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Coal Combustion Waste Impoundment

Round 7 - Dam Assessment Report

Ottumwa Generating Station (Site 012)

Fly Ash Impoundment Dikes
Alliant Energy
Ottumwa, Iowa

Prepared for:

United States Environmental Protection Agency
Office of Resource Conservation and Recovery

Prepared by:

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INTRODUCTION, SUMMARY CONCLUSIONS AND RECOMMENDATIONS

The release of over five million cubic yards from the Tennessee Valley Authority's Kingston, Tennessee facility in December 2008, which flooded more than 300 acres of land, damaging homes and property, is a wake-up call for diligence on coal combustion waste disposal units. We must marshal our best efforts to prevent such catastrophic failure and damage. A first step toward this goal is to assess the stability and functionality of the ash impoundments and other units, then quickly take any needed corrective measures.

This assessment of the stability and functionality of the Ottumwa Generating Station Fly Ash management units is based on a review of available documents and on the site assessment conducted by Dewberry personnel on Wednesday, October 6, 2010. We found the supporting technical documentation lacking critical information (Section 1.1.3) and discrepancies in the hydrologic/hydraulic safety analyses. As detailed in Sections 1.2.1 - 1.2.3 and Section 1.2.6, there are recommendations concerning improvements in the hydrologic/hydraulic studies for both ponds and recommendations based on field observations that may help to maintain a safe and trouble-free operation.

In summary, the Ottumwa Generating Station fly ash embankments are FAIR for continued safe and reliable operation, with no visual/recognized existing or potential management unity safety deficiencies.

PURPOSE AND SCOPE

The U.S. Environmental Protection Agency (EPA) is embarking on an initiative to investigate the potential for catastrophic failure of Coal Combustion Surface Impoundments (i.e., management unit) from occurring at electric utilities in an effort to protect lives and property from the consequences of a dam failure or the improper release of impounded slurry. The EPA initiative is intended to identify conditions that may adversely affect the structural stability and functionality of a management unit and its appurtenant structures (if present); to note the extent of deterioration (if present), status of maintenance and/or a need for immediate repair; to evaluate conformity with current design and construction practices; and to determine the hazard potential classification for units not currently classified by the management unit owner or by a state or federal agency. The initiative will address management units that are classified as having a Less-than-Low, Low, Significant or High Hazard Potential ranking. (For Classification, see pp. 3-8 of the 2004 Federal Guidelines for Dam Safety)

In February 2009, the EPA sent letters to coal-fired electric utilities seeking information on the safety of surface impoundments and similar facilities that receive liquid-borne material that store or dispose of coal combustion waste. This letter was issued under the authority of the

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 104(e), to assist the Agency in assessing the structural stability and functionality of such management units, including which facilities should be visited to perform a safety assessment of the berms, dikes, and dams used in the construction of these impoundments.

EPA requested that utility companies identify all management units including surface impoundments or similar diked or bermed management units or management units designated as landfills that receive liquid-borne material 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. Utility companies provided information on the size, design, age and the amount of material placed in the units. The EPA used the information received from the utilities to determine preliminarily which management units had or potentially could have High Hazard Potential ranking.

The purpose of this report is to evaluate the condition and potential of waste release from **management units that have not been rated for hazard potential classification**. This evaluation included a site visit. Prior to conducting the site visit, a two-person team reviewed the information submitted to EPA, reviewed relevant publicly available information from state or federal agencies regarding the unit hazard potential classification (if any) and accepted information provided BY the management unit owner. Also, after the field visit, additional information and data were received by Dewberry & Davis LLC about the Ottumwa Generating Station fly ash embankments that were reviewed and used in preparation of this report.

Factors considered in determining the hazard potential classification of the management units(s) included the age and size of the impoundment, the quantity of coal combustion residuals or by-products that were stored or disposed of in these impoundments, its past operating history, and its geographic location relative to down gradient population centers and/or sensitive environmental systems.

This report presents the opinion of the assessment team as to the potential of catastrophic failure and reports on the condition of the management unit(s).

LIMITATIONS

The assessment of dam safety reported herein is based on field observations and review of readily available information provided by the owner/operator of the subject coal combustion waste management unit(s). Qualified Dewberry engineering personnel performed the field observations and review and made the assessment in conformance with the required scope of work and in accordance with reasonable and acceptable engineering practices. No other warranty, either written or implied, is made with regard to our assessment of dam safety.

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Doc 05: Ottumwa Generating Station Aerial Photograph
Doc 06: Correspondence dated May 18, 2009 from Alliant Energy to EPA
Doc 07: Ottumwa Generating Station Area Topographic Map
Doc 08: Alliant Energy Surface Pond Visual Inspection, 24, June 2010
Doc 09: Ottumwa Generating Station NPDES Permit
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Doc 11: *Alliant Energy Ottumwa Power Generating Station, Ash Settling Pond Hydrologic Report,* Black & Veatch, October 21, 2010
Doc 12: *Interstate Power and Light Ottumwa Power Generating Station Ash Pond 1 and 2 Slope Stability Report,* Black & Veatch, October 22, 2010
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1.0 CONCLUSIONS AND RECOMMENDATIONS

1.1 CONCLUSIONS

Conclusions are based on visual observations from a one-day site visit on Wednesday, October 6, 2010 and review of technical documentation provided by Alliant Energy.

1.1.1 Conclusions Regarding the Structural Soundness of the Management Unit(s)

The dike embankments and spillway appear to be structurally sound based on a review of the engineering data provided to Dewberry for review and observations made during Dewberry's site visit.

1.1.2 Conclusions Regarding the Hydrologic/Hydraulic Safety of the Management Unit(s)

Hydrologic and hydraulic data provided to Dewberry for review indicate the Main Ash Pond has adequate impoundment capacity to contain the 1 percent 24-hour probability design storm without overtopping. However, there appears to be a discrepancy between the impoundment pool elevation assumed in the analysis and the pool elevation at the time of Dewberry's site visit.

The hydrologic and hydraulic data provided for review did not include the Zero Liquid Discharge Pond.

1.1.3 Conclusions Regarding the Adequacy of Supporting Technical Documentation

The supporting technical documentation is inadequate. Technical documentation lacks critical engineering analyses of slope stability of the dikes. The supporting hydrologic/hydraulic analyses do not show conclusively that the capacity of the impoundments can store the design precipitation event.

1.1.4 Conclusions Regarding the Description of the Management Unit(s)

The description of the management units provided by Alliant Energy was an accurate representation of what Dewberry observed in the field.

1.1.5 Conclusions Regarding the Field Observations

Dewberry staff was provided access to all areas in the vicinity of the management units required to conduct a thorough field observation. The visible parts of the embankment dikes and outlet structure were observed to have no signs of overstress, significant settlement, shear failure, or other signs of instability, although visual observations were hampered by the presence of thick vegetation in some areas.

Embankments appear to be structurally sound. There are no apparent visual indications of unsafe conditions or needed remedial actions.

1.1.6 Conclusions Regarding the Adequacy of Maintenance and Methods of Operation

The current maintenance and methods of operation appear to be adequate for the Main Ash Pond and Zero Liquid Discharge Ponds. There was no evidence of significant repairs or prior releases observed during the field inspection.

1.1.7 Conclusions Regarding the Adequacy of the Surveillance and Monitoring Program

The surveillance program appears to be adequate. Dikes forming the management unit are not instrumented. Installation of a dike monitoring program is not warranted at this time, based on the size of the dikes, the portion of the impoundments currently used to store wet fly ash and stormwater, the history of satisfactory performance, and the ongoing, current inspection program.

1.1.8 Classification Regarding Suitability for Continued Safe and Reliable Operation

The facility is rated FAIR for continued safe and reliable operation. The classification is due to the apparent discrepancy in the hydrologic/hydraulic analyses concerning the Main Ash Pond pool elevation assumed in the analysis and the estimated pool elevation at the time of the site visit, and the lack of hydrologic and hydraulic data for the Zero Liquid Discharge Pond.

1.2 RECOMMENDATIONS

1.2.1 Recommendations Regarding the Structural Stability

Although observations made during the site visit do not indicate signs of overstress, significant settlement, shear failure, or other signs of instability, the structural stability of the ponds cannot be evaluated without reviewing the results of engineering analyses of the slope stability factors of safety under various load conditions.

1.2.2 Recommendations Regarding the Hydrologic/Hydraulic Safety

Resolution of the apparent discrepancy between the Main Ash Pond pool elevation assumed in the hydrologic and hydraulic analysis and the pool elevation estimated during Dewberry's site visit is recommended. If the assumed pool elevation requires adjustment, additional analyses are recommended to verify the conclusion that the impoundment has sufficient capacity to store the 100-year, 24-hour design storm without overtopping.

A hydrologic and hydraulic analysis of the Zero Liquid Discharge Pond is also recommended.

1.2.3 Recommendations Regarding the Supporting Technical Documentation

Continued efforts to locate the original slope stability design and hydrologic/hydraulic documentation are recommended. If the original documentation cannot be located within a reasonable period of time, both a geotechnical engineering evaluation and hydrologic/hydraulic study are recommended to verify the embankment has an acceptable factor of safety for all anticipated loading conditions, including seismic loading, and that the impoundments can store the design precipitation event without overtopping.

1.2.4 Recommendations Regarding the Description of the Management Unit(s)

No recommendations appear warranted at this time.

1.2.5 Recommendations Regarding the Field Observations

No recommendations appear warranted at this time.

1.2.6 Recommendations Regarding the Maintenance and Methods of Operation

Although the maintenance program appears adequate, the following recommendations could improve maintenance and operation:

- Develop a written operation and maintenance plan
- Repair erosion rills on the down-gradient slopes, particularly the Main Ash Pond south dike along the east end
- Clear vegetation at the Main Ash Pond primary spillway pipes down-gradient discharge location
- Remove trees from dike embankments
- Improve surface drainage at the toe of the Zero Liquid Discharge Pond to facilitate drainage of Des Moines River flood water.

1.2.7 Recommendations Regarding the Surveillance and Monitoring Program

No recommendations appear warranted at this time.

1.2.8 Recommendations Regarding Continued Safe and Reliable Operation

No recommendations appear warranted at this time.

1.3 PARTICIPANTS AND ACKNOWLEDGEMENT

1.3.1 List of Participants

William Skalitzky, Alliant Energy
Jenna Wischmeyer, Alliant Energy
Jim Allen, Alliant Energy
Kevin Brehn, Alliant Energy
Mark Hoskins, P.E., Dewberry
Joseph P. Klein, III, P.E., Dewberry

1.3.2 Acknowledgement and Signature

We acknowledge that the management unit referenced herein has been assessed on October 27, 2010

_____ _____

Mark Hoskins, P.E. (IA #19301) Joseph P. Klein, III, P.E.

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2.0 DESCRIPTION OF THE COAL COMBUSTION WASTE MANAGEMENT UNIT(S)

2.1 LOCATION AND GENERAL DESCRIPTION

The Ottumwa Generating Station is located along the west bank of the Des Moines River, approximately 9.2 miles northwest of Ottumwa, Iowa. The plant is operated by Alliant Energy. The fly ash management system consists of two impoundments; Main Ash Pond, also referred as Ash Pond 1, and the Zero Liquid Discharge Pond, also referred to as Ash Pond 2. A schematic of the plant facilities is provided in Appendix A – Doc. 1). The pond locations are shown the aerial photograph in Figure 2.1-1.

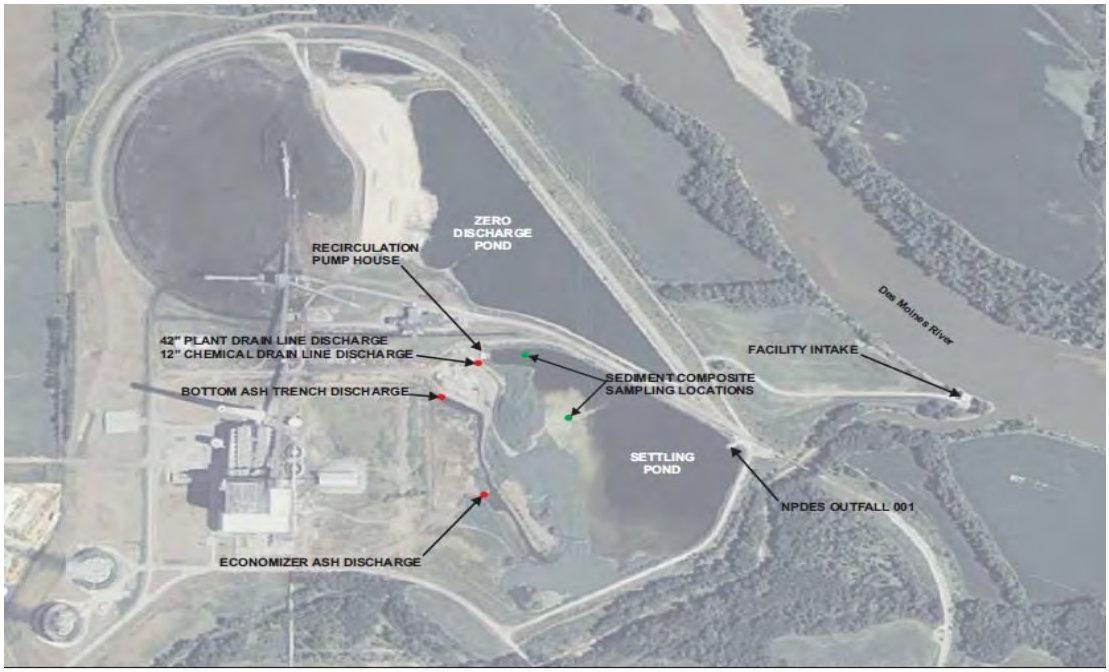

Figure 2.1-1: Ottumwa Generating Station Site Plan. (Source: Settling Pond Maintenance Plan, October, 2006 by Hard Hat Services. See Appendix A - Doc 2)

The fly ash impoundments were designed in the mid to late 1970s by Black & Veatch Consulting Engineers. The Main Ash Pond dike is a clayey silt and silty clay embankment constructed in a rounded "V" alignment to form a side hill impoundment on the east side of the main plant. The Zero Liquid Discharge Pond dike is also a clayey silt and silty clay embankment. The Zero Liquid Discharge Pond abuts the Main Ash Pond such that the ponds are separated by the north section of the Main Ash Pond Embankment (See Appendix A - Doc 1).

Table 2.1: Summary of Dam Dimensions and Size[1]		
	Main Ash Pond (Ash Pond 1)	**Zero Liquid Discharge Pond (Ash Pond 2)**
Dam Height (ft)	25	25
Crest Width (ft)	South Dike: 25 ft. North Dike 60 ft	South Dike: 60 ft. North Dike: 25 ft.
Length (ft)	South Dike: 1750 ft. North Dike 1250 ft	South Dike: 1250 ft. North Dike: 2500 ft.
Side Slopes (upstream) H:V	Data Not Available	Data Not Available
Side Slopes (downstream) H:V	3:1	3:1

[1] Based on original construction drawings (See Appendix A – Docs. 3 and 4)

The Main Ash Pond impoundment area is approximately 18.2 acres and has a total storage capacity of 370,000 cubic yards (229 acre-feet). The Zero Liquid Discharge Pond impoundment area is approximately 17.3 acres and has a total storage capacity of approximately 515,000 cubic yards (319 acre-feet). An aerial photograph of the plant site and impoundments is provided in Appendix A – Doc 5.

The two ponds are separated by a common dike but are not hydraulically connected. Railroad tracks for coal deliveries to the plant are located along the common dike crest. Plant personnel indicated that coal is delivered three to four times per week.

Construction specifications indicate the source of material for the embankments was plant area earthwork.

The plant includes a Coal Pile Runoff Pond located adjacent to the north end of the Zero Liquid Discharge Pond. The Coal Pile Runoff Pond does not receive coal combustion waste or residuals and is not included in this assessment.

2.2 SIZE AND HAZARD CLASSIFICATION

The classification for size, based on the height of the embankment and the impoundment storage, for each impoundment is “Small” based on the U.S. Army Corps of Engineers (USACE) Recommended Guidelines for Safety Inspection of Dams ER 1110-2106 criteria summarized on Table 2.2-1:

Table 2.2-1: USACE ER 1110-2-106 Size Classification		
	Impoundment	
Category	**Storage (Ac-ft)**	**Height (ft)**
Small	50 and < 1,000	25 and < 40
Intermediate	1,000 and < 50,000	40 and < 100
Large	> 50,000	> 100

Dewberry conducted a qualitative hazard classification based on the Federal Guidelines for Dam Safety, dated April, 2004. The hazard assessment classifications are summarized in Table 2.2-2.

Table 2.2-2: FEMA Federal Guidelines for Dam Safety Hazard Classification		
	Loss of Human Life	**Economic, Environmental, Lifeline Losses**
Low	None Expected	Low and generally limited to owner
Significant	None Expected	Yes
High	Probable. One or more expected	Yes (but not necessary for classification)

There are no residences within 1.5 miles down-gradient of the fly ash impoundments. Based on the 25 ft. height of the embankments for each impoundment and the agricultural land between the impoundment and the Des Moines River, the failure or misoperation of the dike is not expected to result in loss of human life. The economic impact is expected to include agricultural and/or Company owned property and possible ash recovery from the Des Moines River. The agricultural land was flooded shortly before Dewberry's site visit and plant personnel indicated that seasonal flooding is common. Therefore crop damage on the agricultural land is not expected to represent a significant economic loss.

Based on the small size of the impoundments, loss of life and significant economic damage are not expected in the event of a failure or misoperation of the impoundments, Dewberry evaluated **each ash pond embankment as "LOW hazard potential"**

2.3 AMOUNT AND TYPE OF RESIDUALS CURRENTLY CONTAINED IN THE UNIT(S) AND MAXIMUM CAPACITY

Materials stored in the Main Ash Pond include ash transport water; boiler wash water; storm water runoff from plant site; plant floor drains; Solids Contact Units

sludge for the treatment of Des Moines River water; cooling tower blowdown; boiler water blowdown and discharge from plant sanitary treatment discharge (See Appendix A – Doc 6).

Materials stored in the Zero Liquid Discharge Pond include storm water from the hydrated fly ash (referred to by commercial name of "C-Stone") Storage Pile; boiler wash water; air heater wash (fly ash); turbine cleans, and boiler chemical cleans (See Appendix A – Doc – 6).

Table 2.3: Maximum Capacity of Unit

Ash Pond Name	**Main Ash Pond**	**Zero Liquid Discharge Pond**
Surface Area (acre)[1]	18.2	17.3
Current Storage Capacity (cubic yards)[1]	288,000	142,000
Current Storage Capacity (acre-feet)	178.5	88.0
Total Storage Capacity (cubic yards)[1]	370,000	515,000
Total Storage Capacity (acre-feet)	229.3	319.2
Crest Elevation (feet)	682	682
Normal Pond Level (feet)	676.5	669

[1] Data taken from Alliant Energy May 18, 2010 letter to EPA (See Appendix A Doc 6)

2.4 PRINCIPAL PROJECT STRUCTURES

2.4.1 Earth Embankments

The approximately 3,000-foot long Main Ash Pond embankment is composed of clayey silt and silty clay excavated from the plant site. The alignment of the embankment is a rounded "V" with north and south segments. The crest width of the south segment is approximately 25 feet with a gravel surface to provide vehicle access. The north segment crest width is approximately 60 feet. The north crest includes a gravel surface for vehicular traffic and an active railroad line for delivery of coal to the plant.

The Zero Liquid Discharge Pond is formed by an approximately 2,500-foot long embankment abutted to the Main Ash Pond embankment near the bottom of the "V". The crest width is approximately 25 feet and includes a gravel surface supporting an active railroad line used to manage coal cars during deliveries to the plant.

2.4.2 Outlet Structures

The Main Ash Pond primary outlet consists of a concrete riser with an invert elevation of approximately 676 ft. The concrete riser has an energy dissipating flow path at the base and a weir directing flow into two 66-inch diameter concrete pipes installed through the embankment. The pipes discharge into an open channel near the toe of the embankment. The open channel discharges directly into the Des Moines River.

The Zero Liquid Discharge Pond does not have an outlet structure.

2.5 CRITICAL INFRASTRUCTURE WITHIN FIVE MILES DOWN GRADIENT

A critical infrastructure survey was not provided to Dewberry for review.

Based on available topographic maps (See Appendix A- Doc 7), surface drainage in the vicinity of the Main Ash Pond is to the south toward Avery Creek. Surface drainage in the vicinity of the Zero Liquid Discharge Pond is to the east toward the Des Moines River. Based on available aerial photographs and a brief driving tour of the area, Dewberry did not identify critical infrastructure assets within 5 miles down-gradient of the fly ash pond.

The City of Chillicothe, Iowa is located approximately 1.6 miles down gradient of the Ottumwa Generating Station. A review of available data indicates that Chillicothe, with an estimated July 2009 population of 84 does not have significant critical infrastructure assets. Critical infrastructure assets are centrally located in or near Ottumwa, IA approximately 7 miles further down gradient.

3.0 SUMMARY OF RELEVANT REPORTS, PERMITS, AND INCIDENTS

Alliant Energy provided a pond inspection report conducted by plant personnel on June 24, 2009 (See Appendix A – Doc 8). The report did not identify issues or concerns pertaining to dike integrity, outfall structure, or a buildup of ash near the dike walls or outfall structure.

3.1 SUMMARY OF LOCAL, STATE, AND FEDERAL ENVIRONMENTAL PERMITS.

Discharge from the Ottumwa Main Ash Pond and Zero Liquid Discharge Pond management unit is regulated by the Iowa Department of Natural Resources (DNR). Iowa DNR has issued a National Pollutant Discharge Elimination System Permit, Iowa permit number 9000101 See Appendix A – Doc -9). The permit was issued on March 5, 2003 and expired March 4, 2008. A permit renewal application is pending.

The NPDES permit includes six outfalls:

- 001 – Main Ash Basin (referred to in permit as Bottom Ash Basin)
- 002 – Coal pile runoff basin
- 003 – Treated sanitary waste from plant
- 004 – Chemical metal cleaning
- 005 – Cooling tower blowdown
- 006 – River intake structure roof drain.

The main ash pond, coal pile runoff pond and intake structure roof drain outfalls discharge to the Des Moines River. The other outfalls discharge to the Main Ash Basin (See Appendix A – Doc – 9 and 10).

The Zero Liquid Discharge Pond has no outfall. A pump must be deployed to remove stored material from that impoundment,

3.2 SUMMARY OF SPILL/RELEASE INCIDENTS

Data reviewed by Dewberry did not indicate any spills, unpermitted releases, or other performance problems with the embankments over the last 10 years.

4.0 SUMMARY OF HISTORY OF CONSTRUCTION AND OPERATION

4.1 SUMMARY OF CONSTRUCTION HISTORY

4.1.1 Original Construction

The Ottumwa Generating Station fly ash ponds were designed in the mid-1970s by Black & Veatch Consulting Engineers. Documentation provided to Dewberry indicates the ash ponds were commissioned into service in 1981.

The embankments of both the Main Fly Ash Pond and the adjoining Zero Liquid Discharge Pond have a crest elevation of 682 ft. The primary spillway riser pipe in the Main Ash Pond has an elevation of 676 ft. The Zero Liquid Discharge Pond has neither a primary nor emergency spillway. Water is transferred from the Zero Liquid Discharge Pond to the Main Pond using a temporary pump deployed by plant personnel.

4.1.2 Significant Changes/Modifications in Design since Original Construction

The embankments have not been significantly changed or modified since the original construction.

4.1.3 Significant Repairs/Rehabilitation since Original Construction

No information was provided regarding major repairs or rehabilitation to the embankment or outlet structures. No evidence of prior releases, failures or patchwork repairs was observed on the earthen embankments during Dewberry's visual assessment. There was no documentation that indicates prior releases or failures have occurred.

4.2 SUMMARY OF OPERATIONAL PROCEDURES

4.2.1 Original Operational Procedures

Wet ash is stored on the eastern side of the impoundment as the primary settling basin. Ash transport water, storm water and other plant discharge water flows to the west side of the impoundment which serves as a secondary settling basin. Decant water flows to the primary spillway located at the southeast corner of the impoundment. A low dike around the primary spillway riser structure provides another settling basin prior to water entering the spillway. Figure 4.2.1-1 shows the location of the spillway structure and the associated low dike.

Figure 4.2.1-1: Main Ash Pond Primary Spillway Structure and Low Dike for Stilling Basin

The Zero Liquid Discharge Pond is operated as the storm water management impoundment for runoff from the adjacent C-Stone pile (hydrated fly ash product sold for re-use, particularly in roadbeds). The Zero Liquid Discharge Pond is occasionally used for temporary storage of fly ash and plant maintenance wash water usually stored in the Main Ash Pond. When temporary storage is no longer needed, water is pumped from the Zero Liquid Discharge Pond into the Main Ash Pond. Pumping is accomplished using a mobile, gas-powered pump.

4.2.2 Significant Changes in Operational Procedures and Original Startup

No significant changes in operational procedures have been made to either the Main Ash Pond or Zero Liquid Discharge Pond since original startup.

4.2.3 Current Operational Procedures

Current operational procedures for both the Main Ash Pond and the Zero Liquid Discharge Pond are consistent with original operation procedure.

4.2.4 Other Notable Events since Original Startup

No additional information was provided to Dewberry concerning other notable events impacting the operation of either the Main Ash Pond or Zero Liquid Discharge Pond impoundment.

5.0 FIELD OBSERVATIONS

5.1 PROJECT OVERVIEW AND SIGNIFICANT FINDINGS

Dewberry personnel Mark Hoskins, P.E. and Joseph Klein, III P.E. performed a site visit on Wednesday October 6, 2010 in company with the participants listed in Section 1.3.

The site visit began at 8:30 AM. The weather was sunny and warm. Photographs were taken of conditions observed. Please refer to photographs in Appendix B and the Dam Inspection Checklist in Appendix C. Selected photographs are included here for ease of visual reference. All pictures were taken by Dewberry personnel during the site visit.

Based on the observations during the site visit no significant findings were noted.

5.2 MAIN ASH POND SOUTH DIKE

5.2.1 Crest

The crest of the Main Ash Pond south dike had no signs of significant depressions, tension cracks or other indications of settlements or shear failure. Figure 5.2.1-1 shows the typical crest conditions.

Figure 5.2.1-1: Main Ash Pond South Crest Viewing West to East

The crest is paved with crushed stone to provide a wearing surface for occasional vehicle traffic.

5.2.2 Upstream/Inside Slope

The up-gradient slope of the Main Ash Pond south dike is vegetated with various species of tall grass and weeds. There were no observed scarps, sloughs, bulging, cracks, depressions or other indications of slope instability. Figure 5.2.2-1 shows a representative section of the up-gradient slope of the embankment.

Figure 5.2.2-1: Main Ash Pond South Dike Up-Gradient Slope at Center Section of Dike

5.2.3 Downstream/Outside Slope and Toe

The western portion of the down-gradient slope of the Main Ash Pond south dike is planted with grass. The down-gradient vegetation changes from grasses to high weeds and trees toward the center and eastern end of the embankment as shown in Figure 5.2.3-1. Erosion was observed at the location where embankment ground cover changed from grass to woodland. Figure 5.2.3-2 shows the erosion at the ground cover transition.

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Figure 5.2.3-1: Main Ash Pond South Dike Down-Gradient Slope at Western End of Embankment.

Figure 5.2.3-2: Main Ash Pond South Dike Down-Gradient Erosion at Change from Grass Ground Cover the Woodlands

The bottom portion of the down-gradient embankment is armored with riprap as protection from erosion during flooding of the adjacent Avery Creek. Figure 5.2.3-3 shows the riprap on the lower portion of the embankment

Figure 5.2.3-3: Main Ash Pond South Dike Down-Gradient Slope Riprap Armoring

No areas of seepage were observed along the toe of the down-gradient slope. Isolated areas of soft, wet surface soils were observed. Plant personnel indicated that wet areas were the result of recent flooding of Avery Creek adjacent to the Main Ash Pond south dike. Figure 5.2.3-4 shows typical conditions observed along the toe of the embankment. Figure 5.2.3-5 shows a soft, wet area observed along the west portion of the embankments.

Figure 5.2.3-4: Main Ash Pond South Dike Down-Gradient Toe

Figure 5.2.3-5: Wet Area at Main Ash Pond South Dike Down Gradient Toe

5.2.4 Abutments and Groin Areas

Neither erosion nor uncontrolled seepage was observed along the groins or abutments. Groin slopes and abutments are protected with the same vegetative cover as the adjoining slopes. Figures 5.2.4-1 and 5.2.4-2 show typical conditions observed at the groins and abutments.

Figure 5.2.4-1: Main Ash Pond South Dike Crest at Western Abutment

Figure 5.2.4.2: Main Ash Pond South Dike Groin Crest at East End

5.3 MAIN ASH POND NORTH DIKE

5.3.1 Crest

The crest of the Main Ash Pond north dike had no signs of significant depressions, tension cracks or other indications of settlement or shear failure. The crest in paved with crushed stone to provide a wearing surface for plant traffic. The crest also contains the main railroad line for coal deliveries to the plant. Figure 5.3.1-1 shows the typical crest conditions.

Figure 5.3.1-1: Main Ash Pond North Dike Crest View East to West

5.3.2 Upstream/Inside Slope

The up-gradient slope of the Main Ash Pond north dike is covered with various species of tall grass and weeds. There were no observed scarps, sloughs, bulging, cracks, depressions or other indications of slope instability. Figure 5.3.2-1 shows a representative section of the up-gradient slope of the embankment.

Figure 5.3.2-1: Main Ash Pond Up-Gradient Slope View East to Wet

5.3.3 Downstream/Outside Slope and Toe

The Main Ash Pond north dike down-gradient slope is covered with trees and tall grass along the upper portion of the slope. The lower portion of the slope is armored with riprap as erosion protection from wave action at the Zero Liquid Discharge Pond. The Main Ash Pond north dike separates the Main Ash Pond and the Zero Liquid Discharge Pond. Figure 5.3.3-1 shows a representative section of the Main Ash Pond North Dike down-gradient slope.

The toe of the Main Ash Pond north dike is below the water line of the Zero Discharge Pond and was not observed.

Figure 5.3.3-1: Main Ash Pond North Dike Down-Gradient Slope

5.3.4 Abutments and Groin Areas

Neither erosion nor uncontrolled seepage was observed along the groins or abutments. Groin slopes and abutments are protected with the same vegetative cover as the adjoining slopes. Figure 5.3.4-1 shows the west abutment of the Main Ash Pond north dike.

Figure 5.3.4-1: Main Ash Pond North Dike Up-Gradient Slope West Abutment

5.4 ZERO LIQUID DISCHARGE POND EAST DIKE

5.4.1 Crest

The crest of the Zero Liquid Discharge Pond east dike had no signs of significant depressions, tension cracks or other indications of settlement or shear failure. The crest is paved with a crushed stone surface to provide a base course for the railroad line supplying coal to the plant. Figure 5.4.1-1 shows the typical crest conditions.

Figure 5.4.1-1: Zero Liquid Discharge Pond East Dike Crest View South to North

5.4.2 Upstream/Inside Slope

The up-gradient slope of the Zero Liquid Discharge Pond is vegetated with tall grasses and weeds with trees growing along the water edge. There were no observed scarps, sloughs, bulging, cracks, depressions or other indications of slope instability. Figure 5.4.2-1 shows a representative section of the embankment.

Figure 5.4.2-1: Zero Liquid Discharge Pond East Dike Up-Gradient Slope

5.4.3 Outside Slope and Toe

The down-gradient slope of the Zero Liquid Discharge Pond East Bank is vegetated with grass. No major scarps sloughs, bulging, cracks, depressions, or other indications of slope instability or signs of uncontrolled seepage were observed. Figure 5.4.3-1 shows a representative section of the embankment.

Figure 5.4.3-1: Zero Liquid Discharge Pond: East Bank Down-Gradient Slope

An area of the upper section of the Zero Liquid Discharge Pond was observed to have been re-graded and re-seeded recently. Plant personnel indicated that the work was done as part of general maintenance after recent heavy rains. Figure 5.4.3-2 shows a recently re-graded and re-planted slope area.

Figure 5.4.3-2: Zero Liquid Discharge Pond East Dike: Re-graded/Re-seeded Area at Top of Down-Gradient Slope

No areas of apparent seepage were observed along the toe of the down-gradient slope. Figure 5.4.3-3 shows a representative section of the embankment toe.

Figure 5.4.3-3: Zero Liquid Discharge Pond East Dike Toe,

Isolated areas of soft soil and standing water were observed that appear to be the result of recent flooding of the Des Moines River. Larger areas of standing water were observed in the adjacent agricultural field that had been flooded as well. Figure 5.4.3-4 shows an area of soft soil and standing water. Figure 5.4.3-5 shows standing water in the field adjacent to the East Dike.

Figure 5.4.3-4: Zero Liquid Discharge Pond East Dike: Soft Wet Area Northern Section of Embankment Toe

Figure 5.4.3-5: Residual Flood Water in Field Adjacent to Zero Liquid Discharge Pond East Dike. Des Moines River in Background

5.4.4 Abutments and Groin Areas

Neither erosion nor uncontrolled seepage was observed along groins or abutments. Groin slopes and abutments are protected with the same vegetative cover as the adjoining slopes. Figures 5.4.4-1 shows typical conditions observed at the north abutment.

Figure 5.4.4-1: Zero Liquid Discharge Pond East Bank North Abutment Area

The south abutment of the Zero Liquid Discharge Pond East Dike is where the dike intersects the down-gradient slope of the Main Ash Pond North Dike. Figure 5.4.4-2 shows the down-gradient slope of the Main Ash Pond and the up-gradient slope of the Zero Liquid Discharge Pond in the area of the junction.

Figure 5.4.4-2: Abutment formed by junction of Main Ash Pond North Dike (Foreground) and Zero Liquid Discharge Pond East Dike

5.5 OUTLET STRUCTURES

5.5.1 Overflow Structure

The Main Ash Pond overflow structure is located at the eastern end of the impoundment near the intersection of the north and south embankments. The overflow structure is located in an area separated from the main pond by a low elevation interior dike to form a secondary settling basin. The spillway riser consists of a reinforced concrete structure with a velocity reducing weir at the base. Figure 5.5.1-1 shows the primary spillway structure.

Figure 5.5.1-1 Main Ash Pond Primary Spillway Riser Structure

Flow into the spillway riser is controlled by lifting the entry gate to the desired elevation. Figure 5.5.1-2 shows the lift structure used to control the elevation of the spillway riser inflow gate.

