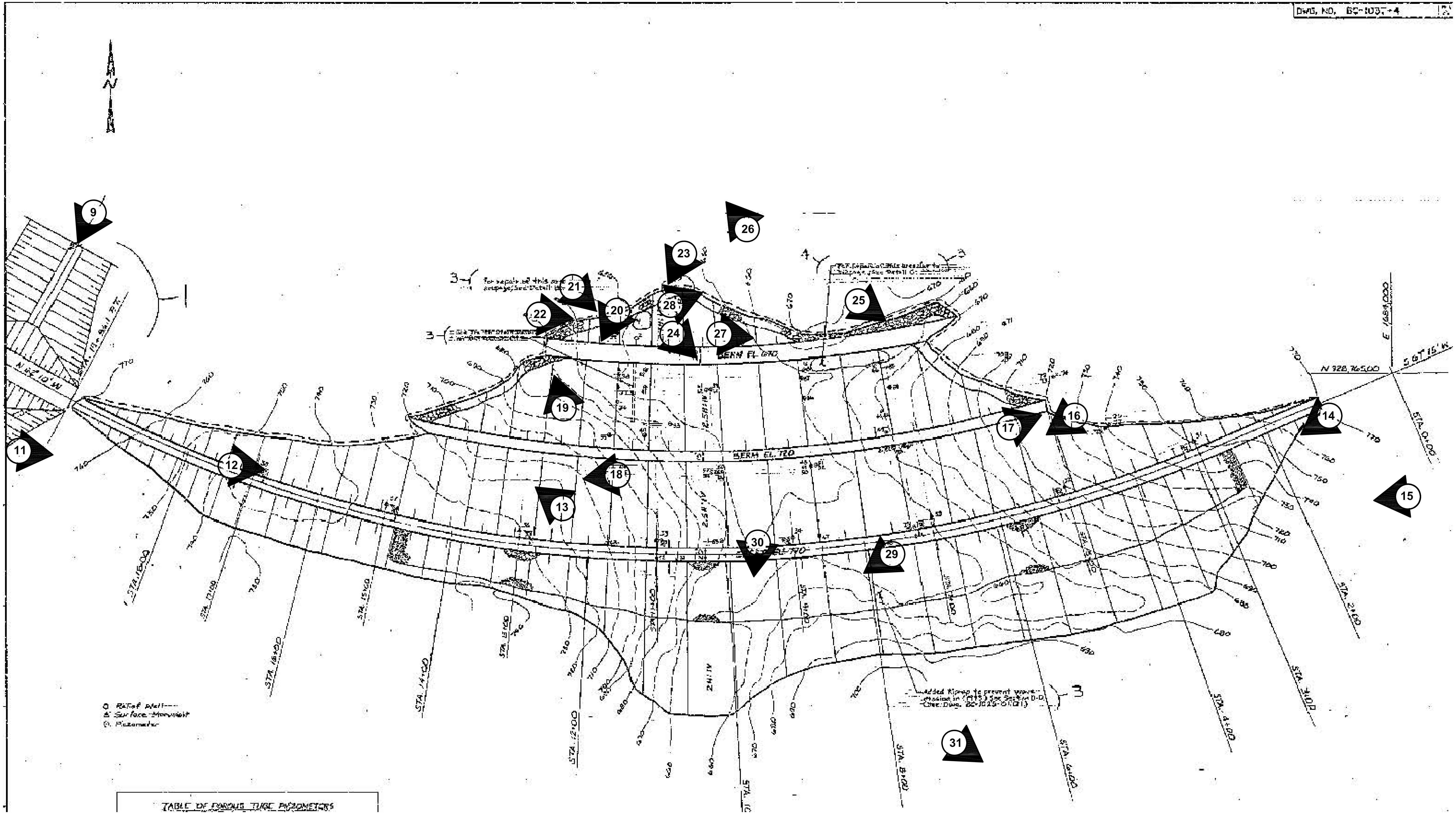

DRAWING REFERENCE: ASH DIKE PLAN, DRAWING BC 1037-04, PLAN OF ASH DAM

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PHOTO LOCATION MAP

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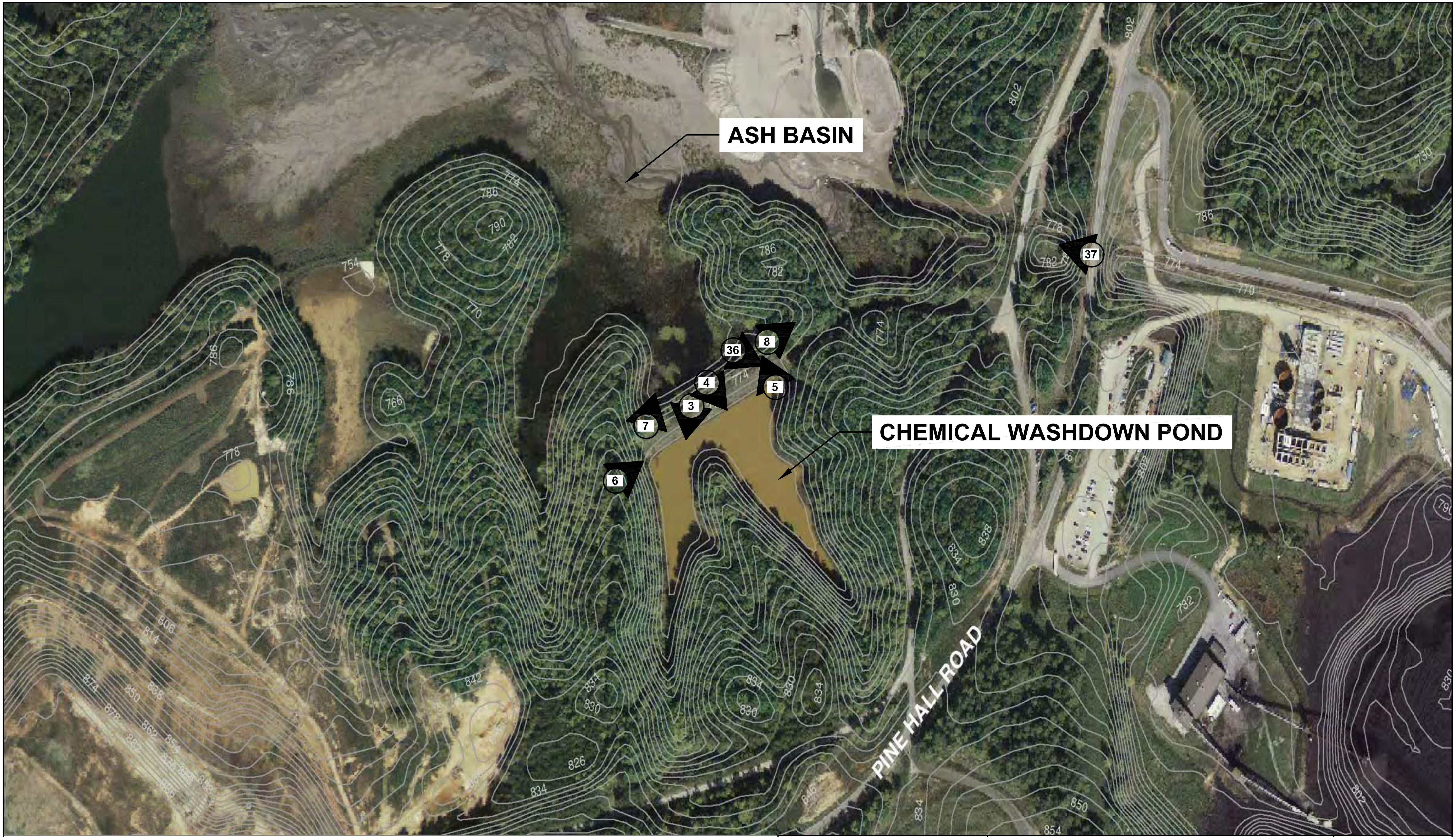
WALNUT COVE, NORTH CAROLINA

PROJECT NO. 20085

DATE: 10/2009

FIGURE 8A

File: K:\20085\CADD\ACAD_SHEET_FILES\7 PHOTO LOCATION MAP.DWG Saved: 10/9/2009 5:11:36 PM Plotted: 10/9/2009 5:40:21 PM User: Everleth, Jennifer



DRAWING REFERENCE: ASH DIKE PLAN, DRAWING BC 1037-04, PLAN OF ASH DAM

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WALNUT COVE, NORTH CAROLINA

PROJECT NO. 20085

DATE: 10/2009

FIGURE 8B

File: K:\20085\CADD\ACAD_SHEET_FILES\7 PHOTO LOCATION MAP.DWG Saved: 10/9/2009 5:11:36 PM Plotted: 10/9/2009 5:41:35 PM User: Everleth, Jennifer

File: K:\20085\CADD\ACAD_SHEET_FILES\8C PHOTO LOCATION MAP.DWG Saved: 10/9/2009 5:22:44 PM PLotted: 10/9/2009 5:42:36 PM User: Everleth, Jennifer

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PHOTO LOCATION MAP

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PROJECT NO. 20085

DATE: 10/2009

FIGURE 8C

1

Abandoned outfall pipe.

