REPORT

Dam Safety Assessment of CCW Impoundments

Chesterfield Power Station

United States Environmental Protection Agency
Washington, DC

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Washington, DC

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1. INTRODUCTION

1.1. GENERAL

In response to the coal combustion waste (CCW) impoundment failure at the TVA/Kingston coal-fired electric generating station in December of 2008, the U. S. Environmental Protection Agency has initiated a nationwide program of structural integrity and safety assessments of coal combustion waste impoundments or "management units". A CCW management unit is defined as a surface impoundment or similar diked or bermed management unit or management units designated as landfills that receive liquid-borne material and are used for the storage or disposal of residuals or by-products from the combustion of coal, including, but not limited to, fly ash, bottom ash, boiler slag, or flue gas emission control residuals. Management units also include inactive impoundments that have not been formally closed in compliance with applicable federal or state closure/reclamation regulations.

The U.S. EPA has authorized O'Brien & Gere to provide site specific impoundment assessments at selected facilities. This project is being conducted in accordance with the terms of BPA# EP10W000673, Order EP10W001240, dated April 8, 2010.

1.2. PROJECT PURPOSE AND SCOPE

The purpose of this work is to provide Dam Safety Assessment of CCW management units, including the following:

- Identify conditions that may adversely affect the structural stability and functionality of a management unit and its appurtenant structures
- Note the extent of deterioration, status of maintenance, and/or need for immediate repair
- Evaluate conformity with current design and construction practices
- Determine the hazard potential classification for units not currently classified by the management unit owner or by state or federal agencies

O'Brien & Gere's scope of services for this project includes performing a site specific dam safety assessment of all CCW management units at the subject facility. Specifically, the scope includes the following tasks:

- Perform a review of pertinent records (prior inspections, engineering reports, drawings, etc.) made available at the time of the site visit to review previously documented conditions and safety issues and gain an understanding of the original design and modifications of the facility.
- Perform a site visit and visual inspection of each CCW management unit and complete the visual inspection checklist to document conditions observed.
- Identify critical infrastructure within 5 miles downgradient of management units.
- Perform an evaluation of the adequacy of the outlet works, structural stability, quality and adequacy of the management unit's inspection, maintenance, and operations procedures.
- Evaluate the risks and effects of potential overtopping and evaluate effects of flood loading on the management units.
- Immediate notification of conditions requiring emergency or urgent corrective action.
- Identify all environmental permits issued for the management units
- Identify all leaks, spills, or releases of any kind from the management units within the last 5 years.
- Prepare a report summarizing the findings of the assessment, conclusions regarding the safety and structural integrity, recommendations for maintenance and corrective action, and other action items as appropriate.

This report addresses the above issues for the Lower Ash Pond and the Upper Ash Pond management units at the Chesterfield Power Station in Chester, Virginia. The Chesterfield Power Station ash pond impoundments are owned and operated by Dominion Virginia Power (DVP) (Virginia Electric & Power Company), a subsidiary of Dominion Resources, Inc. The Chesterfield Power Station CCW impoundments are operated through their operating segment, Dominion Generation in conjunction with a contractor, Shoosmith Brothers, Inc. During the course of this assessment, we obtained information from representatives of Dominion Generation and Dominion Resource Services, Inc.

2. PROJECT/FACILITY DESCRIPTION

DVP's Chesterfield Power Station is the largest fossil-fueled power station in Virginia. Located about 15 miles south of Richmond on the James River in Chesterfield County, the station can generate more than 1,700 megawatts. The location of the Chesterfield Station is depicted on Figure 1. Originally commissioned in 1944, the station utilizes four coal-fired generating units. Unit 6 produces 60 percent of the ash generated at the station.

The facility utilizes two impoundments known as the Lower Ash Pond and the Upper Ash Pond for storage and disposal of water-borne CCW. The Lower Ash Pond is the primary disposal impoundment for the estimated 5 MGD (million gallons per day) sluiced ash discharge. Until 2002, accumulated ash was periodically dredged and pumped to the Upper Ash Pond for final storage. Upon reaching its volume capacity, wet disposal of CCW in the Upper Ash Pond was discontinued and the impoundment is currently undergoing closure procedures. The closure design includes dry disposal of additional ash above the filled-in surface of the wet disposal impoundment. This safety assessment report summarizes the April 2010 inspection of these impoundments at the Chesterfield Station.

2.1. MANAGEMENT UNIT IDENTIFICATION

The locations of the two CCW impoundments inspected during this safety assessment are identified on Figure 2.

2.1.1. Lower Ash Pond

The Lower Ash Pond is located on the south side of the power station. The Lower Ash Pond is not currently regulated as a dam by the Virginia Department of Conservation and Recreation (DCR)—Division of Dam Safety. The Lower Ash Pond was commissioned in 1964 and expanded 5 feet vertically in 1967-1968. CCW materials contained in the Lower Ash Pond include fly ash, bottom ash, boiler slag, coal mill rejects (pyrites), coal fines, coal pile runoff, boiler cleaning waste water, and water from the station master sump. CCW is sluiced via pipes to the Lower Ash Pond at a discharge point on the north side. Water is routed through channels excavated into the accumulated ash into the main body of the Lower Pond. The water in the Lower Pond ultimately discharges into the James River via a concrete decanting structure located in the southwest corner of the pond. The discharge is permitted under VPDES number 0004146 as Outfall 004.

2.1.2. Upper Ash Pond

The Upper Ash Pond is located to the southeast of the Lower Ash Pond. The Upper Ash Pond was commissioned in 1983 to store CCW and other materials consisting of fly ash, bottom ash, boiler slag, flue gas emission control residuals, coal mill rejects, coal fines, and general dredge spoil materials. The CCW stored in the Lower Ash Pond was periodically dredged and hydraulically transferred for final storage in the Upper Ash Pond. Closure of the Upper Ash Pond began in 2002 and continues as of the date of this report. Closure will include capping the filled Upper Ash Pond with compacted dry-placed ash excavated from the Lower Ash Pond. Upon commencement of closure operations in 2002, liquid-borne placement of CCW was terminated. A small stormwater pond is currently in operation within the limits of the former Upper Ash Pond to facilitate stormwater detention, sedimentation and erosion control during the closure operations. The discharge is permitted under VPDES number 0004146 as Outfall 005. The Upper Ash Pond is regulated by the Virginia Department of Conservation & Recreation (DCR) – Division of Dam Safety in accordance with the Virginia Impounding Structures Regulations (Virginia DCR Inventory #04145). The dam (impounding dikes) does not have a National Inventory of Dams hazard rating or number.

2.2. HAZARD POTENTIAL CLASSIFICATION

The Commonwealth of Virginia classifies dams or impounding structures in accordance the Virginia Dam Safety Act, Article 2, Chapter 6, Title 10.1 (10.1-604 et seq) of the Code of Virginia and Dam Safety Impounding Structures Regulations (Dam Safety Regulations), established and published by the Virginia Soil and Water Conservation Board (VSWCB). The regulations are administrated by the Virginia Department of Conservation & Recreation (DCR), Division of Dam Safety. The Impounding Structures Regulations define a dam as any impounding structure that is 25 feet in height, measured from the outboard toe to the crest of the dam, and has a minimum impounding capacity of 15 acre-feet or more at the top of the structure; and, any impounding structure that has a height of six feet or greater and has an impounding capacity of 50 acre-feet or greater.

Dams or impounding structures regulated by the Commonwealth of Virginia are rated according to dam hazard potential classifications as established by the Impounding Structures Regulations. Three hazard potential classifications are defined below:

- *High* - dams that upon failure would cause probable loss of life or serious economic damage
- *Significant* - dams that upon failure might cause loss of life or appreciable economic damage
- *Low* - dams that upon failure would lead to no expected loss of life or significant economic damage. Special criteria: This classification includes dams that upon failure would cause damage only to property of the dam owner.

The definitions for the four hazard potentials (less than low, low, significant and high) to be used in this assessment are included in the EPA CCW checklist found in Appendix A.

Loss of life is not expected in the event of a failure of the earthen dikes of either the Lower or Upper Ash Ponds. The James River, as a navigable waterway for barge traffic, appears to be the only critical infrastructure within 5 miles downgradient of either the Lower or Upper Ash Ponds.

2.2.1. Lower Ash Pond

The Lower Ash Pond is not currently regulated by DCR and therefore, does not currently have an assigned state hazard potential classification.

Based on the EPA CCW checklist definitions and as a result of this assessment, the hazard potential classification recommended for the Lower Ash Pond is **SIGNIFICANT.** This classification is recommended due to the potential economic loss since the Chesterfield Power Station would cease coal-fired generation and potential environmental impacts to the James River and surrounding natural wetlands in the event of a dam breach. Loss of human life is not likely.

2.2.2. Upper Ash Pond

A Dam Break Inundation Zone Mapping Study prepared by Golder Associates, dated January 2010, recommended a hazard classification of *Low* for the Upper Ash Pond. DVP has submitted documentation, to the DCR for re-certification of the Upper Ash Pond as a *Low* hazard potential impoundment; however, the DCR has not responded to the submittal as of the date of this report. The DCR ruling on the final hazard potential classification for the Upper Ash Pond is still pending

The Upper Ash Pond is currently undergoing closure operations and wet disposal of CCW in the Upper Ash Pond was discontinued in 2002. At the time of our inspection, the only free water stored within the Upper Ash Pond area was contained within a small stormwater basin. This basin collects stormwater from the Upper Ash Pond closure operation and facilitates sediment removal from the stormwater. . Given that the Upper Ash Pond is

undergoing closure operations, does not currently receive liquid-borne CCW, and only a small volume of stormwater is contained within the associated stormwater sedimentation pond, the hazard potential classification recommended for the Upper Ash Pond, based on the EPA CCW checklist definitions and this assessment, is **LOW.** Failure or misoperation of the Upper Ash Pond would result in no probable loss of human life and low economic and/or environmental losses.