Figure 5.5.1-2: Main Ash Pond Primary Spillway Structure Inflow Gate Control Lift

The Zero Liquid Discharge Pond does not have an overflow structure.

5.5.2 Outlet Conduit

The spillway weir discharges water into two 66-inch diameter reinforced concrete pipes. The pipes discharge into an open channel drainage ditch near the toe of the down-gradient embankment slope. The drainage ditch discharges to the Des Moines River. The slope area at the spillway pipe outfall is heavily vegetated, which prevents observation. Figure 5.5.2-1 shows the area of the spillway pipes outfall. Figure 5.5.2-2 shows the open drainage ditch that connects the spillway pipe discharges to the Des Moines River

Figure 5.5.2-1: Main Ash Pond Spillway Pipes Discharge Area. Pipe Ends Located near Upper Right Hand Corner

Figure 5.5.2-2: Main Ash Pond Spillway Drainage Ditch from Outfall to Des Moines River.

5.5.3 Emergency Spillway

Neither the Main Ash Pond nor the Zero Liquid Discharge Pond has an emergency spillway.

5.5.4 Low Level Outlet

Neither the Main Ash Pond nor the Zero Liquid Discharge Pond has a low level outlet.

6.0 HYDROLOGIC/HYDRAULIC SAFETY

6.1 SUPPORTING TECHNICAL DOCUMENTATION

6.1.1 Flood of Record

No documentation had been provided about the flood of record.

6.1.2 Inflow Design Flood

Black & Veatch conducted a hydrologic and hydraulic analysis of the capacity of the Main Ash Pond to store water from the design storm event (Appendix A – Doc 11). The design storm event was a 100-year (1 percent probability in a given year) 24-hour event with an intensity of 6.8 inches. The report estimates that the 1 percent probability storm can be retained in the Main Fly Ash Pond, raising the water elevation about 3.7 feet.

The hydrology and hydraulic analysis indicates an initial pool elevation of 670 which is the invert elevation of the Mani Ash Pond spillway weir. The calculated water rise of 3.7 feet results in a water elevation of 673.7 providing a freeboard of 8.3 feet. However, based on field estimates made during the Dewberry site visit, correlation between data in the hydrologic and hydraulic report (Appendix A –Doc 11), the *Settling Pond Maintenance Plan* (Appendix A – Doc 2), and the *Ash Pond Slope Stability Report* (Appendix A – Doc 12), the current Main Ash Pond pool elevation is approximate 677 which is approximately the top of the primary spillway riser. This inconsistency raises concern about the freeboard conclusion presented in the hydrologic and hydraulic report.

Dewberry used the Main Ash Pond Stage – Area Relationship provided in the hydrologic and hydraulic report to make a preliminary estimate of the impact of the design storm on the pool elevation assuming the current 677 elevation. The results indicate an increase of approximately 2.5 feet to 679.5 providing approximately 2.5 feet of freeboard under a 100-year event.

The hydrologic and hydraulic report also included an analysis assuming the spillway pipes were completely blocked. The results indicated an increase in pool elevation of approximately 6.1 feet from 670 to 676.1. Dewberry conducted a preliminary estimate that indicated the increase from the current pool elevation of approximately 677 would be 3.5 feet to elevation 680.5 resulting in a freeboard of 1.5 feet.

The hydrologic and hydraulic analysis did not include an evaluation of the Zero Liquid Discharge Pond.

Spillway Rating

The Black & Veatch hydrologic and hydraulic analysis (Appendix A – Doc 11) indicates a primary spillway discharge of 118 cubic feet per second.

6.1.3 Downstream Flood Analysis

No downstream flood analysis data were provided to Dewberry for review.

6.2 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

Supporting documentation reviewed by Dewberry is generally adequate to assess the hydrologic/hydraulic safety of the Main Ash Pond. However, the apparent discrepancy between the pool elevation assumed in the analysis and the current pool elevation should be resolved.

No hydrologic/hydraulic data pertaining to the Zero Liquid Discharge Pond was provided to Dewberry for review.

6.3 ASSESSMENT OF HYDROLOGIC/HYDRAULIC SAFETY

Based on the lack of technical documentation, the hydrologic and hydraulic safety of the Main Ash Pond and Zero Liquid Discharge Ponds is rated FAIR. It appears that the Main Ash Pond can retain the 1 percent probability design storm without overtopping. However, the apparent discrepancy between the pool elevation assumed in the analysis and the actual pool elevation should be reviewed and resolved.

7.0 STRUCTURAL STABILITY

7.1 SUPPORTING TECHNICAL DOCUMENTATION

7.1.1 Stability Analyses and Load Cases Analyzed

The October 22, 1010 *Interstate Power and Light Ottumwa Power Generating Station Ash Pond 1 and 2 Slope Stability Report* prepared by Black & Veatch summarizes recent stability analyses performed for the Main Ash Pond and Zero Ash Pond impoundment dikes (Appendix A – Doc 12). The slope stability analyses are based on geotechnical information provided by a 1975 ATCE Associates report prepared for the original plant constructions, and current survey information provided in a 2006 report prepared by Hard Hat Services (See Appendix A – Doc 02)

The stability analyses included the results of three loading conditions:

- Long-term stability
- Rapid drawdown
- Seismic loading applied to the steady state loading
    - A horizontal acceleration of 0.04g was used for seismic loading

Based on the results of the analyses, the report concludes that the embankments have stability safety factors at or above the minimum recommended values.

7.1.2 Design Parameters and Dam Materials

Documentation provided to Dewberry for review was the October 22, 1010 *Interstate Power and Light Ottumwa Power Generating Station Ash Pond 1 and 2 Slope Stability Report* prepared by Black & Veatch (Appendix A – Doc 12). The documentation indicated the stability analyses assumed five material strata: stiff clay; soft clay; loose sand; dike fill, and ash. The material properties used for the stability analyses are shown in Table 7.1.2.

Table 7.1.2 Summary of Soil Properties Used in Stability Analyses						
Soil Strata	**Undrained Properties**			**Drained Properties**		
	Unit Weight (pounds/cubic foot)	**Cohesive Strength (pounds/ square foot**	**Angle of Internal Friction (degrees)**	**Unit Weight (pounds/cubic foot)**	**Cohesive Strength (pounds/ square foot**	**Angle of Internal Friction (degrees)**
Stiff Clay	127	1,500	0	127	0	32
Soft Clay	95	740	0	95	0	29
Loose Sand	115	0	29	115	0	20
Dike Fill	130	1,500	0	130	0	30
Ash	90	0	32	90	0	32

7.1.3 Uplift and/or Phreatic Surface Assumptions

The documentation provided to Dewberry did not specifically identify uplift forces acting at the base of the dikes. However the documentation indicates the analyses were conducted using GeoStudio 2007 software which includes uplift pressures in the algorithms used to compute stability safety factors.

The phreatic surfaces used in the analyses were based on groundwater readings taken in the 1976 geotechnical data and current impoundment pool elevations.

The Main Ash Pond phreatic surface used a pool elevation of approximately 676 on the up-gradient slope, falling to approximately elevation 662, at the toe of the down-gradient embankment which corresponds to about 8 feet below the toe. The rapid draw down phreatic surface used a water elevation of approximately 658 at the up-gradient slope. The elevation corresponds to the contact between stored ash and underlying still clay. The down-gradient slope phreatic surface for rapid drawdown was approximately 660.

The Zero Liquid Discharge Pond phreatic surface used a pool elevation of approximately 669 on the up-gradient slope, and intersecting the embankment toe of the down-gradient embankment at approximately elevation 653. The rapid draw down phreatic surface used a water elevation of approximately 662 at the up-gradient slope. The elevation corresponds to the contact between stored ash and underlying still clay. The down-gradient slope phreatic surface for rapid drawdown was approximately 663.

7.1.4 Factors of Safety and Base Stresses

The safety factors computed in the computed in the slope stability report (Appendix A – Doc 12) are listed in Table 7.1.4

Table 7.1.4 Slope Stability Factors of Safety Ottumwa Generating Station Ash Ponds

Loading Condition	Required Safety Factor (U.S. Army Corps of Engineers)[1]	Main Ash Pond	Zero Liquid Discharge Pond
Long-Term Stability	1.5	1.71	2.14
Rapid Drawdown Stability	1.2	2.14	2.41
Seismic Stability	1.2	2.57	1.96

[1] U.S. Army Corps of Engineers Engineering Manual 1110-2-1903 *Slope Stability*, 31 October 2003

Based on the results summarized in Table 7.1.4 **the embankments were found to have slope stability safety factors equal to or greater than the recommended minimum values.**

7.1.5 Liquefaction Potential

The documentation reviewed by Dewberry did not include an evaluation of liquefaction potential. Foundation soils do not appear to be susceptible to liquefaction.

7.1.6 Critical Geological Conditions and Seismicity

The Ottumwa Generating Station is located with the Dissected Loess and Till Plain of the Central Lowlands and Plains physiographic province. Geology along the Des Moines River includes Mississippian age shale, sandstone and limestone formations. Bedrock formations are generally horizontally bedded.

Soil overlying bedrock consists of loess overlying glacial till and weathered material from the parent rock.

In the new stability analyses (Appendix A – Doc 12) a peak ground acceleration of 0.04g was used for seismic loading.

The current Seismic Risk Mao of the United States was reviewed using the U.S. Geologic Survey web site. The 10% probability of exceedance in 50 years ground acceleration for the site is 0.04g to 0.06g. The seismic criteria used in the analyses are appropriate for the Ottumwa Generating Station fly ash management units.

7.2 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

Structural stability documentation is adequate.

7.3 ASSESSMENT OF STRUCTURAL STABILITY

Overall, the structural stability of the dikes appears to be SATISFACTORY based on the following observations during the October 6, 2010 field visit be Dewberry, available recent dam inspection reports and the 2010 slope stability report:

- The crest of the embankments appeared free of depressions and no significant vertical or horizontal alignment variation were observed
- There were no indications of major scarps, sloughs or bulging along the dikes
- Boils, sinks or other uncontrolled seepage was not observed along slope, groins or toe of the dikes
- The computed factors of safety comply with accepted criteria.

8.0 ADEQUACY OF MAINTENANCE AND METHODS OF OPERATION

8.1 OPERATING PROCEDURES

The Main Ash Pond is operated for the storage of wet fly ash as well as water from other plant sources including boiler wash water, plant site storm water runoff, cooling tower blowdown, plant floor drains and leachate from the plant landfill. Wet ash is stored on the eastern side of the impoundment as the primary settling basin. Ash transport water, storm water and other plant discharge waters flow to the west side of the impoundment which serves as a secondary settling basin. Decant water flows to the primary spillway located in the southeast corner of the impoundment. A low dike around the primary spillway riser structure provides another settling basin prior to water entering the spillway. Figure 8.1-1 shows the location of the low interior dike at the primary spillway entrance.

Figure 8.1-1: Low Dike and Final Settling Basin within Main Ash Pond

The Zero Liquid Discharge Pond is operated as the storm water management impoundment for runoff from the adjacent C-Stone pile (hydrated fly ash storage for reuse). The Zero Liquid Discharge Pond is occasionally used for temporary storage of fly ash and plant maintenance wash water usually stored in the Main Ash Pond. When the temporary storage is no longer needed, water is pumped from the Zero Liquid Discharge Pond into the Main Ash Pond. Pumping is accomplished using a mobile, gas powered pump.

8.2 MAINTENANCE OF THE DAM AND PROJECT FACILITIES

Documentation of an operations and maintenance plan was not provided to Dewberry for review.

Based on observations made during the site visit the crests of Main Ash Pond dikes were generally clear of vegetation, except for minor grass and weed growing between the rails of the railroad track along the north embankment. The up-gradient dikes of the Main Ash Pond were generally free of trees and other large vegetation, and appeared well maintained. The west end of the Main Ash Pond south dike is vegetated with various species of grass and other low growing plants. That portion of the dike appears to be well maintained. The east end of the Main Ash Pond south dike is covered with small to mid-size trees and thick, overgrown vegetation. The type and amount of vegetation indicates the east end of the Main Ash Pond south dike receives little maintenance.

The down-gradient slope of the Main Ash Pond north dike, which is also the up-gradient slope of the Zero Liquid Discharge Pond, is armored with riprap near the water line to protect against wave erosion. Above the riprap, the embankment is vegetated with scattered weeds and small trees.

The crest of the Zero Liquid Discharge Pond was clear of vegetations. The up-gradient slope of the Zero Discharge Pond east embankment is armored to protect against wave erosion. Small trees are located along the upper portion of the embankment. The down-gradient slope of the east bank is vegetated with various species of grass and appears to be well maintained. Observations during the site visit indicate that areas of the slope impacted by recent flooding have been re-graded and re-planted.

8.3 ASSESSMENT OF MAINTENANCE AND METHODS OF OPERATIONS

8.3.1 Adequacy of Operating Procedures

Based on the assessments of this report, operating procedures appear to be adequate.

8.3.2 Adequacy of Maintenance

Although the current maintenance program appears to be adequate for potions of the Main Ash Pond and Zero Liquid Discharge Pond, several recommendations are provided to improve maintenance and ensure a trouble free operation:

- Develop a written operations and maintenance plan
- Repair erosion rills on the down-gradient slopes, particularly the Main Ash Pond south dike at the end of the wooded area along the east end
- Clear vegetation at the Main Ash Pond primary spillway pipes down-gradient discharge location
- Remove trees from dike embankments
- Improve surface drainage at the toe of the Zero Liquid Discharge Pond to facilitate drainage of Des Moines River flood water.

9.0 ADEQUACY OF SURVEILLANCE AND MONITORING PROGRAM

9.1 SURVEILLANCE PROCEDURES

Surveillance procedures are specified in the Alliant Energy "Genco Standard Guide for Pond Inspections, Procedure No. GENCO-0-OP-402-01" dated April 30, 2009 See Appendix A – Doc 13). The program requirements include:

- Inspections by knowledgeable plant personnel at intervals determined based on physical construction and arrangement, and local operating conditions, including spring snow melt and flooding. Inspections must be conducted at least annually.
- Additional corporate environmental staff pond inspection conducted a minimum of once a year.

9.2 INSTRUMENTATION MONITORING

Neither the Main Ash Pond nor the Zero Liquid Discharge Pond embankments have an instrumentation monitoring system.

9.3 ASSESSMENT OF SURVEILLANCE AND MONITORING PROGRAM

9.3.1 Adequacy of Inspection Program

Based on the data reviewed by Dewberry, observations made during the site visit, and the size of the embankments, the inspection program is adequate.

9.3.2 Adequacy of Instrumentation Monitoring Program

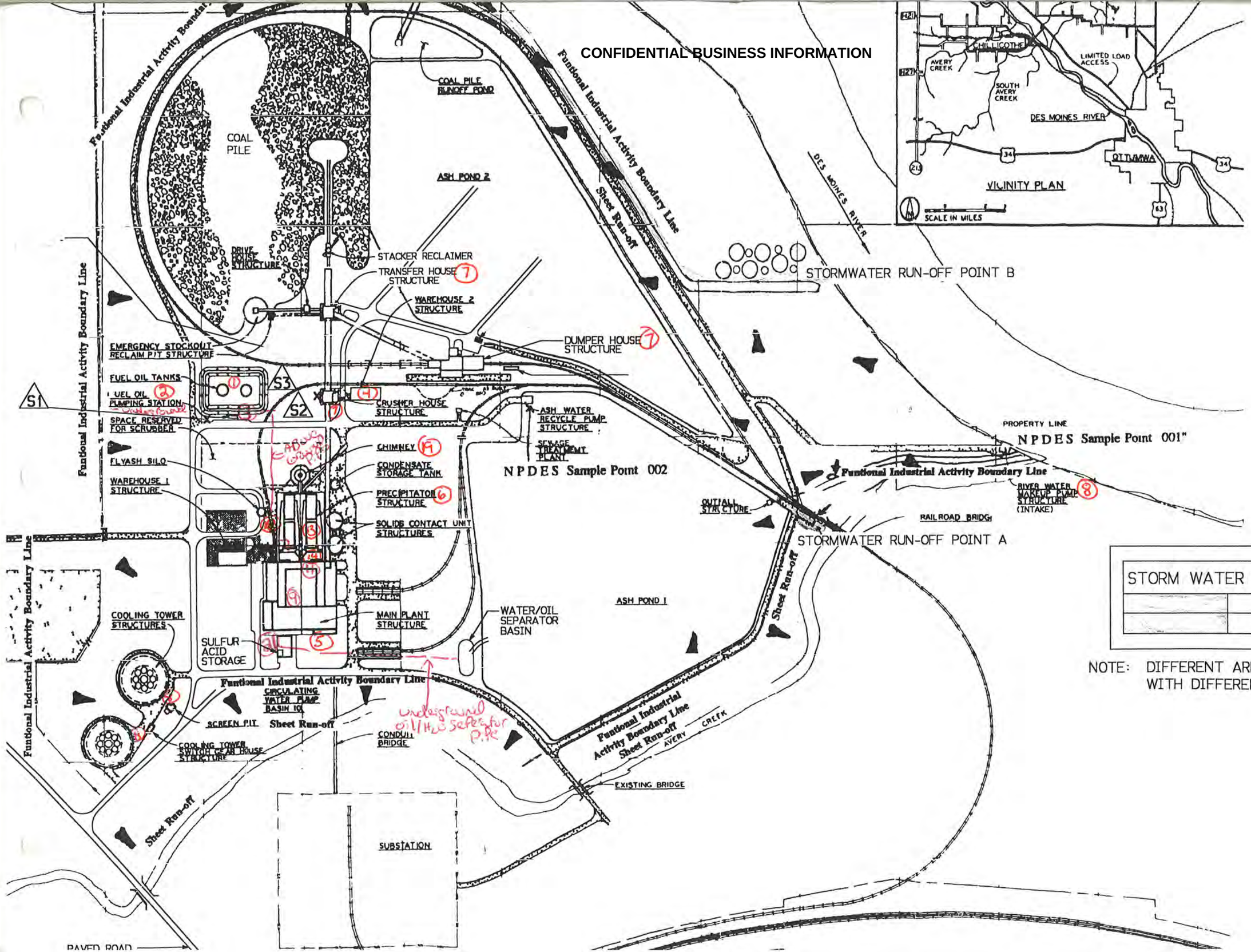
No instrumentation is present at either the Main Ash Pond or Zero Liquid Discharge Pond embankments.

Based on the size of the embankments, the current inspection program, and the observations made during the site visit, an embankment monitoring program is not needed at this time.

APPENDIX A

DOCUMENTS

CONFIDENTIAL BUSINESS INFORMATION



STORM WATER DRAINAGE AREAS	
	AREA 1
	AREA 2

NOTE: DIFFERENT AREAS ARE HIGHLIGHTED WITH DIFFERENT COLORS.

KEY:

- RAILROAD TRACK
- FENCE
- GRAVEL ROAD
- DRAINAGE FLOW
- LOCATION OF 4

CONFIDENTIAL BUSINESS INFORMATION

SETTLING POND MAINTENANCE PLAN
OTTUMWA GENERATION STATION
OTTUMWA, IOWA

October 2006
Revision 0

Prepared for:

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Attachment A OGS Water Use Diagram
Attachment B Historical Ash Production Quantities, Bathymetry, and Hydraulic Calculations
Attachment C Sediment Settling Test Results
Attachment D Historical TSS, Temperature, and Flow Data

1 Introduction

This Settling Pond Maintenance Plan was prepared pursuant to Purchase Order GENCO0056626 dated June 9, 2006. Hard Hat Services (HHS) was retained by Alliant Energy to conduct settling pond investigative work at the Interstate Power & Light (IP&L) Ottumwa Generating Station (OGS) for preparation of this Pond Maintenance Plan. The site investigative work consisted of:

- A Site survey on State Plane Coordinates around the Settling Pond and the Zero Discharge Pond,
- Settling Pond bathymetry survey,
- Zero Discharge Pond bathymetry survey, and
- Collection of a sediment sample to determine the settling characteristics.

This Maintenance Plan provides IP&L with a historical overview of the facility operations, performance of the settling pond, and provides guidance for the settling pond dredging, pond sediment handling, and general budgetary cost estimate to conduct the dredging activities.

2 OGS Background Information

The Ottumwa Generation Station (OGS), located in Ottumwa, Iowa (Figure 1), has a generating capacity of 675 megawatts. OGS first came on line in 1981 and uses steam from coal fired boilers for power generation. At OGS, water that quenches bottom ash from the boilers creates the majority of the flow to the settling pond. The settling pond also receives minor flows from: cooling water tower blow down, the OGS floor drains, chemical cleaning of boilers, the boiler water pretreatment system, discharge from the sanitary wastewater treatment plant, and stormwater runoff.

2.1 Facility Water Use

Water use at the OGS facility is key to understanding the performance of the settling pond and how it can be affected by changes within the facility. A 2003 Water Use Diagram was provided by IP&L, Attachment A. The water use diagram shows that approximately 6.6 million gallons per day (MGD) is withdrawn from the Des Moines River and used for cooling tower make-up, boiler water make-up, and for bearing seals and cooling. The facility discharges approximately 1.5 MGD of the water into the Settling Pond with the remainder evaporating. In addition, 4.0 MGD is recirculated from the settling pond back into the facility for reuse in sluicing ash and other cooling needs bringing the flow through the pond to approximately 5.5 MGD. The average permitted discharge from the settling pond National Pollutant Discharge Elimination System (NPDES) permitted Outfall 001 is 1.5 MGD. Outfall 001 currently discharges into a site creek, which then flows back into the Des Moines River (Figure 1).

2.2 Ash Production Rates

From 2001 to 2005 the facility has burned an average of 2.67 million tons of coal per year. After coal is burned at the facility, approximately 5.2% of the coal remains as ash. The ash is categorized into two major types, bottom ash and fly ash. The fly ash also can be subdivided into two types, economizer fly ash and precipitator fly ash. Both the bottom ash and the economizer fly ash are sent to the settling pond, while the precipitator fly ash is sent to the fly ash storage building for commercial use. During the past five years, the facility has also started to remove the coarse bottom ash from the small settling pond located prior to the main settling pond shown on Figure 1. The approximate percentages of each type of ash produced at the facility are:

- 15% by weight of the total ash is bottom ash
- 85% by weight of the total ash is fly ash
    - 10% by weight of the fly ash is economizer fly ash
    - 90% by weight of the fly ash is precipitator fly ash

Therefore, between the bottom ash and economizer fly ash, an average of 33,750 tons have been sent to the settling pond in each of the last five years, see Attachment B for the ash production calculations. In efforts to reclaim the ash sent to the settling pond and to slow the settling pond filling rate, the facility has been removing ash from a small primary settling pond for the least 5 years. During that time OGS has reclaimed approximately 29,900 tons per year as a sellable product. Therefore the amount of ash filling the settling pond each year is approximately 3,850 tons per year.

2.3 Typical Bottom Ash Properties

In order to project the performance of the settling the pond under different fill rates, water depths, flow rates and ash characteristics, Table 2.1 has been included to provide typical bottom ash properties as published by American Electric Power. These properties are used to determine the volume fill capacities used in this report.

Table 2.1 Typical Properties for Bottom Ash

Specific Gravity	2.3
Permeability	0.019 cm/sec
Maximum Relative Density	89 lb/ft^3
Minimum Relative Density	73 lb/ft^3
Gravel Composition	10% by weight
Sand Composition	80% by weight
Silt & Clay Composition	10% by weight

2.4 Historical Aerial Photos

Figure 2 shows various aerial photos from the 1930s to 2005. The aerial photos illustrate how the surface area of the settling pond has decreased in size in addition to location changes of the ash inputs into the settling pond. Upon inspection photos, from 2002 until now, a large tan colored plume has developed in the settling pond. It appears that the plume has resulted from the discharge from the 42” plant drain. HHS is unaware of the reason why the large amounts of sediments are filling this area of the settling pond. From 1994 the southern end of the pond has greatly decreased in surface area. This is largely due to the sediments entering the pond from the bottom ash trench and the economizer ash discharges.

3 Field Activities

The following field activities were completed at the OGS:

- Survey on State Plane Coordinates around the Settling Pond and the Zero Discharge Pond (Figure 3)
- Settling Pond and Zero Discharge Pond bathymetry survey (Figure 3)
- Collection of a sediment sample to determine the settling characteristics of the bottom ash in the pond (Attachment C)

3.1 Bathymetry of Settling Pond and Zero Discharge Pond

On July 10th of 2006, personnel and equipment arrived at the OGS to begin the bathymetry and general survey for the two ponds including the immediate surrounding area. The surveys were conducted by French-Reneker Associates Inc., a licensed Iowa land surveyor, and managed by Hard Hat Services. A Survey Depth Sounder model 455 XPe manufactured by Innerspace Technologies was used to collect water depth data for the bathymetry survey. The transducer for the 455 XPe was mounted to the side of a small boat. By mounting a Differential Global Positioning System (DGPS) survey instrument directly above the transducer at a known height, the elevation of the pond bottom was obtained by subtracting the know height and the Depth Sounder reading from the GPS elevation. Since the transducer needs to be submerged to work properly, readings in less than 2 ft. of water depth were not used in preparing the pond bathymetric map. In areas of water 2 feet or less in depth, manual readings were taken collected to obtain a comprehensive survey. For depths greater than 2 feet, the accuracy of the sounder equipment was checked periodically, against manual measurements. The results of these checks indicated the equipment was consistently accurate throughout the course of the study.

Elevation data was based on site benchmark information with a base station to allow for accurate comparison to previous survey information. Measuring started in the Zero Discharge Pond by traveling in a line from one corner to another while the depth sounder equipment recorded a location (northing and easting) and depth data point every second. The process continued by reversing the direction of travel and collecting data in a parallel line 100 feet from the first. The Innerspace software for the sounding equipment allowed for programming of the desired measurement line across the pond as well as the offset for the next. When data collection began, the software indicated the direction and distance from the desired path. Once data was collect over the entire surface of the pond in this direction, the pond was traversed in a similar fashion, but perpendicular to the first set of data lines. In theory, this would then create a 100-by-100 foot grid of elevation data.

It was discovered almost immediately that the weeds present in the southern half of the zero discharge pond were going to cause problems with data collection. Not only did the weeds cause erroneous reading with the transducer, it was also difficult to maneuver the boat. While the grid approach on this section of the pond was abandoned, all efforts were made to at least obtain manual measurements. This collection of points was sufficient to accurately map this area. The remainder of the zero discharge pond (northern half) and the settling pond were, for the most part, clear of the weeds and data collection proceeded very smoothly.

In addition to the pond bathymetry information, the water's edge was surveyed for both ponds as well as the area immediately surrounding them. Some difficulties were experienced while collecting data for the settling pond, which resulted mainly from the presence of dense vegetation along the southwest side of the settling pond. Best possible efforts were made to collect data in this area. All the stored data collected during the surveys, was exported from the Innerspace software as ascot files and used to generate Figure 3.

3.2 Sediment Sample Collection and Settling Test Results

3.2.1 Sediment Sample Collection

During collection of the bathymetry data for the Recirculation pond, a sediment sample was taken for later characterization. The sample was removed with a standard post-hole digger, placed in a 5-gallon bucket, and sealed prior to transport. The majority of the sediment sample was collected from the middle of the plume area, where the ash water enters the settling pond, Figure 1. The sample was collected to an estimated 3-foot depth, with sediments from the top to bottom of the sample location mixed together in the bucket. The remainder of the sample was taken from the shallow area near the recycle pump intakes.

3.1.1 Settling Test Method and Results

The large diameter settling column test is designed to measure the rate at which solids would settle in a confined disposal facility under quiescent conditions. If run for a substantially long time the settling test will provide a measure of the constant flocculent settling rate, a variable hindered settling rate and a compression-settling rate. These three types of settling correspond to the following:

1. Flocculent Settling – settling of particles in suspension that may be affected by the proximity of the particles, but not by the rate at which water can move to the top of the settling column
2. Hindered Settling – settling of particles in suspension where the water that is trying to go to the top of the settling columns is hindered by the particles.
3. Compression Settling – settling that occurs when the particles have reached a state where the particles are in contact with each other and further settlement is caused by the weight of the particles expelling water from the remaining void space.

The procedure for the large-diameter settling test is contained in the United States Army Corps of Engineers Engineering Manual, Confined Disposal of Dredged Material (EM 1110-2-5027). The settling column is an 8-inch diameter clear PVC tube with a detachable bottom section. The tube is suspended from the ceiling by hooks during the test. The detachable bottom section contains a three-inch diameter drain and a mechanism to agitate the test dredge slurry using compressed air. The clear column has sampling ports spaced at 6-inch intervals starting 6-inches from the top of the column for the recovery of water samples at different heights during the test. The column holds approximately 15-gallons of sediment and water mixture. Pictures of the column running the tests are included in Attachment C and show the general construction of the column.

The test is run by mixing sediment into water at the expected concentration that will occur during dredging. The water may be from the water body or synthesized (i.e., addition of salt to allow for the impacts of seawater on settling) to model site conditions. The sediment and water are mixed together in buckets that are then poured into the settling column while the compressed air agitation is used to uniformly suspend the sediment in the water. The mixing occurs using an electric drill-stirring device (similar to a stirrer for a paint bucket) to insure that lumps or cohesive particles are fully mixed into the water.

After the settling column is loaded, stopping the compressed air agitation starts the test. Three samples are immediately drawn from a port near the top, middle, and bottom of the column. These samples provide a measure of the starting dry solids content in the slurry mix. If the sediment contains a significant sand fraction, the starting solids content is usually lower than the solids content as mixed. This occurs because some of the sand remains in the mixing buckets and because some of the coarser sand may settle to the bottom even with air agitation.

An interface between the slurry and clear water (clear in the sense that light comes through) is measured over time to determine the drop in height of the interface. Once a sufficient amount of clear water forms over the top of the settling slurry, water samples may be recovered from the sampling ports. These samples are normally tested for turbidity and total suspended solids, however, other testing may also be completed for chemicals of interest, since the volume of water in the settling column is sufficient to meet most sample size requirements.

The settling rate of the sediment and the solids content of the settled solids are recorded during the test and are used to size a hydraulic containment facility for the sediment, predict the size of the containment needed to store the sediment, and to assess the likely solids content (and/or the water quality) of discharge water from the containment facility.

A settling column test was conducted from August 5, 2006 to August 12, 2006. The results indicate that the unhindered zone settling rate was 0.25 inches/minute and lasted for approximately 2-hours. There was then a hindered settling process that last to approximately 2 ½ days. During the hindered settling time the rate of settlement was non-linear. Finally there is compression settlement due to self-weight of the solids occurring from 2 1/2 to 7 days with a final solids content of 32% by dry weight.

If we assume that the water content (solids content) of the sample as received in the bucket is the in-place solids content (conservative assumption since it is likely denser than the in-pond condition), the bulking ratio is 1.2 (i.e., if we hydraulically dredge 100,000 cubic yards we will need 120,000 cubic yards to store the volume). The water quality of the elutriate shows that the TSS should be approximately 100-150 ppm at the end of zone settling (2-hours) and around 30 ppm at the end of the hindered settling (2 1/2 days).

Because of the fast unhindered zone settling rate, the size of the pond required to settle out the hydraulically placed material will not be based on the hydraulic settling efficiency (i.e., 1-2 acres would be adequate for settling). The required pond size will be based on either the desired water quality at overflow or on storage of the dredged volume including allowance for freeboard and ponding depth.

4 Outfall 001 Historical Data

IP&L has provided HHS with the historical data from 1995 to July 2006 for total suspended solids (TSS), temperature, and flow for the OGS. Graphs have been produced from the historical data and are located in Attachment D.

4.1 Historical Temperature Data

The temperature data, as expected, is cyclical with the time of year, with highs during the summer and lows during the winter. The average monthly temperatures ranged from 36° to 86° Fahrenheit. After analysis of the data was complete, no trends, other than the seasonal variation, were observed.

4.2 Historical Flow Data

NPDES permitted Outfall 001 has averaged close to 1.5 MGD from 1998 to 2006. The historical monthly flows have ranged from 0.6 MGD up to 2.4 MGD with higher flows recorded in the past 12 months. From January of 2005 the flow data has been more sporadic with higher highs and lower lows. Although higher and more sporadic flows have been recorded, analysis of the data does not show a trend toward increased flows.

4.3 NPDES Permit Requirements and Historical TSS Data Evaluation

The NPDES discharge requirements at Outfall 001 for TSS include, a 30 mg/L monthly average with a maximum of 100 mg/L allowable in the discharge. The monthly average TSS data provided by IP&L, was plotted from January of 1998 to June 2006 and ranged from 5.5 mg/L to 29 mg/L. The average TSS value over the entire data set was 14.8 mg/L.

4.3.1 Linear Fit to the TSS Data

Trend analysis, which consisted of using a linear fit model to the historical TSS data, has provided limited insight into predicting the future TSS increases. Although, the linear fit line shows an increase over time, the statistical analysis of the quality of the fit to the data revealed that the trend line should not be used to predict future data points (the regression coefficient was 0.016, the closer to 1.0 the better the linear fit to the data). The linear fit indicates that the monthly average has increased from 13.7 mg/L in January of 1998 to 16 mg/L in June of 2006.

4.3.2 Standard Deviation of the Linear Fit Data

A standard deviation of 5.86 mg/L was calculated from the data set. The standard deviation represents the boundaries where 68% of the data points fall within 5.86 mg/l of the average value. Therefore, approximately 68% of the time the TSS value is within 5.86 mg/L on either side of the average value. In June of 2006, the upper limit of the standard deviation is shown at almost 22 mg/L, which is approximately 2/3 of NPDES discharge value. Although the linear fit model cannot be used to predict when the average monthly discharge concentration will exceed 30 mg/L, the data does indicate a slight upward trend as the pond has been filled with ash, reducing its efficiency as a settling basin.

5 Settling Pond Operational Recommendations

5.1 Settling Pond Ash Quantity and Zero Discharge Pond Capacity

In order to determine how much of the settling pond volume has been filled with sediment from the time when OGS was brought on line in 1981 until now, the original settling pond bottom contours would be needed, in addition to the existing pond bottom contours, which were surveyed by French-Reneker Associates Inc (Figure 3). The difference between these two sets of contours will quantify the volume of sediment within the settling pond. In efforts to provided HHS with the original pond contours, IP&L provided OGS Drawing S1005, which is a proposed design drawing and not an as-built drawing of the settling pond. This is not ideal because the actual contours after the plant was constructed are unknown, but it has been used because is the best information available. Another concern with Drawing S1005 is the borrow area called out in the south end of the settling pond. If soil was removed during construction of the plant from the proposed borrow area shown on Drawing S1005, the sediment in this area would not be accounted for in the total sediment volume described below.