2

Old channel to Belews Lake.

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3

Chemical washdown dike gauge station.

4

Chemical washdown existing pool.

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5

Chemical washdown pond overflow structure.

6

Upstream face of chemical washdown pond.

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7

Downstream face of chemical washdown pond.

8

Influent line to chemical washdown pond.

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9

Ash tower outlet structure.

10

Ash tower outlet structure.

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11

Upstream face of ash dike, west side.

12

Downstream face of ash dike from west side.

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13

Downstream face of ash dike and west groin.

14

Upstream face, east side.

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15

Upstream face, east side.

16

Downstream face at 720 Bench, looking west.

17

Drainage structure at east groin, undermined of chute.

18

Horizontal drains at EL 720 bench, west side.

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19

Precast drainage structures west (left) groin.

20

Rip rap repair and seepage area.

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21

Horizontal drains from rip rap repair.

22

Drain swale and rip rap repair. Bridge to Parshall flume.

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23

Horizontal drains from rip rap repair.

24

Rip rap repair with horizontal drains at EL 670 bench.

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25

East (right groin) downstream. Drainage ditch.

26

Parshall Flume.

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27

Wet rutted area.

28

Slope instability noted in prior inspection report.

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29

Upstream face erosion on ash dike.

30

Localized sloughing.

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31

View of old outlet structure.

32

Outlet pipeline route.

33

Outlet flume

34

Downstream view of outlet flume.

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35

Abandoned ash tower outfall structure.

36

Chemical washdown pond inlet.

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37

Sluice pipe lines to Ash Pond.

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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 Ash Basin Dike, which were available at the time of our site visits and provided to us by Duke Energy. The design assumptions are listed with the applicable summary of analysis in the following sections.

3.2 Hydrologic and Hydraulic Design

The Ash Basin and Main Dam for Belews Lake at the Belews Creek Steam Station were originally constructed in 1971. The Ash Basin was designed to provide additional decanting ability prior to discharging effluent back into Belews Lake. As previously discussed, the discharge point was modified in 1984 due to environmental concerns. The current discharge now returns water back into Little Belews Creek and into the Dan River. Only the Ash Basin and Ash Basin Dike are the subject of CHA's review. The Main Dam and Belews Lake reservoir do not contain coal combustion residuals and are outside the scope of this investigation.

The Seventh Five-year Independent Consultant Inspection indicates that the Ash Basin Dike has been classified as an Intermediate Hazard by NCUC in accordance with North Carolina Dam Safety Regulations. The results of the first five year inspection were summarized in this document. This assessment assumes that 100% of the design storm over the watershed area of 711 acres will be stored in the Ash Basin with approximately 5 feet of freeboard at a normal pool of Elev. 760 feet and a flood level at Elev. 761 feet. The report did not state what design storm was used for the analysis. Calculations supporting these conclusions were also not provided to CHA. This report also noted that the hazard classification required a detailed review to further quantify the risks based upon operational conditions of the facility.

CHA's cursory review of the regulatory criteria suggests that under the current guidelines the Ash Basin Dike may qualify as a Very Large High Hazard impoundment. As such, based on the height of the dike and the hazard classification, the spillway would be required to safely pass or store the inflows resulting from the Probable Maximum Precipitation (PMP). Under the existing Intermediate classification, the design storm may be limited to ¾ of the PMP.

A preliminary hydraulics and hydrology Analysis was performed by CHA for the Ash Basin. The analysis was used to confirm that the Ash Basin will adequately store the volume generated during the appropriate design storm event. CHA considered that the Ash Basin Dam qualifies under the intermediate hazard class (Class B) and is also a very large dam, greater than 100 feet in height. Due to these criteria the dam is required to pass ¾ of the PMF without overtopping, based on the North Carolina Dam Safety Guidelines.

The Probable Maximum Precipitation of 29.15 inches was generated using basin characteristics, information gathered from the HMR-51 and 52, and the HMR Boss Program. The entire watershed contained 711 acres which consisted of open space, pond/basin, forest, and impervious areas. A hydrograph was generated based on the calculated time of concentration and curve numbers, using TR-55 Methodologies. Rainfall amounts for the 2-year and 100-year events were referenced from the NRCS Rainfall Distributions Atlas. In the event that the dam is considered to be a high hazard structure (Class C), the analysis provided also confirms adequate capacity to mitigate the full PMF. The table below provides the summarized information for the Ash Basin during the 100% PMF event.