2.3. IMPOUNDING STRUCTURE DETAILS

The following sections summarize the structural components and basic operations of the Lower Ash Pond and the Upper Ash Pond. The location of these impoundments on the station property is shown on Figure 2. Site Plans of the Lower Ash Pond and the Upper Ash Pond and their relevant features are provided as Figure 3 and Figure 4, respectively, with photograph locations and directions noted. It should be noted that the site plans shown in Figures 2, 3, and 4 are adapted from aerial imagery as noted and may not depict all current features or conditions. Additionally, photos taken during the visual inspection are incorporated in a Photographic Logs provided as Appendices B and C for the Lower Ash Pond and Upper Ash Pond, respectively.

2.3.1. Embankment Configuration

Lower Ash Pond

The Lower Ash Pond is a combined incised/diked earthen embankment structure that impounds an area of approximately 49 acres. The Lower Ash Pond is diked on the majority of its perimeter except on the north side of the pond where the east and west dikes tie into surrounding grades. The crest is at approximately elevation (EL) 20 feet above mean sea level (MSL). The west dike is the highest at approximately 19 feet above the outboard toe of slope at the southwest corner of the pond (see Figure 3). The Stone & Webster design drawings indicate the west dike to have outboard slopes of 1.5 horizontal to 1 vertical (1.5H:1V) The south and east dike cross-sections are shown with an outboard slope of 4H:1V. The design drawings indicate that all embankment (dike) fill was to come from excavation within the pond footprint. Available geotechnical data indicates the embankment materials to consist of clayey sand, silty sand, sandy silt, lean clay, fat clay, and elastic silt, generally loose to medium dense, and soft to stiff.

Upper Ash Pond

The Upper Ash Pond is a diked earthen embankment structure. The Upper Ash Pond, during its years of active operation, impounded an area of approximately 112 acres. The Upper Ash Pond is diked over its entire perimeter. The crest of the Upper Ash Pond dike is at EL 42 feet above MSL, and the pond bottom as designed was at EL 2.5 feet above MSL. The Upper Ash Pond was not designed with a liner. The dike has a maximum height of approximately 44 feet. Based on the design drawings prepared by J. K. Timmons & Associates, Inc., dated May 18 and June 28, 1983, the inboard slopes were designed at 2H:1V and the outboard slopes were designed at 2.5 to 3H:1V. Toe drains consisting of a 3-foot wide gravel filled trench with a 6-inch diameter perforated pipe were installed along the majority of the dikes. Toe drain pump stations are positioned at the approximate mid-point of the north and south dikes. The toe drain pumps recycle the water collected in the toe drains back to the pond.

As mentioned previously, the Upper Ash Pond is currently undergoing operations to permanently close the unit. The Upper Ash Pond has been completely filled with CCW and is no longer receiving water-borne CCW. Dried CCW is currently being placed and compacted in thin lifts as part of the final closure operations. This closure operation will allow placement of dried and compacted CCW at 3H:1V slopes up to EL 130. Based on projections in the closure plan, completion of these closure activities is expected sometime between 2023 and 2028.

2.3.2. Type of Materials Impounded

Lower Ash Pond

CCW materials contained in the Lower Ash Pond include fly ash, bottom ash, boiler slag, coal mill rejects (including some pyrites), coal fines, coal pile runoff, boiler cleaning waste water, and water from the station master sump. CCW is sluiced to the Lower Ash Pond at a single discharge point on the north side.

Upper Ash Pond

As mentioned above, water-borne CCW is no longer being transferred to the Upper Ash Pond; however, the Upper Ash Pond Closure Plan includes placement of dried and compacted CCW above the crest elevation of the original perimeter dikes. The CCW is excavated from the Lower Ash Pond, stockpiled to drain, then hauled to the Upper Ash Pond dry disposal area. Based on projections in the closure plan, closure operations are anticipated to be complete in the 2023 to 2028 time frame. Prior to commencement of closure operations, the Upper Ash Pond received CCW transferred via hydraulic dredging from the Lower Ash Pond. Previous hydraulically-placed CCW materials consist of fly ash, bottom ash, boiler slag, flue gas emission control residuals, coal mill rejects, coal fines, and general dredge spoil materials.

2.3.3. Outlet Works

Lower Ash Pond

The Lower Ash Pond is an incised/diked impoundment that has been designed to receive sluice flows and direct precipitation. The Lower Ash Pond outlet structure, located within the southwestern corner of the impoundment, consists of a concrete weir equipped with stop logs to govern the water level in the pond (See Appendix B – Photo 7). A perimeter baffle serves to exclude floating debris and cenospheres from the discharge. The effluent discharges into a 27-inch concrete pipe that extends through the embankment to outfall into the James River. A 30-inch steel pipe has been installed over the end of the concrete outlet pipe to extend the pipe outlet away from the toe of the embankment to outfall into a plunge pool. This measure was completed in 1987 to mitigate scouring of the embankment toe by the discharge from the concrete pipe. The pond discharge to the James River is permitted under VPDES permit # 0004146.

Upper Ash Pond

As discussed above, the Upper Ash Pond no longer receives water-borne CCW; however, a small stormwater pond is in operation within the northeastern portion of the Upper Ash Pond. This stormwater pond serves to collect stormwater runoff from the dry disposal pond closure operation that is currently underway. The outlet structure of the storm water pond is the same outlet structure formerly used for the Upper Ash Pond. The outlet structure consists of a concrete decanting tower with orifice and valve controls and fixed weir overflow. Reportedly, the orifice/valves are normally maintained closed and the pond is periodically pumped of water and accumulated sediments. The pumped water and sediment are returned to the Lower Ash Pond. If the water level reaches a high enough level, it can discharge over a fixed weir to the James River. The concrete outlet structure discharges into a 24-inch concrete pipe that extends through the embankment to outfall into the James River. (See Appendix C – Photo 4). The pond discharge to the James River is permitted under VPDES permit # 0004146.

3. RECORDS REVIEW

A review of the available records related to design, construction, operation and inspection of the impoundments was performed as part of this assessment. The documents provided by DVP are listed below for each impoundment:

Lower Ash Pond

Table 3.1 *Summary of Lower Ash Pond Documents Reviewed*

Document	Dates	By	Description
Design Drawings	Illegible	Stone & Webster Engineering Corporation.	Grading plan, typical sections and details, toe drain improvements, outlet structure plans
Memorandum-Instability and Erosion for Ash Pond Outfall Structure Discharge Pipe	July 6, 1987	Internal Civil Engineering	Description of seepage and slope stability problem along outlet pipe. Description of repair measures.
Annual Inspection Report	1/21/2009	Dominion	Internal engineer's visual dam safety inspection
Letter of Response to EPA Request for Information	3/23/2009	Dominion	Answers to questions related to CCW management units on-site
SWPPP Site Plan	12/31/2009	Dominion	Stormwater flow diagram
Geotechnical Engineering Study, Stability Evaluation of Lower Ash Pond Dikes	2/5/2010	Schnabel Engineering, LLC	Report of dike stability analysis

Table 3.2 *Summary of Upper Ash Pond Documents Reviewed*

Document	Dates	By	Description
Design Drawings	7/5/83 11/1/83	J.K. Timmons & Associates, Inc.	Phase I and II design drawings, plans, sections, and details
Design Geotechnical Report	12/20/82	Schnabel Engineering Assoc.	Design geotechnical study of Upper Ash Pond site
Final Slope Stability Analysis	1983	Schnabel Engineering Assoc.	Design slope stability analysis for the embankments
Conceptual Study of North & South Dike Repairs	1993	Virginia Power-Fossil & Hydro Engineering	Geotechnical Study and conceptual design of north and south dike repairs
Geotechnical Study of Henricus Park Access Road	1993	Schnabel Engineering Associates	Geotechnical investigation of access road along toe of Upper Ash Pond dike
Geotechnical Study-North Dike	1995	Schnabel Engineering Associates	Geotechnical study to investigate stability issues with the north dike
Upper Ash Pond Groundwater Observation Well Installation	March 2000	Schnabel Engineering Associates	Report of groundwater levels in dikes surrounding Upper Ash Pond
Revised Closure Plan—Upper Ash Pond	September 2003	GAI Consultants	Final report of pond closure plan with supporting engineering analyses, drawings, etc.
Annual Impoundment Inspection Reports	2005 through 2010	Dominion	Annual inspection reports by engineer as required by the Virginia DCR
SWPPP Site Plan	12/31/2009	Dominion	Stormwater flow diagram
Letter of Response to EPA Request for Information	3/23/2009	Dominion	Answers to questions related to CCW management units on-site
Operation & Maintenance (O&M) Certificate Application for Impounding Structures	January 2010	Dominion	O&M document required for VA state regulated impoundments. Includes O&M Plan, Inspection Plan, Dam Break Inundation Map

Table 3.2 *Summary of Upper Ash Pond Documents Reviewed*

Document	Dates	By	Description
Annual Inspection Report for Virginia Regulated Impounding Structures	January 2010	Dominion	Internal engineer's visual dam safety inspection of Upper Ash Pond
Emergency Preparedness Plan for Low Hazard Virginia Regulated Impounding Structures	January 2010	Dominion	Emergency Preparedness Plan for Upper Ash Pond

3.1. ENGINEERING DOCUMENTS

Review of the design drawings and geotechnical investigation reports revealed information on the construction chronology, ash pond modifications, and past issues, which are summarized below for each impoundment.