Two different sediment/ash quantities were generated from the June 2006 bathymetry and the design contours provided by IP&L. The first quantity was generated by determining the volume of sediment from within the current limit of the settling pond (the area enclosed by the present water surface). The second quantity was determined by using the original pond boundary determined by the facility design drawings, see Figure 3. The sediment quantities are illustrated in Table 5.1.

The bathymetry survey conducted on the zero discharge pond was used to determine the storage capacity in the pond if it were used as a dewatering/disposal facility for the dredged sediments. Two different volumes were calculated for the zero discharge pond. The first volume determined the current volume of water within the zero discharge pond. The second determined the maximum volume for sediment storage below the 680 elevation, which is approximately two feet below the railroad tracks. These potential storage quantities are illustrated in Table 5.1.

Table 5.1 Settling Pond and Zero Discharge Pond Volumes

Pond Elevation	Sediment Quantity
Settling Pond Sediment within the Current Pond Boundary	288,400 CY
Settling Pond Sediment within the Original Design boundary	370,000 CY
Zero Discharge Pond Storage Volume in Current Water Surface	141,500 CY
Zero Discharge Pond Storage Volume up to Elevation 680 Feet	514,900 CY

5.2 Settling Pond Dredging Boundaries

Early on in the project, IP&L expressed that the facility preferred keeping the settling pond the same size and wanted to remove only the sediment within the current pond boundary. Section 3.1.1, which analyzed the ash settling characteristics, shows that

increasing the settling pond size will not have a dramatic affect on the settling performance of the pond. Therefore, the pond size can remain same and still provide adequate settling capabilities.

When the dredging activities are conducted, the original pond bottom shown on Figure 3 should be reestablished to provide the maximum sediment storage capacity within the current pond boundary, which will maximize the time period between dredging events. The sediment appears to be thickest approximately 100 feet in the settling pond from the west edge with a maximum sediment depth of 14 feet.

5.3 Future Settling Pond Operations

Hydraulic retention time, which is commonly referred to as HRT, is defined as the average time that water will remain in the settling pond before it is discharged. Based on the settling characteristics of the sample collected from the settling pond, HHS recommends that the settling pond have a minimum HRT of 5 days. The 5-day HRT was determined by taking the settling time to achieve 30 PPM in TSS during the settling test, which was 2.5 days and multiplying it by a Factor of Safety of 2. The Factor of Safety accounts for the poor hydraulic efficiency of the settling pond, the non-quiescent environment, and additional time to drop the TSS below the 30 PPM NPDES Outfall 001 requirement. Therefore a HRT of 5 days should allow the discharge TSS to drop below the NPDES discharge limits for Outfall 001 provided there are no major disturbances within the pond and that the sediment sample collected was representative of the ash that is discharged to the pond in future years.

Currently the settling pond has a HRT of 6.83 days. Using the known volume of water in the settling pond, it can be filled with approximately 56,000 tons of ash before the settling pond would reach a HRT of 5 days. Given that the OGS has discharged approximately 33,750 tons of ash per year to the ponds in the last 5 years, the time until the 5-day HRT is reached will be in 1.6 years, see calculations in Attachment B. Of course this assumes that zero of the ash sent to the settling pond is being reclaimed. If IP&L reclaims an average amount between 20,000 – 25,000 tons of ash per year, than the time before the 5-day HRT would be reached would be extended from 1.6 years to somewhere between 4 to 6.5 years.

If IP&L does not have future plans to reclaim ash, than HHS recommends that IP&L dredge the settling pond before September of 2008 because of the decreased hydraulic retention time within the settling ponds. Conversely, if IP&L reclaims 25,000 tons per year, then the settling pond would not require dredging until 2012. If the settling pond is not dredged in the appropriate time frame, the facility may risk violating their NPDES permit limit for TSS at Outfall 001.

6 Hydraulic Dredging Activities

6.1 Hydraulic Dredging Sediment Removal

There are numerous methods of dredging using water as the transport media for moving sediment from a pond to a disposal location. Because of the size of the pond, some means of hydraulic dredging will not be applicable to the facility. Small hydraulic suction dredges that can be transported on one to three trucks are the likely candidates for the hydraulic dredging of the settling pond at the OGS. Since the ash is likely fine sand and/or coarse silt, a dredge with some type of cutterhead arrangement on the end of the dredge ladder would be required to loosen the sediment, so that the suction line can collect the sediment in the pipeline.

There are two basic cutterhead types that are used in small ponds. They are:

1. Conventional conical cutterhead on a swinging ladder dredge (either the entire dredge swings or just the ladder swings).
2. Augerhead dredge that advances along a cable line anchored to each bank (sometimes referred to as a Mudcat dredge, actually a trademark name).

Most large dredges have the pump located on the deck of the barge and the sediment and water are drawn up the intake pipe by suction. On many of the smaller dredges the pump is hydraulically driven and is located on the ladder of the dredge near the suction point.

Based on the volume of the project a single 10-12-inch dredge would be able to complete the project in a single season at a pumping rate of 4,000 gallons per minute. If the dredge is able to obtain solids at 10% by weight and pump rate of 4,000 gpm, the dredge will move approximately 150 cubic yards per hour or 3,000 cubic yards per day.

6.2 Sediment Handling during Dredging

After many conversations with the facility personnel, it has been determined that the best disposal area would likely be the zero discharge pond located immediately north of the settling pond. Using the zero discharge pond as the disposal area is convenient because the containment for the dredged material would not have to be constructed from native material on the site. This significantly lowers the preconstruction/site preparation costs.

A drainage pipe must be installed to drain the supernate, which is the clearer water at the water surface, back into the settling pond. During our conversations with IP&L, at one time a pipe connected the two ponds, but this pipe has since been grouted shut. Therefore, a pipe with a shutoff valve must be installed under the railroad tracks and sized to allow sufficient drainage from the zero discharge pond to the settling pond.

The drainage from the zero discharge pond would be dependant on how permeable the underlying soil/ash deposits are and the permeability of the ash that is dredged into the zero discharge pond. If the substrata under the zero discharge pond is significantly permeable, which is likely not the case, most of the water would drain into the subgrade and no discharge would occur from the zero discharge pond back to the settling pond because the water will seep back to the pond through the ground.

6.3 Hydraulic Dredging Cost Budgeting

The hydraulic dredging of the pond using the zero-discharge pond as a disposal location would require the following construction activities:

1. Prepare and file permit application with Iowa DNR.
2. Design and permitting/approval for jacking pipe under rail.
3. Prepare a design, probably performance based, for selection of dredging contractor.
4. Bidding and contractor selection
5. Mobilization of the dredging equipment and pipeline with assembly of pipeline by fusion welding, jacking of discharge pipe under rail spur, and construction of discharge weir in zero discharge pond.
6. Operation of dredge to remove designated sediment with operation of zero discharge pond including treatment of discharge water to keep TSS below design specified limits.
7. Construction management including survey of contractor activities to insure compliance with the sediment removal goals of the project.
8. Demobilization and preparation of as-built of pond.

A budgetary estimate of the probable cost of the project is based on the cost for similar activities is located in Table 6.3.1.

Table 6.3.1 Dredging Budgetary Estimate

Item	Units	Unit Price	Total
Permitting	1	Lump Sum	$25,000
Design	1	Lump Sum	$75,000
Contractor Procurement	1	Lump Sum	$25,000
Mobilization/Demobilization	1	Lump Sum	$250,000
Dredging	300,000 yd^3	$12/$yd^3$	$3,600,000
Construction Management	1	Lump Sum	$180,000
		TOTAL	**$4,155,000**

7 Summary of Conclusions

From the in depth study of the settling characteristics, settling pond flow data, historical aerial photographs, bathymetry survey, and calculations, a number of conclusions have been made for the settling pond. The conclusions are described below:

- The zero discharge pond has sufficient capacity to store the sediments within the current limits of the settling pond
- The total estimated quantity of sediments within the limits of the existing settling pond are 288,400 cubic yards, which uses the bathymetry data and IP&L OGS Drawing S1005
- The current hydraulic retention time of the settling pond is 6.83 days
- The minimum hydraulic retention time before IP&L risks violating the discharge requirements is 5 days
- If zero ash is reclaimed as sellable product, then IP&L has 1.6 years before a hydraulic retention time of 5 days is achieved. If this is the case, then the settling pond should be dredged by September of 2008
- If 20,000 tons of ash per year is reclaimed, then IP&L has 4 years before a hydraulic retention time of 5 days is achieved. If this is the case, then the settling pond should be dredged by September 2010
- The budgetary cost for the design, permitting, dredging, and construction management is $4,155,000.

O:\154 - Alliant Energy\154.005 Ottumwa\006 Pond Maintenance Plan\Pond Maintenance Plan\Pond Maintenance Plan.doc

FIGURES

August 2005 aerial photo taken from the
Iowa State University Information System Support and Resource Facility website.

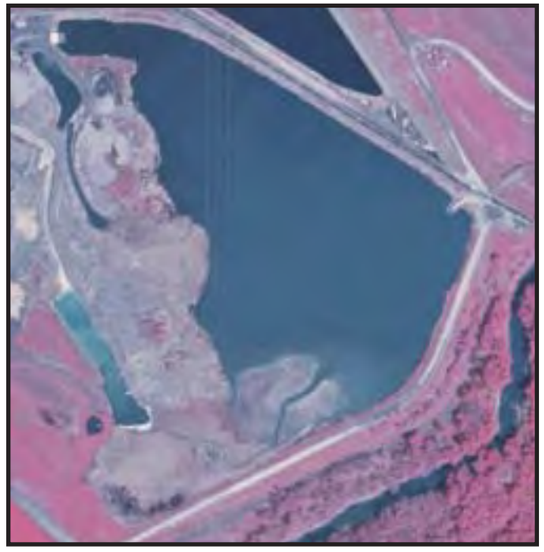
HARD HAT SERVICES™
Engineering, Construction and Management Solutions

INTERSTATE POWER & LIGHT OTTUMWA GENERATING STATION	FIGURE 1
FACILITY LAYOUT	DATE: OCT 2006

1930s

1994

2005



2002

2004

All aerial photos were taken from the
Iowa State University Information System Support and Resource Facility website.

HARD HAT SERVICES™ Engineering, Construction and Management Solutions	INTERSTATE POWER & LIGHT OTTUMWA GENERATING STATION	FIGURE 2
	HISTORICAL AERIAL PHOTOGRAPHS	DATE: OCT 2006

CONFIDENTIAL BUSINESS INFORMATION

ZERO DISCHARGE POND:

WATER SURFACE AREA: 752,878 SQ FT. (17.28 AC).

EXISTING VOLUME AVAILABLE TO WATER LEVEL (ELEV. 668.7) = 141,540 CU YDS.

EXISTING VOLUME AVAILABLE TO ELEV. 680.0 = 514,908 CU YD.

SETTLING POND:

WATER SURFACE AREA: 790,725 SQ FT. (18.15 AC).

EXISTING VOLUME AVAILABLE TO WATER LEVEL (ELEV. 668.7) = 185,922 CU YDS.

VOLUME OF INPLACE MATERIAL ABOVE ORIGINAL DESIGN SURFACE
USING EXISTING WATER LEVEL AS A BOUNDARY = 288,357 cu yd.

VOLUME OF INPLACE MATERIAL ABOVE ORIGINAL DESIGN SURFACE
USING RECENT SURVEY EXTENTS AS BOUNDARY = 369,994 cu yd

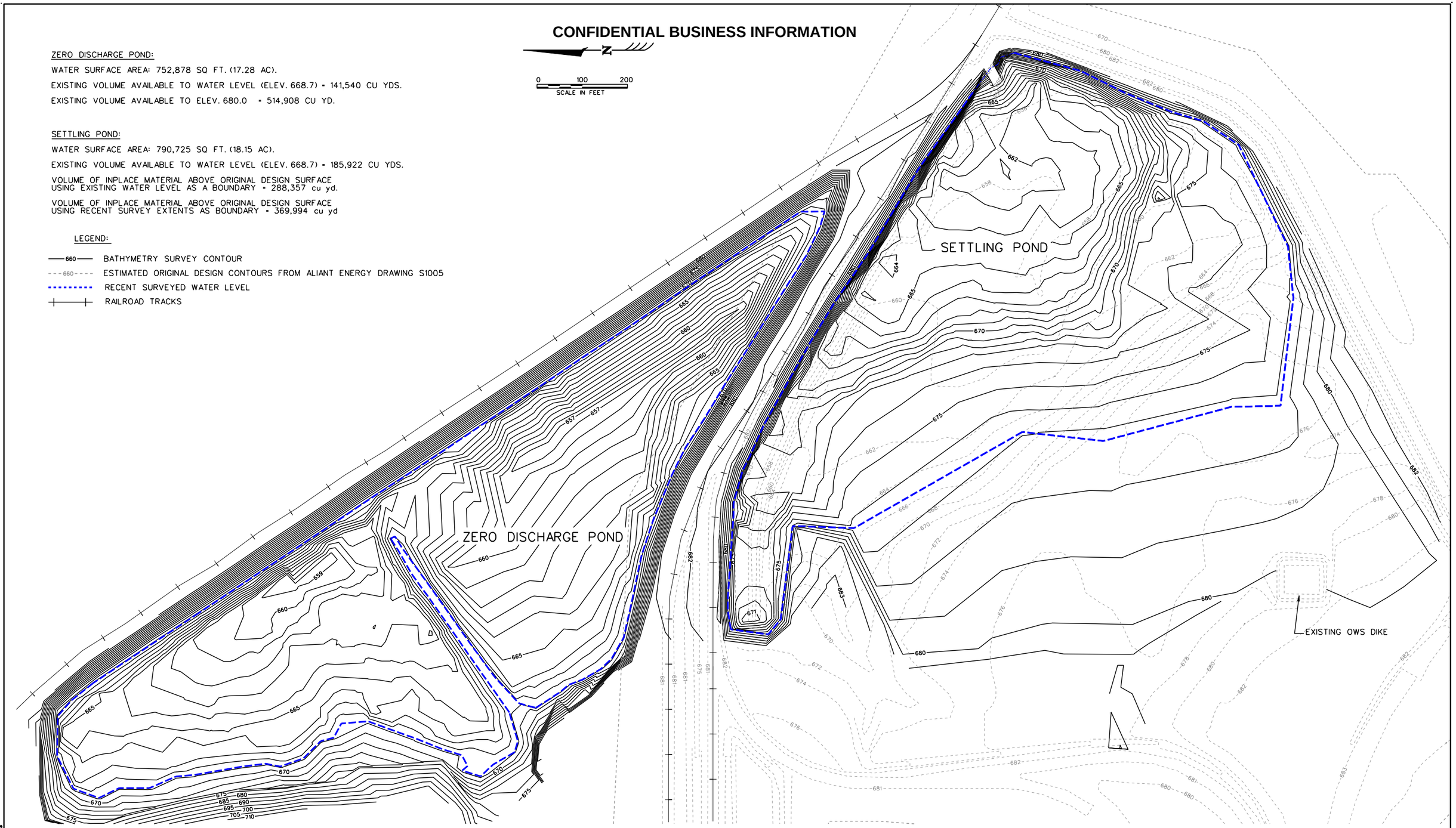
LEGEND:

660 — BATHYMETRY SURVEY CONTOUR

660 - - - ESTIMATED ORIGINAL DESIGN CONTOURS FROM ALIANT ENERGY DRAWING S1005

RECENT SURVEYED WATER LEVEL

RAILROAD TRACKS



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Engineering, Construction and Management Solutions

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(630) 637-9470

ALLIANT ENERGY
OTTUMWA, IOWA

CURRENT POND VOLUMES

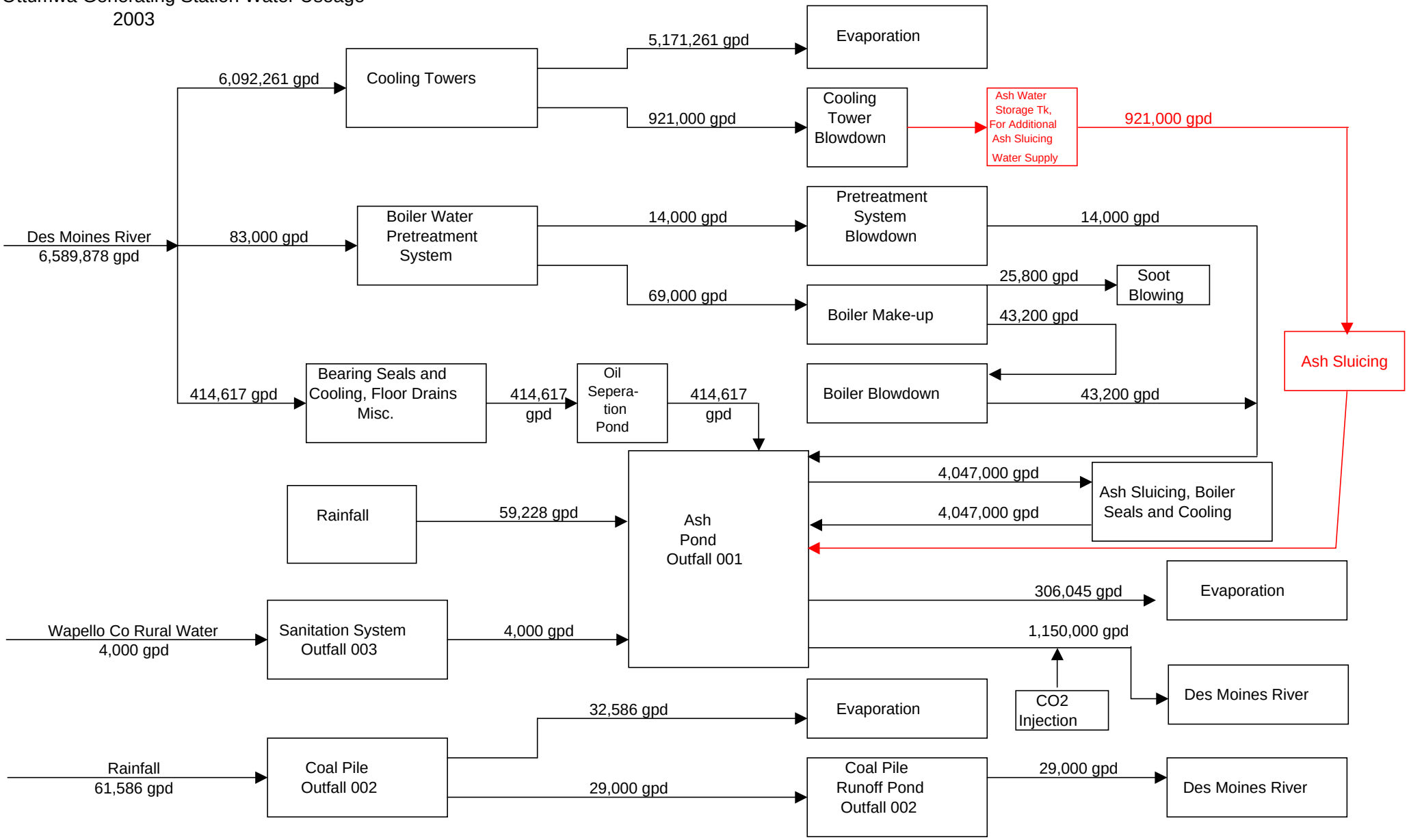
FIGURE: 3

ATTACHMENT A

OGS Water Use Diagram

CONFIDENTIAL BUSINESS INFORMATION

Ottumwa Generating Station Water Useage
2003



ATTACHMENT B

Historical Ash Production Quantities, Bathymetry, and Hydraulic Calculations

Historical Ash Production Quantities

Historical Ash Production Quantities from 2001 to 2005

Assumptions:

Total ash production is comprised of 15% bottom ash and 85% fly ash.
Fly ash is comprised of 10% economizer fly ash and 90% precipitator fly ash.
Assume all of the bottom ash and economizer ash is sent to the settling pond.

Historical Coal Burn Data

	2001	2002	2003	2004	2005	Average
Tons of Coal Burned	2,827,162	2,852,255	3,124,469	2,776,928	2,212,228	2,758,608
% Ash Content	5.47	5.26	5.33	4.93	4.97	5.19
Tons of Ash/Year	154,646	150,029	166,534	136,903	109,948	143,612

Quantities of Each Type of Ash

	2001	2002	2003	2004	2005	Average
Tons of Precipitator Ash	118,304	114,772	127,399	104,730	84,110	109,863
Tons of Economizer Ash	13,145	12,752	14,155	11,637	9,346	12,207
Tons of Bottom Ash	23,197	22,504	24,980	20,535	16,492	21,542
Total Tons of Ash (calc. check)	*154,646*	*150,029*	*166,534*	*136,903*	*109,948*	

Ash Input to Settling Pond

	2001	2002	2003	2004	2005	Average
Tons of Ash to Settling Pond	36,342	35,257	39,136	32,172	25,838	33,749
Tons of Ash Sold	27,368	19,787	29,606	41,753	30,880	29,879
Ash Introduced into the Settling Pond	8,974	15,470	9,530	-9,581	-5,042	3,870

Historical Bathymetry Data and Hydraulic Calculations

Pond Surface Area Decrease

	Jun-81	Jun-85	Aug-88	Jun-89	Jul-90	Apr-94	Apr-00	Jul-06	TOTAL
Est Surface Area (SA) - SF	1,588,000	1,366,500	1,188,000	1,038,840	984,150	826,200	665,000	790,725	790,725
Decrease in SA - SF		221,500	178,500	149,160	54,690	157,950	161,200	(125,725)	797,275
Time Period - Yr		4.00	3.17	0.83	1.08	3.75	6.00	6.25	25.08
Percent Decrease in SA per Yr		4%	5%	17%	5%	5%	4%	-2.5%	50.2%
Volume of Water - CF		Data not available	Data not available	Data not available	Data not available	5,926,490	5,690,925	5,019,894	
Volume Decrease per Yr - CF							39,261	107,365	
Percent Decrease in Vol per Yr							0.69%	2.14%	

Note: Historical Pond Survey data was provide to HHS by IP&L

Ash Generation to Settling Pond Prior to Ash Reclamation

	Jun-85	Aug-88	Jun-89	Jul-90	Apr-94	Average
Tons Ash Input from Coal Burn	99,960	72,980	13,934	16,250	30,036	
Avg Tons Ash Input Per Yr	24,990	23,046	16,721	15,000	8,010	17,554

Ash Generation to Settling Pond During Ash Reclamation

	2001	2002	2003	2004	2005	Average
Tons of Ash Input into the Pond (see Sheet 1)	36,342	35,257	39,136	32,172	25,838	33,749
Tons Ash input (see Sheet 1)	8,974	15,470	9,530	-9,581	-5,042	3,870

Current Settling Pond Characteristics

Survey Pond Volume (MGal) =	37.55	
Avg Discharge in past year (MGD) =	1.5	
Recycle Rate (MGD) =	4.0	
Total Flow (MGD) =	5.5	
Theoretical Residence Time (days) =	6.83	= Survey Pond Volume / TOTAL Flow

Assumptions:

Theoretical residence time is equal to the actual residence time in the Settling Pond.

HHS suggests that a minimum residence time (RT) of 5 days is used, based on the settling test information.

Minimum Suggested HRT is (Day) = 5

Assume that the density of the ash in place is approximately 83 lbs/cubic foot

Calculations:

Required volume for min. RT (MG) =	27.50	in ft^3 =	3,676,471
Remaining Volume in Settling Pond Before HRT of 5 Days (MGal) =	10.05	in ft^3 =	1,343,423
Ash Storage in Settling Pond (Tons) =	55,752		
Years to RT if ash is not reclaimed =	1.65	Years	

Suggestions:

If ash reclamation activities slow down, than IP&L should dredge the ash material from within the ponds within the next 1.6 years.

ATTACHMENT C

Sediment Settling Test Results

CONFIDENTIAL BUSINESS INFORMATION

HARD HAT SERVICES™
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Interstate Power and Light
Settling Test Photos
Ottumwa Generating Station
no scale

Figure 1

Date
8/28/2006

Harrington Engineering & Construction, LLC
A HARD HAT SERVICES™ Company

CONFIDENTIAL BUSINESS INFORMATION

Settling Data

Project Name: Alliant - Ottumuwa Generating Station

Project No.: 154.005.006

Logged By: TJH

Sample ID: Ash Settling Pond

Date: August 5 through August 11, 2006

Column Height = 84.50 inches

Temperature: 85 °F

Date/ Time	Time Interval	Interface Height	Depth to Interface	At 15"		At 21"		At 45"		At 51"		At 63"	
				TSS	Turbidity	TSS (ppm)	Turbidity	TSS	Turbidity	TSS	Turbidity	TSS	Turbidity
8/5/06 9:40	0:00:00	74.00	10.50										
8/5/06 9:41	0:01:00	73.50	11.00										
8/5/06 9:42	0:02:00	73.00	11.50										
8/5/06 9:44	0:04:00	72.38	12.13										
8/5/06 9:49	0:09:00	70.50	14.00										
8/5/06 10:00	0:20:00	66.75	17.75										
8/5/06 10:40	1:00:00	55.13	29.38			588							
8/5/06 11:25	1:45:00	47.13	37.38										
8/5/06 12:04	2:24:00	41.75	42.75										
8/5/06 13:15	3:35:00	34.25	50.25			124							
8/5/06 14:30	4:50:00	28.00	56.50										
8/5/06 15:44	6:04:00	24.00	60.50										
8/5/06 19:01	9:21:00	21.75	62.75			78							
8/5/06 20:55	11:15:00	21.00	63.50										
8/6/06 7:50	22:10:00	18.50	66.00										
8/6/06 9:53	24:13:00	18.25	66.25			50							
8/6/06 13:30	27:50:00	17.75	66.75										
8/6/06 18:30	32:50:00	17.25	67.25										
8/6/06 21:15	35:35:00	17.00	67.50			51							
8/7/06 7:00	45:20:00	16.50	68.00			41							
8/7/06 19:00	57:20:00	16.00	68.50										
8/8/06 19:00	81:20:00	15.75	68.75			21							
8/11/06 7:00	141:20:00	15.50	69.00										
8/12/06 8:00	166:20:00	15.38	69.13			5							

CONFIDENTIAL BUSINESS INFORMATION

Settling Data

Project Name: Alliant - Ottumuwa Generating Station

Project No.: 154.005.006

Logged By: TJH

Sample ID: Ash Settling Pond

Date: August 5 through August 11, 2006

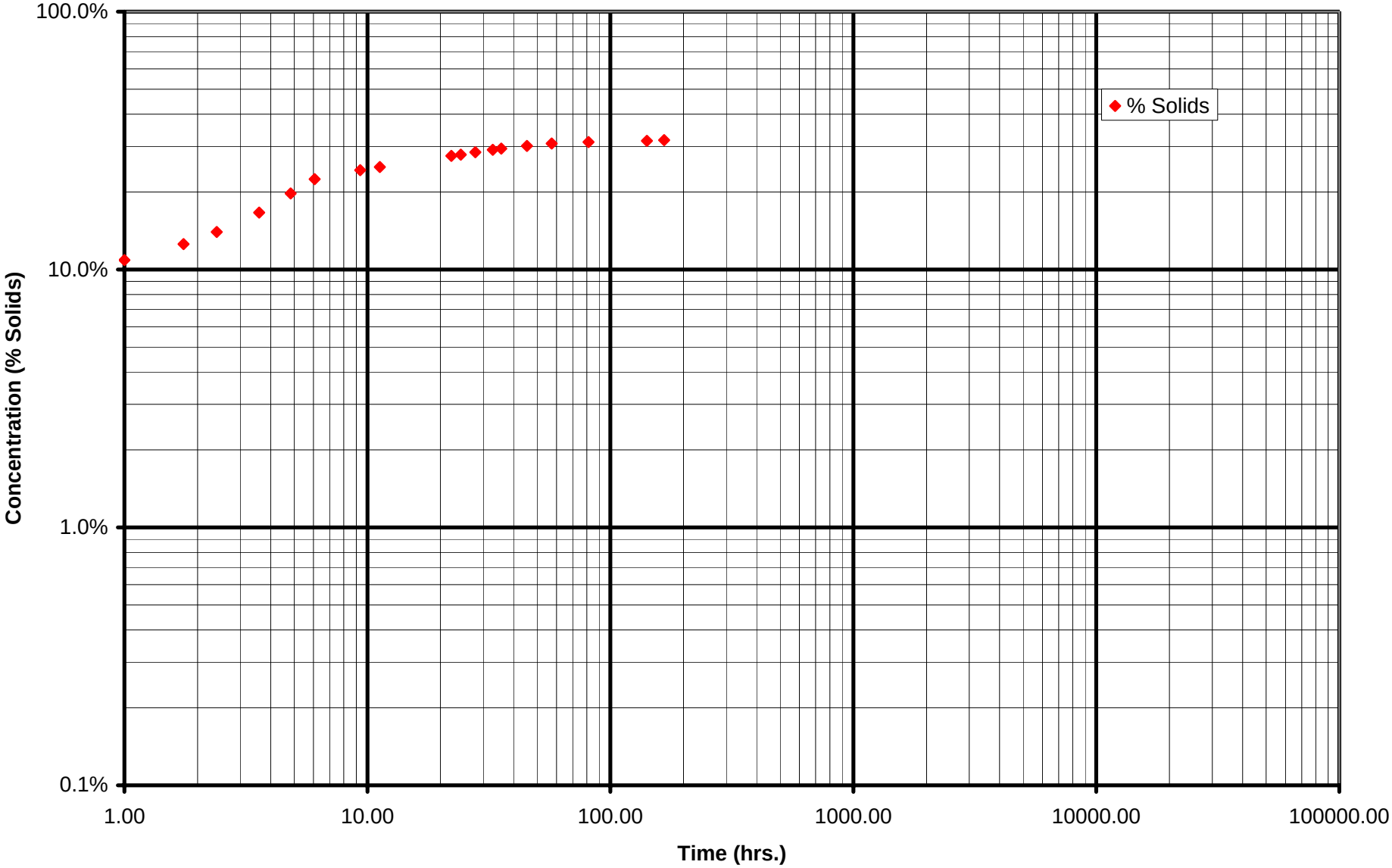
Initial Solids 8.3%

Temperature: 85 ^{o}F

Date/ Time	Time Interval	Interface Height	Concentration %
8/5/06 9:40	0:00:00	74.00	8.3%
8/5/06 9:41	0:01:00	73.50	8.4%
8/5/06 9:42	0:02:00	73.00	8.4%
8/5/06 9:44	0:04:00	72.38	8.5%
8/5/06 9:49	0:09:00	70.50	8.7%
8/5/06 10:00	0:20:00	66.75	9.1%
8/5/06 10:40	1:00:00	55.13	10.9%
8/5/06 11:25	1:45:00	47.13	12.6%
8/5/06 12:04	2:24:00	41.75	14.0%
8/5/06 13:15	3:35:00	34.25	16.6%
8/5/06 14:30	4:50:00	28.00	19.7%
8/5/06 15:44	6:04:00	24.00	22.4%
8/5/06 19:01	9:21:00	21.75	24.3%
8/5/06 20:55	11:15:00	21.00	25.0%
8/6/06 7:50	22:10:00	18.50	27.6%
8/6/06 9:53	24:13:00	18.25	27.9%
8/6/06 13:30	27:50:00	17.75	28.5%
8/6/06 18:30	32:50:00	17.25	29.1%
8/6/06 21:15	35:35:00	17.00	29.5%
8/7/06 7:00	45:20:00	16.50	30.1%
8/7/06 19:00	57:20:00	16.00	30.8%
8/8/06 19:00	81:20:00	15.75	31.2%
8/11/06 7:00	141:20:00	15.50	31.6%
8/12/06 8:00	166:20:00	15.38	31.8%

CONFIDENTIAL BUSINESS INFORMATION

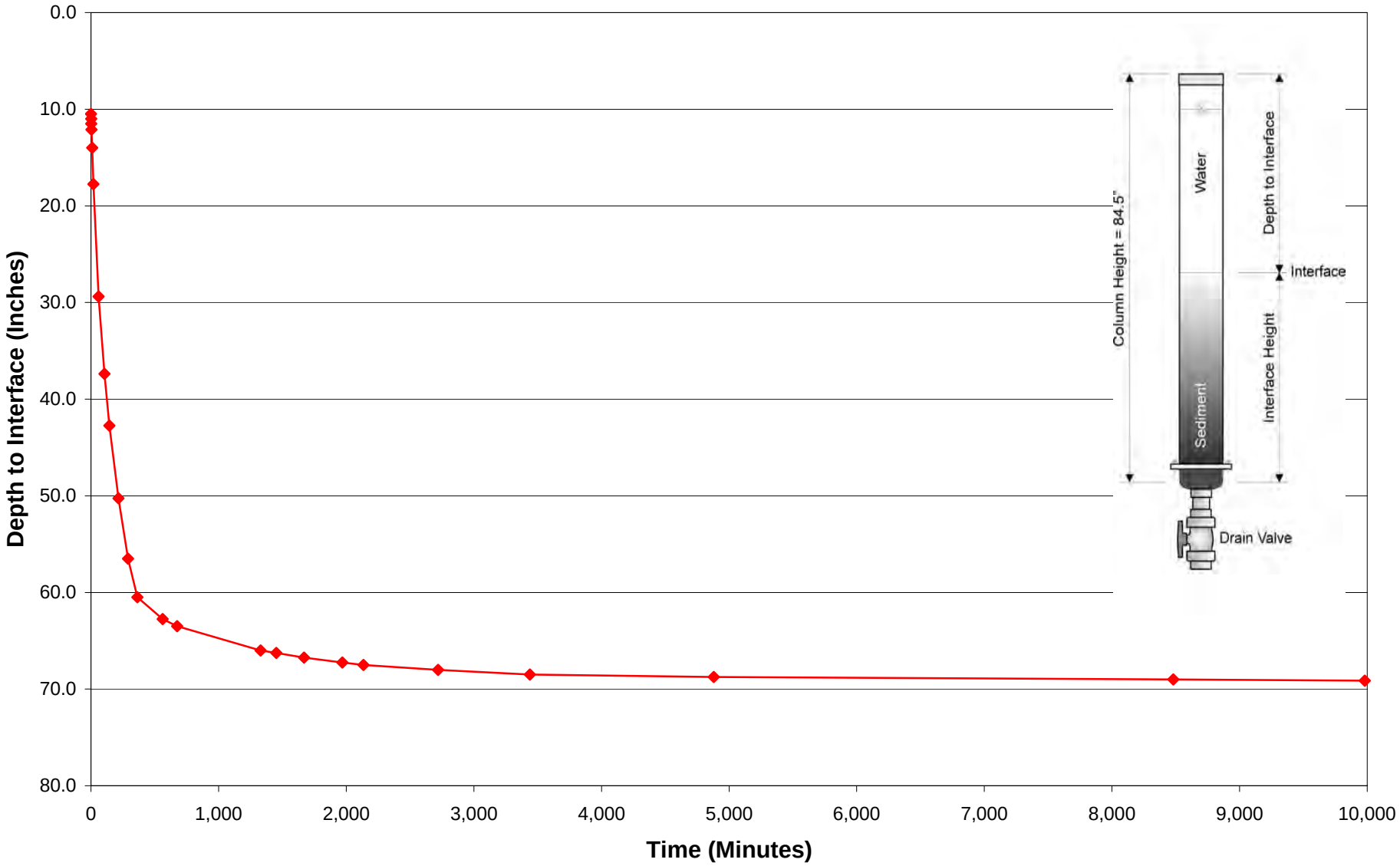
Ottumwa Settling Pond Sediment Sample
Time vs. Concentration