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Table 2 - Ash Basin Flood Modeling

Pond	Peak Flow Rate In (cfs)	Peak Flow Rate Out (cfs)	Peak WSE (ft)	Top of Pond Elev. (ft)	Freeboard (ft)	Bottom of Pond Elev. (ft) (assumed)	Normal Pool Elev.* (ft)	Outlets
Ash Basin	12,485	44	764.7	770.0	5.3	740.0	760.0	24" SDR culvert (US inv 745.5 ft)

*Normal pool elevation was assumed at the normal design pool (760.0 ft) for conservative estimates. Actual water surface elevation is closer to 751.0 ft. The outlet pipe inside diameter is 21 inches.

Based on the Dam Safety Guidelines published by the State of North Carolina, the spillway system shall be capable of removing from the reservoir at least 80 percent of the volume above the elevation of the primary spillway within 15 days of the design storm peak.

As summarized in the results above, the Ash Basin at the Duke Energy Plant will adequately store the volume generated during the Probable Maximum Flood (PMF) allowing for approximately 5 feet of freeboard. It was recommended in the 'Seventh, Five-Year Independent Consultant Inspection' (dated February 2009) that the lake drain regulations be reviewed and the existing capacity of the Ash Tower drawdown to be quantified. CHA agrees with this recommendation, as initial results identify that the existing system is not capable of removing the specified volume generated by the design storm in accordance with the Dam Safety Guidelines.

3.3 Structural Adequacy & Stability

The North Carolina Department of Environment and Natural Resources (NC DENR), Land Quality Section, Dam Safety Program regulations state "a minimum factor of safety of 1.5 for slope stability for normal loading conditions, and 1.25 for quick drawdown conditions and for construction conditions, shall be required unless the design engineer provides a thoroughly documented basis for using other safety factors."

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Table 3 - Minimum Safety Factors Required by NCDENR

Load Case	Required Minimum Factor of Safety
Steady State Conditions at Present Pool or Flood Elevation	1.5
Rapid Draw-Down Conditions from Present Pool Elevation	1.25

NC DENR regulation also state "Foundation bearing capacity and sliding base analyses should be considered for all dams and may be required for class B and C dams. Where bearing capacity or sliding base analyses are required, documentation of assumptions, computations, and safety factors shall be included in the final design report. A minimum factor of safety against bearing capacity and sliding wedge failure of 2.0 shall be required unless the design engineer provides a thoroughly documented basis for using other safety factors."

Additional industry guidelines such as those published in the US Army Corps of Engineers Engineering Manual (EM) 1110-2-1902, Table 3-1 suggest the following guidance values for minimum factors of safety as shown in Table 3 below.

Table 4 - Additional Minimum Safety Factors Recommended by US Army Corps of Engineers

Load Case	Required Minimum Factor of Safety
Maximum Surcharge Pool (Flood) Condition	1.4
Seismic Conditions from Present Pool Elevation	1.0

In Sections 3.3.1 and 3.3.2 we discuss our review of the effects of overtopping, stability analyses, and performance of the Ash Basin Dike. The chemical washdown dike was not reviewed.

3.3.1 Liquefaction Analysis

Seismic loading conditions were not evaluated in any of the previous slope stability evaluations of the Ash Basin Dike. The Seventh Five-year Independent Consultant Inspection report states that the dike is located in Seismic Zone 1 based upon the U. S. Army Corps of Engineers document ER 1110-2-1806 " Earthquake Design and Evaluation for Civil Works Projects" dated

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July, 1995. The report recommends that a standard seismic analysis consistent with the USACOE guidelines in this manual be completed.

3.3.2 Ash Basin Dike

CHA was provided with past independent consultant reports that summarized the results of various stability analyses performed throughout the past 38 years. In addition, various stability calculations completed by Duke Energy Corporation were provided for CHA's review. Most recently, Duke Energy performed stability analyses of the dike in 1984 and again in 1988 using different soil strength parameters for each stability analysis as summarized below in Table 5. These parameters are consistent with the Duke summary prepared in March 1984. The soil values noted on Drawing BC-1037-1 of the original dike design however are slightly different that those summarized below and also include parameter use for the end of construction analysis.