Lower Ash Pond

- The Lower Ash Pond was originally constructed in 1964. The dikes were raised 5 feet in 1967-1968.
- The Lower Ash Pond was designed by Stone & Webster Engineering Corporation. Construction was also overseen by Stone & Webster.
- The Lower Ash Pond was constructed as a combined incised/diked structure. The excavated material was used to construct the dikes.
- The dikes were designed with crushed stone or clean gravel toe drains.
- No engineered liner was provided on the interior of the pond
- In the late 1980's, toe drain improvements along the east dike were designed by J.K. Timmons & Associates. Improvements included provision of a filtered gravel collection trench along the downstream edge of the existing blanket drain, with outlet pipes at intervals along the length of the toe drain.
- In 1987, seepage along primary decanting structure outlet pipe developed. In addition, discharge of effluent from the outlet pipe was scouring the toe of the dike. Investigations were conducted and repairs consisting of extension of outlet pipe, grouting of soils along outlet pipe, and installation of a sheet pile cutoff wall through the crest mitigated the problem. No issues in this area have arisen since the corrective action was implemented.
- In March of 1995, some areas of minor to moderate seepage were noted along the east dike. Seepage was attributed to higher than normal water levels in the impoundment during dredging operations. Monitoring indicated that seepage was not worsening and was not detrimental to the stability of the dike.
- In February of 2009, Schnabel Engineering was retained to perform a geotechnical engineering study and stability analysis of the Lower Ash Pond dikes. Their February 2010 report indicated the downstream slope stability factors of safety against deep-seated failure to meet accepted criteria for embankment dams under all load cases analyzed with the exception of normal pool –steady state seepage with truck surcharge loading. Stability factors of safety against shallow failure or sloughing of the downstream slope were generally below the accepted criteria for all load cases at steep sections of the west dike. Recommendations for improving stability of steeper portions of the west dike were provided in the report, but had not been implemented at the time of this assessment.

- The boring logs, design drawings, and the report text indicate that the existing dikes were founded on native soils consisting of recent fine and coarse-grained alluvial soils.

- No indication or mention of ash, coal slimes, or other CCW by-products within the dikes or dike foundations was noted in our review of the engineering records listed above.

- No indication of former spills or releases of impounded materials from the Ash Pond was noted in the records reviewed.

- Review of FEMA Flood Insurance Map No. 5100350094C for Chesterfield County indicates that the 100-year flood is approximately 17 feet above MSL at the Lower Ash Pond. The Lower Ash Pond has a crest elevation of approximately EL 20 feet above MSL. The Lower Ash Pond dikes will not be overtopped under these conditions.

Upper Ash Pond

- The Upper Ash Pond was constructed in 1983.

- The entire perimeter of the Upper Ash Pond is diked with earthen embankments with a maximum height of 44 feet.

- No liner or cutoff wall was constructed for the Upper Ash Pond dikes.

- Toe drains are installed in the dikes that discharge into pumped sump pits.

- In 1993, fill was placed along the northeast end of the north dike toe berm, as part of the construction of an access road to Henricus Park. The placement of fill over soft soils in combination with high water levels in the pond and associated raising of the phreatic surface initiated a slope failure of the toe berm. Measures were taken to stabilize the slope and no releases from the impoundment occurred.

- In 1996 during another dredging operation, higher water levels in the pond caused seepage in the area of the above slope failure. "Relief Wells" (vertical pumping wells) were installed along the crest above the distressed area to lower the phreatic surface. The wells were effective in mitigating the seepage and stabilizing the slope in this area. No further problems in this area were experienced.

- The Closure Plan was originally submitted to the VA Dept. of Environmental Quality in 1996. Closure began in 2002 and continues as of the date of this report.

- Review of FEMA Flood Insurance Maps No. 5100350094C and 5100350100B for Chesterfield County indicates that the 100-year flood is approximately 17 feet above MSL at the Upper Ash Pond. The Upper Ash Pond has a crest elevation of approximately EL 42 feet above MSL. The Upper Ash Pond dikes will not be overtopped under these conditions.

3.1.1. Stormwater Inflows

Stormwater inflows to the Lower Ash Pond are minimal. The impounding structure is comprised of diked embankments on three sides which direct stormwater away from the impoundment and limit runoff to that precipitation which falls directly on the water surface and crest of the embankments. The land area to the north is generally graded away from the Lower Ash Pond. Therefore, the area north of the impoundment is not a source of significant runoff into the Lower Ash Pond.

The Upper Ash Pond has been filled completely and is currently being closed by placing compacted dry ash in an engineered fill above the original top of pond elevation. Stormwater generated on the surface of the Upper Ash Pond is directed to a small stormwater sedimentation pond located at the northeast end of the Upper Ash Pond area. Hydrology and hydraulic analyses were performed to support a dam break analysis of this stormwater pond, which indicate the outlet structure to be capable of passing a 100-year storm event without overtopping the dikes.

3.1.2. Stability Analyses

Lower Ash Pond

Slope stability analysis of the downstream slopes of the east, west, and south dikes were performed by Schnabel Engineering in 2010. Load cases analyzed include normal pool, steady-state seepage with and without haul truck surcharge, and normal pool, steady-state seepage with seismic load. The geotechnical report, dated February 5, 2010, indicated that the downstream slope of the west dike does not generally meet accepted stability criteria for embankment slope stability. The report indicates that the downstream slopes of the south and east dikes meet the accepted stability criteria. Portions of the west dike north of the outfall structure are steep and therefore subject to shallow sloughing of the slope face, which was indicated in the stability analysis. Shallow slope failures generally do not lead to loss of the entire embankment, but can present a maintenance issue and may lead to further deterioration of the overall embankment stability if neglected. Deep-seated slope failures can lead to loss of the embankment and release of ash. The lowest factor of safety for deep-seated failure of the west embankment was found to be 1.3 for the normal pool, steady-state loading condition with haul truck surcharge. While the calculated factor of safety does not meet the accepted criteria of 1.5 for this load case, it does indicate that the slope is stable, but needs improvement to increase the factor of safety of this section of the west dike.

Upper Ash Pond

Slope stability analyses were completed during the design phase of the Upper Ash Pond to determine the slope configuration for the dikes. Based on our review of the design phase slope stability analysis and the design embankment cross-sections, the dikes appear to have been designed in accordance with the recommendations set forth by the stability analysis.

The Closure Plan of the Upper Ash Pond included stability analyses to demonstrate that the dike stability would be maintained during the dry placement of CCW above the filled-in ash pond. The results of the stability analyses documented in the Closure Plan indicate that slope stability factors of safety are satisfactory based on the anticipated conditions during closure.

3.1.3. Modifications from Original Construction

Lower Ash Pond

The Lower Ash Pond has undergone two minor modifications since its commissioning in 1964. The first modification in 1967-68 consisted of raising the crest elevation of the dikes 5 feet. In the mid-1980's, toe drain improvements were installed along the east dike to improve seepage management. In 1987, seepage developed along the outlet pipe that extends from the decanting structure through the west dike. Scarps developed in the downstream slope in the region of the outfall pipe, which were attributed to the seepage problem. Repairs to correct the seepage included adding a steel pipe extension to the downstream end of the outlet pipe, grouting the soils along the outlet pipe to mitigate the seepage, and installing a sheet pile partial cutoff wall to lengthen the seepage path through the embankment.

Upper Ash Pond

The Upper Ash Pond was not expanded or modified significantly during its years of operation as a final ash disposal impoundment from 1983 to 2002. Some seepage resulting in instability of the toe berm along the north end of the north dike was experienced during construction of an access road to Henricus Park, which extended along the toe berm of the northern dike. In order to lower the phreatic surface and restore stability to the dike's toe berm, several pumped wells were installed at the crest of the embankment in the area of instability. The wells were effective at restoring stability and allowed completion of the access road and repair of the dike toe berm.

As discussed previously, the Upper Ash Pond is currently undergoing closure operations which include dry placement of CCW above the filled ash pond surface. The plan calls for mounding of compacted dry-placed CCW to a maximum elevation of EL 130 feet, approximately 88 feet above the crest of the dikes. Based on projections presented in the Closure Plan, final closure is expected to be complete sometime between 2023 and 2028.

As part of the hydrologic and hydraulic design of the stormwater pond, the hydraulic control for the outlet structure was converted from removable stop planks to a valved, low-level outlet orifices in the front wall of the decanting tower with a high level outlet fixed weir at approximately EL 30.67 feet.

3.1.4. Instrumentation

Although temporary piezometers and slope inclinometers have been installed to support previous engineering analyses, no regularly monitored instrumentation was present at the Lower Ash Pond or the Upper Ash Pond at the time of our inspection.

3.2. PREVIOUS INSPECTIONS

Mr. John Cima, PE of DVP's Fossil & Hydro Engineering staff has been responsible for conducting safety inspections of the Chesterfield impoundments for the past 25 years. The most recent inspection report for the Lower Ash Pond, dated January 21, 2009, indicated excessive vegetation was present on the upstream and downstream slopes of the west and east dikes, and recommendations were provided to regularly mow/cut the vegetation. Some standing water was observed beyond the toe area of the west dike, which were attributed to seepage, poor drainage, or both. Although the annual dam safety inspections are not required by the state, DVP has elected to continue the annual inspections of the Lower Ash Pond to formally monitor and document the condition of the impoundment.