HE&C
Harrington Engineering & Construction, LLC
A HARD HAT SERVICES Company

CONFIDENTIAL BUSINESS INFORMATION

Settling Curve - Pond Sediment
Ottumuwa Settling Pond



HE&C
Harrington Engineering & Construction, LLC
A HARD HAT SERVICES Company

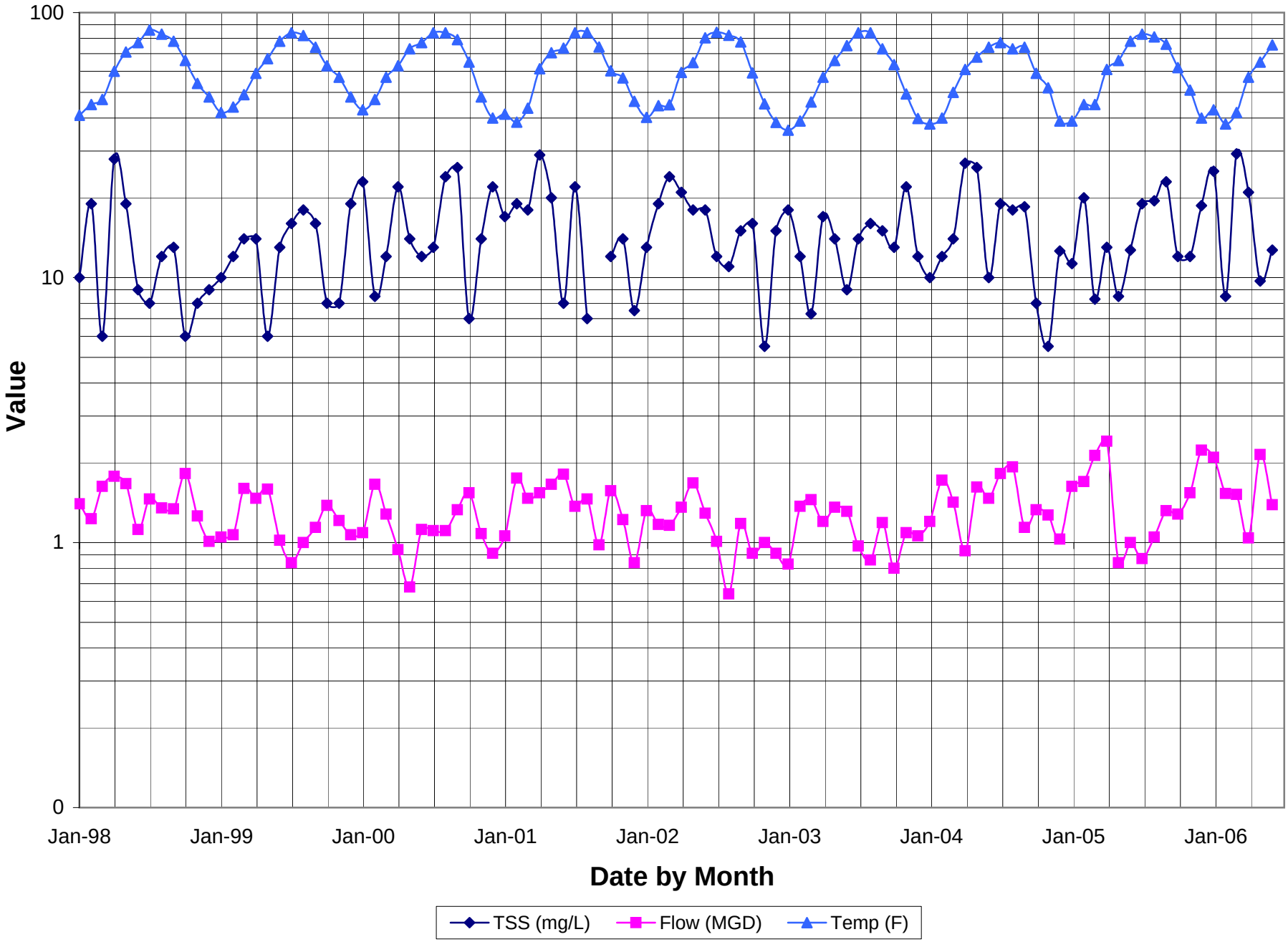
ATTACHMENT D

Historical TSS, Temperature, and Flow Data

HARD HAT SERVICES™
Engineering, Construction and Management Solutions

CONFIDENTIAL BUSINESS INFORMATION

Ottumwa Generating Station



HARD HAT SERVICES™
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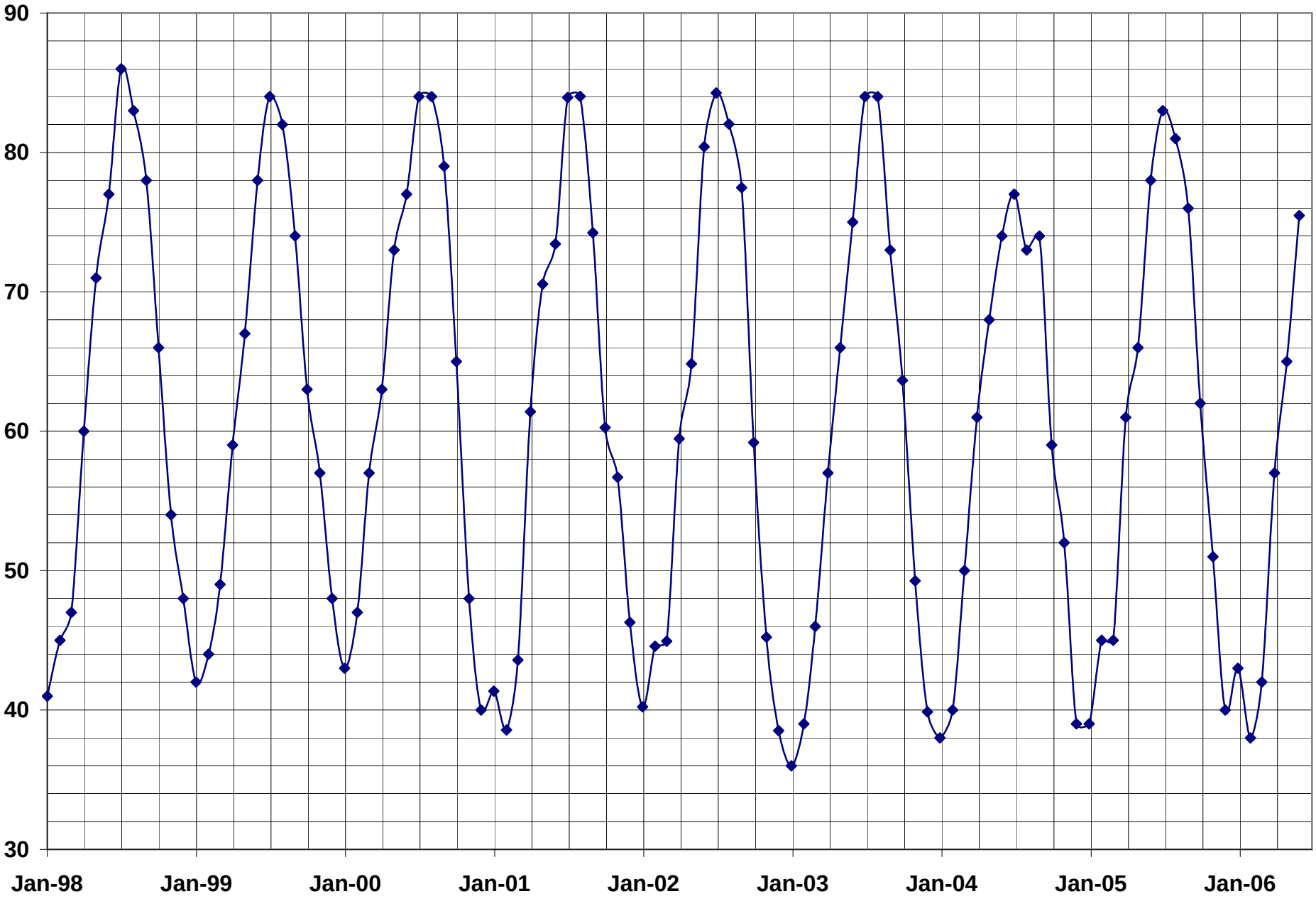
CONFIDENTIAL BUSINESS INFORMATION

Ottumwa Generating Station

Temp (F)



HARD HAT SERVICES™
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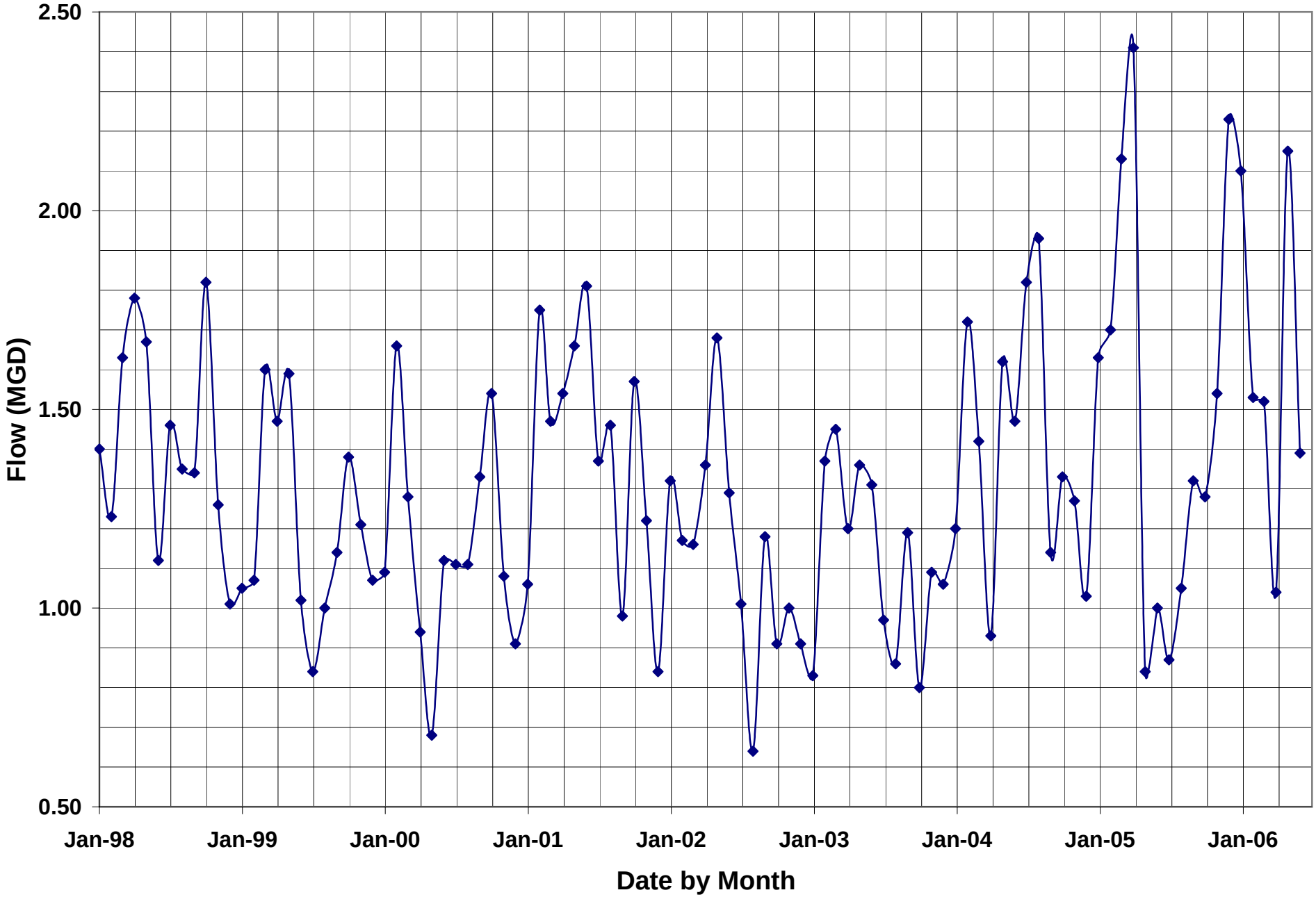
CONFIDENTIAL BUSINESS INFORMATION

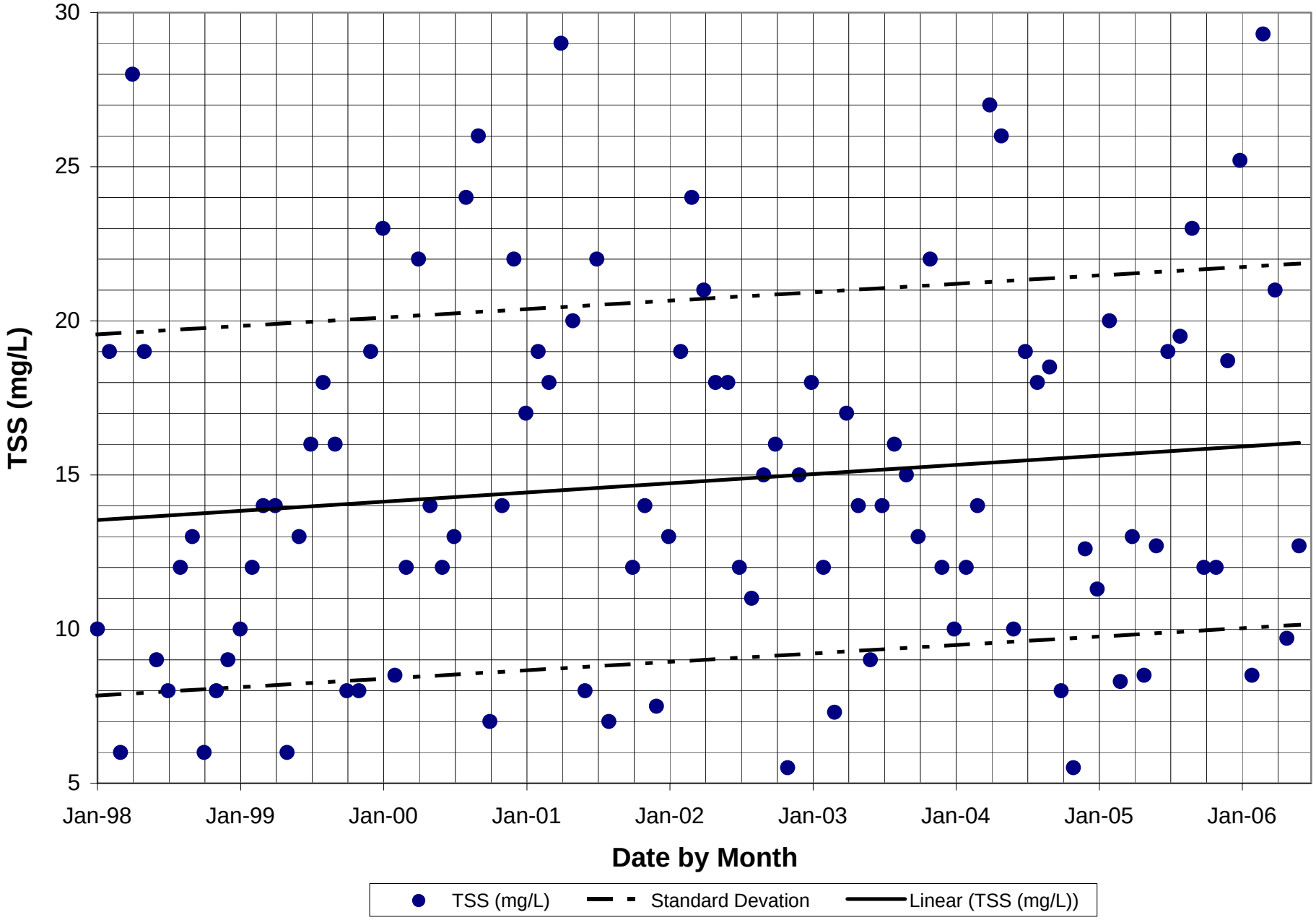
Ottumwa Generating Station

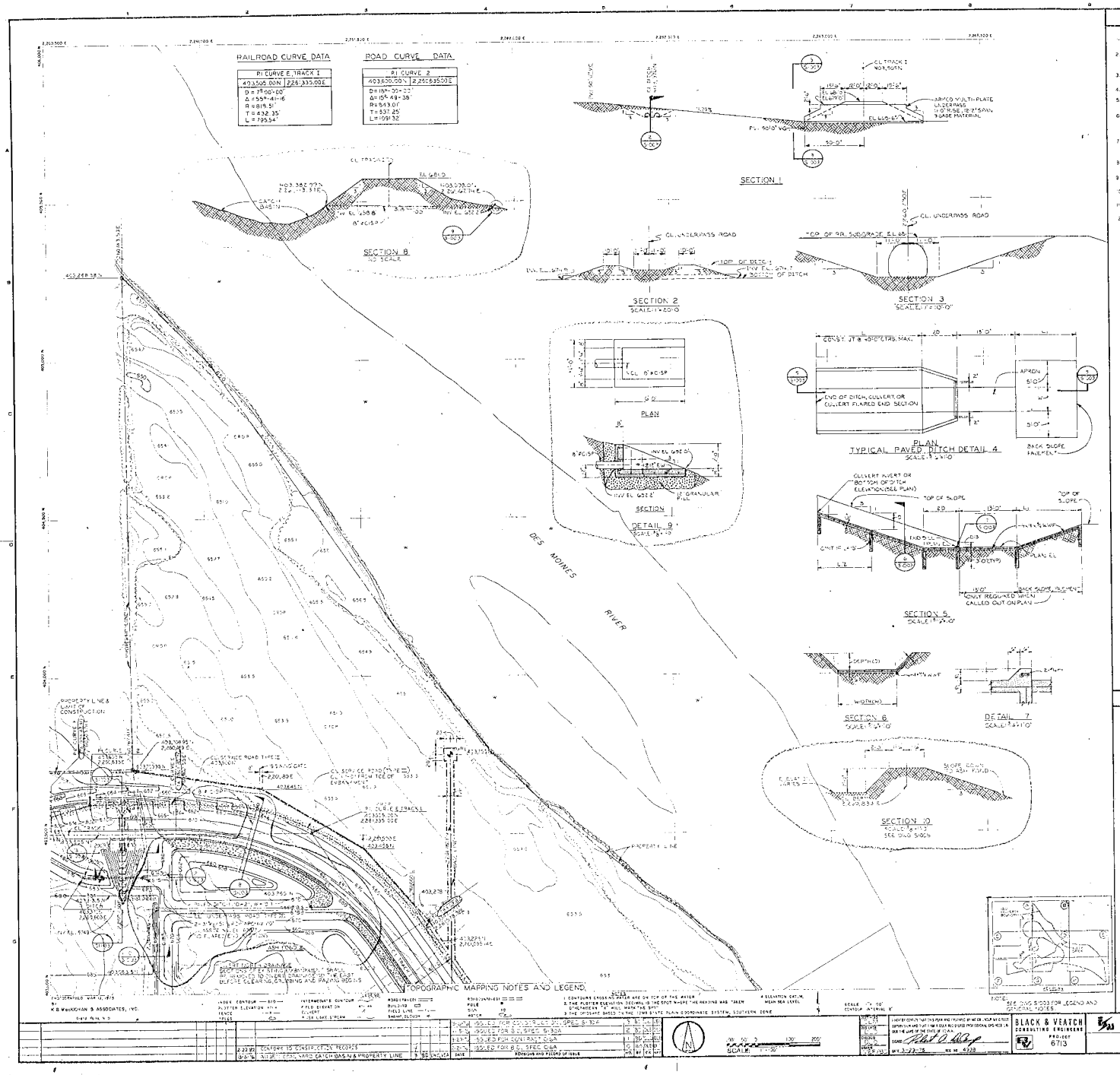


HARD HAT SERVICES™
Engineering, Construction and Management Solutions

CONFIDENTIAL BUSINESS INFORMATION

Ottumwa Generating Station





GENERAL NOTES

1. ALL WORK SHOWN ON THESE DRAWINGS SHALL BE PERFORMED BY CONTRACT 6713 C-5A UNLESS SPECIFICALLY NOTED OTHERWISE.
2. ALL EXISTING MONUMENTS, SECTION CORNERS AND REFERENCE POINTS FOR SUCH SHALL BE PRESERVED UNLESS SHOWN OTHERWISE ON THE DRAWINGS.
3. ALL TREES OUTSIDE OF THE GRADED AREAS SHALL REMAIN UNLESS SPECIFICALLY NOTED OTHERWISE.
4. ALL EXISTING FENCES SHALL BE REMOVED WITHIN 1M" OF CONST.
5. ALL CUT & FILL AND DITCH SLOPES SHALL BE 3 HORIZONTAL TO 1 VERTICAL UNLESS SPECIFICALLY NOTED OTHERWISE.
6. ROAD SECTION DUPLICATED COUNTY ROAD - BY OTHERS (SECTION NORTH AND SOUTH MAIN ACCESS ROAD, MAIN ACCESS ROAD AND PLANT ROAD SOUTH) SHALL BE INSTALLED PRIOR TO CLOSING EXISTING COUNTY ROAD.
7. A 6" HIGH LAYER OF TOPSOIL SHALL BE PLACED ON ALL AREAS ALONG CROSS CONTROL FINISH CONTOURS SHOWN ON THE DRAWINGS ARE FINAL SURFACES.
8. ALL RIPRAPPED SHALL HAVE FLARED END SECTIONS UNLESS INDICATED OTHERWISE.
9. ALL POWER POLES WITHIN THE LIMITS OF GRADING WILL BE REMOVED BY THE COMPANY.
10. TRACK WORK (SUBBALLAST, BALLAST, TIES, RAILS, ETC.) SHALL NOT BE REQUIRED FOR TRACK 1 RETURN (SPEC. 6713 S-30A)
11. THE BURLINGTON NORTHERN RR WILL PURCHASE AND INSTALL THE SWITCH AND TURNOUT FROM THEIR MAINLINE.
12. ALL RIP-RAP SHALL HAVE POLYPROPYLENE REINFORCEMENT. ALL RIP RAP SHALL HAVE A MIN. 9" THICKNESS.

CONSTRUCTION LEGEND

690	INDICATES FINISH CONTOUR, ELEVATION - FEET, MSL, UNDER SPEC. 6713 C-6A
	INDICATES LIMIT OF CONSTRUCTION UNDER SPEC. 6713 C-6A
BV#	INDICATES EXISTING MONUMENT AND NUMBER (BASE LINE AND BENCH MARK)
	INDICATES EXISTING BASE LINE
	INDICATES EXTENT OF CRUSHED ROCK OR GRAVEL SURFACING UNDER SPEC. 6713 C-6A
	INDICATES EXTENT OF RIPRAP WORK (RIPRAP AND BEDDING) UNDER SPEC 6713 C-6A
BV#	INDICATES MONUMENT AND NUMBER FURNISHED AND INSTALLED UNDER SPEC. 6713 C-6A (BASE LINE AND BENCH MARK) SEE DWG S 002 FOR DETAIL
—XX—	INDICATES FENCING FURNISHED AND INSTALLED UNDER SPEC. 6713 C-6A
	INDICATES PROPERTY LINE
—XXX—	INDICATES EXISTING FENCE (CHAIN LINK) FURNISHED AND INSTALLED BY THE COMPANY

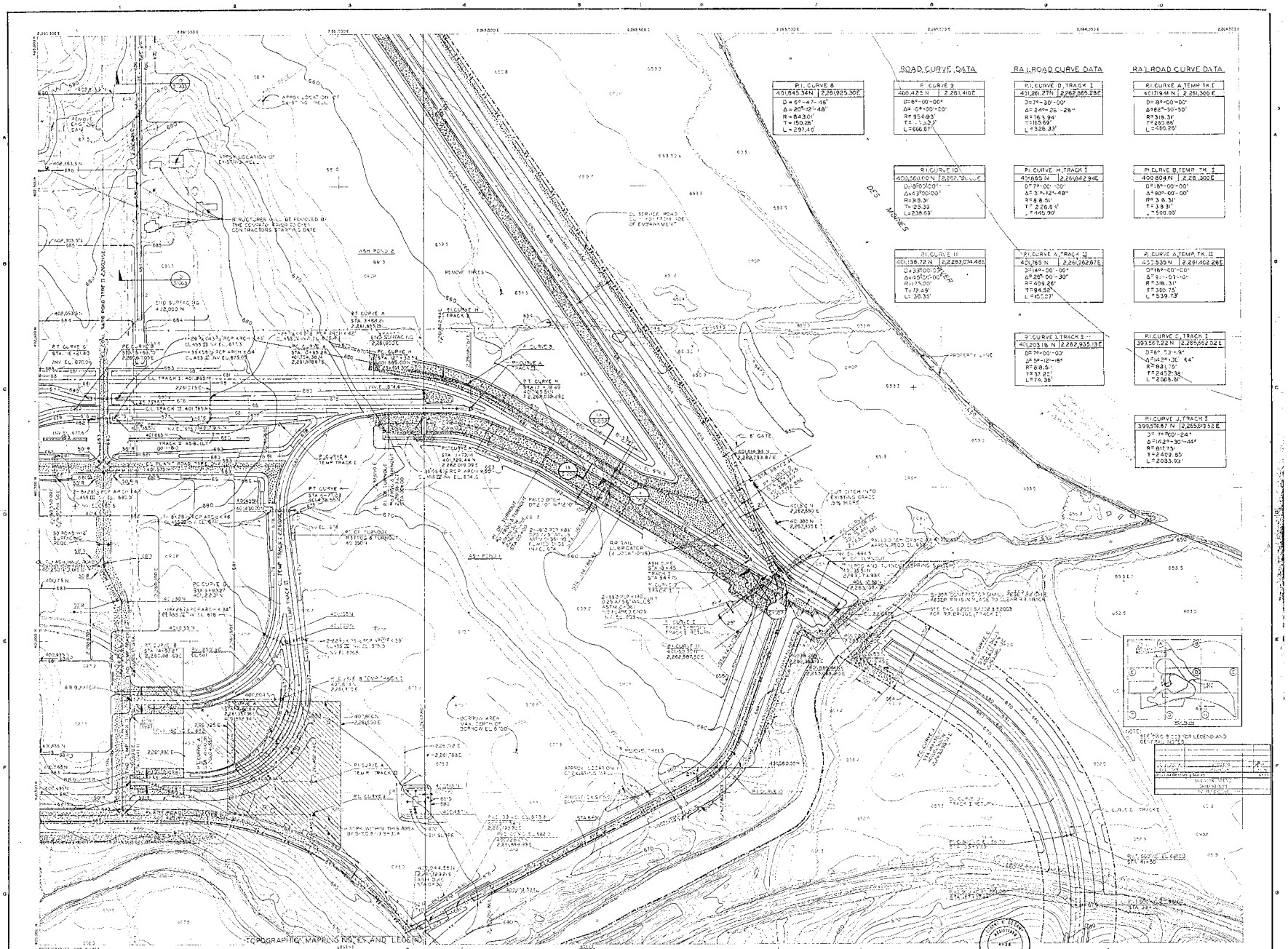
4-22-76	CORRECT IS CONSTRUCTION RECORDS		
3-8-76	ALIGN TRACK AND CATCH BASIN & PROPERTY LINE	3	BS
3-5-76	ISSUED FOR CONSTRUCTION SPEC. 6713-C-6A	2	BS
2-23-76	ISSUED FOR B.C. SPEC. 6713-C-6A	1	BS
2-2-76	ISSUED FOR B.C. SPEC. C-6A	0	BS
DATE	REVISION AND RECORD OF ISSUE	BY	CK

BLACK & VEATCH CONSULTING ENGINEERS PROJECT 6713

IOWA SOUTHERN UTILITIES COMPANY
OTTUMWA GENERATING STATION - UNIT 1

SITEWORK - AREA B
GRADING PLAN

DWG. NO. S1003


ROAD CURVE DATA
RAILROAD CURVE DATA
RAILROAD CURVE DATA
P.I. CURVE B
401,845.34N 2,261,925.30E
D = 69°-47'-48"
Δ = 20°-12'-48"
R = 843.31'
T = 150.26'
L = 297.40'
P.I. CURVE D, TRACK I
451,261.27N 2,262,869.28E
P.I. CURVE A, TEMP. TK. I
401,719.41 N 2,261,300 E
P.I. CURVE H, TRACK I
P.I. CURVE B, TEMP. TK. I
P.I. CURVE I
P.I. CURVE A, TRACK II
P.I. CURVE A, TEMP. TK. II
P.I. CURVE I, TRACK I
P.I. CURVE C, TRACK I
P.I. CURVE J, TRACK I
DES MOINES
PROPERTY LINE
ASH POND 2
ASH POND 1
SPRING SMITH
TOPOGRAPHIC MAPPING NOTES AND LEGEND
BLACK & VEATCH
CONSULTING ENGINEERS
PROJECT 6713
IOWA SOUTHERN UTILITIES COMPANY
OTTUMWA GENERATING STATION - UNIT 1
SITEWORK-AREA D
GRADING PLAN
S1005
ISSUED FOR CONSTRUCTION, SPEC S-30A
ISSUED FOR B.V. SPEC S-30A
ISSUED FOR CONTRACT C-6A
ISSUED FOR B.D. SPEC C-6A
REFERENCE ISSUE NO.
REVISED FOR PROJECT DIVERSION & MISC. REVISION

© 2010 Google
Image USDA Farm Service Agency
Imagery Date: Jun 20, 2009
41°05'54.75" N 92°33'08.04" W elev 681 ft
©2009 Google
Eye alt 8210 ft

Alliant Energy Corporate Services, Inc.
Legal Department
200 First Street SE
P.O. Box 351
Cedar Rapids, IA 52406-0351

Office: 319.786.4505
www.alliantenergy.com

May 18, 2009

VIA OVERNIGHT DELIVERY

Mr. Richard Kinch
US Environmental Protection Agency
Two Potomac Yard
2733 S. Crystal Dr.
5th Floor: N-5738
Arlington, VA 22202-2733

RE: Response to Request for Information Under Section 104(e) of the Comprehensive Environmental Response, Compensation, and Liability Act

Dear Mr. Kinch:

On May 4, 2009, the Ottumwa Generating Station, a facility owned and operated by Interstate Power and Light Company ("IPL"), on whose behalf this response is submitted, received a "Request for Information Under Section 104(e) of the Comprehensive Environmental Response, Compensation, and Liability Act" (hereinafter "Request") from the United States Environmental Protection Agency ("EPA"). EPA's Request was undated. EPA's Request required a response within 10 business days of receipt; therefore, this response is timely filed.

EPA's Request seeks information relating to Ottumwa Generating Station's surface impoundments or similar diked or bermed management unit(s) or management units designated as landfills which receive liquid-borne material from a surface impoundment used for 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. EPA seeks responses to ten specific questions set forth in Enclosure A to the Request.

This letter and the enclosed documents respond to EPA's Request. IPL has made diligent and good faith efforts to provide documents and information that are in its possession and which IPL could reasonably collect and prepare for production within the timeframe allotted.

A. General Objections

Based on its review of and good-faith efforts to respond timely to the Request, IPL wishes to note for the record that it has several objections to the form and content of the Request.

IPL objects to the Request on the grounds that it is unduly burdensome and overly broad, seeks irrelevant information, is vague and unclear in its scope, requires legal conclusions to be made, and is otherwise unreasonable, thereby exceeding EPA's authority under CERCLA Section 104(e).

IPL objects to the Request to the extent that it seeks information beyond the scope of EPA's authority under Section 104(e) of CERCLA. Section 104(e) authorizes EPA to request, upon reasonable notice, information or documents relating to the following:

1. The identification, nature, and quantity of materials which have heen or arc generated, treated, stored, or disposed of at a vessel or facility or transported to a vessel or facility.
2. The nature or extent of a release or threatened release of a hazardous substance or pollutant or contaminant at or from a vessel or facility.
3. Information relating to the ability of a person to pay for or to perform a cleanup.

IPL does not object to questions relating to the (1) type and quantity of materials stored, temporarily or permanently, in the surface impoundments and (2) nature and extent of actual releases or threatened releases; however, IPL believes that the other questions in the Request, e.g., structural integrity, dates of commissioning/expansion, PE certifications, etc., are beyond the scope of EPA's authority under Section 104(e).

IPL also objects to the extent that the Request seeks information that may be subject to attorney-client privilege or other applicable privilege, or which constitutes protected attorney work product, or which is otherwise not discoverable.

Where the questions in the Request are vague, ambiguous, overbroad, or beyond the scope of EPA's CERCLA Section 104(e) authority, IPL has made appropriate and reasonable efforts to provide responsive information to the best of its ability to interpret the questions. Subject to and without waiving its objections, IPL states that it is providing information at this time based on its review conducted in response to the specific items in the Request. In the event that IPL discovers additional responsive material, it will submit such material to EPA as soon as reasonably possible.