Table 5 - Soil Strength Properties as Determined by Duke Energy

Soil Stratum	Unit Weight (pcf)	Friction Angle (φ)	Cohesion (psf)	Description
Original Embankment Fill				
▪ 1971 Analysis	120	27°	400	Saturated conditions
▪ 1984 Analysis	120	34°	0	
▪ 1988 Analysis				
Foundation Soils				Less than 2 ksf
▪ 1971 Analysis	NR	NR	NR	
▪ 1984 Analysis	120	30°	250	
▪ 1988 Analysis	NR	NR	NR	
Foundation Soils				Greater than 2 ksf
▪ 1971 Analysis	NR	NR	NR	
▪ 1984 Analysis	115	26°	200	
▪ 1988 Analysis				
Weathered Rock				
▪ 1971 Analysis	135	25	750	
▪ 1984 Analysis	135	25	750	
▪ 1988 Analysis	135	25	750	
Filter Material				
▪ 1984 analysis	120	32	0	

NR – Not Recorded in documentation provided to CHA

The 1984 and 1988 shear strength and unit weight values used for Duke Energy's slope stability analyses were based on triaxial shear test results on undisturbed samples obtained from borings through the original embankment. This testing was completed in 1982 and 1983. The 1984 and 1988 analyses used a phreatic surface developed from actual piezometer readings on instruments installed as part of the 1971 construction and additional monitoring points installed in 1984.

The resulting computed factors of safety from Duke Energy's analyses are reported in Table 6 below. The stability analyses consider the soil parameters shown above, several operating pool levels as well as the ongoing monitoring of the phreatic surface in the downstream face of the dam. The current operating pool is at Elev. 750 feet with a maximum pool at Elev. 760 feet and flood pool at Elev. 761 feet. Calculated phreatic surfaces were used in at least the 1984 to evaluate the effectiveness of the proposed horizontal drain installation program.

Table 6 - Summary of Safety Factors from Duke Energy Analyses

Load Case	Required Minimum Factor of Safety	Calculated Minimum Factor of Safety			
Steady State Conditions (Downstream Slope)	1.5	Pool Elev. (feet)			
		745.6	752	755	760
▪ 1971 Analysis					1.50
▪ 1984 Analysis		1.45			1.37
▪ 1988 Analysis(1)			1.30	1.29	1.28

Note 1: Analysis completed at station 10+00 using effective stress parameters

In addition to the above analysis additional slope stability reviews were reported in documentation provided by Duke Energy Corporation. A 1986 and 2003 study was noted to have been completed to review the effectiveness of the horizontal drain installation in improving the overall stability of the dike. The factor of safety in these documents is reported to be 1.6 under steady state conditions. These documents were not available to CHA for review.

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A comparison of current phreatic surface elevations within the embankment was completed in 2004 by Duke Energy against the levels used for the existing stability analysis. The review concluded that the phreatic surface levels are slightly increasing but not significant enough to warrant completing a revised stability evaluation. It was recommended that a similar review be completed at the time of the next five year inspection.

Based upon the current fluctuations in the water level monitoring data in the downstream embankment as reported in the 2009 Independent Inspection Report, CHA recommends that an updated stability analysis be completed of the dike considering the following:

- Actual phreatic surface in the embankment,
- Current operating conditions,
- A rapid drawdown scenario, and
- Seismic conditions.

3.4 Foundation Conditions

Documents reviewed by CHA indicate that the Ash Basin Dike was not constructed on wet ash, slag or other unsuitable materials. Design plans indicate that it was founded on residual soils or weathered rock. CHA was not provided with documentation of foundation preparation for the dike or Ash Tower spillway.

3.5 Operations & Maintenance

Belews Creek Steam Station staff makes monthly inspections and piezometer and seepage readings at the Ash Basin pond. In accordance with NCUC requirements, an independent third party inspection is made every 5 years. The next 5 year inspection is due in November 2013. Normal maintenance operations include mowing the grass on the dikes twice a year.

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4.0 CONCLUSIONS/RECOMMENDATIONS

4.1 Acknowledgement of Management Unit Condition

I acknowledge that the management units referenced herein was personally inspected by me and was found to be in the following condition: **Fair.** This indicates acceptable performance is expected under required loading conditions in accordance with applicable safety regulatory criteria; however some additional analyses should be performed and documented to verify that these criteria are met.

Duke Energy provided CHA with descriptions of a proactive maintenance and monitoring program at these facilities. These efforts should be continued.

CHA presents recommendations for maintenance and updating of analyses for more complete recordkeeping.

4.2 Maintaining Vegetation Growth

Appropriate grass vegetated the dikes. However, there were areas of sparse vegetation where reseeding maintenance should be performed. There are also some areas where the grass cover appeared to be removed by sliding mower wheels. Duke Energy should perform reseeding as required yearly to maintain a good grass cover on the dikes. If mower damage routinely occurs in the same areas each time grass is re-established, consideration should be given to using alternative methods (such as weed-whacking) of cutting the grass in these areas.