Annual Inspections Reports of the Upper Ash Pond by the owner's engineer are required by the Virginia Impounding Structures Regulations for Significant and High hazard potential classified impoundments. The most recent inspection conducted by Mr. John Cima, PE of DVP's Hydro & Fossil Engineering is dated January 28, 2010. This inspection report indicated that the pond, dikes, and appurtenances were in good conditions. A few minor maintenance items were identified which included recommendations for maintenance of vegetation by mowing twice a year, rust removal and painting of the decant structure bridge and handrails, removal of two clumps of trees on the far west dike downstream slope, regrading of any poorly drained crest areas, operational maintenance of toe drain sumps and dewatering (relief) wells, and periodic removal of silt from the concrete-lined drainage ditches.

3.3. OPERATOR INTERVIEWS

Numerous plant and corporate personnel took part in the inspection proceedings. The following is a list of participants from the inspection of the Chesterfield Power Station CCW management units:

Table 3.3 *List of Participants*

Name	Affiliation	Title
John A. Cima, PE	Dominion Resource Services, Inc.	Consulting Engineer, Geotechnical
Dawn K. Garber, PE	Dominion Generation	Supervisor, Environmental Quality
Michael Isper	Dominion Resource Services, Inc.	Corporate Environmental Quality
Carissa R. Agnese	Dominion Generation	Senior Environmental Compliance Coordinator
Amelia H. Boschen	Dominion Generation	Environmental Compliance Coordinator
D. Dreher Whetstone, PE	O'Brien & Gere	Technical Associate
Dana R. Pizarro, PE	O'Brien & Gere	Vice President

Facility personnel provided a good working knowledge of the CCW management units and general plant operations and provided requested historical documentation. These personnel also accompanied O'Brien & Gere throughout the visual inspections to answer questions and provide additional information as needed in the field. Additional information not provided at the meeting was provided on May 18, 2010 by Dominion representatives.

4. VISUAL INSPECTION

The following sections summarize the visual inspection of the Lower Ash Pond and Upper Ash Pond which occurred on April 28, 2010. At the time of the inspection, O'Brien & Gere completed an EPA inspection checklist for each pond, which was submitted electronically to EPA May 11, 2010. A copy of the completed inspection checklists is included as Appendix A.

4.1. GENERAL

The weather on the dates of the inspection was clear and approximately 82 degrees. The visual inspection consisted of a thorough site walk along the perimeter of the ash ponds. O'Brien & Gere team members made observations at the toe and crest of the embankments, and along the embankment slopes. We also observed outlet structures and their current operation.

Photos of relevant features and conditions observed during the inspection were taken by O'Brien & Gere and are provided in Appendices B and C. An aerial photograph (2009) of the Lower Ash Pond is presented as Figure 3 and the Upper Ash Pond is shown on Figure 4, which provide photograph locations and directions.

4.2 SUMMARY OF FINDINGS

Lower Ash Pond

During the visual site inspection of the Lower Ash Pond, the perimeter of the impoundment was walked by the inspection team. The following observations were made during the inspection:

- Sluiced CCW discharge enters the pond at the northern end and is routed to the south end of the pond through shallow channels that have been excavated into the accumulated CCW deposits (Photos 1 and 2). Stockpiles of ash excavated from the channels are allowed to dry, loaded onto trucks and hauled to the Upper Ash Pond closure area.

- As can be seen in Figure 3, the CCW has accumulated above the normal pool level over an estimated 40 percent of the pond area. Water in the pond is isolated to primarily the south half of the pond.

- A bottom ash handling area is present within the northeastern corner of the pond. Bottom ash material is stockpiled and staged for beneficial re-use exporting.

- Portions of the downstream slope of the western dike appeared to be steeper than typical embankment dam or dike sections. (Photo 4) The recent stability analysis by Schnabel indicated that these slopes are susceptible to shallow slides or sloughs.

- The natural ground beyond the toe of the west dike slope exhibited some relatively small wet areas, which could be indicative of seepage, poor surface drainage or both. (Photo 5)

- The station discharge canal eastern slope beyond the downstream toe of the western dike is covered with riprap for erosion protection.

- The inboard slopes along the all dikes are overgrown with high vegetation. (Photo 3 and 4) Very little of the inboard dike slope is exposed above the ash/water levels.

- The crest of the western dike is a paved roadway that carries ash truck traffic to and from the Upper Ash Pond. The crest appeared to be in good condition. (Photo 3)

- The outlet (decanting) structure appeared to be in good operating condition (Photo 7). The metal railings and support members exhibited some minor corrosion. The outlet pipe, the source of the former 1980's seepage problem, appeared to be in good condition with no signs of seepage emerging from the embankment slope at the outfall plunge pool area. (Photo 6)

- A steel sheet pile wall is present along the upstream side of the west dike crest to the south of the outlet structure. The sheet pile wall was installed to mitigate a previous seepage problem in this area. (Photo 8)

- The crest and downstream slope of east dike were covered with well-maintained grass. The upstream slope of the east dike was overgrown with thick reedy vegetation. A few small trees were observed as well. (Photo 10) Very little of the inboard dike slope is exposed above the ash/water levels. There is mostly ash and little free water along the east dike.

- Several wet areas were observed at the downstream toe of the east dike. The wetness appeared to be due to poor stormwater drainage in isolated low-lying areas, but may also be related to discharge from the toe drains. Mowing tractor has created ruts in wet, soft areas that contribute to pooling of stormwater. (Photo 11)

<u>Upper Ash Pond</u>

The following observations were made during the inspection:

- The Upper Ash Pond is undergoing closure operations which include stockpiling of compacted dry CCW above the crest elevation of the ash pond dikes. Water-borne disposal of CCW is no longer being conducted at the Upper Ash Pond.

- The outer dikes of the pond are covered with well-maintained grass. (Photo 1)

- The crest of the dikes serve as gravel-surface roads which were observed to be in good condition. (Photo 2) Some minor ponding of stormwater was observed in isolated locations on the crest.

- Concrete-lined ditches are in-place along the toe of the dry CCW disposal area. (Photo 3) Stormwater and water discharged from the toe drain pump stations in the ditches is conveyed to the stormwater/sedimentation pond at the northeastern end of the pond.

- The original outlet/decanting structure is now used for outlet control of the closure stormwater/sedimentation pond. The outlet is a controlled discharge with closed valves and a fixed weir. If the water level reaches a high enough level, it can discharge over the fixed weir. Accumulated water and sediment are periodically pumped to the Lower Ash Pond. The inboard slopes of the stormwater pond are lined with riprap to reduce erosion of the slopes. (Photo 4)

- The toe drain pump stations, which pump to the concrete-lined ditches at the perimeter of the dry CCW disposal area, were observed to be collecting some flow and the pumps were functioning normally. (Photos 6 & 7) Drainage piping for the toe drain pump station is installed below the ground in the embankments.

- The relief/dewatering wells were observed at the eastern end of the north dike. These wells were formerly used to lower the phreatic surface through the dike when instability of the downstream toe berm and Henricus Park access road was experienced. The pumped wells are not currently in use but remain serviceable in the unlikely event they are needed. (Photo 5)

- Areas of standing water were observed at isolated areas within the ditches along the downstream toe of the south dike. The water appeared to be due to poor drainage in the ditches and not due to seepage.

- A water line is in place along the toe of slope of the north dike to supply water to Henricus Park. This pipe can be isolated with a diversion valve located at the west end of the north dike. It is not known if the pipe can be isolated at the east end of the dike.

5. CONCLUSIONS

Based on the ratings defined in the RFP (Satisfactory, Fair, Poor and Unsatisfactory), the information reviewed and the visual inspection, the overall condition of the dam is as follows:

Lower Ash Pond

The Lower Ash Pond dam is considered to be in **FAIR** condition, due to calculated slope stability factors of safety of the west dike that are below typically accepted criteria for embankment dams**.** While acceptable performance is expected under all required loading conditions, recent stability analyses for a deep-seated slope failure of the downstream slopes indicate that two sections of the west dike have calculated factors of safety less than the typically accepted USACE factor of safety criteria of 1.5, under normal pool, steady state seepage loading conditions with truck surcharge load. Slope stability analyses for a shallow slope failure mode indicate calculated factors of safety of 1.0 or less for two sections of the west dike for all loading conditions. The report recommends several options for improving the stability of the west dike. We understand that DVP Fossil & Hydro Engineering is assessing the various options and plans to implement the stabilizing measures in the near future.

In addition to the above, several minor maintenance deficiencies were noted during the inspection:

- Heavy vegetation along freeboard portion of upstream slopes
- Poor drainage and /or areas of minor seepage along the toe of slopes of the western and eastern dikes
- Minor corrosion of metal components of outlet structure
- Channel excavation into or very close to upstream embankment at isolated location of eastern dike

Our interviews with plant engineering personnel responsible for the operation of the impoundment indicate that regular operations procedures are in use at the Lower Ash Pond. The regular operating procedures of the facility do not appear to be impacting the structural integrity of the impounding embankments.

The plant engineering staff maintain all design documents and inspection reports in a well organized manner. Annual inspection reports are completed by Dominion's in-house geotechnical engineer. The station operations personnel make daily "drive-by" observations to monitor general conditions of the impoundment. Quarterly inspections will be conducted by station personnel starting in the third quarter of 2010. Based on these findings, we are of the opinion that the operations and maintenance procedures being practiced at the Lower Ash Pond are adequate, although we recommend additional maintenance actions be implemented to correct some of the conditions observed as presented in Section 6.