Because EPA has requested that IPL respond to this request within only 10 business days, IPL has not had the opportunity to determine whether the responsive contents of this letter constitute **"confidential business information,"** as defined by 40 CFR Part 2,

Subpart B. Therefore, with the exception of the Iowa Department of Natural Resources inspection report provided in response to item number 6 of EPA's Enclosure A, IPL requests that **EPA treat this letter and the narrative responses within as "confidential business information."**

Finally, IPL objects to the following phrase as vague, unclear, and ambiguous: "surface impoundment or similar diked or bermed management unit(s) or management units designated as landfills which receive liquid-borne material for storage or disposal of residual or by-products from the combustion of coal." For purposes of this Request, IPL interprets this phrase to mean:

1. Any surface impoundment that directly receives coal combustion by-products (CCB) in a liquid-borne manner (i.e., water mixed with ash) from the coal combustion process in the boiler, as well as any subsequent surface impoundments through which this CCB and water mixture may pass before the water exits the CCB management units via the NPDES permitted discharge point. This includes current operating CCB management units, as well as any surface impoundments which historically received CCB and which still contain free liquids.
2. IPL's interpretation of this phrase does not include storm water retention ponds, coal pile runoff retention ponds, cooling water ponds, etc. which may contain small incidental amounts of CCB which was transmitted via rain waters or as fugitive dust. These ponds and impoundments were neither designed nor intended for temporary or long-term storage or disposal of CCB.

B. Specific Responses to Items in Enclosure A

1. Relative to the National Inventory of Dams criteria for High, Significant, Low, or less-than-Low Hazard Potential, please provide the potential hazard rating for each management unit and indicate who established the rating, what the basis of the rating is, and what federal or state agency regulates the unit(s). If the unit(s) does not have a rating, please note that fact.

a. Main Ash Pond: Based on its review of readily available records and interviews with long term staff, IPL has not identified that this pond was ever rated relative to the "National Inventory of Dams" criteria by any federal or state regulatory agency.

b. Zero Liquid Discharge Pond: Based on its review of readily available records and interviews with long term staff, IPL has not identified that this pond was ever rated relative to the "National Inventory of Dams" criteria by any federal or state regulatory agency.

2. What year was each management unit commissioned and expanded?

a. Main Ash Pond: Commissioned in 1981.

b. Zero Liquid Discharge Pond: Commissioned in 1981.

---

3. What materials are temporarily or permanently contained in the unit? Use the following categories to respond to this question: (1) fly ash; (2) bottom ash: (3) boiler slag; (4) flue gas emission control residuals; (5) other. If the management unit contains more thau one type of material, please identify all that apply. Also, if you identify "other", please specify the other types of materials that are temporarily or permanently contained in the unit(s).

a. Main Ash Pond: Materials temporarily or permanently contained are

- Fly ash
- Bottom ash
- Other: ash transport water, boiler water wash, air heater wash (fly ash), steam grade water production wastewaters, storm water runoff from plant site, leachate from OML Landfill; plant floor drains, Solids Contact Units sludge for the treatment of Des Moines River water; cooling tower blowdown; and boiler blowdown (steam/water).

b. Zero Liquid Discharge Pond: Materials temporarily or permanently contained are

- Storm Water Runoff from the C-Stone (hydrated flyash) Storage pile
- Other: boiler water wash, air heater wash (fly ash), turbine cleans, and boiler chemical cleans

---

4. Was the management unit(s) designed by a Professional Engineer? Is or was the construction of the waste management (s) under the supervision of a Professional Engineer? Is inspection and monitoring of the safety of the waste management unit(s) under the supervision of a Professional Engineer?'

a. Main Ash Pond:

- Based on review of readily available records, the pond was designed by a Professional Engineer.
- Based on review of readily available records, the pond was constructed under the supervision of a Professional Engineer.

- Inspection and monitoring of the safety of the pond is not under the supervision of a Professional Engineer.

b. Zero Liquid Discharge Pond:

- Based on review of readily available records, the pond was designed by a Professional Engineer.
- Based on review of readily available records, the pond was constructed under the supervision of a Professional Engineer.
- Inspection and monitoring of the safety of the pond is not under the supervision of a Professional Engineer.

---

5. When did the company last assess or evaluate the safety (i. e., structural integrity) of the management unit(s)? Briefly describe the credentials of those conducting the structural integrity assessments/evaluations. Identify actions taken or planned by facility personnel as a result of these assessments or evaluations. If corrective actions were taken, briefly describe the credentials of those performing the corrective actions, whether they were company employees or contractors. If the company plans an assessment or evaluation in the future, when is it expected to occur?

a. Main Ash Pond:

- IPL conducted a visual structural inspection on March 5, 2009.
- The assessment team inspecting the pond on March 5, 2009, consisted of a Civil Engineer; Senior Environmental Specialist; and a Plant Manager with an Engineering Degree.
- The March 5, 2009, inspection recommended the removal of some small trees on the inside of the berm that will be accomplished by December 31, 2009, by plant personnel or contractors working under the direct supervision of plant personnel.
- IPL currently has no future assessment/evaluation formally scheduled, but has developed an internal evaluation program which will include periodic assessments.

b. Zero Liquid Discharge Pond:

- IPL conducted a visual structural inspection on March 5, 2009.
- The assessment team inspecting the pond on March 5, 2009, consisted of a Civil Engineer; Senior Environmental Specialist; and a Plant Manager with an Engineering Degree.
- The March 5, 2009, inspection recommended the removal of some small trees on the inside of the berm that will be accomplished by December 31, 2009, by plant personnel or contractors working under the direct supervision of plant personnel.

- IPL currently has no future assessment/evaluation formally scheduled, but has developed an internal evaluation program which will include periodic assessments.

---

6. When did a State or a Federal regulatory official last inspect or evaluate the safety (structural integrity) of the management unit(s)? If you are aware of a planned state or federal inspection or evaluation in the future, when is it expected to occur? Please identify the Federal or State regulatory agency or department which conducted or is planning the inspection or evaluation.
Please provide a copy of the most recent official inspection report or evaluation.

a. Main Ash Pond:
   - This pond is part of a wastewater management unit subject to an NPDES permit. The Iowa Department of Natural Resources performed a Facility Wastewater Inspection on February 21, 2008. The inspection report does not include an evaluation of the structural integrity of the pond.
   - IPL is not aware of any planned state or federal regulatory agency future inspection to evaluate the safety (structural integrity) of this pond.
   - A copy of the Iowa Department of Natural Resources Facility Wastewater Inspection report is attached for your awareness.

b. Zero Liquid Discharge Pond:
   - This pond is part of a wastewater management unit subject to an NPDES permit. The Iowa Department of Natural Resources performed a Facility Wastewater Inspection on February 21, 2008. The inspection report does not include an evaluation of the structural integrity of the pond.
   - IPL is not aware of any planned state or federal regulatory agency future inspection to evaluate the safety (structural integrity) of this pond.
   - A copy of the Iowa Department of Natural Resources Facility Wastewater Inspection report is attached for your awareness.

---

7. Have assessments or evaluations, or inspections conducted by State or Federal regulatory officials conducted within the past year uncovered a safety issue(s) with the management unit(s), and if so, describe the actions that have been or are being taken to deal with the issue or issues.
Please provide any documentation that you have for these actions.

a. Main Ash Pond: There have been no assessments, evaluations, or inspections by a state or federal regulatory agency within the past year.

b. Zero Liquid Discharge Pond: There have been no assessments, evaluations, or inspections by a state or federal regulatory agency within the past year.

---

8. What is the surface area (acres) and total storage capacity of each of the management units? What is the volume of materials currently stored in each of the management unit(s). Please provide the date that the volume measurement was taken. Please provide the maximum height of the management unit(s). The basis for determining maximum height is explained later in this Enclosure.

a. Main Ash Pond:
   - Surface area: 18.2 acres
   - Total storage capacity: 370,000 cubic yards; measurement date – 2006.
   - Volume of materials stored: 288,000 cubic yards; measurement date – 2006.
   - Maximum height of management unit: 25 feet

b. Zero Liquid Discharge Pond:
   - Surface area: 17.3 acres
   - Total storage capacity: 515,000 cubic yards; measurement date – 2006.
   - Volume of materials stored: 142,000 cubic yards; measurement date – 2006.
   - Maximum height of management unit: 25 feet

---

9. Please provide a brief history of known spills or unpermitted releases from the unit within the last ten years, whether or not these were reported to State or federal regulatory agencies. For purposes of this question, please include only releases to surface water or to the land (do not include releases to groundwater).

a. Main Ash Pond: IPL is not aware of any known spills or unpermitted releases from this pond within the past 10 years. For purposes of this question, all discharges exiting the pond via the discharge point governed under the NPDES permit, including any water quality exceedances, are interpreted to be "permitted releases".

b. Zero Liquid Discharge Pond: IPL is not aware of any known spills or unpermitted releases from this pond within the past 10 years. For purposes of this question, all discharges exiting the pond via the discharge point governed under the NPDES permit, including any water quality exceedances, are interpreted to be "permitted releases".

---

10. Please identify all current legal owner(s) and operator(s) at the facility.

a. The Operator is: Interstate Power and Light Company

b. The Owners are:

- Interstate Power and Light Company
- MidAmerican Energy Company

C. **Confidentiality of IPL's Response.**

As noted above, IPL requests that EPA treat the information submitted herein as "confidential business information".

* * * *

Please find attached the affidavit of John Larsen, Vice President-Generation, that is being submitted with this response to the information request. Please feel free to contact me at (319) 786-4686 if you have any questions concerning this response.

Very truly yours,

Daniel L. Siegfried
Managing Attorney

Enclosure: Iowa DNR Wastewater Compliance Inspection Report dated March 11, 2008.

Certification

I certify that the information contained in this response to EPA's request for information and the accompanying documents is, based on my personal belief and my knowledge of the actions taken to respond to the information request and subject to the explanation that follows, true, accurate, and complete. The response points out ambiguities and other difficulties in responding to the request, and where that is true, a good faith effort has been made to provide information that is reasonably available and responsive to the request. As to the portions of this response for which I cannot personally verify their accuracy, I certify under penalty of law that this response and all attachments were prepared in accordance with a system designed to reasonably assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

Signature: _____

Name: John O. Larsen

Title: Vice President - Generation

Fields of Opportunities

STATE OF IOWA

CHESTER J. CULVER, GOVERNOR
PATTY JUDGE, LT. GOVERNOR

DEPARTMENT OF NATURAL RESOURCES
RICHARD A. LEOPOLD, DIRECTOR

March 11, 2008

Jim Allen, Plant Manager
Alliant Energy - Ottumwa Generating Station
20775 Power Plant Rd.
Ottumwa, IA 52501

SUBJECT: Wastewater Inspection Report
Facility No. 6-90-00-1-01

Dear Mr. Allen:

On 2-21-2008, I conducted an inspection of the Ottumwa Generating Station's wastewater treatment facilities. Enclosed is a copy of my inspection report.

If you have any questions about the report, feel free to contact me at this office.

Sincerely,

FIELD SERVICES & COMPLIANCE BUREAU

Paul Brandt

Paul Brandt
Environmental specialist Senior

J:/pbrandt/ww/ottm-gen0208-ltr

Encl. Inspection Report

xc: Records Section, DNR, Des Moines
William Skalitzky, Alliant Energy, P.O. Box 77007, Madison, WI 53707-1007
File - industrial - Alliant, Ottumwa Generating Station

IOWA DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL SERVICES DIVISION
WASTEWATER TREATMENT FACILITY INSPECTION

NPDES Permit #: 6-90-00-1-01

FACILITY	NAME: Alliant Energy – Ottumwa Generating Station		OWNER: Interstate Power & Light /MidAmerican		
	ADDRESS: 20775 Power Plant Rd.	CITY: Ottumwa	STATE: Iowa	ZIP: 52501-8797	PHONE: 641 935-2901

RECEIVING STREAM	STREAM NAME: Des Moines River

INSPECTION	DATE THIS INSPECTION: **2-21-2008**	DATE LAST INSPECTION: 6-1-2005
PURPOSE	Compliance Evaluation Inspection	

NOW TREATING	MGD (average daily) : 1.75 (from 001)	POUNDS BOD: NA	PE (BOD) : NA
	POPULATION SERVED: NA		

RESPONSIBLE OPERATOR	NAME: Jim Allen, Plant Manager	GRADE: NA	CERTIFICATION NUMBER: NA

PERSONS INTERVIEWED	NAME: Kevin Brehm	TITLE: Environmental & Safety Specialist
	NAME: Jim Allen	TITLE: Plant Manager

TREATMENT PROCESS	[ ] TRICKLING FILTER [ ] ACTIVATED SLUDGE = > MODIFICATION: [X] LAGOON [ ] AERATED LAGOON [ ] OTHER/SUPPLEMENTARY:
PROCESS WASTE DESCRIPTION	Various industrial waste streams from electrical power plant

PERMIT COMPLIANCE SUMMARY		
EFFLUENT LIMITATIONS	SELF-MONITORING RESULTS: [X] Sat. [ ] Marg.* [ ] Unsat.*	SAMPLES THIS INSPECTION: [ ] Sat. [ ] Marg.* [ ] Unsat.* [X] None Collected
	VISUAL APPEARANCE OF EFFLUENT: Clear	VISUAL APPEARANCE OF RECEIVING STREAM: Frozen over except near bank at outfall

SELF-MONITORING	Operation Reports submitted: [X] Sat. [ ] Marg.* [ ] Unsat.*	REQUIRED DATA ON REPORT: [X] Sat. [ ] Marg.* [ ] Unsat.*	TESTING ADEQUACY: [X] Sat. [ ] Marg.* [ ] Unsat.*

COMPLIANCE SCHEDULE	COMPLIANCE WITH SCHEDULE: [ ] Sat. [ ] Marg.* [ ] Unsat.* NA	NEXT ITEM DUE: NA	DATE DUE: NA

* Explain in Comments and Recommendations Section

AUTHENTICATION	INSPECTOR: Paul Brandt	DATE: 3-10-08	REVIEWER: James T. Sievers	DATE:

GENERAL INFORMATION

The NPDES permit for the Ottumwa Generating Station includes six outfalls, 001 through 006. The first two outfalls are the only ones that discharge to a water of the state - 001 bottom ash basin and 002 coal pile runoff basin. Both discharge to drainage ditches to the Des Moines River. Outfalls 003, 004 & 005 (domestic wastewater sewage treatment plant, chemical metal cleaning, and cooling tower blowdown respectively) all discharge to the bottom ash basin. Outfall 006 is for storm water around the river intake structure.

Cooling water is obtained from the Des Moines River. The lime sludge/river solids removed from the intake water is discharged to the bottom ash pond. Potable water for the plant comes from Wapello Rural Water Association. There is also a large total retention lagoon on site referred to as the zero discharge pond. There are no waste streams piped to it and all storm water is diverted from it.

DISCHARGE MONITORING

Monthly reports are submitted to DNR Field Office #6. Reports are generally on time and contain all required data, sampled at the specified frequencies. Most of the testing is sent to Test America (DNR certified lab #7).

Monthly reports for the year 2007 were reviewed. All discharges, except one, were within the specified limits; that one was the coal pile runoff pond (002) in October. Effluent flow from the bottom ash basin averages about 1.75 MGD. The cooling tower blowdown contributes about 0.648 MGD to the basin. All discharges from the bottom ash pond (001) were within permit limits.

There were three discharges (draw downs) from the coal pile runoff basin. The discharge in October exceeded permit limits for TSS (138 mg/l versus limit of 50). The discharge was shut off once the lab results showed it to be high and reported to Field Office #6. Mr. Brehm reported the high solids were probably a result of the coal pile being very large, heavy rains, and the basin needing dredging.

There are several monitoring wells around the ash basin and these are sampled quarterly for sulfates - this is required in the permit.

FACILITY INSPECTION

001 - The bottom ash basin is a large earthen lagoon. The effluent structure is equipped with a Parshall flume for flow measurement and a carbon dioxide injection system for pH control; pH is maintained between 8.0-8.6. New flow monitoring equipment has been installed since the last inspection. We observed the outfall at the Des Moines River. The discharge was running clear at this time.

002 - The coal pile runoff basin - there is actually a smaller basin above the main basin, and most of the settling (coal fines) takes place in the upper basin. The main pond is scheduled for dredging soon. At the time of this inspection, a road was being constructed so the dredging contractor can get machinery to the basin. The upper basin and ditches will probably be cleaned out too.

On 2-8-08, Alliant notified DNR Field Office #6 of an on-going wastewater leak from the coal pile runoff basin outlet manhole and that the pond would have to be drained to determine the cause and repairs for the leak. The leaking water was running down a ditch, over the access road and into another ditch where the 002 discharge normally occurs. At the time of the inspection, the pond had been drained to a low level, but the cause of the leak not determined due to very inclement weather. Monitoring results for the drawdown showed it to meet permit limits (TSS = 22 mg/l; Zn & Cr less than detection).

003 - Sanitary wastes from the power plant are treated in a separate system. This consists of a 15,000 gallon septic tank, an 8000 gallon recirculation tank and an AdvanTex 100 filter system. The recirculation tank and filter system were installed in December, 2006 (construction permit # 2007-0088-S) to replace an older activated sludge package plant. The new system is inside a new building. The building was planned with plenty of room, with the idea that disinfection will need to be installed at some point in the future. This domestic wastewater plant is outfall 003 and discharges to the bottom ash pond (001). The waste stream is regulated for CBOD, TSS and pH. Average flow ranges about 2000 to 9000 GPD. All discharges from 003 were within the permit limits for the review period.

004 - Chemical Metal Cleaning - never used - no discharge in 2007. (It would go to the bottom ash pond if there was a discharge).

005 - Cooling Tower Blowdown - not observed. This waste stream goes to the bottom ash pond (001). It is regulated for Zn & Cr. There were no permit violations in 2007.

006 - Roof drain from river intake structure - the concern here is due to an electrical transformer on the roof of the building. The discharge is actually the downspout running down the side of the building. Observed nothing unusual here. There are no monitoring or discharge requirements associated with this outfall, other than observations during storm water inspections.

Other Discharges - All floor drains in the power plant go to an oil/water separator (OWS). This is a typical underground unit located on the south side of the power plant. It discharges to a very small pond called the "oil separation pond". Transformer pad areas also drain to the oil separation pond, as do some of the secondary containments around outdoor bulk storage tanks. The oil separation pond discharges to the bottom ash pond (001). The oil separation pond was not observed at this time due to snow.

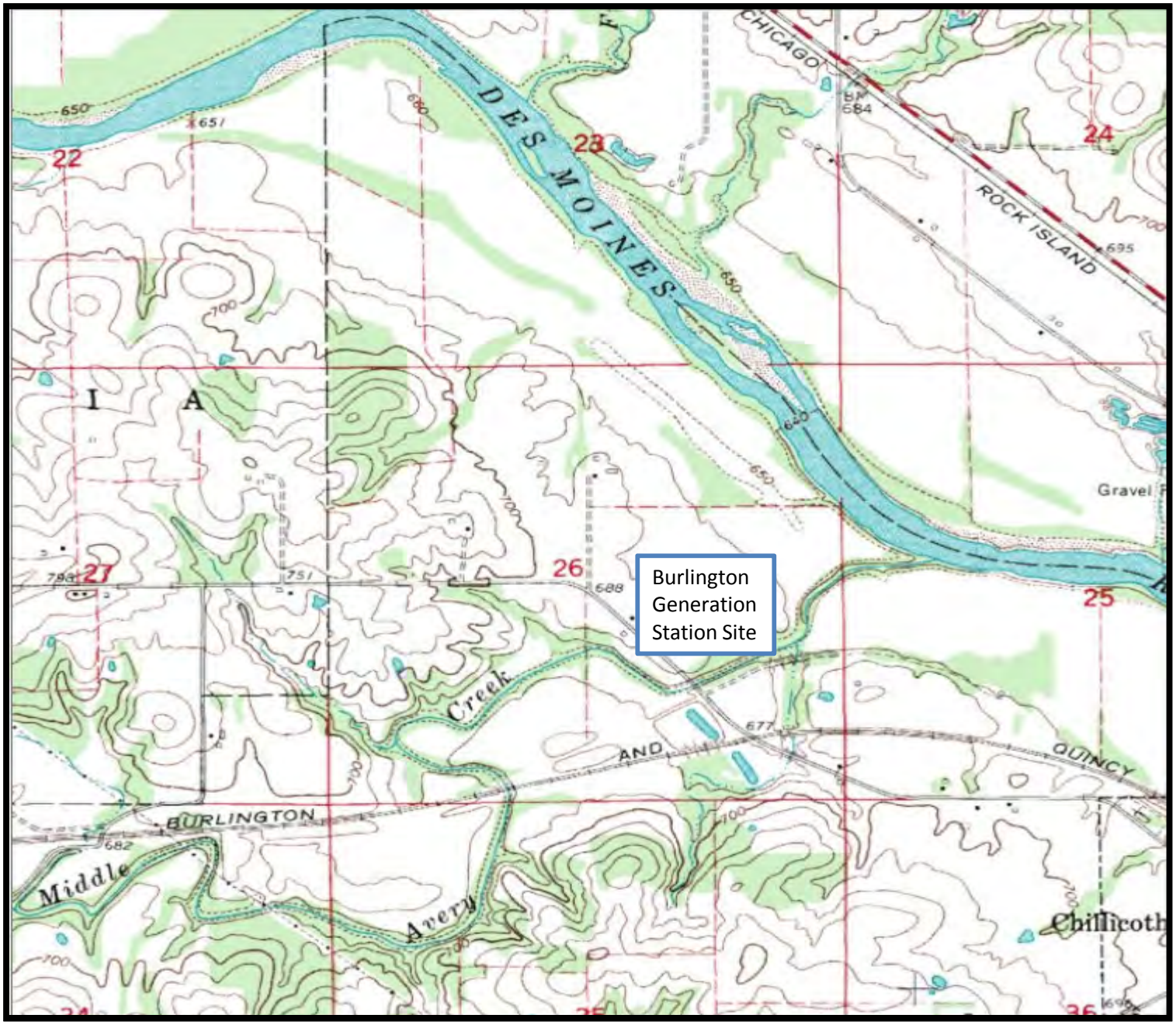
Storm Water - All storm water on the plant grounds goes to either the bottom ash pond or the coal pile runoff basin (001/002). There are no other storm water runoff points at the facility. Monthly storm water inspections are conducted and documented. I reviewed the monthly inspections at this time and they include a very thorough checklist of plant storm water runoff concerns.

SUMMARY

Based on file reviews and on-site observations, Alliant appears to be running an effective wastewater treatment program. The only discharge violation to occur during the review period (calendar year 2007) was an October drawdown of 002, the coal pile runoff basin. The up-coming dredging project should help this situation.

The cause of the 2-2-08 leak at the coal pile runoff basin has not been determined yet. The reason for the leak needs to be identified and appropriate repairs made.

J:/pbrandt/ww/ottm-gen0208-rpt


Burlington
Generation
Station Site
DES MOINES
CHICAGO
ROCK ISLAND
BURLINGTON
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QUINCY
Middle
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CONFIDENTIAL BUSINESS INFORMATION

ALLIANT ENERGY SURFACE POND VISUAL INSPECTION

PLANT NAME:	DATE COMPLETED:	LIST POND INSPECTED:
Ottumwa Generating Station	24-Jun-10	Bottom ash pond
INSPECTOR(S): List Below	WEATHER CONDITIONS: Describe Weather Conditions	
Al White, Kevin Brehm	Clear	
PLANT MANAGEMENT REVIEW(if applicable): Spell Name	SIGNATORY REVIEW:	
Plant Manager:Jim Allen		
E&S Specialist Kevin Brehm		

1. Dike Integrity	Yes	No	Action Needed?
Visual Signs of Animal Activity into the dike wall that may impact the integrity of the dike wall?		X	
Trees growing on top or side of dike in which the root system may impact the integrity of the dike wall?		X	
Woody type shrubs growing on top or side of dike in which the root system may impact the integrity of the dike wall?		X	
Any visual seeps of water through the dike wall?		X	
Any areas of soft soil/dead vegetation on the dike wall?		X	
Any areas of eroison caused either by wind eroison; storm water runoff into or outside the dike wall?		X	
Any evidence of ash pond water washing over the dike wall?		X	
Where applicable, are any of the valving or piping used to control the discharge from a pond leaking?		X	
Any ponding of water outside the dike wall?		X	
Any evidence of damage caused by heavy equipment?		X	
2. Outfall Structure			
Any areas of erosion or animal activity near or at the entrance of the outfall structure or pipe that may cause wastewater to travel along the outside of the pipe?		X	
Any areas of erosion; animal activity; swirling of wastewater on the discharge side of the outfall structure that may impact the integrity of the dike or structure?		X	
Woody type shrubs growing on top or side of dike in which the root system may impact the integrity of the dike wall?		X	
3. Visable Solids			
Is there a build up of settled ash visible near the dike walls or discharge structure?		X	

IOWA DEPARTMENT OF NATURAL RESOURCES
National Pollutant Discharge Elimination System (NPDES) Permit

PERMITTEE

INTERSTATE POWER & LIGHT COMPANY
20775 POWER PLANT ROAD
OTTUMWA, IA 52501

IDENTITY AND LOCATION OF FACILITY

IP&L-OTTUMWA STATION
Section 26, T 73N, R15W
WAPELLO County, Iowa

IOWA NPDES PERMIT NUMBER: 9000101

RECEIVING STREAM

DES MOINES RIVER

DATE OF ISSUANCE: 03-05-2003

ROUTE OF FLOW

DATE OF EXPIRATION: 03-04-2008

YOU ARE REQUIRED TO FILE FOR RENEWAL OF THIS PERMIT BY: 09-06-2007

EPA NUMBER: IA0060909

This permit is issued pursuant to the authority of section 402(b) of the Clean Water Act (33 U.S.C 1342(b)), Iowa Code section 455B.174, and rule 567—64.3, Iowa Administrative Code. You are authorized to operate the disposal system and to discharge the pollutants specified in this permit in accordance with the effluent limitations, monitoring requirements and other terms set forth in this permit.

You may appeal any conditions of this permit by filing a written notice of appeal and request for administrative hearing with the director of this department within 30 days of your receipt of this permit.

Any existing, unexpired Iowa operation permit or Iowa NPDES permit previously issued by the department for the facility identified above is revoked by the issuance of this permit. This provision does not apply to any authorization to discharge under the terms and conditions of a general permit issued by the department or to any permit issued exclusively for the discharge of storm water.

FOR THE DEPARTMENT OF NATURAL RESOURCES

By _____
Wayne Farrand, Supervisor
Wastewater Section
ENVIRONMENTAL SERVICES DIVISION

Outfall Number	Description
001	BOTTOM ASH BASIN WHICH INCLUDES ASH TRANSPORT WATER, COOLING TOWER BLOWDOWN, LANDFILL LEACHATE, LOW VOLUME WASTE, SANITARY WASTE, METAL CLEANING & STORMWATER.
002	COAL PILE RUNOFF BASIN DISCHARGE
003	SEWAGE TREATMENT PLANT DOMESTIC WASTEWATER DISCHARGE PRIOR TO COMBINATI9ON WITH ANY OTHER WASTEWATER DISCHARGE.
004	CHEMICAL METAL CLEANING WASTE PRIOR TO MIXING WITH OTHER WASTESTREAMS.
005	COOLING TOWER BLOWDOWN PRIOR TO MIXING WITH OTHER WASTESTREAMS.
006	STORM WATER ASSOCIATED WITH INDUSTRIAL ACTIVITY FROM THE AREA OF THE WATER INTAKE STRUCTURE..

Facility Name: IP&L-OTTUMWA STATION

Page

Permit Number: 9000101

Effluent Limitations

OUTFALL NO.: 001 BOTTOM ASH BASIN WHICH INCLUDES ASH TRANSPORT WATER, COOLING TOWER BLOWDOWN, LANDFILL LEACHATE, LOW VOLU

You are prohibited from discharging pollutants except in compliance with the following effluent limitations:

			EFFLUENT LIMITATIONS							
			Concentration				Mass			
Wastewater Parameter	Season	Type	7 Day Average	30 Day Average	Daily Maximum	Units	7 Day Average	30 Day Average	Daily Maximum	Units
TOTAL SUSPENDED SOLIDS	YEARLY	FINAL		30.0000	100.0000	MG/L		453.00	1509.00	LBS/DAY
PH (MINIMUM - MAXIMUM)	YEARLY	FINAL	6.0000		9.0000	STD UNITS				
CHLORINE,TOTAL RESIDUAL	YEARLY	FINAL			.1000	MG/L			1.50	LBS/DAY
OIL AND GREASE	YEARLY	FINAL		15.0000	20.0000	MG/L		226.00	302.00	LBS/DAY

NOTE: If seasonal limits apply, summer is from April 1 through October 31, and winter is from November 1 through March 31.

lity Name: IP&L-OTTUMWA STATION

Permit Number: 9000101

Effluent Lim. .tions

OUTFALL NO.: 002 COAL PILE RUNOFF BASIN DISCHARGE.

You are prohibited from discharging pollutants except in compliance with the following effluent limitations:

			EFFLUENT LIMITATIONS							
			Concentration				Mass			
Wastewater Parameter	Season	Type	7 Day Average	30 Day Average	Daily Maximum	Units	7 Day Average	30 Day Average	Daily Maximum	Units
TOTAL SUSPENDED SOLIDS	YEARLY	FINAL			50.0000	MG/L				
PH (MINIMUM - MAXIMUM)	YEARLY	FINAL	6.0000		9.0000	STD UNITS				

NOTE: If seasonal limits apply, summer is from April 1 through October 31, and winter is from November 1 through March 31.

lity Name: IP&L-OTTUMWA STATION

Permit Number: 9000101

Effluent Lin .tions

OUTFALL NO.: 003 SEWAGE TREATMENT PLANT DOMESTIC WASTEWATER DISCHARGE PRIOR TO COMBINATION WITH ANY OTHER WASTEWATER DISCHA

You are prohibited from discharging pollutants except in compliance with the following effluent limitations:

			EFFLUENT LIMITATIONS							
			Concentration				Mass			
Wastewater Parameter	Season	Type	7 Day Average	30 Day Average	Daily Maximum	Units	7 Day Average	30 Day Average	Daily Maximum	Units
CBOD5	YEARLY	FINAL	40.0000	25.0000		MG/L				
TOTAL SUSPENDED SOLIDS	YEARLY	FINAL	45.0000	30.0000		MG/L				
PH (MINIMUM - MAXIMUM)	YEARLY	FINAL	6.0000		9.0000	STD UNITS				

NOTE: If seasonal limits apply, summer is from April 1 through October 31, and winter is from November 1 through March 31.

lity Name: IP&L-OTTUMWA STATION

Page

Effluent Lim .tions

Permit Number: 9000101

OUTFALL NO.: 004 CHEMICAL METAL CLEANING WASTE PRIOR TO MIXING WITH OTHER WASTESTREAMS.

You are prohibited from discharging pollutants except in compliance with the following effluent limitations:

Wastewater Parameter	Season	Type	EFFLUENT LIMITATIONS							
			Concentration				Mass			
			7 Day Average	30 Day Average	Daily Maximum	Units	7 Day Average	30 Day Average	Daily Maximum	Units
COPPER,TOTAL (AS CU)	YEARLY	FINAL		1.0000	1.0000	MG/L				
IRON,TOTAL (AS FE)	YEARLY	FINAL		1.0000	1.0000	MG/L				

NOTE: If seasonal limits apply, summer is from April 1 through October 31, and winter is from November 1 through March 31.

Ility Name: IP&L-OTTUMWA STATION

Page

Permit Number: 9000101

Effluent Lim. .tions

OUTFALL NO.: 005 COOLING TOWER BLOWDOWN PRIOR TO MIXING WITH OTHER WASTESTREAMS.

You are prohibited from discharging pollutants except in compliance with the following effluent limitations:

			EFFLUENT LIMITATIONS							
			Concentration				Mass			
Wastewater Parameter	Season	Type	7 Day Average	30 Day Average	Daily Maximum	Units	7 Day Average	30 Day Average	Daily Maximum	Units
CHROMIUM,TOTAL (AS CR)	YEARLY	FINAL		.2000	.2000	MG/L				
ZINC,TOTAL (AS ZN)	YEARLY	FINAL		1.0000	1.0000	MG/L				

NOTE: If seasonal limits apply, summer is from April 1 through October 31, and winter is from November 1 through March 31.

F ity Name: IP&L-OTTUMWA STATION

Page

Permit Number: 9000101

Non-Standa. Effluent Limitations

OUTFALL NO.: 001 BOTTOM ASH BASIN WHICH INCLUDES ASH TRANSPORT WATER, COOLING TOWER BLOWDOWN, LANDFILL LEACHATE, LOW VOLUME

Wastewater Parameter	Non-Standard Limits
CHLORINE,TOTAL RESIDUAL	NEITHER FREE AVAILABLE CHLORINE NOR TOTAL RESIDUAL CHLORINE MAY BE DISCHARGED FROM ANY UNIT FOR MORE THAN 2 HOURS IN ANY ONE DAY AND NOT MORE THAN ONE UNIT IN ANY PLANT MAY DISCHARGE FREE AVAILABLE CHLORINE OR TOTAL RESIDUAL CHLORINE AT ANY ONE TIME.

Fa ity Name: IP&L-OTTUMWA STATION

Permit Number: 9000101

OUTFALL NO.: 002 COAL PILE RUNOFF BASIN DISCHARGE.

Non-Standa. Effluent Limitations

Wastewater Parameter	Non-Standard Limits
TOTAL SUSPENDED SOLIDS	ANY UNTREATED OVERFLOW FROM FACILITIES DESIGNED, CONSTRUCTED AND OPERATED TO TREAT THE VOLUME OF COAL PILE RUNOFF WHICH IS ASSOCIATED WITH A 10 YEAR, 24 HOUR RAINFALL EVENT SHALL NOT BE SUBJECT TO THE EFFLUENT LIMITATIONS FOR TOTAL SUSPENDED SOLIDS.

F lity Name: IP&L-OTTUMWA STATION

Permit Number: 9000101

Monitoring and Reporting Requirements

(a) Samples and measurements taken shall be representative of the volume and nature of the monitored wastewater.

(b) Analytical and sampling methods as specified in 40 CFR Part 136 or other methods approved in writing by the department, shall be utilized.

(c) Chapter 63 of the rules provides you with further explanation of your monitoring requirements.

(d) You are required to report all data including calculated results needed to determine compliance with the limitations contained in this permit. This includes daily maximums and minimums, 30-day averages and 7-day averages for all parameters that have concentration (mg/l) and mass (lbs/day) limits. Also, flow data shall be reported in million gallons per day (MGD).

(e) Results of all monitoring shall be recorded on forms provided by, or approved by, the department, and submitted to the department by the fifteenth day following the close of the reporting period. Your reporting period is on a monthly basis, ending on the last day of each month.