4.3 Drainage Swale Maintenance

Sediment was evident in rip rap drainage swales and in some of the concrete swales. The sediment observed appeared to be related to surface runoff and tended to be accumulated at the

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toe of the swales. Duke Energy should monitor the condition of these drainage swales and if the sediment appears to be clogging the rip rap and impeding surface runoff from being adequately conveyed away from the earthen embankments, the rip rap should be cleaned of sediment.

4.4 Tree and Root Removal

Small trees and brush has become established over the upstream toe of the Ash Basin Dike and in a portion of the abutment areas. CHA recommends these trees be removed under the direction of a professional engineer.

4.5 Outlet Pipe Inspections

The seepage from the abandoned outlet pipe should be monitored. Analytical testing or dye testing may confirm if it is originating from the Ash Basin or is groundwater infiltration into the pipe.

4.6 Monitoring

As discussed in Section 2.3.1, flowing seepage was observed at the toe of the lower bench of the dike from a repair area at the left abutment. Duke Energy was aware of this seepage and makes observations of this area during their routine inspections. CHA recommends that Duke Energy develop a methodology to better quantify the seepage from the open stone and embankment materials. Quantifiable measurements will allow Duke Energy and outside consultants to see changes if they occur. Any changes would need to be addressed.

Seepage from several of the horizontal drains has been noted to be increasing at the toe, right abutment and central portions of the downstream toe. CHA recommends that the monitoring frequency be returned to the previous monthly schedule used in 2006/07 to ascertain if this is a long term or seasonal condition.

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All piezometers and observation wells should be included in the monthly monitoring effort considering the concern regarding the phreatic level in the downstream embankment. A detailed review of the collected data should be completed by Duke Energy.

4.7 Chemical Washdown Pond

Duke Energy should review regulatory compliance issues for this impoundment which will be under the jurisdiction of the North Carolina Department of Environment and Natural Resources after January 1, 2010.

4.8 Hydrologic and Hydraulic Evaluation Update

As discussed in Section 3.2, CHA recommends the hydrologic and hydraulic analysis be updated to confirm that the primary and secondary ponds can safely store or pass the design storm, which currently is the inflow from the ¾ PMP. A modification to the hazard classification will change the design storm to the PMP. The removal of the design storm from the impoundment within the specified regulatory time period of 15 days also needs to be reviewed as there currently is only one spillway.

4.9 Hazard Assessment

We recommend that a breach analysis be performed for the Ash Basin Dike to determine whether development downstream would suggest a high hazard classification under the rules of the North Carolina Department of Environment and Natural Resources is warranted for the impoundments.

The EPA Hazard Potential checklist included in Appendix A identifies the facility as a high hazard impoundment due to the probable loss of human life resulting from a failure. Further study of the downstream reach of the dam including a review of the inundation resulting from the

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breach caused by the PMF as well as a review of the current level of development and human habitation may result in a lowering of this classification.

4.10 Stability Analysis

CHA recommends that soil properties, including shear strength under current conditions, be confirmed for the dike. Monitoring of the phreatic surface as previously noted will be required to accurately develop a model for an updated stability model. We also recommend that a rapid drawdown analysis be performed for the dike once the soil properties are confirmed. A seismic review should also be completed in accordance with ACOE guidelines.

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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 Belews Creek Steam 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.

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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: Belews Creek Steam Plant	Date: September 8, 2009
Unit Name: Active Ash Basin	Operator's Name: Duke Energy Corporation
Unit I.D.:	Hazard Potential Classification: High Significant Low
Inspector's Name: Rick Loewenstein/Malcolm D. Hargraves, P.E.	

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?	Yearly		18. Sloughing or bulging on slopes?		X
2. Pool elevation (operator records)?	751		19. Major erosion or slope deterioration?		X
3. Decant inlet elevation (operator records)?	751		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	D/N/A		Is water entering inlet, but not exiting outlet?		X
5. Lowest dam crest elevation (operator records)?	770		Is water exiting outlet, but not entering inlet?		X
6. If instrumentation is present, are readings recorded (operator records)?	X		Is water exiting outlet flowing clear?	X	
7. Is the embankment currently under construction?		X	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation,stumps, topsoil in area where embankment fill will be placed)?	D/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

North Carolina Utilities Commission established hazard rating. "D/N/A" = Does not apply.