Upper Ash Pond

The Upper Ash Pond is considered to be in **SATISFACTORY** condition. The Closure Plan currently being implemented at the Upper Ash Pond indicates the dikes to be stable under all applicable loading conditions. Based on our inspection and review of the available records, the Closure Plan is being implemented according to design and the facility is well maintained. In addition, no significant dam safety deficiencies were identified during the review of the existing records or the site inspection. Several minor maintenance items were noted which include the following:

- Minor depressions or rutting at isolated portions on the crest of the dikes
- An underground pressurized water line is present at the toe of the north dike, which could lead to localized undermining of the toe in the event of a rupture in the water line.
- Areas of standing water were observed in the ditch along the south dike, which appears to be due to poor drainage in the ditch.

6. RECOMMENDATIONS

Based on the findings of our visual inspection and review of the available engineering records for the Lower Ash Pond and the Upper Ash Pond, O'Brien & Gere recommends that measures be taken to improve the stability of the west dike in order to bring the factor of safety up to USACE criteria for embankment dams. Both ponds could benefit from some minor maintenance to correct specific items cited previously. The recommended measures are outlined as follows:

6.1. URGENT ACTION ITEMS

None of the recommendations are considered to be urgent, since the issues noted do not appear to threaten the structural integrity of the dam in the near term.

6.2. LONG TERM IMPROVEMENT

Lower Ash Pond

Measures should be implemented to improve the stability of the downstream slope of the western dike and bring the stability factors of safety up to accepted criteria for all loading conditions and failure modes. The stability improvements implemented should include a means to improve drainage and monitor seepage along the toe of western dike.

Additional maintenance recommendations are provided below:

- Paint metal components of outlet structure to control corrosion
- Use care when digging flow channels in accumulated ash to avoid undercutting/excavation into upstream slope of east dike
- Periodically remove accumulated sediment from embankment toe ditches and regrade to improve drainage of stormwater

Upper Ash Pond

In general, the Upper Ash Pond appeared to be in good condition. No major improvements to the Upper Ash Pond are recommended at this time. Some minor maintenance recommendations are provided below:

- Place additional crushed stone road base in rutted or depressed areas along the crest. Regrade to prevent ponding of stormwater and further deterioration by truck traffic.
- Clean rust from metal components of decanting tower and repaint to maintain the structural members over the long term.
- Periodically remove accumulated sediment from toe ditches along south dike and regrade to improve drainage.

6.3. MONITORING AND FUTURE INSPECTION

O'Brien & Gere recommends that annual inspections by an engineer with experience in performance of dam safety inspections be continued in accordance with current practices.

Areas of saturation at the toe of slopes should be monitored for increases in flow rate and turbidity, which could indicate developing seepage problems.

We also recommend that quarterly inspections be performed along the toe of the Upper Ash Pond north dike to inspect for seepage due to a potential leak in the water line serving Henricus Park.

6.4 TIME FRAME FOR COMPLETION OF REPAIRS/IMPROVEMENTS

Stability improvement measures for the west dike of the Lower Ash Pond should be implemented within one year of the date of this final report. Maintenance items should be addressed within one year of this final report.

6.5. CERTIFICATION STATEMENT

I acknowledge that the Lower Ash Pond and Upper Ash Pond CCW management units referenced herein were personally inspected by me on April 28, 2010, and were found to be in the following condition:

Lower Ash Pond

~~SATISFACTORY~~
FAIR
~~POOR~~
~~UNSATISFACTORY~~

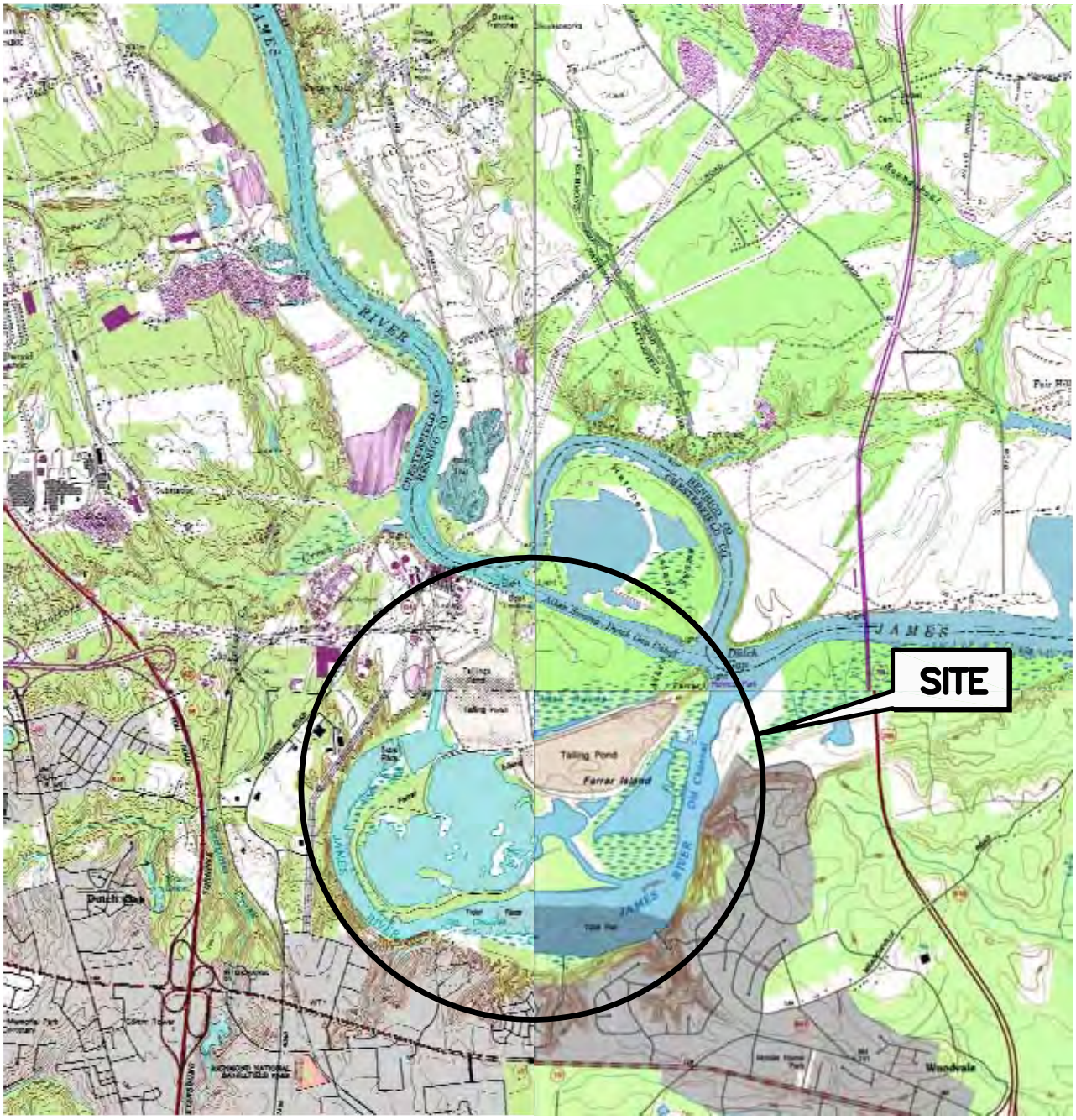
Upper Ash Pond

SATISFACTORY
~~FAIR~~
~~POOR~~
~~UNSATISFACTORY~~

Signature: _____ Date: Final: September 29, 2010

Dana R. Pizarro, PE
Virginia PE #037259

FIGURE 1



ADAPTED FROM: CHESTER, HOPEWELL, DUTCH GAP & DREWRY'S BLUFF QUADRANGLES, VIRGINIA U.S.G.S. 7.5 MIN. QUADS

VIRGINIA

QUADRANGLE LOCATION

US EPA
DAM SAFETY ASSESSMENT OF CCW IMPOUNDMENTS

CHESTERFIELD POWER STATION
CHESTER, VIRGINIA

SITE LOCATION MAP

1"=4000' 4000 0 4000

46122-CHESTERFIELD-F01
SEPTEMBER 2010

O'BRIEN & GERE

2010 © O'Brien & Gere Engineers, Inc.

I:\US-EPA.13498\46122.ASSESS-OF-DAM-S\DOCS\DWG\SHEETS\46122-CHESTERFIELD-F01.DWG, 09/24/2010 3:10PM

FIGURE 2

N

NOTE
Aerial imagery provided by National Agriculture Imagery Program (USDA, 2009).

DOMINION GENERATION
CHESTERFIELD POWER STN.
CHESTER, VIRGINIA

SITE LAYOUT

0 500 1,000 2,000
Feet

SEPTEMBER 2010
13498/46122

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PATH: I:\Us-Epa.13498\STDS\GIS\Coal_Impoundments\Figures\Chesterfield_FIG-2_site.mxd
NAME: KaufmaDR
DATE: 9/14/2010 8:53:26 AM

FIGURE 3

N

LEGEND

1 Photograph Direction/Location

NOTE
Aerial imagery provided by National Agriculture Imagery Program (USDA), 2009.