Outfall Number	Wastewater Parameter	Sample Frequency	Sample Type	Monitoring Location
001	FLOW	7/WEEK	24 HR TOTAL	FINAL EFFLUENT
001	TOTAL SUSPENDED SOLIDS	1/MONTH	GRAB	FINAL EFFLUENT
001	PH (MINIMUM - MAXIMUM)	1/MONTH	GRAB	FINAL EFFLUENT
001	CHLORINE,TOTAL RESIDUAL	1/MONTH	GRAB	FINAL EFFLUENT
001	OIL AND GREASE	1/MONTH	GRAB	FINAL EFFLUENT
001	TEMPERATURE	7/WEEK	GRAB	FINAL EFFLUENT
001	DURATION OF CHLORINE DISCHARGE	7/WEEK	MEASUREMENT	MONTHLY REPORT
001	PH (MINIMUM - MAXIMUM)	1/12 MONTHS	GRAB	FINAL EFFLUENT FROM LEACHATE POND
001	ARSENIC,TOTAL (AS AS)	1/12 MONTHS	GRAB	FINAL EFFLUENT FROM LEACHATE POND
001	BARIUM,TOTAL (AS BA)	1/12 MONTHS	GRAB	FINAL EFFLUENT FROM LEACHATE POND
001	CADMIUM,TOTAL (AS CD)	1/12 MONTHS	GRAB	FINAL EFFLUENT FROM LEACHATE POND
001	CHROMIUM,TOTAL (AS CR)	1/12 MONTHS	GRAB	FINAL EFFLUENT FROM LEACHATE POND
001	COPPER,TOTAL (AS CU)	1/12 MONTHS	GRAB	FINAL EFFLUENT FROM LEACHATE POND
001	LEAD,TOTAL (AS PB)	1/12 MONTHS	GRAB	FINAL EFFLUENT FROM LEACHATE POND
001	NICKEL,TOTAL (AS NI)	1/12 MONTHS	GRAB	FINAL EFFLUENT FROM LEACHATE POND
001	SOLIDS,DISSOLVED	1/12 MONTHS	GRAB	FINAL EFFLUENT FROM LEACHATE POND
001	ZINC,TOTAL (AS ZN)	1/12 MONTHS	GRAB	FINAL EFFLUENT FROM LEACHATE POND
001	SULFATE,TOTAL (AS SO4)	1/3 MONTH	GRAB	TEST WELLS SURROUNDING ASH BASINS
002	FLOW	1/MONTH	24 HR TOTAL	ONLY DURING PERIOD OF DISCHARGE
002	TOTAL SUSPENDED SOLIDS	1/MONTH	GRAB	ONLY DURING PERIOD OF DISCHARGE
002	PH (MINIMUM - MAXIMUM)	1/MONTH	GRAB	ONLY DURING PERIOD OF DISCHARGE

F lity Name: IP&L-OTTUMWA STATION

Permit Number: 9000101

Monitoring and Reporting Requirements

(a) Samples and measurements taken shall be representative of the volume and nature of the monitored wastewater.

(b) Analytical and sampling methods as specified in 40 CFR Part 136 or other methods approved in writing by the department, shall be utilized.

(c) Chapter 63 of the rules provides you with further explanation of your monitoring requirements.

(d) You are required to report all data including calculated results needed to determine compliance with the limitations contained in this permit. This includes daily maximums and minimums, 30-day averages and 7-day averages for all parameters that have concentration (mg/l) and mass (lbs/day) limits. Also, flow data shall be reported in million gallons per day (MGD).

(e) Results of all monitoring shall be recorded on forms provided by, or approved by, the department, and submitted to the department by the fifteenth day following the close of the reporting period. Your reporting period is on a monthly basis, ending on the last day of each month.

Outfall Number	Wastewater Parameter	Sample Frequency	Sample Type	Monitoring Location
003	FLOW	1/WEEK	24 HR TOTAL	RAW WASTE OR FINAL EFFLUENT(FLOW)
003	CBOD5	1/3 MONTH	24 HR COMP	FINAL EFFLUENT
003	TOTAL SUSPENDED SOLIDS	1/3 MONTH	24 HR COMP	FINAL EFFLUENT
003	PH (MINIMUM - MAXIMUM)	1/3 MONTH	GRAB	FINAL EFFLUENT
003	SETTLEABLE SOLIDS	1/WEEK	GRAB	FINAL EFFLUENT
003	TEMPERATURE	1/3 MONTH	GRAB	FINAL EFFLUENT
003	DISSOLVED OXYGEN (MINIMUM)	1/WEEK	GRAB	AERATION BASIN CONTENTS
003	SOLIDS,MIXED LIQUOR SUSPENDED	1/MONTH	GRAB	AERATION BASIN CONTENTS
003	TEMPERATURE	1/WEEK	GRAB	AERATION BASIN CONTENTS
003	30-MINUTE SETTLEABILITY	1/WEEK	GRAB	AERATION BASIN CONTENTS
004	FLOW	1/WEEK	24 HR TOTAL	EFFLUENT FROM CHEMICAL METAL CLEANING WASTES (ONLY DURING PERIOD OF DISCHARGE)
004	COPPER,TOTAL (AS CU)	1/WEEK	GRAB	EFFLUENT FROM CHEMICAL METAL CLEANING WASTES (ONLY DURING PERIOD OF DISCHARGE)
004	IRON,TOTAL (AS FE)	1/WEEK	GRAB	EFFLUENT FROM CHEMICAL METAL CLEANING WASTES (ONLY DURING PERIOD OF DISCHARGE)
005	FLOW	1/MONTH	24 HR TOTAL	COOLING TOWER BLOWDOWN PRIOR TO MIXING WITH OTHER WASTESTREAMS
005	CHROMIUM,TOTAL (AS CR)	1/WEEK	GRAB	COOLING TOWER BLOWDOWN PRIOR TO MIXING WITH OTHER WASTESTREAMS
005	ZINC,TOTAL (AS ZN)	1/WEEK	GRAB	COOLING TOWER BLOWDOWN PRIOR TO MIXING WITH OTHER WASTESTREAMS

Facility Name: .IP&L – Ottumwa Station
Facility Number: 90-00-1-01

ADDITIONAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

COOLING TOWER BLOWDOWN

1. No detectable amounts of the 126 priority pollutants listed in Appendix "A" of 40 CFR Part 423 may be discharged in cooling tower blowdown as a result of the use of cooling tower maintenance chemicals, except that chromium and zinc may be discharged subject to the effluent limitations specified on page #7 and the monitoring requirements specified on page # 11 of this permit.

2. Compliance with this requirement may be demonstrated either by sampling and analysis of the cooling tower blowdown or by certification that the discharge complies with this requirement as follows:

   a)
   If compliance is to be demonstrated by sampling and analysis the permittee shall analyze a sample of cooling tower blowdown at least once each six (6) months for each of the 126 priority pollutants listed in Appendix "A" of 40 CFR Part 423. The samples shall consist of cooling tower blowdown collected at a point prior to mixing with any other water or wastewater and at a time that is representative of normal facility operations. Results of this monitoring shall be submitted with the monthly operation report.

   b)
   As an alternative to the monitoring specified in part "a", the permittee may certify compliance following an evaluation that the use of cooling tower maintenance chemicals does not result in a detectable amount of any of the 126 priority pollutants, except chromium and zinc, in cooling tower blowdown as a result of this chemical use. If the permittee elects this certification option the following statement shall be submitted at least once each six (6) months with the monthly operation report:

"I certify to the best of my knowledge and belief that no detectable concentrations of the 126 priority pollutants listed in Appendix "A" of 40 CFR part, except as specifically authorized by the NPDES permit, were discharged in cooling tower blowdown as a result of the use of cooling tower maintenance chemicals since filing the last report".

STORM WATER DISCHARGES COVERED UNDER THIS PERMIT

PART I. DESCRIPTION OF STORM WATER DISCHARGES

A. STORM WATER DISCHARGE ASSOCIATED WITH INDUSTRIAL ACTIVITY

This permit authorizes the discharge of storm water associated with industrial activity from outfalls 001, 002 and 006 identified on page 2 of this permit.

B. STORM WATER DISCHARGE NOT ASSOCIATED WITH INDUSTRIAL ACTIVITY

Storm water discharge associated with industrial activity (as defined in chapter 567-60 of the Iowa Administrative Code) authorized by this permit may be combined with other sources of storm water that are not classified as associated with industrial activity pursuant to 40 CFR 122.26(b)(14) or with wastewater from outfalls defined elsewhere in this permit.

C. LIMITATION ON COVERAGE

Unless specifically identified elsewhere in this permit, the following discharges are not authorized under this permit:

- non-storm water discharges except those listed elsewhere in this permit,
- the discharge of hazardous substances or oil resulting from an on-site spill,
- storm water discharge associated with industrial activity from construction activity, specifically any land disturbing activity of one or more acres;

D. NON-STORM WATER DISCHARGES

The following non-storm water discharges may be authorized by this permit provided the non-storm water component of the discharge is in compliance with the conditions listed in the storm water portion of this permit:

discharges from fire fighting activities, fire hydrant flushing, potable water sources including waterline flushing, drinking fountain water, uncontaminated compressor condensate, irrigation drainage, lawn watering, routine external building washdown that does not use detergents or other compounds, air conditioning condensate, uncontaminated springs, uncontaminated ground water, and foundation or footing drains where flows are not contaminated with process materials such as solvents.

PART II. SPECIAL CONDITIONS

ADDITIONAL REQUIREMENTS FOR FACILITIES WITH SALT STORAGE

Storage piles of salt used for deicing or other commercial or industrial purposes and that generate a storm water discharge to waters of the United States shall be enclosed or covered to prevent exposure to precipitation, except for exposure resulting from adding or removing materials from the pile.

PART III. STORM WATER POLLUTION PREVENTION PLAN

A storm water pollution prevention plan shall be developed and implemented. The storm water pollution prevention plan will be prepared in accordance with good engineering practices. The plan must identify potential sources of pollution that may reasonably be expected to affect the quality of storm water discharge associated with industrial activity from the facility. In addition, the plan must describe and ensure the implementation of practices that are used to reduce the pollutants in storm water discharge associated with industrial activity at the facility and to ensure compliance with the terms and conditions of this permit. You are required to implement the storm water pollution prevention plan required under this part as a condition of this permit.

A. CONTENTS OF THE STORM WATER POLLUTION PREVENTION PLAN

The plan shall include, at a minimum, the following items.

1. Pollution Prevention Team The plan shall identify a specific individual or individuals within the facility organization as members of a Storm Water Pollution Prevention Team that is responsible for developing the storm water pollution prevention plan and assisting the facility or plant manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member.

2. Description of Potential Pollutant Sources The plan shall provide a description of potential sources which may reasonably be expected to add pollutants to storm water discharges or which may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. The plan shall identify all activities and significant materials that may potentially be pollutant sources. The plan shall include, at a minimum:

a. Drainage and Site Plan - A site map shall be developed for the facility. This map shall include, at a minimum: the location of all structures (manufacturing buildings, garages, etc.), impervious areas, the location of each storm water outfall and/or connection to the municipal storm sewer; types of discharges included in each discharge; an outline of the portions of the drainage area of each outfall within the facility boundaries and a prediction of the direction of flow in each area; each existing structural control measure to reduce pollutants in storm water runoff; surface water bodies; locations where materials are exposed to precipitation; and locations of major spills or leaks identified under Part III.A.2.c. The map shall also indicate the locations of the following activities: any bag house or other air pollution control device, the portion of the site where regular sweeping or equivalent housekeeping measures will be implemented to prevent the accumulation of spilled materials or settled dust, fueling stations; vehicle and equipment maintenance and/or cleaning areas; loading/unloading areas; locations used for the treatment, storage or disposal of wastes; storage tanks and other containers; processing and storage areas; access roads, rail cars and tracks; the location of transfer of substances in bulk; and machinery.

b. Inventory of Exposed Materials and Management Practices - an inventory of the types of materials handled at the site that potentially may be exposed to precipitation. Such inventory shall include a narrative description of "significant materials" that have been handled, treated, or disposed of in a manner to allow exposure to storm water beginning from 3 years prior to the issuance date of this permit, method and location of on-site storage or disposal; materials management practices employed to minimize contact of materials with storm water runoff beginning 3 years prior to the issuance date of this permit to the present; the location and a description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives.

c. Spills and Leaks - a list of any hazardous condition occurrence(s) at areas that are exposed to precipitation or that otherwise drain to a storm water conveyance at the facility dating 3 years prior to the issuance date of this permit. Such list shall be updated as appropriate during the term of the permit.

d. Sampling Data - a summary of any existing discharge sampling data describing pollutants in storm water collected 5 years before the permit issuance date and actual sampling data obtained for this permit shall be included in the storm water pollution prevention plan. All sampling data shall be held for a period of at least 5 years.

e. Risk Identification and Summary of Potential Pollutant Sources -

(1) A narrative description of the potential pollutant sources from the following: loading, unloading, and transfer of chemicals; outdoor storage of salt, pallets, coal, drums, containers, fuels, or other materials; outdoor manufacturing or processing activities; significant dust or particulate generating processes; fueling stations; vehicle and equipment maintenance and/or cleaning areas; locations used for the treatment, storage or disposal (on or off site) of wastes and wastewater; storage tanks and other containers; processing and storage areas; access roads, rail cars and tracks; the location of transfer of substances in bulk; and machinery.

(2) The description shall specifically list any significant potential source of pollutants at the site and for each potential source, any pollutant or pollutant parameter (e.g., total suspended solids) of concern shall be identified.

(3) Factors to consider include: quantity of chemicals used, produced or discharged, the likelihood of contact with storm water and the history of significant leaks or spills. In addition, flows with a significant potential for causing erosion shall be identified.

3. Measures and Controls The permittee shall develop a description of storm water management controls appropriate for the facility, and implement such controls. The appropriateness and priorities of controls in a plan

shall reflect identified potential sources of pollutants at the facility. The description of storm water management controls shall address the following minimum components, including a schedule for implementing such controls:

(1) Good Housekeeping - Good housekeeping requires that areas that may contribute pollutants to storm water discharges are maintained in a clean, orderly manner. The following areas must be specifically addressed:

a. Fugitive Dust Emissions. - The plan must describe measures that prevent or minimize fugitive dust emissions from coal handling areas. The permittee shall consider establishing procedures to minimize offsite tracking of coal dust. To prevent offsite tracking the facility may consider specially designed tires, or washing vehicles in a designated area before they leave the site, and controlling the wash water.

b. Delivery Vehicles. - The plan must describe measures that prevent or minimize contamination of storm water runoff from delivery vehicles arriving on the plant site. At a minimum the permittee should consider the following:

Develop procedures for the inspection of delivery vehicles arriving on the plant site, and ensure overall integrity of the body or container; and

Develop procedures to deal with leakage or spillage from vehicles or containers, and ensure that proper protective measures are available for personnel and environment.

c. Fuel Oil Unloading Areas. - The plan must describe measures that prevent or minimize contamination of storm water runoff from fuel oil unloading areas. At a minimum the facility operator must consider using the following measures, or an equivalent:

Use containment curbs in unloading areas;

During deliveries station personnel familiar with spill prevention and response procedures must be present to ensure that any leaks or spills are immediately contained and cleaned up; and

Use spill and overflow protection (drip pans, drip diapers, and/or other containment devices shall be placed beneath fuel oil connectors to contain any spillage that may occur during deliveries or due to leaks at such connectors).

d. Chemical Loading/Unloading Areas. - The plan must describe measures that prevent or minimize the contamination of storm water runoff from chemical loading/unloading areas. Where practicable, chemical loading/unloading areas should be covered, and chemicals should be stored indoors. At a minimum the permittee must consider using the following measures or an equivalent:

Use containment curbs at chemical loading/unloading areas to contain spills; and

During deliveries station personnel familiar with spill prevention and response procedures must be present to ensure that any leaks or spills are immediately contained and cleaned up.

e. Miscellaneous Loading/Unloading Areas. - The plan must describe measures that prevent or minimizes the contamination of storm water runoff from loading and unloading areas. The facility may consider covering the loading area, minimizing storm water run-on to the loading area by grading, berming, or curbing the area around the loading area to direct storm water away from the area, or locate the loading/unloading equipment and vehicles so that leaks can be contained in existing containment and flow diversion systems.

f. Liquid Storage Tanks - The plan must describe measures that prevent or minimize contamination of storm water runoff from above ground liquid storage tanks. At a minimum the facility operator must consider employing the following measures or an equivalent:

Use protective guards around tanks;

Use containment curbs;

Use spill and overflow protection (drip pans, drip diapers, and/or other containment devices shall be placed beneath chemical connectors to contain any spillage that may occur during deliveries or due to leaks at such connectors); and

Use dry cleanup methods.

g. Large Bulk Fuel Storage Tanks. - The plan must describe measures that prevent or minimize contamination of storm water runoff from liquid storage tanks. At a minimum the facility operator must consider employing the following measures, or an equivalent:

Comply with applicable State and Federal laws, including Spill Prevention Control and Countermeasures (SPCC); and

Containment berms.

The plan must describe measures to reduce the potential for an oil spill, or a chemical spill, or reference the appropriate section of their SPCC plan. At a minimum the structural integrity of all above ground tanks, pipelines, pumps and other related equipment shall be visually inspected on a monthly basis. All repairs deemed necessary based on the findings of the inspections shall be completed immediately to reduce the incidence of spills and leaks occurring from such faulty equipment.

h. Oil Bearing Equipment in Switchyards. - The plan must describe measures to reduce the potential for storm water contamination from oil bearing equipment in switchyard areas. The facility operator may consider level grades and gravel surfaces to retard flows and limit the spread of spills; collection of storm water runoff in perimeter ditches.

i. Residue Hauling Vehicles. - All residue hauling vehicles shall be visually inspected before entering or leaving the permittees property and shall have proper covering over the load, adequate gate sealing and overall integrity of the body or container to minimize spillage.

j. Ash Loading Areas. Plant procedures shall be established to reduce and/or control the tracking of ash or residue from ash loading areas including, where practicable, requirements to clear the ash building floor and immediately adjacent roadways of spillage, debris and excess water before each loaded vehicle departs.

k. Areas Adjacent to Disposal Ponds or Landfills. The plan must describe measures that prevent or minimize contamination of storm water runoff from areas adjacent to disposal ponds or landfills. The facility must develop procedures to

Reduce ash residue which may be tracked on to access roads traveled by residue trucks or residue handling vehicles; and

Reduce ash residue on exit roads leading into and out of residue handling areas.

l. Landfills, Scrapyards, Surface Impoundments, Open Dumps, General Refuse Sites. -The plan must address landfills, scrapyards, surface Impoundments, open dumps and general refuse sites.

m. Maintenance Activities. - vehicle maintenance activities performed on the plant site, the permittee shall use Best Management Practices (BMPs).

n. Material Storage Areas. The plan must describe measures that prevent or minimize contamination of storm water from material storage areas (including areas used for temporary storage of miscellaneous products, and construction materials stored in lay down areas). The facility operator may consider flat yard grades, runoff collection in graded swales or ditches, erosion protection measures at steep outfall sites (e.g., concrete chutes, riprap, stilling basins), covering lay down areas, storing the materials indoors, covering the material with a temporary covering made of polyethylene, polyurethane, polypropylene, or hypalon. Storm water run-on may be minimized by constructing an enclosure or building a berm around the area.

(2) Preventive Maintenance - A preventive maintenance program shall involve timely inspection and maintenance of storm water management devices (e.g., cleaning oil/water separators, catch basins) as well as inspecting and testing facility equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters, and ensuring appropriate maintenance of such equipment and systems.

(3) Spill Prevention and Response Procedures - Spill prevention and response procedures shall be developed. Areas where potential spills (that can contribute pollutants to storm water discharges) can occur and their accompanying drainage points shall be identified clearly in the storm water pollution prevention plan. Where appropriate, specifying material handling procedures, storage requirements, and use of equipment such as diversion valves in the plan should be considered. Procedures for cleaning up spills shall be identified in the plan and made available to the appropriate personnel. The necessary equipment to implement a clean up (e.g., absorbent materials) should be available to personnel.

This permit does not relieve the permittee of the spill notification requirements as specified in 455B.386 of the Iowa Code. Iowa law requires that as soon as possible, but no more than six hours after the onset of a "hazardous condition", the Department and the local sheriff's office, or the office of the sheriff of the affected county be notified.

(4) Inspections - Qualified personnel shall conduct at least monthly inspections to assess the effectiveness of the storm water pollution prevention plan. Such inspections shall be documented and this documentation shall be retained as part of the pollution prevention plan. Changes based on the results of these inspections shall be made in a timely manner.

All areas exposed to precipitation shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loading shall be evaluated to determine whether they are adequate and properly implemented or whether additional control measures are needed. Structural storm water management measures (diking, berming, curbing, sediment and erosion control measures, stabilization controls, etc.) shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

(5) Employee Training - Employee training programs shall inform personnel responsible for implementing activities identified in the storm water pollution prevention plan or otherwise responsible for storm water management at all levels of responsibility of the components and goals of the storm water pollution prevention plan. Training should address topics such as conducting inspections, spill response, good housekeeping, and material management practices. Training shall address proper procedures for equipment and vehicle washing including where and how vehicles must be washed so that there is no unpermitted discharge of wash water. The pollution prevention plan shall identify periodic dates for at least annual training. More frequent training may be necessary if there is a high turnover of employees or if employee participation is essential to the stom water pollution prevention plan.

(6) Record keeping and Internal Reporting Procedures - A description of incidents (such as spills, or other discharges), along with other information describing the quality and quantity of storm water discharges shall be included in the plan required under this part. Inspections and maintenance activities shall be documented and records of such activities shall be incorporated into the plan.

(7) Facility Security - Facilities shall have the necessary security systems to prevent accidental or intentional entry that could cause a discharge. Security systems described in the plan shall address fencing, lighting, vehicular traffic control, and securing of equipment and buildings.

b. Structural Practices - The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity [see Part III.A.2. Description of Potential Pollutant Sources of this permit] shall be considered when determining reasonable and appropriate structural measures. The plan shall provide that measures that the permittee determines to be reasonable and appropriate shall be implemented and maintained.

c. Management of Runoff - The plan shall contain a description of storm water management practices used and/or to be used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site. Appropriate measures may include: vegetative swales, rip-rap, reuse of collected storm water (such as for a process or as an irrigation source), inlet controls (such as oil/water separators), snow management activities, infiltration devices, use of porous pavements, and wet detention/retention devices.

d. Sediment and Erosion Control - The plan shall identify areas that, due to topography, activities, or other factors, have a potential for significant soil erosion. Plans shall describe permanent stabilization practices and shall ensure that disturbed portions of the site are stabilized. Stabilization practices may include: permanent seeding, mulching, geotextiles, sod stabilization, vegetative buffer strips, protection of trees, preservation of mature vegetation, and other appropriate measures.

e. Non-Storm Water Discharges

(1) The plan shall include a certification that the storm water discharge has been tested or evaluated for the presence of non-storm water discharges. The certification shall include the identification of potential significant sources of non-storm water at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the on-site drainage points that were directly observed during the test.

(2) Except for flows from fire fighting activities, sources of non-storm water listed in Part I.D. Non-Storm Water Discharges of this permit that are combined with storm water discharge associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

4. Comprehensive Site Compliance Evaluation. A member(s) of the pollution prevention team or a qualified professional designated by the team shall conduct, at a minimum, annual site compliance evaluations.

a. Areas contributing to a storm water discharge associated with industrial activity such as material storage and handling, loading and unloading, process activities, and plant yards shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loading shall be

evaluated to determine whether they are adequate and properly implemented in accordance with the terms of this permit or whether additional control measures are needed. Structural storm water management measures, sediment and erosion control measures, other structural pollution prevention measures identified in the plan, as well as process related pollution control equipment shall be observed or tested to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

b. Based on the results of the evaluation, the description of Potential Pollutant Sources (Part III.A.2.) and pollution prevention Measures And Controls (Part III.A.3.) identified in the plan shall be revised as appropriate within 2 weeks of such evaluation. In addition, implementation of any changes to the plan shall be made in a timely manner, but in no case more than 12 weeks after the evaluation.

c. A report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, observations relating to the implementation of the plan, and actions taken shall be retained as part of the plan for at least 3 years after the date of the evaluation. The report shall also identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the plan and this permit. The report shall be signed in accordance with Standard Condition #22 of this permit.

B. ADDITIONAL POLLUTION PREVENTION PLAN REQUIREMENTS

In addition to the previously specified contents of the pollution prevention plan, the storm water pollution prevention plan shall include a complete discussion of measures taken to conform with the following applicable guidelines:

1. Requirements for Storm Water Discharges Associated With Industrial Activity that Discharge Into or Through Municipal Separate Storm Sewer Systems Serving a Population of 100,000 or More

a. Facilities covered by this permit must comply with applicable requirements in municipal storm water management programs developed under a NPDES permit issued for the discharge from the municipal separate storm sewer system that receives the facility's discharge, provided the discharger has been notified of such conditions.

b. Permittees that discharge storm water associated with industrial activity through a municipal separate storm sewer system serving a population of 100,000 or more, or a municipal system designated by the Department shall make the pollution prevention plan available to the municipal operator of the system upon request.

C. SIGNATURE AND PLAN REVIEW

1. Signature / Location The plan shall be signed and shall be retained on-site at the facility that generates the storm water discharge.

2. Availability The storm water pollution prevention plan, annual site compliance inspection report, Comprehensive Site Compliance Evaluation Reports, or other information shall be made available upon request to the Department.

3. Required Modifications The Department may notify the permittee at any time that the plan does not meet one or more of the minimum requirements of this part. Such notification shall identify those provisions of the permit that are not being met, and identify which provisions of the plan require modification in order to meet the minimum requirements of this part. Within 30 days of such notification from the Department, (or as otherwise provided by the Department), the permittee shall make the required changes to the plan and shall submit to the Department a written certification that the requested changes have been made.

D. KEEPING PLANS CURRENT

The permittee shall amend the plan whenever there is a change in design, construction, operation, or maintenance, that has a significant effect on the potential for the discharge of pollutants to the waters of the United States or if the storm water pollution prevention plan proves to be ineffective in eliminating or significantly minimizing the discharge of pollutants from sources identified under Part III.A.2. of this permit, or in otherwise achieving the general objectives of controlling pollutants in storm water discharges associated with industrial activity. New owners shall review the existing plan and make appropriate changes.

The storm water pollution prevention plan required by this permit must be modified within 14 calendar days of the occurrence of any "hazardous condition" to: provide a description of the release, the circumstances leading to the release, and the date of the release. In addition, the plan must be reviewed by the permittee to identify measures to

prevent the reoccurrence of such a condition and to respond to such discharges, and the plan must be modified where appropriate.

E. SIGNATORY REQUIREMENTS

Storm Water Pollution Prevention Plans, reports, certifications or information either submitted to the Department (and/or the operator of a large or medium municipal separate storm sewer system), or that this permit requires be maintained by the permittee, shall be signed as required by Standard Condition #22 of this permit.

PART IV. DEFINITIONS

1. Hazardous Condition includes, but is not limited to: releases of oil or hazardous substances in excess of reportable quantities under Section 311 of the Clean Water Act (see 40 CFR 110.10 and CFR 117.21) or Section 102 of CERCLA (see 40 CFR 302.4).

2. Large and medium municipal separate storm sewer system means all municipal separate storm sewers that are either.

(1) located in an incorporated place (city) with a population of 100,000 or more as determined by the latest Decennial Census by the Bureau of Census (these cities are listed in Appendices F and G of 40 CFR Part 122); or

(2) located in the counties with unincorporated urbanized populations of 100,000 or more, except municipal separate storm sewers that are located in the incorporated places, townships or towns within such counties (these counties are listed in Appendices H and I of 40 CFR Part 122); or

(3) owned or operated by a municipality other than those described in paragraph (1) or (2) above and that are designated by the Department as part of the large or medium municipal separate storm sewer system.

3. Significant materials includes, but is not limited to: raw materials; fuels; materials such as solvents, detergents, and plastic pellets; finished materials such as metallic products; raw materials used in food processing or production; hazardous substances designated under Section 101(14) of Comprehensive Environmental Response, Compensation and Liability Act (CERCLA); any chemical the facility is required to report pursuant to Emergency Planning and Community Right-to-Know Act (EPCRA) Section 313; fertilizers; pesticides; and waste products such as ashes, slag and sludge that have the potential to be released with stormwater discharges.

4. Storm water means storm water runoff, snow melt runoff, and surface runoff and drainage.

5. Waters of the United States means.

All waters that are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters that are subject to the ebb and flow of the tide;

a. All interstate waters, including interstate wetlands;

b. All other waters such as interstate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds the use, degradation, or destruction of which would affect or could affect interstate or foreign commerce including any such waters:

c. That are or could be used by interstate or foreign travelers for recreational or other purposes;

d. From which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or

e. That are used or could be used for industrial purposes by industries in interstate commerce;

f. All impoundment of waters otherwise defined as waters of the United States under this definition;

g. Tributaries of waters identified in paragraphs (a) through (d) of this definition;

h. The territorial sea; and

i. Wetlands adjacent to waters (other than waters that are themselves wetlands) identified in paragraphs (a) through (f) of this definition,

STANDARD CONDITIONS

19. UPSET PROVISION

(a) Definition - "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

(b) Effect of an upset. An upset constitutes an affirmative defense in an action brought for noncompliance with such technology based permit effluent limitations if the requirements of paragraph *"c"* of this condition are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

(c) Conditions necessary for demonstration of an upset. A permittee who wishes to establish the affirmative defense of upset shall demonstrate through properly signed, contemporaneous operating logs, or other relevant evidence that;

(1) An upset occurred and that the permittee can identify the cause(s) of the upset.
(2) The permitted facility was at the time being properly operated; and
(3) The permittee submitted notice of the upset to the Department in accordance with 40 CFR 122.41(l)(6)(ii)(B).
(4) The permittee complied with any remedial measures required by Item #5 of the Standard Conditions of this permit.

(d) Burden of Proof. In any enforcement proceeding, the permittee seeking to establish the occurrence of an upset has the burden of proof.

20. FAILURE TO SUBMIT FEES

This permit may be revoked, in whole or in part, if the appropriate permit fees are not submitted within thirty (30) days of the date of notification that such fees are due.

21. BYPASSES

(a) Definition - Bypass means the intentional diversion of waste streams from any portion of a treatment facility.

(b) Prohibition of bypass. Bypass is prohibited and the department may take enforcement action against a permittee for bypass unless:

(1) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

(2) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate backup equipment should have been installed in the exercise of reasonable engineering judgement to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance;

(3) The permittee submitted notices as required by paragraph *"d"* of this section.

(c) The Director may approve an anticipated bypass after considering its adverse effects if the Director determines that it will meet the three conditions listed above.

(d) Reporting bypasses. Bypasses shall be reported in accordance with 567-63.6 IAC.

22. SIGNATORY REQUIREMENTS

Applications, reports or other information submitted to the Department in connection with this permit must be signed and certified as required by 567-64.3(8) IAC.

23. USE OF CERTIFIED LABORATORIES

Effective October 1, 1996, analyses of wastewater, groundwater or sewage sludge that are required to be submitted to the department as a result of this permit must be performed by a laboratory certified by the State of Iowa. Routine, on-site monitoring for pH, temperature, dissolved oxygen, total residual chlorine and other pollutants that must be analyzed immediately upon sample collection, settleable solids, physical measurements, and operational monitoring tests specified in 567-63.3(4) are excluded from this requirement.

STANDARD CONDITIONS

1. **DEFINITIONS**

(a) 7 day average means the sum of the total daily discharges by mass, volume or concentration during a 7 consecutive day period, divided by the total number of days during the period that measurements were made. Four 7 consecutive day periods shall be used each month to calculate the 7-day average. The first 7-day period shall begin with the first day of the month.

(b) 30 day average means the sum of the total daily discharges by mass, volume or concentration during a calendar month, divided by the total number of days during the month that measurements were made.

(c) daily maximum means the total discharge by mass, volume or concentration during a twenty-four hour period.

2. **DUTY TO COMPLY**

You must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act and is grounds for enforcement action; permit termination, revocation and reissuance, or modification; or denial of a permit renewal application. Issuance of this permit does not relieve you of the responsibility to comply with all local, state and federal laws, ordinances, regulations or other legal requirements applying to the operation of your facility.
{See 40 CFR 122.41(a) and 567-64.7(4)(e)) IAC}

3. **DUTY TO REAPPLY**

If you wish to continue to discharge after the expiration date of this permit you must file an application for reissuance at least 180 days prior to the expiration date of this permit.
{See 567-64.8(1) IAC}

4. **NEED TO HALT OR REDUCE ACTIVITY**

It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.
{See 40 CFR 122.41(c) and 567-64.7(5)(j) IAC}

5. **DUTY TO MITIGATE**

You shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.
{See 40 CFR 122.41(d) and 567-64.7(5)(i) IAC}

6. **PROPERTY RIGHTS**

This permit does not convey any property rights of any sort or any exclusive privileges.

7. **TRANSFER OF TITLE**

If title to your facility, or any part of it, is transferred the new owner shall be subject to this permit.
{See 567-64.14 IAC}

You are required to notify the new owner of the requirements of this permit in writing prior to any transfer of title. The Director shall be notified in writing within 30 days of the transfer

8. **PROPER OPERATION AND MAINTENANCE**

All facilities and control systems shall be operated as efficiently as possible and maintained in good working order. A sufficient number of staff, adequately trained and knowledgeable in the operation of your facility shall be retained at all times and adequate laboratory controls and appropriate quality assurance procedures shall be provided to maintain compliance with the conditions of this permit.
{See 40 CFR 122.41(e) and 567 64.7(5)(f) IAC}

9. **DUTY TO PROVIDE INFORMATION**

You must furnish to the Director, within a reasonable time, any information the Director may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. You must also furnish to the Director, upon request, copies of any records required to be kept by this permit.

10. **MAINTENANCE OF RECORDS**

You are required to maintain records of your operation in accordance with 567-63.2 IAC.

11. **PERMIT MODIFICATION, SUSPENSION OR REVOCATION**

(a) This permit may be modified, suspended, or revoked and reissued for cause including but not limited to those specified in 567-64.3(11) IAC.