1. Duke Energy makes monthly and yearly inspections; water levels, seepage volumes, and settlement recorded.

9. Occasional 1" to 3" diameter trees and heavier vegetation noted on upstream slope in and above rip rap armor.

17., 19. Isolated, superficial scarps and loosened soil noted on upstream slope above rip rap where grass and weed vegetation was about 2' to 3' in height. Minor erosion also noted in isolated areas on upstream slope.

21. Horizontal drains and underdrains/toe drains at and below lower bench (el. 670) are actively flowing. These drains and adjacent abutment groins are more active adjacent to left (downstream view) abutment (10 to 15 gpm).

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW) Impoundment Inspection

Impoundment NPDES Permit # NC00244606 INSPECTOR Loewenstein/Hargraves
Date September 8, 2009

Impoundment Name Active Ash Basin
Impoundment Company Duke Energy Corporation
EPA Region 4
State Agency (Field Office) Addresss N C Department of Environment and Natural Resources
2090 US Highway 70; Swannanoa, NC 28778
Name of Impoundment Active Ash Basin
(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: CCW, Boiler Slag, Boiler Cleaning Waste, water runoff storage

Nearest Downstream Town : Name Pine Hall, NC
Distance from the impoundment 2 to 3 miles
Impoundment
Location: Longitude 80 Degrees 4 Minutes 31.58 Seconds
Latitude 36 Degrees 17 Minutes 47.47 Seconds
State NC County Stokes

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

If So Which State Agency? NCUC (until 1-1-10) NCDENR (after 1-1-10)

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.

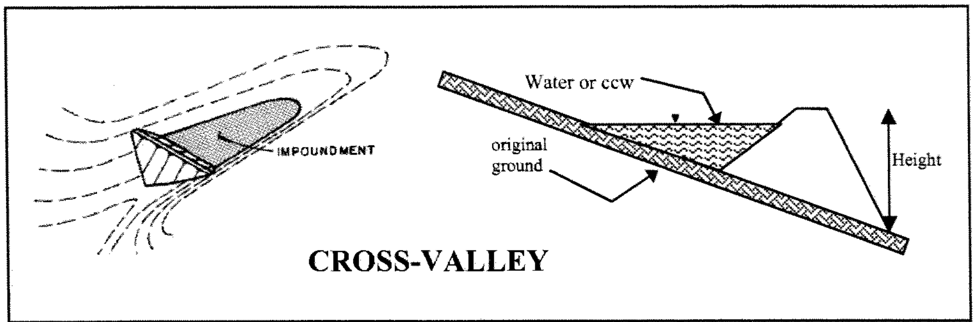
______ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns.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

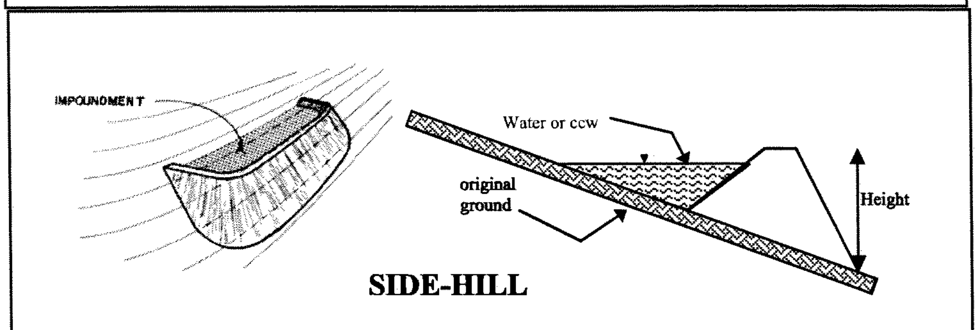
__X__ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

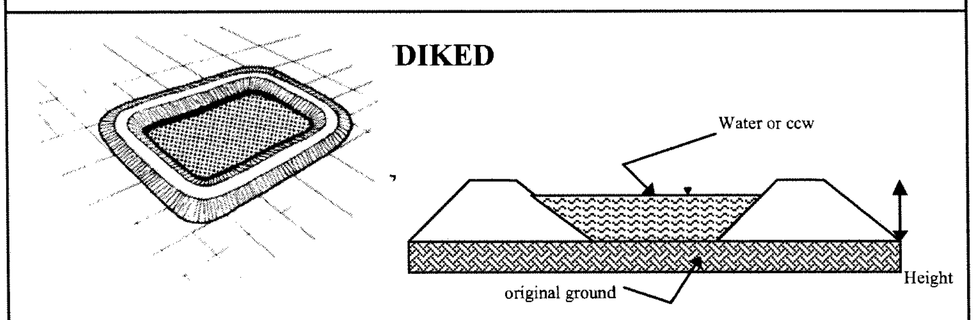
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