DOMINION GENERATION
CHESTERFIELD POWER STN.
CHESTER, VIRGINIA

PHOTO LOCATIONS LOWER ASH POND

0 200 400 800
Feet

SEPTEMBER 2010
13498/46122

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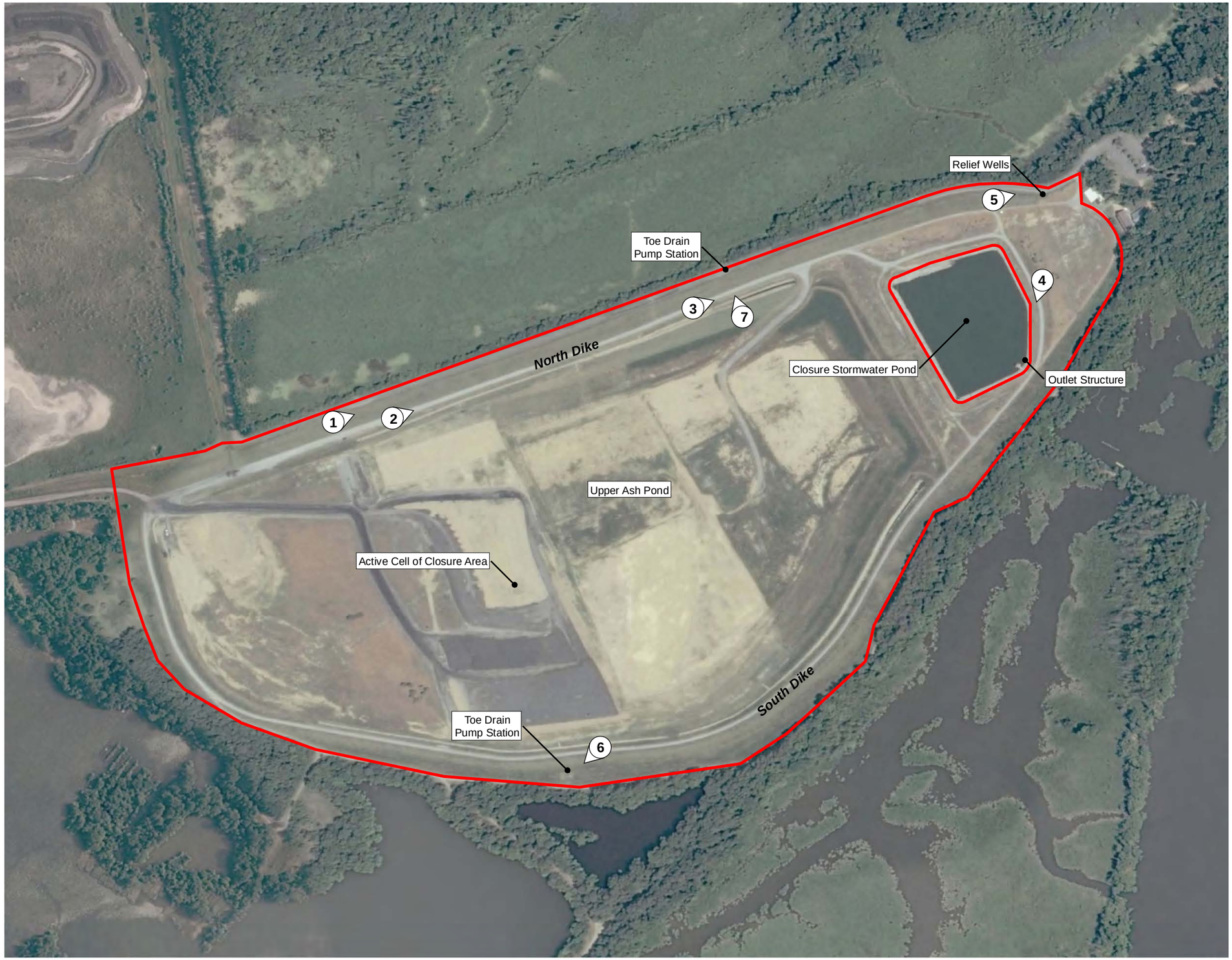
NAME: KaufmaDR

DATE: 9/14/2010 8:56:57 AM

FIGURE 4



N

LEGEND

1 Photograph Direction/Location

NOTE
Aerial imagery provided by National Agriculture Imagery Program (USDA), 2009.

DOMINION GENERATION
CHESTERFIELD POWER STN.
CHESTER, VIRGINIA

PHOTO LOCATIONS
UPPER ASH POND

0 200 400 800
Feet

SEPTEMBER 2010
13498/46122

O'BRIEN & GERE
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NAME: KaufmaDR

DATE: 9/15/2010 8:28:44 AM

APPENDIX A

Visual Inspection Checklists

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name:	Chesterfield Station	Date:	4/28/2010
Unit Name:	Lower Pond	Operator's Name:	Dominion
Unit I.D.:	004	Hazard Potential Classification:	High **Significant** Low
Inspector's Name:	D. Whetstone, P.E./Dana Pizarro, 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?	Annually		18. Sloughing or bulging on slopes?		✓
2. Pool elevation (operator records)?	17.3		19. Major erosion or slope deterioration?		✓
3. Decant inlet elevation (operator records)?	17.9		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	N/A		Is water entering inlet, but not exiting outlet?		✓
5. Lowest dam crest elevation (operator records)?	20.0		Is water exiting outlet, but not entering inlet?		✓
6. If instrumentation is present, are readings recorded (operator records)?		✓	Is water exiting outlet flowing clear?	✓	
7. Is the embankment currently under construction?		✓	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)?			From underdrain?		
9. Trees growing on embankment? (If so, indicate largest diameter below)		✓	At isolated points on embankment slopes?		✓
10. Cracks or scarps on crest?		✓	At natural hillside in the embankment area?		✓
11. Is there significant settlement along the crest?		✓	Over widespread areas?		✓
12. Are decant trashracks clear and in place?	✓		From downstream foundation area?	✓	
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		✓	"Boils" beneath stream or ponded water?		✓
14. Clogged spillways, groin or diversion ditches?		✓	Around the outside of the decant pipe?		✓
15. Are spillway or ditch linings deteriorated?		✓	22. Surface movements in valley bottom or on hillside?		✓
16. Are outlets of decant or underdrains blocked?		✓	23. Water against downstream toe?	✓	
17. Cracks or scarps on slopes?		✓	24. Were Photos taken during the dam inspection?	✓	

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

Inspection Issue #	Comments
1.	By professional engineer plan to do quarterly internal inspections
12.	Floating booms around perimeter of weir.
21.	Some wet areas at toe of west dike, no flow; no turbidity
6.	No instrumentation present

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # VA0004146 INSPECTOR D. Whetstone/D. Pizarro
Date 4/28/2010

Impoundment Name Lower Ash Pond
Impoundment Company Dominion – Chesterfield Station
EPA Region 3
State Agency (Field Office) Address VA Dept. of Environmental Quality
Piedmont Regional Office
Name of Impoundment 4949-A Cox Road, Glen Allen, VA 23060 (Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New _____ Update _____

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

IMPOUNDMENT FUNCTION: Storage of CCR

Nearest Downstream Town : Name Hopewell, VA
Distance from the impoundment 9 miles
Impoundment Location:
Longitude 37 Degrees 22 Minutes 22 Seconds
Latitude 77 Degrees 22 Minutes 50 Seconds
State VA County Chesterfield

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

If So Which State Agency?_____

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

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

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

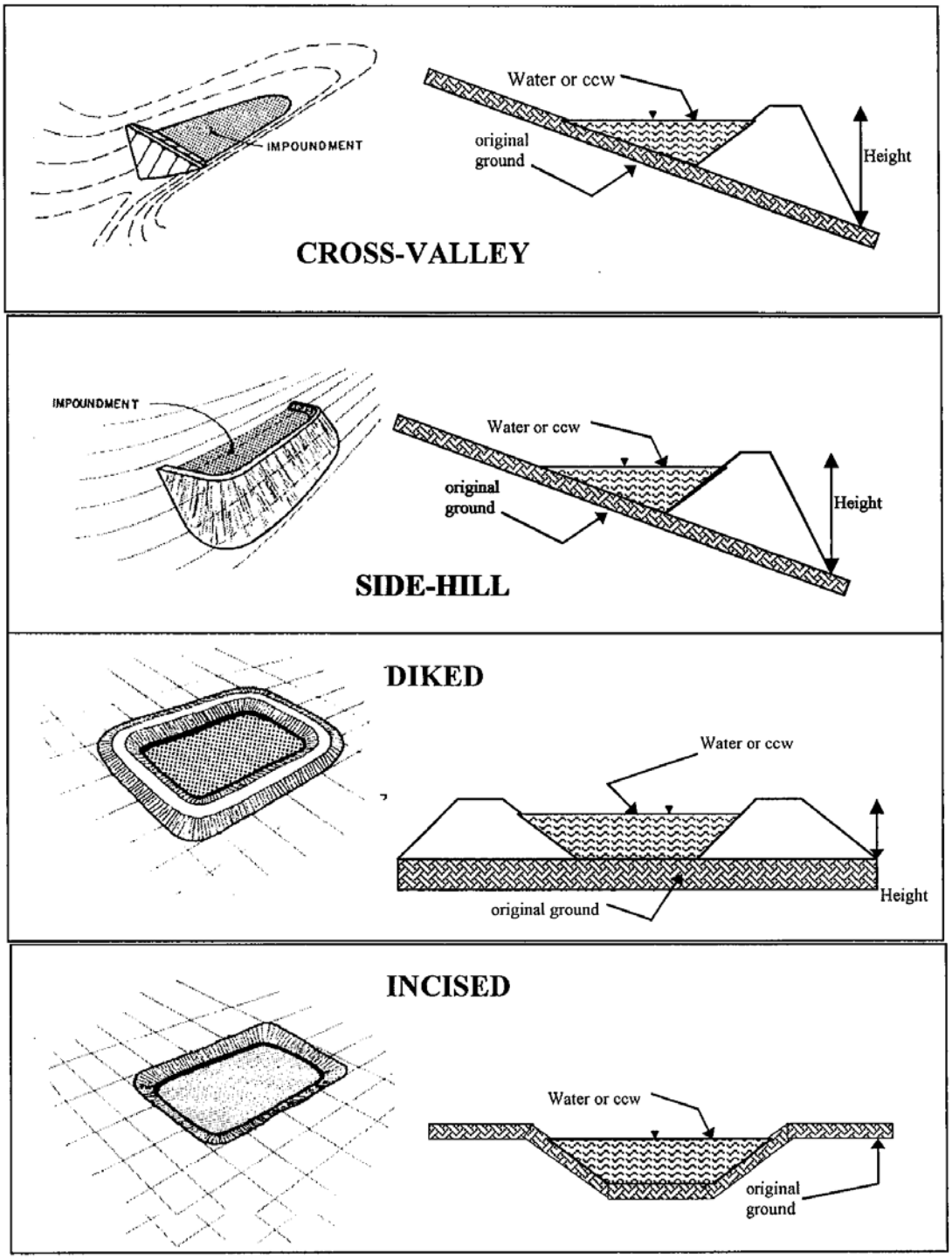
_X___ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns.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