(b) This permit may be modified due to conditions or information on which this permit is based, including any new standard the department may adopt that would change the required effluent limits.
{See 567-64.3(11) IAC}

(c) If a toxic pollutant is present in your discharge and more stringent standards for toxic pollutants are established under Section 307(a) of the Clean Water Act, this permit will be modified in accordance with the new standards.
{See 40 CFR 122.62(a)(6) and 567-64.7(5)(g) IAC}

The filing of a request for a permit modification, revocation or suspension, or a notification of planned changes or anticipated noncompliance does not stay any permit condition.

12. **SEVERABILITY**

The provisions of this permit are severable and if any provision or application of any provision to any circumstance is found to be invalid by this department or a court of law, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected by such finding.

STANDARD CONDITIONS

13. INSPECTION OF PREMISES, RECORDS, EQUIPMENT, METHODS AND DISCHARGES

You are required to permit authorized personnel to:

(a) Enter upon the premises where a regulated facility or activity is located or conducted or where records are kept under conditions of this permit.

(b) Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit.

(c) Inspect, at reasonable times, any facilities, equipment, practices or operations regulated or required under this permit.

(d) Sample or monitor, at reasonable times, for the purpose of assuring compliance or as otherwise authorized by the Clean Water Act.

14. TWENTY-FOUR HOUR REPORTING

You shall report any noncompliance that may endanger human health or the environment. Information shall be provided orally within 24 hours from the time you become aware of the circumstances. A written submission that includes a description of noncompliance and its cause; the period of noncompliance including exact dates and times, whether the noncompliance has been corrected or the anticipated time it is expected to continue; and the steps taken or planned to reduce, eliminate, and prevent a reoccurrence of the noncompliance must be provided within 5 days of the occurrence. The following instances of noncompliance must be reported within 24 hours of occurrence:

(a) Any unanticipated bypass which exceeds any effluent limitation in the permit.
{See 40 CFR 122.41(l)(5)(ii)(A)}

(b) Any upset which exceeds any effluent limitation in the permit.
{See 40 CFR 122.41(l)(5)(ii)(B)}

(c) Any violation of a maximum daily discharge limit for any of the pollutants listed by the Director in the permit to be reported within 24 hours.
{See 40 CFR 122.41(l)(5)(ii)(C)}

15. OTHER NONCOMPLIANCE

You shall report all instances of noncompliance not reported under Condition #14 at the time monitoring reports are submitted.

16. ADMINISTRATIVE RULES

Rules of this Department which govern the operation of your facility in connection with this permit are published in Part 567 of the Iowa Administrative Code (IAC) in Chapters 60-64 and 120-122. Reference to the term "rule" in this permit means the designated provision of Part 567 of the Iowa Administrative Code.

17. NOTICE OF CHANGED CONDITIONS

You are required to report any changes in existing conditions or information on which this permit is based:

(a) Facility expansions, production increases or process modifications which may result in new or increased discharges of pollutants must be reported to the Director in advance. If such discharges will exceed effluent limitations, your report must include an application for a new permit.
{See 567-64.7(5)(a) IAC}

(b) If any modification of, addition to, or construction of a disposal system is to be made, you must first obtain a written permit from this Department.
{See 567-64.2 IAC}

(c) If your facility is a publicly owned treatment works or otherwise may accept waste for treatment from industrial contributors see 567-64.3(5) IAC for further notice requirements.

(d) You shall notify the Director as soon as you know or have reason to believe that any activity has occurred or will occur which would result in the discharge of any toxic pollutant which is not limited in this permit.
{See 40 CFR 122.42(a)}

You must also notify the Director if you have begun or will begin to use or manufacture as an intermediate or final product or byproduct any toxic pollutant which was not reported in the permit application

18. OTHER INFORMATION

Where you become aware that you failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report, you must promptly submit such facts or information.

ALLIANT ENERGY CORPORATION
OTTUMWA GENERATING STATION

DATE: September 5, 2002 – Revised February 6, 2002 (see attached comments)

FROM: Mohammed Shams
RE: REISSUANCE OF IOWA NPDES PERMIT
IOWA NPDES PERMIT # 90-00-1-01
TO: RECORD

AUTHORIZED PERSON: Bill Skalitzky
TELEPHONE NUMBER: (608) 252-3108

PROCESS DESCRIPTION

Outfall 001:
Discharge from bottom ash basin which includes ash transport water, cooling tower blowdown (outfall #005), landfill leachate, low volume waste sources, sanitary waste (outfall #003), metal cleaning waste (outfall #004), and stormwater runoff.

Outfall 002:
Coal pile runoff basin discharge, and stormwater runoff.

Outfall 003:
Sewage treatment plant domestic wastewater discharge prior to combination with any other wastewater discharge.

Outfall 004:
Chemical metal cleaning waste prior to mixing with wastewater discharge.

Outfall 005:
Cooling tower blowdown prior to mixing with other wastestreams.

EFFLUENT LIMITATIONS:
Proposed limits are identical to the current NPDES permit.

Outfall 001:
Total Residual Chlorine: BAT more stringent than WLA dated 5/31/1996
0.921 mgd/1.81 mgd = 0.51 x 0.2 mg/l = 0.1 mg/l
Total Suspended Solids, pH and Oil & Grease: BPT – 40 CFR, Part 423.12.

Outfall 002:
Total Suspended Solids and pH: BPT – 40 CFR, Part 423 (b) (9 and 10).

Outfall 003:
Proposed limits are based on standard/secondary treatment.

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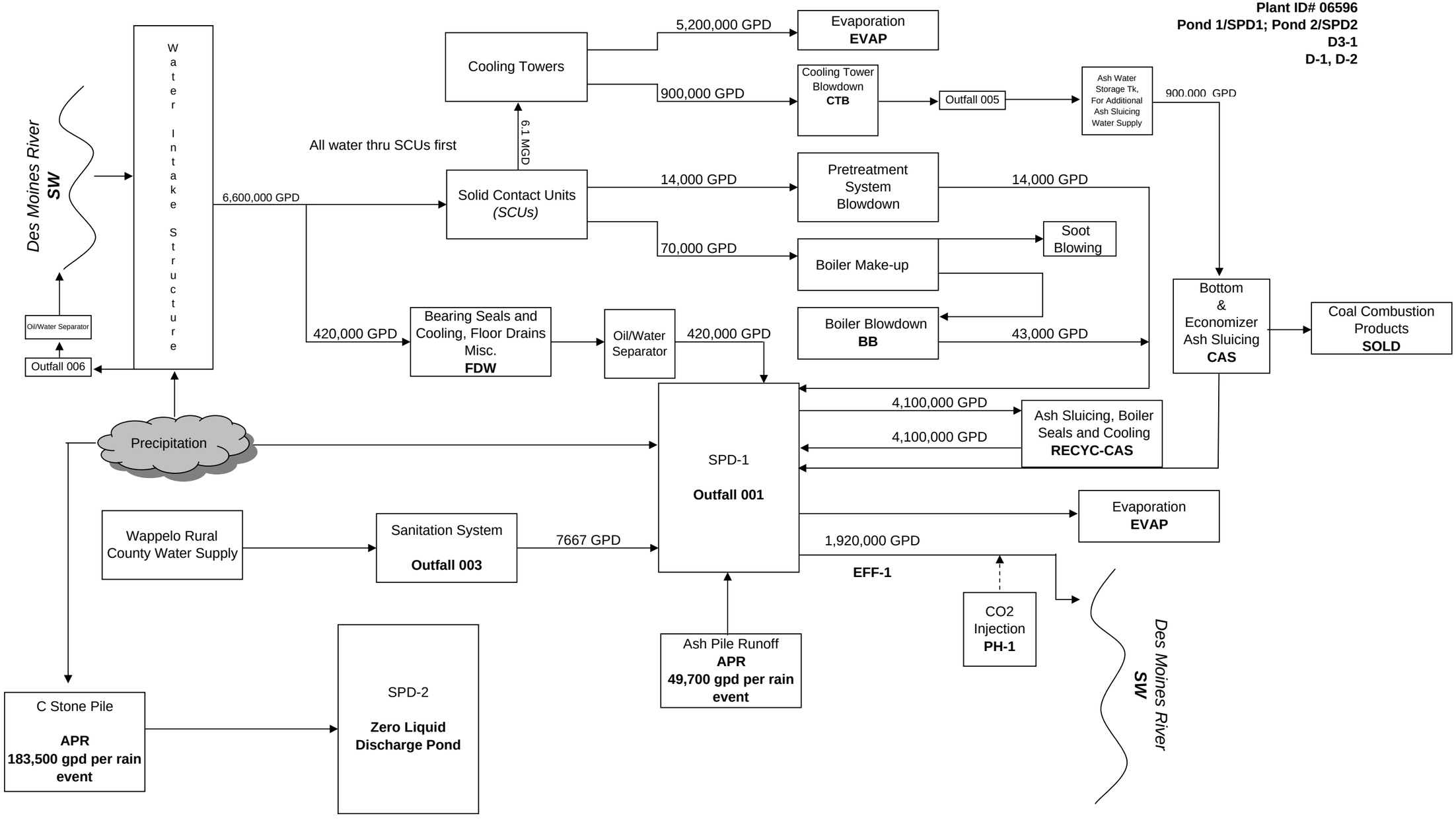
IPL - Ottumwa Generating Station
Plant ID# 06596
Pond 1/SPD1; Pond 2/SPD2
D3-1
D-1, D-2



NOTES:
1. Coal Pile Runoff Discharge is a controlled discharge, so these values are not a constant discharge
2. Cooling Tower Blowdown can be used to sluice ash

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Alliant Energy
Ottumwa Power Generating Station

Ash Settling Pond
Hydrological Report

B&V Project 169664
B&V File No. 41.0402

October 21, 2010
Revision B – Client Review

BLACK & VEATCH
Building a world of difference.

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Appendix A Ash Settling Pond Hydrological Analysis Calculation

1.0 Introduction

This report presents the site conditions, hydrologic conditions, and hydrologic evaluation for the Alliant Energy – Ottumwa Generating Station ash settling pond. Current bathymetric survey information for the pond was provided by Hard Hat Services in a 2006 report.

The purpose of the hydrologic evaluation was to determine the peak water surface elevation in the ash settling pond in response to the 100-year, 24-hour design precipitation event. This peak stage when compared to the ash settling pond crest elevation, is used to assess if sufficient freeboard is available to safely pass the design storm event through the pond. The HEC-1 Flood Hydrograph Package computer modeling program developed by the US Army Corps of Engineers was used for the hydrologic analysis.

This report presents the general site conditions, along with hydrologic conditions and a summary of the hydrologic evaluation. The Ash Settling Pond Hydrological Analysis calculation, included in Appendix A of this report, provides detailed development of the model's input parameters, along with a discussion of the analysis and results. Output data files from the model are also provided in Appendix A.

1.1 Limitations

The data, analysis, conclusions, and recommendations in this report were based on site conditions existing at the time of the investigations and on the assumption that the information obtained from the investigations is representative of the conditions at the site.

This report was prepared solely for the benefit of Alliant Energy ("Client") by Black & Veatch Corporation ("B&V") under the terms and conditions of the Engineering Services Agreement made effective 14th day of February, 2008 (Client Contract 32589) between Client and B&V ("the Agreement") and is based on information not within the control of the Client or B&V. Neither the Client nor B&V has made an analysis, verified data, or rendered an independent judgment of the validity of the information provided by others. WHILE IT IS BELIEVED THAT THE INFORMATION, DATA, AND OPINIONS CONTAINED HEREIN WILL BE RELIABLE UNDER THE CONDITIONS AND SUBJECT TO THE LIMITATIONS SET FORTH HEREIN, CLIENT AND B&V DO NOT GUARANTEE THE ACCURACY THEREOF. EXCEPT AS OTHERWISE ALLOWED BY THE AGREEMENT, THIS REPORT MAY NOT BE USED BY ANYONE WITHOUT THE EXPRESS WRITTEN AUTHORIZATION OF B&V, AND SUCH USE SHALL CONSTITUTE AGREEMENT BY THE USER THAT ITS RIGHTS, IF ANY, ARISING FROM THIS

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REPORT SHALL BE SUBJECT TO THE TERMS OF THE B&V AUTHORIZATION, AND IN NO EVENT SHALL USER'S RIGHTS, IF ANY, EXCEED THOSE OF CLIENT UNDER THE AGREEMENT.

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2.0 Executive Summary

The ash settling pond at the Ottumwa Generating Station receives plant discharges and stormwater runoff. This report provides the hydrologic evaluation for the ash pond in response to the 100-year, 24-hour design precipitation event. The peak stage in the ash pond, in response to the design event, was 673.67. The crest elevation of the ash pond is 682.0 feet; thus, there was a minimum of 8.33 feet of freeboard in the pond. Considering the peak stage, the ash pond can safely pass the 100-year, 24-hour design precipitation event.

3.0 Site Conditions

3.1 Site Location

The Ottumwa Generating Station is located in northwestern Wapello County, Iowa, approximately 1.5 miles northwest of Chillicothe, Iowa. The station is located west of the Des Moines River, and the surrounding area includes wildlife areas and agricultural land.

3.2 Site Description

The Ottumwa Generating Station is a coal fired facility with a nominal generation capacity of 675 megawatts. The coal yard is positioned north of the generation area, and the ash ponds are positioned east of the generation area.

The ash ponds include a settling pond and a zero discharge pond. The ash ponds are adjacent to the Des Moines River and separated by a coal railway spur berm with the settling pond to the south. The ash settling pond collects discharges from four points from the generation facility: 1) a 42 inch plant drain line discharge, 2) a 12 inch chemical drain line discharge, 3) a bottom ash trench discharge, and 4) an economizer ash discharge; all of which are located on the west side of the pond. The ash pond also collects stormwater through direct precipitation over the pond area and stormwater runoff from the plant area. A National Pollutant Discharge Elimination System (NPDES) outfall is located on the east side of the ash pond.

3.3 Site Contour Description

The original and grading site contour information was provided by Drawings S1001 through S1005 dated February and March 1982, References 1 through 5. Ash pond bathymetry survey contours were provided in the Pond Maintenance Plan produced in 2006, Reference 6. Information on the outfall was provided by Drawing S2030 dated February 1982, Reference 7.

The site area is subdivided into higher and lower ground areas. The generation area, coal storage area, substation area, and the Burlington Northern Railway along the southern part of the site area are located within the higher ground areas. The ash ponds are located within the lower ground areas; the Avery Creek, which runs from the southwest to the northeast into the Des Moines River, is the lowest point across the site. The 1982grading plan for the ash settling pond indicated that the pond area ranged in bottom elevation from 656 to 682 feet, with a note that the maximum depth of the borrow excavation was at an elevation of 670 feet. The grading plan also indicated the trench for

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the 42 and 12 inch discharge lines located in the northwest corner of the ash settling pond reached a bottom elevation of 658 feet.

The 2006 Pond Maintenance Plan indicated that the pond area ranged in bottom elevation from 662 to 680 feet, with the depth of ash material ranging from 2 to 13 feet across the pond area. The 2006 data indicated that the ash level at the discharge trench was 671 feet, indicating depth of ash material to be 13 feet.

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4.0 Hydrologic Conditions

Hydrologic conditions are developed in detail in the Ash Settling Pond Hydrological Analysis calculation, provided as Appendix A of this report. Hydrologic conditions provided in the calculation include development of the design storm event and the design precipitation distribution. Watershed drainage areas are determined along with the infiltration characteristics and time lag of each basin. Finally, reservoir modeling parameters including the ash settling pond stage-storage and stage-discharge relationships are developed.

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5.0 Hydrologic Evaluation

A hydrograph routing analysis was performed to assess the response of the ash settling pond to the 100-year, 24-hour precipitation event. The HEC-1 Flood Hydrograph software package developed by the US Army Corps of Engineers was used to perform the analysis.

The initial water surface elevation in the pond at the start of the analysis was 670.0, which corresponds to the invert elevation of the ash pond discharge weir. An inflow hydrograph was developed because of direct precipitation over the pond area, and a second inflow hydrograph was developed because of stormwater runoff from the watershed contributing to the pond. These two hydrographs were combined and routed through the pond considering the stage-storage and stage-discharge relationships of the pond.

The peak stage in the pond in response to the 100-year, 24-hour event was 673.67. The crest elevation of the ash pond is 682.0 feet; thus, there was a minimum of 8.33 feet of freeboard in the pond. The peak discharge from the pond was 118 cubic feet per second (cfs). Considering the peak stage, the ash pond can safely pass the 100-year, 24-hour design storm event.

As a sensitivity analysis, and to consider an extreme case, the hydrologic model was revised to assess the performance of the system in the event that the discharge structure was completely blocked. For this analysis, all input parameters remained the same as in the original analysis, except there was no discharge from the pond during the design event. This case resulted in a peak stage in the pond of 676.13 feet, resulting in a minimum of 5.87 feet of freeboard. Thus, even for this extreme event, the ash pond has sufficient freeboard to safely handle the 100-year, 24-hour design storm event.

The Ash Settling Pond Hydrological Analysis calculation, included in Appendix A of this report, provides detailed development of the model's input parameters, along with a discussion of the analysis and results. Output data files from the model are also provided in Appendix A.

6.0 References

1. Black & Veatch Consulting Engineers, Iowa Southern Utilities Company, Ottumwa Generating Station – Unit 1, B&V Drawing Number S1001, Sitework – Site Area, Original Contour Plan, Revision 2, Conform to Construction Records February 22, 1982.

2. Black & Veatch Consulting Engineers, Iowa Southern Utilities Company, Ottumwa Generating Station – Unit 1, B&V Drawing Number S1002, Sitework – Area A, Grading Plan, Revision 4, Conform to Construction Records, February 22, 1982.

3. Black & Veatch Consulting Engineers, Iowa Southern Utilities Company, Ottumwa Generating Station – Unit 1, B&V Drawing Number S1003, Sitework – Area B, Grading Plan, Revision 4, Conform to Construction Records, February 22, 1982.

4. Black & Veatch Consulting Engineers, Iowa Southern Utilities Company, Ottumwa Generating Station – Unit 1, B&V Drawing Number S1004, Sitework – Area C, Grading Plan, Revision 5, Conform to Construction Records, February 22, 1982.

5. Black & Veatch Consulting Engineers, Iowa Southern Utilities Company, Ottumwa Generating Station – Unit 1, B&V Drawing Number S1005, Sitework – Area D, Grading Plan, Revision 4, Conform to Construction Records, March 30, 1982.

6. Hard Hat Services, Settling Pond Maintenance Plan, Ottumwa Generating Station, Ottumwa, Iowa, Prepared for Alliant Energy, October 2006, Revision 0.

7. Black & Veatch Consulting Engineers, Iowa Southern Utilities Company, Ottumwa Generating Station – Unit 1, B&V Drawing Number S2030, Yard Structures – Outfall Structure, Plans Sections & Details, Revision 2, Conform to Construction Records, February 22, 1982.

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Appendix A
Ash Settling Pond Hydrological Analysis Calculation

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Calculation Record

Client Name: Alliant Energy Page 1 of 47

Project Name: Ottumwa Generating Station Project No.: 169664

Calculation Title: Ash Settling Pond Hydrological Analysis

Calculation No./File No.: 169664.51.0402

Calculation Is: (check all that apply) ☐ Preliminary ☐ Final ☐ Nuclear Safety-Related

Objective Assess the response of the ash storage pond to the 100-Year recurrence interval design storm event.

.

Unverified Assumptions Requiring Subsequent Verification

No.	Assumption	Verified By	Date

See Page _____ of this calculation for additional assumptions.

This Section Used for Computer Generated Calculations

Program Name/Number: HEC-1 Version: 4.1

Evidence of or reference to computer program verification, if applicable:

Bases or reference thereto supporting application of the computer program to the physical problem:

Review and Approval

Rev	Prepared By	Date	Verified By	Date	Approved By	Date
0	G. V. Johnson	10/21/10				

BLACK & VEATCH

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COMPUTER GENERATED CALCULATIONS

Owner: Alliant Energy Computed By: G. V. Johnson

Plant: Ottumwa Generating Station Unit: _____ Date: October 21 20 10

Project No.: 169664 File No.: 169664.51.0402

Title: Ash Settling Pond Hydrological Analysis

PROGRAM NO.: HEC-1 VERSION: 4.1

RUN DATE: 10/18/2010 and 10/19/2010 RUN TIME: Multiple runs

CASE: _____ NO. OF PAGES: 36

STATUS* _____

By: G. V. Johnson Date: 10/21 20 10

REVIEW AND APPROVAL

1. Input Data Printout

   Checked By: _____ Date: _____ 20 _____

2. Output Data Printout

   Checked By: _____ Date: _____ 20 _____

3. Approved: _____ Date: _____ 20 _____

*No special indication of status is required for calculations other than those that are superseded or declared void.

OBJECTIVE: Assess the response of the ash storage pond to the 100-Year recurrence interval design storm event.

REFERENCES:

1) Settling Pond Maintenance Plan, Ottumwa Generation Station, Ottumwa, Iowa, Oct 2006, Rev. 0, Prepared for: Alliant Energy, Prepared by: Hard Hat Services.

2) Open-Channel Hydraulics, Ven Te Chow, McGraw-Hill, 1959.

3) HY-8 v.7.2, Culvert Analysis Software Package, Federal Highway Administration, Build Date Jul 20, 2009.

4) Email sent by Tony Morse, Environmental Specialist II, Alliant Energy Services, 10/07/2010, 4:23 PM, providing runoff areas and coefficients.

5) NOAA's National Weather Service, Hydrometeorological Design Studies Center, Precipitation Frequency Data Server (PFDS), Current Precipitation Frequency Information and Documents for IOWA, website accessed: 10/13/2010, website address: http://hdsc.nws.noaa.gov/hdsc/pfds/other/ia_pfds.html

6) U.S. Dept. of Agricuture, Soil Conservation Service, TR 55 Urban Hydrology for Small Watersheds, June 1986.

7) HEC-1 Flood Hydrograph Package, Version 4.1, U.S. Army Corps of Engineers Hydrologic Engineering Center, June 1998.

8) Iowa Southern Utilities Co., Ottumwa Generating Station - Unit 1, Sitework - Grading Plan, Black & Veatch Dwgs. S1001, S1002, S1003, S1004, and S1005.

9) Iowa Southern Utilities Co., Ottumwa Generating Station - Unit 1, Yard Structures - Outfall Structure, Black & Veatch Dwg. S2030.

10) USDA Natural Resources Conservation Service, Web Soil Survey, accessed 10/13/2010, website address: http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

Discussion:

The Ash Settling Pond is located on the east side of the site. It is designed to collect the water that quenches bottom ash from the boilers. The pond also collects cooling tower blowdown, floor drains and other plant discharges, and stormwater runoff from an area of 134.39 acres, which includes the pond and a portion of the plant area. The ash pond crest elevation is 682.0, and the pond begins to discharge when the water surface elevation reaches 670.0. The stage-storage relationship for the pond is based on bathymetry developed during a 2006 survey performed by Hard Hat Services (Reference 1).

The HEC-1 Flood Hydrograph Package developed by the U.S. Army Corps of Engineers is used to route the stormwater runoff hydrographs through the ash settling pond. In this analysis it is assumed that the initial water surface in the ash pond is at the invert of the discharge weir, which is at elevation 670.0.

Input data for the model is developed below.

Design Storm Event: (From Ref. 5)

100-Year - 24-Hour Precipitation: **6.8** inches

Design Precipitation Distribution:

Design Precipitation Distribution: **SCS Type II**

Drainage Areas: (From Ref. 1 and 4)

Ash Pond + U/S Watershed Area:	134.39	acres =	**0.2100** square miles
Ash Pond Area @ Elev. 682	43.05	acres =	**0.0673** square miles
Ash Pond Upstream Watershed	91.34	acres =	**0.1427** square miles

Hydrologic Soil Group: (From Ref. 10)

HSG = **B** (From Web Soil Survey, See Pages 8 and 9)

Infiltration Characteristics:

Industrial Area Curve Number, HSG = B	**88**	(Ref. 6)
Ash Settling Pond Curve Number:	**98**	(Direct Precip. Over dry area)

Time-of-Concentration: Method from TR-555 (Ref. 6), Parameters from Ref. 8.

Upstream Watershed Time-of-Concentration

Sheet Flow:	Surface Description:	grass
Manning's Roughness n:		0.24
Flow Length (ft):		300
2 Yr.-24 Hour Precip. (in):		3.25
Upstream Invert		752.0
Downstream Invert		734.0
Land Slope, s:		0.0600
Travel Time (hrs):		0.366
Shallow Conc. Flow:	Surf Descrip.:	aggregate
Flow Length (ft):		700
Upstream Invert		734.0
Downstream Invert		690
Slope, s:		0.0629
Velocity, v (ft/sec):		5.2
Travel Time (hrs):		0.037
Channel Flow:	Surface Description:	grassed
Flow Area (ft^2):		32
Wetted Perimeter (ft):		22.65
Slope, s:		0.0065
Flow Length (ft):		2450
Manning's Roughness n:		0.03
Velocity, v (ft/sec):		5.04
Travel Time (hrs):		0.135
Time of Concentration, (sum of Tt),(hrs):		**0.539**
Tc (minutes):		**32.3**

Time Lag:

Upstream Watershed Time Lag = 0.6*tc, (hrs): **0.323**

Ash Pond Time Lag (direct precipitation), (hrs) **0.001**

Stage - Area Relationship:

The Stage - Area relationship for the pond is developed from bathymetric survey data provided in Figure 3, Current Pond Volumes, from Reference 1.

Elevation	Area (sq. ft.)	Area (acres)
670	284000	6.52
672	348400	8.00
675	567600	13.03
678	899600	20.65
680	1250800	28.71
682	1722000	39.53

Stage - Discharge Relationship:

Stormwater discharge passes over a broad-crested weir, through a parshall flume, then drops and passes through 2 - 66 inch diameter concrete culverts. A culvert analysis was performed (see pages 10 and 11), and it was determined that flow through the discharge structure was controlled by the weir.

Weir flow in the table below is based on the equation: Q = CLH^1.5
where Q is discharge in cfs, C is the weir coefficient, which equals 2.63 for a broad-crested weir, L is the weir length = 6 feet, and H is the head in feet over the weir invert elevation of 670.0.

Discharge structure layout and design parameters are provided in References 8 and 9.

Elevation	Q (cfs)
670.0	0.0
671.0	15.8
672.0	44.6
675.0	176.4
678.0	357.1
680.0	499.0
682.0	656.0

Results:

HEC-1 model output for the 100-Year recurrence interval precipitation event is included as pages 12 through 29 of this calculation.

The initial water surface elevation in the ash pond at the start of the design event is 670.0, which corresponds to the invert of the discharge weir. In response to the 100-Year, 24-Hour design precipitation event, the peak rate of stormwater runoff into the pond is 331 cfs. The peak rate of direct precipitation on the pond area is 223 cfs, and the peak inflow into the pond from the combined hydrographs is 521 cfs.

In this analysis, the pond begins to discharge stormwater as soon as the water surface elevation exceeds 670.0. The peak stage in the pond in response to the 100-Year event is 673.67, and the peak discharge from the pond is 118 cfs.

The minimum freeboard in the pond during the 100-Year event is 8.33 feet. Thus, the ash pond safely handles the 100-Year, 24-Hour precipitation event.

Conservative assumptions were made throughout this analysis. A very high SCS curve number of 98 was used to model direct precipitation on the ash pond, even though only 6.52 acres of the 43.05 acres of the pond area are inundated at the start of the design event. A conservative SCS curve number of 88 (Industrial Area) was used for the contributing watershed, even though portions of the watershed were open space. In addition, the initial water surface elevation of 670.0 exceeds the actual water surface elevation of 668.7 at the time of the bathymetric survey.

As an extreme case, the pond was modeled with an initial water surface elevation of 670.0, and the discharge structure completely blocked. HEC-1 model output for this event is included as pages 30-47 of this calculation. Even for this extreme case, in response to the 100-Year, 24-Hour precipitation event, the water surface elevation in the pond only rises to 676.13. Thus, the pond would safely handle the design event, with a minimum freeboard of 5.87 feet, even if the discharge structure was completely blocked.

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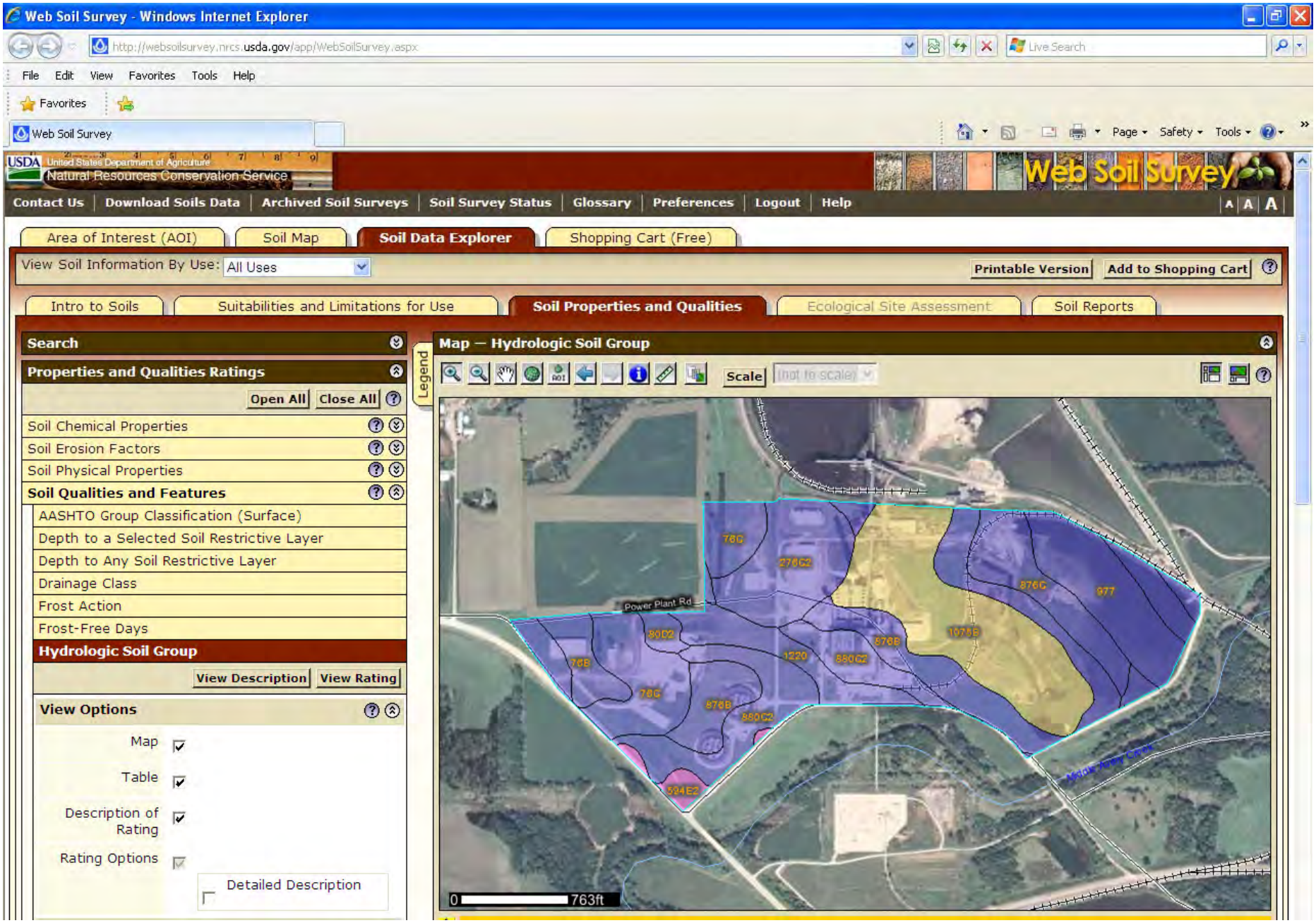


Tables — Hydrologic Soil Group — Summary By Map Unit

Summary by Map Unit — Wapello County, Iowa

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
76B	Ladoga silt loam, 2 to 5 percent slopes	B	4.4	3.1%
76C	Ladoga silt loam, 5 to 9 percent slopes	B	16.9	12.2%
80D2	Clinton silt loam, 9 to 14 percent slopes, moderately eroded	B	1.9	1.4%
220	Nodaway silt loam, 0 to 2 percent slopes	B	0.8	0.6%
276C2	Ladoga-Hedrick silt loams, 5 to 9 percent slopes, moderately eroded	B	13.3	9.6%
594E2	Galland loam, 14 to 18 percent slopes, moderately eroded	D	1.9	1.4%
876B	Ladoga silt loam, benches, 2 to 5 percent slopes	B	22.2	16.0%
876C	Ladoga silt loam, benches, 5 to 9 percent slopes	B	10.3	7.4%
880C2	Clinton silt loam, benches, 5 to 9 percent slopes, moderately eroded	B	16.7	12.1%
977	Richwood silt loam, 0 to 2 percent slopes	B	12.5	9.0%
977B	Richwood silt loam, 2 to 5 percent slopes	B	2.8	2.0%
1075B	Givin silt loam, benches, 2 to 5 percent slopes	C	27.3	19.8%
1220	Nodaway silt loam, channeled, 0 to 2 percent slopes	B	7.3	5.3%
Totals for Area of Interest			**138.3**	**100.0%**

Description — Hydrologic Soil Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