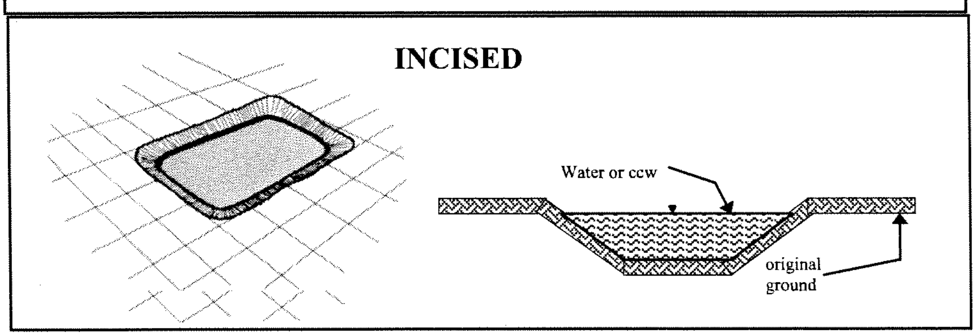
In the event of a failure under full pool at elevation 760, the waste would affect Pine Hall, Route 1909 (Middleton Loop), and eventually spill into the Dan River with the potential loss of human life due to the location of nearby roadways and the village of Pine Hall and probable high environmental impacts due to the material volume, dam height (130 feet), and pollution hazard.

CONFIGURATION:









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

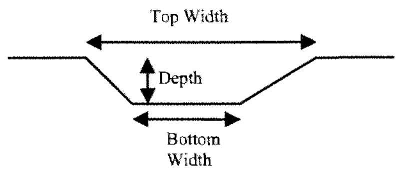
Embankment Height 130 feet   Embankment Material Native Borrow
Pool Area 325 acres at elev. 760 acres   Liner None
Current Freeboard 19 feet   Liner Permeability D/N/A

TYPE OF OUTLET (Mark all that apply)

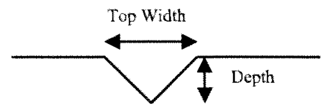
D/N/A **Open Channel Spillway**
_____ Trapezoidal
_____ Triangular
_____ Rectangular
_____ Irregular

_____ depth
_____ bottom (or average) width
_____ top width

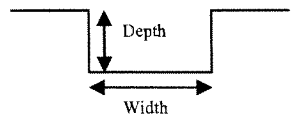
TRAPEZOIDAL



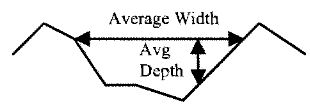
TRIANGULAR



RECTANGULAR

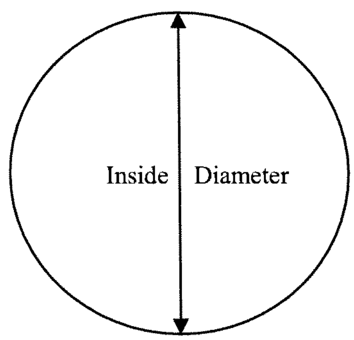


IRREGULAR



_X_ **Outlet**

21 inside diameter



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

Is water flowing through the outlet? YES _X_ NO _______

_____ **No Outlet**

_____ **Other Type of Outlet** (specify) ______________________________

The Impoundment was Designed By Duke Power Company

Has there ever been a failure at this site? YES __________ NO __X__________

If So When? ______________________________

If So Please Describe :

Has there ever been significant seepages at this site? YES _______ NO See note

If So When? Late 1970's, early 1980's (see note)

IF So Please Describe:

The seepage in this case involved groundwater through the embankment and not liquid borne ash. As a result, this seepage did not result in an unpermitted release. An apparently high phreatic surface resulted in wet spots and seeps on the downstream slope slightly above the upper berm at elevation 720, and between this upper berm and the lower berm at elevation 670. As a result, a system of horizontal drains was installed relieve pore pressure and convey the water to the concrete lined ditches on the berms and to the rock lined ditch at the toe of the dam. As built drawings depicting this system are dated from 1992. Prior to installing the horizontal drains, pressure relief wells and trench drains were also constructed to aid with seepage control around 1979/1980.

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

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

If so Please Describe :

There have been monitoring wells/piezometers, trench drains, pressure relief wells, and horizontal drain installed as a part of a seepage control system and a monitoring and maintenance program. Water level measurements and seepage volumes have been and continue to be recorded monthly at these locations.