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

DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

Significant due to potential for environmental losses from release of CCR into off-site wetlands and river

CONFIGURATION:

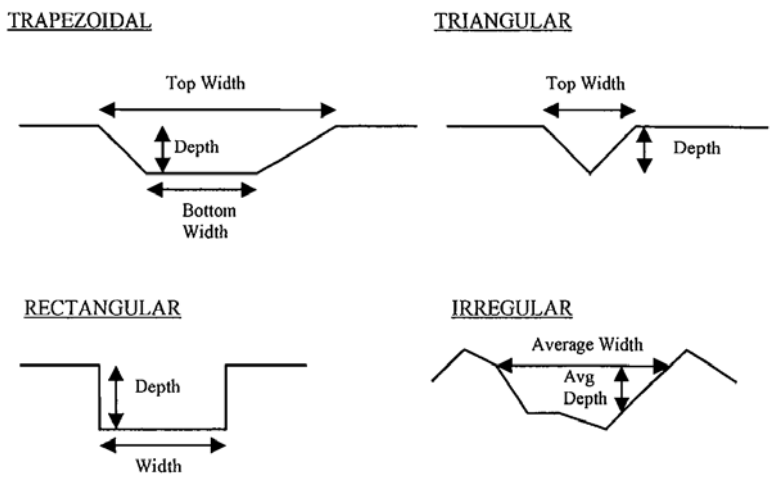


_____ Cross-Valley
_____ Side-Hill
_____ Diked
_____ Incised (form completion optional) _X_____Combination Incised/Diked

Embankment Height ____19____ feet Embankment Material _Various soil materials_____
Pool Area __49_____ acres Liner _None_____
Current Freeboard _3-5_____ feet Liner Permeability _____--_____

TYPE OF OUTLET (Mark all that apply)

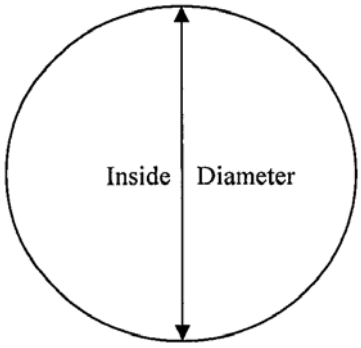
_____ **Open Channel Spillway**
_____ Trapezoidal
_____ Triangular
_____ Rectangular
_____ Irregular



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

_X___ **Outlet**

_27__ inside diameter **w/30" steel pipe over discharge end**



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

Is water flowing through the outlet? YES _X_____ NO _____

_____ **No Outlet**

_X___ **Other Type of Outlet** (specify) _Decanting structure. Adjustable weir with operator baffled – cenosphere capture pumping system. Drop structure to outlet pipe (Outfall 004). Pipe in embankment (reported to be concrete). Final discharge piping is fabricated steel or ductile iron_____

The Impoundment was Designed By _Stone and Webster_____
_____

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 _x_____ NO _____

If So When? _1987_____

IF So Please Describe: _____

Outlet pipe outfall scour and seepage along pipe through embankment in 1987. Repair included extension of outfall pipe into stilling basin, and grouting along length of pipe through embankment. No history of problems since the above repair was completed.

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

If so, which method (e.g., piezometers, gw pumping,...)? _Toe Drain Improvements

If so Please Describe : _Toe drain improvements to east dike were completed in mid-1980's to improve downstream slope seepage.

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name:	Chesterfield Station	Date:	4/28/2010
Unit Name:	Upper Pond	Operator's Name:	Dominion
Unit I.D.:	005	Hazard Potential Classification:	High Significant (Low)
Inspector's Name:	D. Whetstone, P.E./Dana Pizarro, 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?	Annually		18. Sloughing or bulging on slopes?		✓
2. Pool elevation (operator records)?	N/A		19. Major erosion or slope deterioration?		✓
3. Decant inlet elevation (operator records)?	N/A		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	N/A		Is water entering inlet, but not exiting outlet?		✓
5. Lowest dam crest elevation (operator records)?	42 ft		Is water exiting outlet, but not entering inlet?		✓
6. If instrumentation is present, are readings recorded (operator records)?		✓	Is water exiting outlet flowing clear?	N/A	
7. Is the embankment currently under construction?		✓	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)?			From underdrain?		
9. Trees growing on embankment? (If so, indicate largest diameter below)		✓	At isolated points on embankment slopes?		✓
10. Cracks or scarps on crest?		✓	At natural hillside in the embankment area?		✓
11. Is there significant settlement along the crest?		✓	Over widespread areas?		✓
12. Are decant trashracks clear and in place?	N/A		From downstream foundation area?		✓
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		✓	"Boils" beneath stream or ponded water?		✓
14. Clogged spillways, groin or diversion ditches?		✓	Around the outside of the decant pipe?		✓
15. Are spillway or ditch linings deteriorated?		✓	22. Surface movements in valley bottom or on hillside?		✓
16. Are outlets of decant or underdrains blocked?		✓	23. Water against downstream toe?		✓
17. Cracks or scarps on slopes?		✓	24. Were Photos taken during the dam inspection?	✓	

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

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # VA0004146 INSPECTOR D. Whetstone/D. Pizarro
Date 4/28/2010

Impoundment Name Upper Ash Pond
Impoundment Company Dominion – Chesterfield Station
EPA Region 3
State Agency (Field Office) Address VA Dept. of Environmental Quality
Piedmont Regional Office
Name of Impoundment 4949-A Cox Road, Glen Allen, VA 23060 (Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New _____ Update _____

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

IMPOUNDMENT FUNCTION: Storage of CCR under closure

Nearest Downstream Town : Name Hopewell, VA
Distance from the impoundment 8 miles
Impoundment Location:
Longitude 37 Degrees 22 Minutes 22 Seconds
Latitude 77 Degrees 21 Minutes 53 Seconds
State VA County Chesterfield

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

If So Which State Agency? VA Deptment of Conservation and Recreation
VADCR – Dam Safety Section

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

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

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

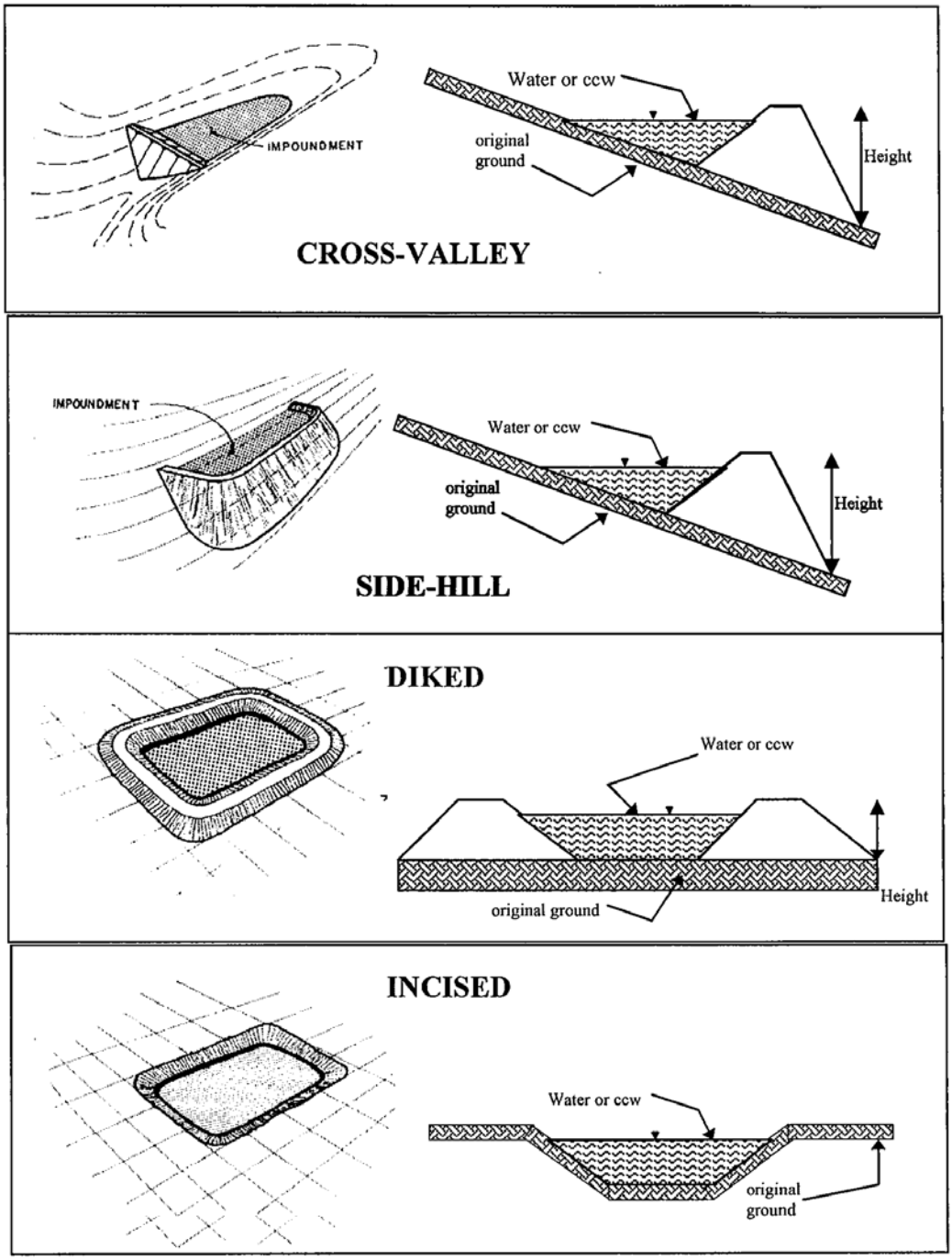
_____ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns.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

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

DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

State rating – pond is closed except for small sediment pond at east end

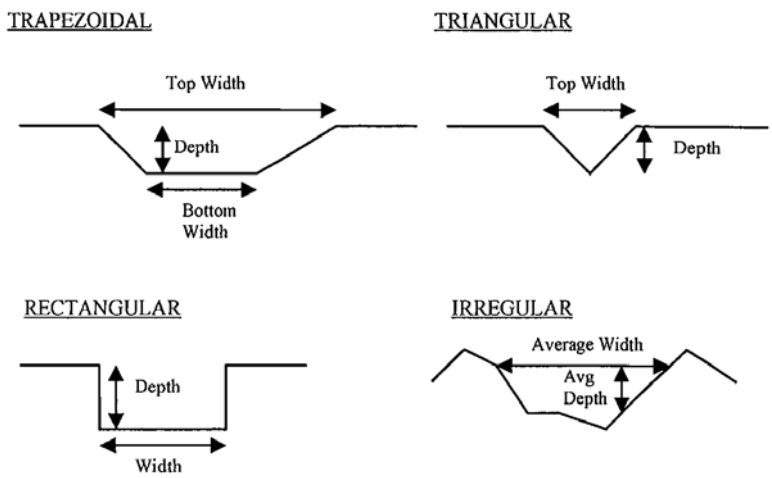
CONFIGURATION:



_____ Cross-Valley
_____ Side-Hill
_X___ Diked
_____ Incised (form completion optional) _____Combination Incised/Diked
Embankment Height ___44___ feet Embankment Material _Various soil materials_____
Pool Area __112*_____ acres Liner _None_____
Current Freeboard _N/A_____ feet Liner Permeability _____--_____
*Original pool surface

TYPE OF OUTLET (Mark all that apply)

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

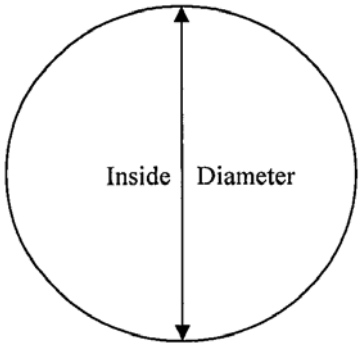


_____ depth
_____ bottom (or average) width
_____ top width

_X___ **Outlet**

_24__ inside diameter

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



Is water flowing through the outlet? YES _____ NO _X____

_____ **No Outlet**

_X___ **Other Type of Outlet** (specify) _Concrete riser with orofice/valve controls_____

The Impoundment was Designed By _JK Timmons & Schnabel_____

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 _x_____ NO _____

If So When? _1993 and 1996_____

IF So Please Describe: __Refer to geotechnical reports. See next page._____

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

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

If so Please Describe : 1996 – installed 8 wells through crest to lower phreatic surface and control seepage through northeast corner. Control measures effective.

APPENDIX B

Photographs-Lower Ash Pond

PHOTOGRAPHIC LOG (Appendix B)

Client: US EPA	Project Number: 46122
Site Name: Chesterfield Power Station – Lower Ash Pond	Location: Chester, VA

Orientation: NW

Description: View of sluiced CCW discharge to lower ash pond

Date: 4/28/2010

Photo Number: 1

Photographer: DRP

Orientation: SE

Description: Excavated channel in accumulated ash

Note: Stockpiles of ash to be transported to Upper Ash Pond closure area

Date: 4/28/2010

Photo Number: 2

Photographer: DRP

O'BRIEN & GERE

PHOTOGRAPHIC LOG (Appendix B)

Client: US EPA	Project Number: 46122
Site Name: Chesterfield Power Station – Lower Ash Pond	Location: Chester, VA

Orientation: South

Description: View along down slope toe of west dike

Date: 4/28/2010

Photo Number: 3

Photographer: DRP

Orientation: South

Description: View along downstream slope and toe of west dike

Note: Steepness of slope

Date: 4/28/2010

Photo Number: 4

Photographer: DRP

O'BRIEN & GERE

PHOTOGRAPHIC LOG (Appendix B)

Client: US EPA	Project Number: 46122
Site Name: Chesterfield Power Station – Lower Ash Pond	Location: Chester, VA

Orientation: West

Description: Wet areas at toe of west dike due to seepage and/or poor drainage

Date: 4/28/2010

Photo Number: 5

Photographer: DRP

Orientation: South

Description: View of outfall into riprap line plunge pool

Date: 4/28/2010

Photo Number: 6

Photographer: DRP

O'BRIEN & GERE

PHOTOGRAPHIC LOG (Appendix B)

Client: US EPA	Project Number: 46122
Site Name: Chesterfield Power Station – Lower Ash Pond	Location: Chester, VA

Orientation: East

Description: View of outlet/decant weir structure with floatable debris baffles in background

Date: 4/28/2010

Photo Number: 7

Photographer: DRP

Orientation: South

Description: View of sheet pile cutoff wall at south end of west dike

Date: 4/28/2010

Photo Number: 8

Photographer: DRP

O'BRIEN & GERE

PHOTOGRAPHIC LOG (Appendix B)

Client: US EPA	Project Number: 46122
Site Name: Chesterfield Power Station – Lower Ash Pond	Location: Chester, VA

Orientation: North

Description: Cenosphere harvesting area at south end of pond

Date: 4/28/2010

Photo Number: 9

Photographer: DRP

Orientation: South

Description: View along east dike
Note: Trees and heavy vegetation on upstream slope and impoundment interior

Date: 4/28/2010

Photo Number: 10

Photographer: DRP

O'BRIEN & GERE

PHOTOGRAPHIC LOG (Appendix B)

Client: US EPA	Project Number: 46122
Site Name: Chesterfield Power Station – Lower Ash Pond	Location: Chester, VA

Orientation: South

Description: Wet area and rutting due to tractor at toe of east dike

Date: 4/28/2010

Photo Number: 11

Photographer: DDW

APPENDIX C

Photographs-Upper Ash Pond

O'BRIEN & GERE

PHOTOGRAPHIC LOG (Appendix C)

Client: US EPA	Project Number: 46122
Site Name: Chesterfield Power Station – Upper Ash Pond	Location: Chester, VA

Orientation: NE

Description: View along downstream slope of north dike

Date: 4/28/2010

Photo Number: 1

Photographer: DDW

Orientation: NE

Description: View along crest of north dike

Note: Dry disposal of ash in the right background

Date: 4/28/2010

Photo Number: 2

Photographer: DDW

O'BRIEN & GERE

PHOTOGRAPHIC LOG (Appendix C)

Client: US EPA	Project Number: 46122
Site Name: Chesterfield Power Station – Upper Ash Pond	Location: Chester, VA

Orientation: NE

Description: Concrete-lined ditches for stormwater management of runoff from dry closure areas

Date: 4/28/2010

Photo Number: 3

Photographer: DDW

Orientation: South

Description: Stormwater/ sediment pond and outlet structure

Date: 4/28/2010

Photo Number: 4

Photographer: DDW

O'BRIEN & GERE

PHOTOGRAPHIC LOG (Appendix C)

Client: US EPA	Project Number: 46122
Site Name: Chesterfield Power Station – Upper Ash Pond	Location: Chester, VA

Orientation: East

Description: Relief/ dewatering wells at northeast corner of upper ash pond

Date: 4/28/2010

Photo Number: 5

Photographer: DDW

Orientation: South

Description: Toe drain sump/pump station at toe of south dike

Date: 4/28/2010

Photo Number: 6

Photographer: DDW

O'BRIEN & GERE

PHOTOGRAPHIC LOG (Appendix C)

Client: US EPA	Project Number: 46122
Site Name: Chesterfield Power Station – Upper Ash Pond	Location: Chester, VA

Orientation: N/A

Description: Interior of toe drain sump/pump station

Date: 4/28/2010

Photo Number: 7

Photographer: DDW