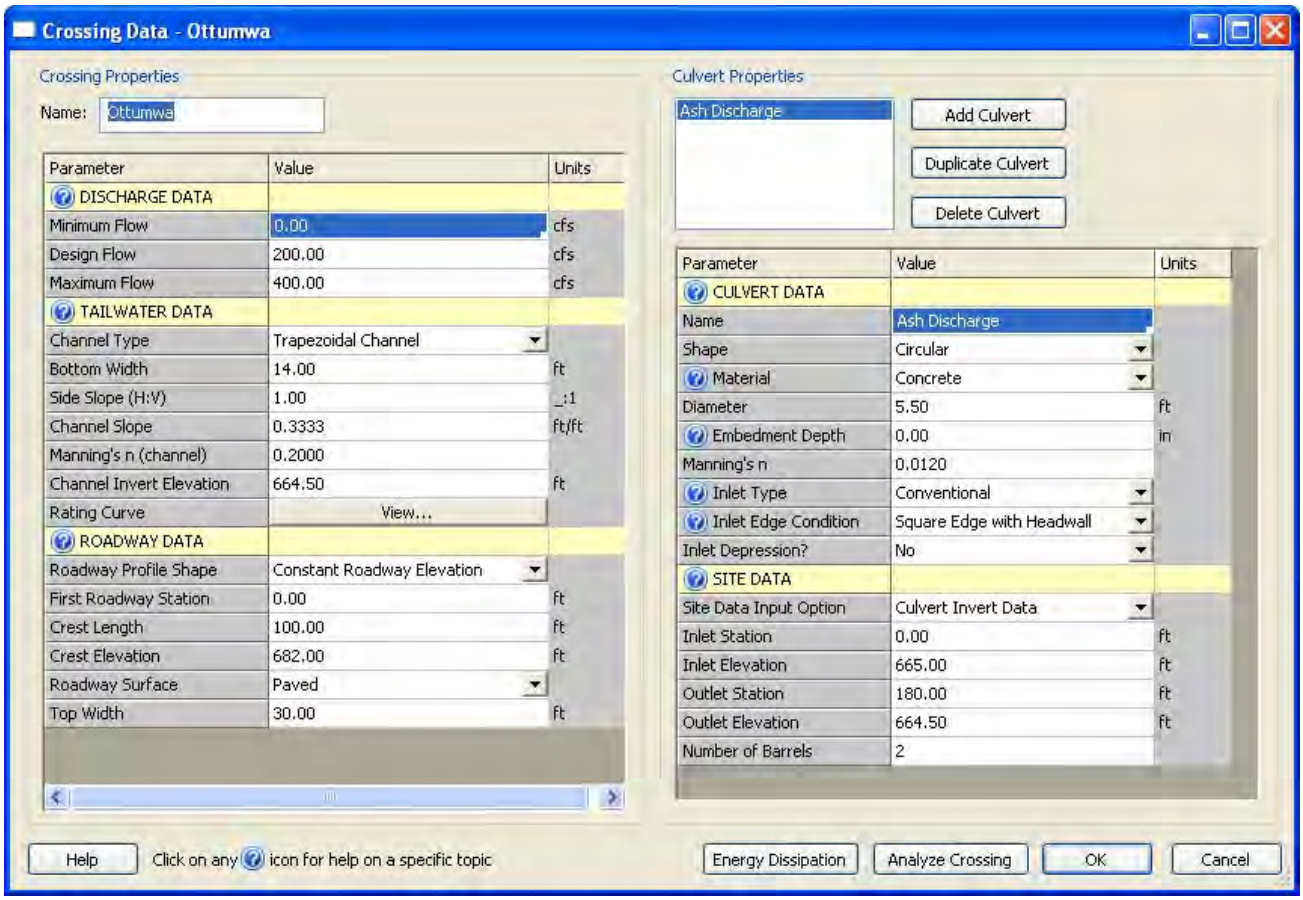
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Ottumwa Generating Station – Ash Pond discharge culverts HY-8 input parameters:



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HY-8 Analysis Results

Crossing Summary Table

Culvert Crossing: Ottumwa

Headwater Elevation (ft)	Total Discharge (cfs)	Ash Discharge Discharge (cfs)	Roadway Discharge (cfs)	Iterations
665.00	0.00	0.00	0.00	1
666.64	40.00	40.00	0.00	1
667.36	80.00	80.00	0.00	1
667.97	120.00	120.00	0.00	1
668.86	160.00	160.00	0.00	1
669.37	200.00	200.00	0.00	1
669.84	240.00	240.00	0.00	1
670.30	280.00	280.00	0.00	1
670.74	320.00	320.00	0.00	1
671.20	360.00	360.00	0.00	1
671.64	400.00	400.00	0.00	1
682.00	869.12	869.12	0.00	Overtopping

```
1****************************************                                                    ****************************************
 *                                      *                                                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                                    *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                                    *    HYDROLOGIC ENGINEERING CENTER     *
 *           VERSION 4.1                *                                                    *          609 SECOND STREET           *
 *                                      *                                                    *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   18OCT10  TIME  14:49:49  *                                                    *           (916) 756-1104             *
 *                                      *                                                    *                                      *
 ****************************************                                                    ****************************************


                                                X     X  XXXXXXX   XXXXX           X
                                                X     X  X        X     X         XX
                                                X     X  X        X               X
                                                XXXXXXX  XXXX     X        XXXXX   X
                                                X     X  X        X                X
                                                X     X  X        X     X          X
                                                X     X  XXXXXXX   XXXXX          XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


1                                                   HEC-1 INPUT                                                PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

             1          ID   Alliant Energy - Ottumwa Generating Station
             2          ID   HEC-1 Analysis of Ash Settling Pond and Site Contributing to Pond
             3          ID   100-YR - 24 HR Precipitation Event
             4          ID   Black & Veatch Project No. 169664
             5          ID   Input File: OTTUMWA.IN   Output File:  OTTUMWA.OUT
             6          IT      10 18OCT10    0600     300
             7          IO       0       0
             8          IN      30
                        * **********

             9          KK   SUB1
            10          KM   Runoff From Site Contributing Area
            11          BA  0.1427
            12          PB     6.8
```

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13          PC   0.005   0.011   0.017   0.022   0.029   0.035   0.042   0.048   0.056   0.064
14          PC   0.072   0.080   0.090   0.100   0.110   0.120   0.134   0.147   0.163   0.181
15          PC   0.204   0.235   0.283   0.663   0.735   0.772   0.799   0.820   0.835   0.850
16          PC   0.865   0.880   0.889   0.898   0.907   0.916   0.925   0.934   0.943   0.952
17          PC   0.958   0.964   0.970   0.976   0.982   0.988   0.994   1.000
18          LS       0      88       0
19          UD   0.323
            * **********

20          KK   SUB2
21          KM   Precipitation on Ash Settling Pond at Elevation 682
22          BA  0.0673
23          LS       0      98       0
24          UD   0.001
            * **********

25          KK   COMB1
26          KM   Combine Subbasins 1 and 2.
27          HC       2
            * **********

28          KK    RES1
29          KM   Reservoir Routing Operation
30          RS       1    ELEV   670.0
31          SA    6.52    8.00   13.03   20.65   28.71   39.53
32          SE   670.0   672.0   675.0   678.0   680.0   682.0
33          SQ       0    15.8    44.6   176.4   357.1   499.0   656.0
34          SE   670.0   671.0   672.0   675.0   678.0   680.0   682.0
            * **********
            *DIAGRAM
35          ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     9       SUB1
                 .
                 .
    20           .       SUB2
                 .           .
                 .           .
    25       COMB1............
                 V
                 V
    28        RES1

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1*****************************************                                    ****************************************
 *                                       *                                    *                                      *
```

```
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                    *    U.S. ARMY CORPS OF ENGINEERS     *
*               JUN   1998              *                                    *    HYDROLOGIC ENGINEERING CENTER    *
*            VERSION 4.1                *                                    *          609 SECOND STREET          *
*                                       *                                    *       DAVIS, CALIFORNIA 95616       *
*  RUN DATE   18OCT10  TIME  14:49:49   *                                    *           (916) 756-1104            *
*                                       *                                    *                                     *
*****************************************                                    *****************************************
```

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                         Alliant Energy - Ottumwa Generating Station
                         HEC-1 Analysis of Ash Settling Pond and Site Contributing to Pond
                         100-YR - 24 HR Precipitation Event
                         Black & Veatch Project No. 169664
                         Input File: OTTUMWA.IN   Output File:  OTTUMWA.OUT

   7 IO          OUTPUT CONTROL VARIABLES
                       IPRNT           0  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                        NMIN          10  MINUTES IN COMPUTATION INTERVAL
                       IDATE     18OCT10  STARTING DATE
                       ITIME        0600  STARTING TIME
                          NQ         300  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE     20OCT10  ENDING DATE
                      NDTIME        0750  ENDING TIME
                      ICENT           19  CENTURY MARK

                  COMPUTATION INTERVAL     .17 HOURS
                       TOTAL TIME BASE   49.83 HOURS

         ENGLISH UNITS
              DRAINAGE AREA         SQUARE MILES
              PRECIPITATION DEPTH   INCHES
              LENGTH, ELEVATION     FEET
              FLOW                  CUBIC FEET PER SECOND
              STORAGE VOLUME        ACRE-FEET
              SURFACE AREA          ACRES
              TEMPERATURE           DEGREES FAHRENHEIT


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   9 KK     *     SUB1   *
```

```
*            *
**************
                Runoff From Site Contributing Area

 8 IN          TIME DATA FOR INPUT TIME SERIES
                    JXMIN          30  TIME INTERVAL IN MINUTES
                   JXDATE     18OCT10  STARTING DATE
                   JXTIME         600  STARTING TIME

             SUBBASIN RUNOFF DATA

11 BA          SUBBASIN CHARACTERISTICS
                    TAREA         .14  SUBBASIN AREA

               PRECIPITATION DATA

12 PB               STORM        6.80  BASIN TOTAL PRECIPITATION

13 PI            INCREMENTAL PRECIPITATION PATTERN
                   .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                   .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                   .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                   .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                   .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                   .00       .01       .01       .01       .01       .01       .01       .01       .01       .01
                   .01       .01       .01       .02       .02       .02       .13       .13       .13       .02
                   .02       .02       .01       .01       .01       .01       .01       .01       .01       .01
                   .01       .00       .00       .00       .00       .01       .00       .00       .00       .00
                   .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                   .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                   .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                   .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                   .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                   .00

18 LS          SCS LOSS RATE
                    STRTL         .27  INITIAL ABSTRACTION
                   CRVNBR       88.00  CURVE NUMBER
                    RTIMP         .00  PERCENT IMPERVIOUS AREA

19 UD          SCS DIMENSIONLESS UNITGRAPH
                     TLAG         .32  LAG

                                                                  ***

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

                                                     UNIT HYDROGRAPH
                                                 12 END-OF-PERIOD ORDINATES
              56.      161.      155.       89.       45.       23.       12.        6.        3.        2.
               1.        0.
```

HYDROGRAPH AT STATION SUB1

DA MON HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q	DA MON HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q
18 OCT 0600	1	.00	.00	.00	0.	19 OCT 0700	151	.00	.00	.00	0.
18 OCT 0610	2	.01	.01	.00	0.	19 OCT 0710	152	.00	.00	.00	0.
18 OCT 0620	3	.01	.01	.00	0.	19 OCT 0720	153	.00	.00	.00	0.
18 OCT 0630	4	.01	.01	.00	0.	19 OCT 0730	154	.00	.00	.00	0.
18 OCT 0640	5	.01	.01	.00	0.	19 OCT 0740	155	.00	.00	.00	0.
18 OCT 0650	6	.01	.01	.00	0.	19 OCT 0750	156	.00	.00	.00	0.
18 OCT 0700	7	.01	.01	.00	0.	19 OCT 0800	157	.00	.00	.00	0.
18 OCT 0710	8	.01	.01	.00	0.	19 OCT 0810	158	.00	.00	.00	0.
18 OCT 0720	9	.01	.01	.00	0.	19 OCT 0820	159	.00	.00	.00	0.
18 OCT 0730	10	.01	.01	.00	0.	19 OCT 0830	160	.00	.00	.00	0.
18 OCT 0740	11	.02	.02	.00	0.	19 OCT 0840	161	.00	.00	.00	0.
18 OCT 0750	12	.02	.02	.00	0.	19 OCT 0850	162	.00	.00	.00	0.
18 OCT 0800	13	.02	.02	.00	0.	19 OCT 0900	163	.00	.00	.00	0.
18 OCT 0810	14	.01	.01	.00	0.	19 OCT 0910	164	.00	.00	.00	0.
18 OCT 0820	15	.01	.01	.00	0.	19 OCT 0920	165	.00	.00	.00	0.
18 OCT 0830	16	.01	.01	.00	0.	19 OCT 0930	166	.00	.00	.00	0.
18 OCT 0840	17	.02	.02	.00	0.	19 OCT 0940	167	.00	.00	.00	0.
18 OCT 0850	18	.02	.02	.00	0.	19 OCT 0950	168	.00	.00	.00	0.
18 OCT 0900	19	.02	.02	.00	0.	19 OCT 1000	169	.00	.00	.00	0.
18 OCT 0910	20	.01	.01	.00	0.	19 OCT 1010	170	.00	.00	.00	0.
18 OCT 0920	21	.01	.01	.00	0.	19 OCT 1020	171	.00	.00	.00	0.
18 OCT 0930	22	.01	.01	.00	0.	19 OCT 1030	172	.00	.00	.00	0.
18 OCT 0940	23	.02	.02	.00	0.	19 OCT 1040	173	.00	.00	.00	0.
18 OCT 0950	24	.02	.02	.00	0.	19 OCT 1050	174	.00	.00	.00	0.
18 OCT 1000	25	.02	.02	.00	0.	19 OCT 1100	175	.00	.00	.00	0.
18 OCT 1010	26	.02	.02	.00	1.	19 OCT 1110	176	.00	.00	.00	0.
18 OCT 1020	27	.02	.02	.00	1.	19 OCT 1120	177	.00	.00	.00	0.
18 OCT 1030	28	.02	.02	.00	1.	19 OCT 1130	178	.00	.00	.00	0.
18 OCT 1040	29	.02	.01	.00	1.	19 OCT 1140	179	.00	.00	.00	0.
18 OCT 1050	30	.02	.01	.00	2.	19 OCT 1150	180	.00	.00	.00	0.
18 OCT 1100	31	.02	.01	.00	2.	19 OCT 1200	181	.00	.00	.00	0.
18 OCT 1110	32	.02	.01	.00	2.	19 OCT 1210	182	.00	.00	.00	0.
18 OCT 1120	33	.02	.01	.00	2.	19 OCT 1220	183	.00	.00	.00	0.
18 OCT 1130	34	.02	.01	.00	2.	19 OCT 1230	184	.00	.00	.00	0.
18 OCT 1140	35	.02	.02	.01	3.	19 OCT 1240	185	.00	.00	.00	0.
18 OCT 1150	36	.02	.02	.01	3.	19 OCT 1250	186	.00	.00	.00	0.
18 OCT 1200	37	.02	.02	.01	3.	19 OCT 1300	187	.00	.00	.00	0.
18 OCT 1210	38	.02	.01	.01	4.	19 OCT 1310	188	.00	.00	.00	0.
18 OCT 1220	39	.02	.01	.01	4.	19 OCT 1320	189	.00	.00	.00	0.
18 OCT 1230	40	.02	.01	.01	4.	19 OCT 1330	190	.00	.00	.00	0.
18 OCT 1240	41	.02	.01	.01	4.	19 OCT 1340	191	.00	.00	.00	0.
18 OCT 1250	42	.02	.01	.01	5.	19 OCT 1350	192	.00	.00	.00	0.
18 OCT 1300	43	.02	.01	.01	5.	19 OCT 1400	193	.00	.00	.00	0.
18 OCT 1310	44	.02	.01	.01	5.	19 OCT 1410	194	.00	.00	.00	0.

18 OCT 1320	45	.02	.01	.01	5.	*	19 OCT 1420	195	.00	.00	.00	0.
18 OCT 1330	46	.02	.01	.01	5.	*	19 OCT 1430	196	.00	.00	.00	0.
18 OCT 1340	47	.03	.02	.02	6.	*	19 OCT 1440	197	.00	.00	.00	0.
18 OCT 1350	48	.03	.02	.02	7.	*	19 OCT 1450	198	.00	.00	.00	0.
18 OCT 1400	49	.03	.02	.02	8.	*	19 OCT 1500	199	.00	.00	.00	0.
18 OCT 1410	50	.03	.01	.02	8.	*	19 OCT 1510	200	.00	.00	.00	0.
18 OCT 1420	51	.03	.01	.02	9.	*	19 OCT 1520	201	.00	.00	.00	0.
18 OCT 1430	52	.03	.01	.02	9.	*	19 OCT 1530	202	.00	.00	.00	0.
18 OCT 1440	53	.04	.02	.02	9.	*	19 OCT 1540	203	.00	.00	.00	0.
18 OCT 1450	54	.04	.02	.02	10.	*	19 OCT 1550	204	.00	.00	.00	0.
18 OCT 1500	55	.04	.01	.02	11.	*	19 OCT 1600	205	.00	.00	.00	0.
18 OCT 1510	56	.04	.02	.03	12.	*	19 OCT 1610	206	.00	.00	.00	0.
18 OCT 1520	57	.04	.02	.03	12.	*	19 OCT 1620	207	.00	.00	.00	0.
18 OCT 1530	58	.04	.01	.03	13.	*	19 OCT 1630	208	.00	.00	.00	0.
18 OCT 1540	59	.05	.02	.03	14.	*	19 OCT 1640	209	.00	.00	.00	0.
18 OCT 1550	60	.05	.02	.04	16.	*	19 OCT 1650	210	.00	.00	.00	0.
18 OCT 1600	61	.05	.02	.04	18.	*	19 OCT 1700	211	.00	.00	.00	0.
18 OCT 1610	62	.07	.02	.05	19.	*	19 OCT 1710	212	.00	.00	.00	0.
18 OCT 1620	63	.07	.02	.05	22.	*	19 OCT 1720	213	.00	.00	.00	0.
18 OCT 1630	64	.07	.02	.05	25.	*	19 OCT 1730	214	.00	.00	.00	0.
18 OCT 1640	65	.11	.03	.08	28.	*	19 OCT 1740	215	.00	.00	.00	0.
18 OCT 1650	66	.11	.03	.08	34.	*	19 OCT 1750	216	.00	.00	.00	0.
18 OCT 1700	67	.11	.02	.09	40.	*	19 OCT 1800	217	.00	.00	.00	0.
18 OCT 1710	68	.87	.14	.73	79.	*	19 OCT 1810	218	.00	.00	.00	0.
18 OCT 1720	69	.87	.09	.78	187.	*	19 OCT 1820	219	.00	.00	.00	0.
18 OCT 1730	70	.87	.06	.80	297.	*	19 OCT 1830	220	.00	.00	.00	0.
18 OCT 1740	71	.16	.01	.15	331.	*	19 OCT 1840	221	.00	.00	.00	0.
18 OCT 1750	72	.16	.01	.16	264.	*	19 OCT 1850	222	.00	.00	.00	0.
18 OCT 1800	73	.16	.01	.16	183.	*	19 OCT 1900	223	.00	.00	.00	0.
18 OCT 1810	74	.08	.00	.08	131.	*	19 OCT 1910	224	.00	.00	.00	0.
18 OCT 1820	75	.08	.00	.08	95.	*	19 OCT 1920	225	.00	.00	.00	0.
18 OCT 1830	76	.08	.00	.08	71.	*	19 OCT 1930	226	.00	.00	.00	0.
18 OCT 1840	77	.06	.00	.06	57.	*	19 OCT 1940	227	.00	.00	.00	0.
18 OCT 1850	78	.06	.00	.06	47.	*	19 OCT 1950	228	.00	.00	.00	0.
18 OCT 1900	79	.06	.00	.06	40.	*	19 OCT 2000	229	.00	.00	.00	0.
18 OCT 1910	80	.05	.00	.05	35.	*	19 OCT 2010	230	.00	.00	.00	0.
18 OCT 1920	81	.05	.00	.05	31.	*	19 OCT 2020	231	.00	.00	.00	0.
18 OCT 1930	82	.05	.00	.05	28.	*	19 OCT 2030	232	.00	.00	.00	0.
18 OCT 1940	83	.03	.00	.03	26.	*	19 OCT 2040	233	.00	.00	.00	0.
18 OCT 1950	84	.03	.00	.03	23.	*	19 OCT 2050	234	.00	.00	.00	0.
18 OCT 2000	85	.03	.00	.03	21.	*	19 OCT 2100	235	.00	.00	.00	0.
18 OCT 2010	86	.03	.00	.03	19.	*	19 OCT 2110	236	.00	.00	.00	0.
18 OCT 2020	87	.03	.00	.03	19.	*	19 OCT 2120	237	.00	.00	.00	0.
18 OCT 2030	88	.03	.00	.03	18.	*	19 OCT 2130	238	.00	.00	.00	0.
18 OCT 2040	89	.03	.00	.03	18.	*	19 OCT 2140	239	.00	.00	.00	0.
18 OCT 2050	90	.03	.00	.03	18.	*	19 OCT 2150	240	.00	.00	.00	0.
18 OCT 2100	91	.03	.00	.03	18.	*	19 OCT 2200	241	.00	.00	.00	0.
18 OCT 2110	92	.03	.00	.03	18.	*	19 OCT 2210	242	.00	.00	.00	0.
18 OCT 2120	93	.03	.00	.03	18.	*	19 OCT 2220	243	.00	.00	.00	0.
18 OCT 2130	94	.03	.00	.03	18.	*	19 OCT 2230	244	.00	.00	.00	0.
18 OCT 2140	95	.02	.00	.02	17.	*	19 OCT 2240	245	.00	.00	.00	0.
18 OCT 2150	96	.02	.00	.02	15.	*	19 OCT 2250	246	.00	.00	.00	0.

18 OCT 2200	97	.02	.00	.02	13.	*	19 OCT 2300	247	.00	.00	.00	0.
18 OCT 2210	98	.02	.00	.02	12.	*	19 OCT 2310	248	.00	.00	.00	0.
18 OCT 2220	99	.02	.00	.02	12.	*	19 OCT 2320	249	.00	.00	.00	0.
18 OCT 2230	100	.02	.00	.02	11.	*	19 OCT 2330	250	.00	.00	.00	0.
18 OCT 2240	101	.02	.00	.02	11.	*	19 OCT 2340	251	.00	.00	.00	0.
18 OCT 2250	102	.02	.00	.02	11.	*	19 OCT 2350	252	.00	.00	.00	0.
18 OCT 2300	103	.02	.00	.02	11.	*	20 OCT 0000	253	.00	.00	.00	0.
18 OCT 2310	104	.02	.00	.02	11.	*	20 OCT 0010	254	.00	.00	.00	0.
18 OCT 2320	105	.02	.00	.02	11.	*	20 OCT 0020	255	.00	.00	.00	0.
18 OCT 2330	106	.02	.00	.02	11.	*	20 OCT 0030	256	.00	.00	.00	0.
18 OCT 2340	107	.02	.00	.02	11.	*	20 OCT 0040	257	.00	.00	.00	0.
18 OCT 2350	108	.02	.00	.02	11.	*	20 OCT 0050	258	.00	.00	.00	0.
19 OCT 0000	109	.02	.00	.02	11.	*	20 OCT 0100	259	.00	.00	.00	0.
19 OCT 0010	110	.02	.00	.02	11.	*	20 OCT 0110	260	.00	.00	.00	0.
19 OCT 0020	111	.02	.00	.02	11.	*	20 OCT 0120	261	.00	.00	.00	0.
19 OCT 0030	112	.02	.00	.02	11.	*	20 OCT 0130	262	.00	.00	.00	0.
19 OCT 0040	113	.02	.00	.02	11.	*	20 OCT 0140	263	.00	.00	.00	0.
19 OCT 0050	114	.02	.00	.02	11.	*	20 OCT 0150	264	.00	.00	.00	0.
19 OCT 0100	115	.02	.00	.02	11.	*	20 OCT 0200	265	.00	.00	.00	0.
19 OCT 0110	116	.02	.00	.02	11.	*	20 OCT 0210	266	.00	.00	.00	0.
19 OCT 0120	117	.02	.00	.02	11.	*	20 OCT 0220	267	.00	.00	.00	0.
19 OCT 0130	118	.02	.00	.02	11.	*	20 OCT 0230	268	.00	.00	.00	0.
19 OCT 0140	119	.01	.00	.01	11.	*	20 OCT 0240	269	.00	.00	.00	0.
19 OCT 0150	120	.01	.00	.01	10.	*	20 OCT 0250	270	.00	.00	.00	0.
19 OCT 0200	121	.01	.00	.01	8.	*	20 OCT 0300	271	.00	.00	.00	0.
19 OCT 0210	122	.01	.00	.01	8.	*	20 OCT 0310	272	.00	.00	.00	0.
19 OCT 0220	123	.01	.00	.01	8.	*	20 OCT 0320	273	.00	.00	.00	0.
19 OCT 0230	124	.01	.00	.01	7.	*	20 OCT 0330	274	.00	.00	.00	0.
19 OCT 0240	125	.01	.00	.01	7.	*	20 OCT 0340	275	.00	.00	.00	0.
19 OCT 0250	126	.01	.00	.01	7.	*	20 OCT 0350	276	.00	.00	.00	0.
19 OCT 0300	127	.01	.00	.01	7.	*	20 OCT 0400	277	.00	.00	.00	0.
19 OCT 0310	128	.01	.00	.01	7.	*	20 OCT 0410	278	.00	.00	.00	0.
19 OCT 0320	129	.01	.00	.01	7.	*	20 OCT 0420	279	.00	.00	.00	0.
19 OCT 0330	130	.01	.00	.01	7.	*	20 OCT 0430	280	.00	.00	.00	0.
19 OCT 0340	131	.01	.00	.01	7.	*	20 OCT 0440	281	.00	.00	.00	0.
19 OCT 0350	132	.01	.00	.01	7.	*	20 OCT 0450	282	.00	.00	.00	0.
19 OCT 0400	133	.01	.00	.01	7.	*	20 OCT 0500	283	.00	.00	.00	0.
19 OCT 0410	134	.01	.00	.01	7.	*	20 OCT 0510	284	.00	.00	.00	0.
19 OCT 0420	135	.01	.00	.01	7.	*	20 OCT 0520	285	.00	.00	.00	0.
19 OCT 0430	136	.01	.00	.01	7.	*	20 OCT 0530	286	.00	.00	.00	0.
19 OCT 0440	137	.01	.00	.01	7.	*	20 OCT 0540	287	.00	.00	.00	0.
19 OCT 0450	138	.01	.00	.01	7.	*	20 OCT 0550	288	.00	.00	.00	0.
19 OCT 0500	139	.01	.00	.01	7.	*	20 OCT 0600	289	.00	.00	.00	0.
19 OCT 0510	140	.01	.00	.01	7.	*	20 OCT 0610	290	.00	.00	.00	0.
19 OCT 0520	141	.01	.00	.01	7.	*	20 OCT 0620	291	.00	.00	.00	0.
19 OCT 0530	142	.01	.00	.01	7.	*	20 OCT 0630	292	.00	.00	.00	0.
19 OCT 0540	143	.00	.00	.00	7.	*	20 OCT 0640	293	.00	.00	.00	0.
19 OCT 0550	144	.00	.00	.00	4.	*	20 OCT 0650	294	.00	.00	.00	0.
19 OCT 0600	145	.00	.00	.00	2.	*	20 OCT 0700	295	.00	.00	.00	0.
19 OCT 0610	146	.00	.00	.00	1.	*	20 OCT 0710	296	.00	.00	.00	0.
19 OCT 0620	147	.00	.00	.00	1.	*	20 OCT 0720	297	.00	.00	.00	0.
19 OCT 0630	148	.00	.00	.00	0.	*	20 OCT 0730	298	.00	.00	.00	0.

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       19 OCT 0640  149     .00     .00     .00         0.       *       20 OCT 0740  299     .00     .00     .00         0.
       19 OCT 0650  150     .00     .00     .00         0.       *       20 OCT 0750  300     .00     .00     .00         0.
                                                                 *
*****************************************************************************************************************************

    TOTAL RAINFALL =    6.80, TOTAL LOSS =    1.40, TOTAL EXCESS =    5.40

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     49.83-HR
+   (CFS)       (HR)
                          (CFS)
+     331.     11.67                  65.         21.         10.          10.
                        (INCHES)     4.218       5.399       5.399        5.399
                         (AC-FT)      32.         41.         41.          41.

                         CUMULATIVE AREA =     .14 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   20 KK    *     SUB2   *
            *            *
            **************
                           Precipitation on Ash Settling Pond at Elevation 682

              SUBBASIN RUNOFF DATA

   22 BA          SUBBASIN CHARACTERISTICS
                        TAREA         .07  SUBBASIN AREA

                  PRECIPITATION DATA

   12 PB                STORM        6.80  BASIN TOTAL PRECIPITATION

   13 PI            INCREMENTAL PRECIPITATION PATTERN
                        .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                        .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                        .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                        .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                        .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                        .00       .01       .01       .01       .01       .01       .01       .01       .01       .01
                        .01       .01       .01       .02       .02       .02       .13       .13       .13       .02
                        .02       .02       .01       .01       .01       .01       .01       .01       .01       .01
                        .01       .00       .00       .00       .00       .01       .00       .00       .00       .00
                        .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                        .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                        .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
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                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00

  23 LS          SCS LOSS RATE
                      STRTL         .04  INITIAL ABSTRACTION
                     CRVNBR       98.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

  24 UD          SCS DIMENSIONLESS UNITGRAPH
                       TLAG         .00  LAG

                                                                  ***

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

                                                        UNIT HYDROGRAPH
                                                    5 END-OF-PERIOD ORDINATES
               194.       54.       11.        2.        0.
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HYDROGRAPH AT STATION SUB2

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DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q	*	DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q
18	OCT	0600	1	.00	.00	.00	0.	*	19	OCT	0700	151	.00	.00	.00	0.
18	OCT	0610	2	.01	.01	.00	0.	*	19	OCT	0710	152	.00	.00	.00	0.
18	OCT	0620	3	.01	.01	.00	0.	*	19	OCT	0720	153	.00	.00	.00	0.
18	OCT	0630	4	.01	.01	.00	0.	*	19	OCT	0730	154	.00	.00	.00	0.
18	OCT	0640	5	.01	.01	.00	0.	*	19	OCT	0740	155	.00	.00	.00	0.
18	OCT	0650	6	.01	.01	.00	1.	*	19	OCT	0750	156	.00	.00	.00	0.
18	OCT	0700	7	.01	.01	.00	1.	*	19	OCT	0800	157	.00	.00	.00	0.
18	OCT	0710	8	.01	.01	.00	1.	*	19	OCT	0810	158	.00	.00	.00	0.
18	OCT	0720	9	.01	.01	.00	1.	*	19	OCT	0820	159	.00	.00	.00	0.
18	OCT	0730	10	.01	.01	.01	1.	*	19	OCT	0830	160	.00	.00	.00	0.
18	OCT	0740	11	.02	.01	.01	2.	*	19	OCT	0840	161	.00	.00	.00	0.
18	OCT	0750	12	.02	.01	.01	2.	*	19	OCT	0850	162	.00	.00	.00	0.
18	OCT	0800	13	.02	.01	.01	2.	*	19	OCT	0900	163	.00	.00	.00	0.
18	OCT	0810	14	.01	.01	.01	2.	*	19	OCT	0910	164	.00	.00	.00	0.
18	OCT	0820	15	.01	.00	.01	2.	*	19	OCT	0920	165	.00	.00	.00	0.
18	OCT	0830	16	.01	.00	.01	2.	*	19	OCT	0930	166	.00	.00	.00	0.
18	OCT	0840	17	.02	.00	.01	3.	*	19	OCT	0940	167	.00	.00	.00	0.
18	OCT	0850	18	.02	.00	.01	3.	*	19	OCT	0950	168	.00	.00	.00	0.
18	OCT	0900	19	.02	.00	.01	3.	*	19	OCT	1000	169	.00	.00	.00	0.
18	OCT	0910	20	.01	.00	.01	3.	*	19	OCT	1010	170	.00	.00	.00	0.
18	OCT	0920	21	.01	.00	.01	3.	*	19	OCT	1020	171	.00	.00	.00	0.
18	OCT	0930	22	.01	.00	.01	3.	*	19	OCT	1030	172	.00	.00	.00	0.
18	OCT	0940	23	.02	.00	.01	4.	*	19	OCT	1040	173	.00	.00	.00	0.
18	OCT	0950	24	.02	.00	.01	4.	*	19	OCT	1050	174	.00	.00	.00	0.

18 OCT 1000	25	.02	.00	.02	4.	*	19 OCT 1100	175	.00	.00	.00	0.
18 OCT 1010	26	.02	.00	.02	4.	*	19 OCT 1110	176	.00	.00	.00	0.
18 OCT 1020	27	.02	.00	.02	4.	*	19 OCT 1120	177	.00	.00	.00	0.
18 OCT 1030	28	.02	.00	.02	4.	*	19 OCT 1130	178	.00	.00	.00	0.
18 OCT 1040	29	.02	.00	.02	4.	*	19 OCT 1140	179	.00	.00	.00	0.
18 OCT 1050	30	.02	.00	.02	4.	*	19 OCT 1150	180	.00	.00	.00	0.
18 OCT 1100	31	.02	.00	.02	4.	*	19 OCT 1200	181	.00	.00	.00	0.
18 OCT 1110	32	.02	.00	.02	4.	*	19 OCT 1210	182	.00	.00	.00	0.
18 OCT 1120	33	.02	.00	.02	4.	*	19 OCT 1220	183	.00	.00	.00	0.
18 OCT 1130	34	.02	.00	.02	4.	*	19 OCT 1230	184	.00	.00	.00	0.
18 OCT 1140	35	.02	.00	.02	5.	*	19 OCT 1240	185	.00	.00	.00	0.
18 OCT 1150	36	.02	.00	.02	5.	*	19 OCT 1250	186	.00	.00	.00	0.
18 OCT 1200	37	.02	.00	.02	5.	*	19 OCT 1300	187	.00	.00	.00	0.
18 OCT 1210	38	.02	.00	.02	5.	*	19 OCT 1310	188	.00	.00	.00	0.
18 OCT 1220	39	.02	.00	.02	6.	*	19 OCT 1320	189	.00	.00	.00	0.
18 OCT 1230	40	.02	.00	.02	6.	*	19 OCT 1330	190	.00	.00	.00	0.
18 OCT 1240	41	.02	.00	.02	6.	*	19 OCT 1340	191	.00	.00	.00	0.
18 OCT 1250	42	.02	.00	.02	6.	*	19 OCT 1350	192	.00	.00	.00	0.
18 OCT 1300	43	.02	.00	.02	6.	*	19 OCT 1400	193	.00	.00	.00	0.
18 OCT 1310	44	.02	.00	.02	6.	*	19 OCT 1410	194	.00	.00	.00	0.
18 OCT 1320	45	.02	.00	.02	6.	*	19 OCT 1420	195	.00	.00	.00	0.
18 OCT 1330	46	.02	.00	.02	6.	*	19 OCT 1430	196	.00	.00	.00	0.
18 OCT 1340	47	.03	.00	.03	7.	*	19 OCT 1440	197	.00	.00	.00	0.
18 OCT 1350	48	.03	.00	.03	8.	*	19 OCT 1450	198	.00	.00	.00	0.
18 OCT 1400	49	.03	.00	.03	8.	*	19 OCT 1500	199	.00	.00	.00	0.
18 OCT 1410	50	.03	.00	.03	8.	*	19 OCT 1510	200	.00	.00	.00	0.
18 OCT 1420	51	.03	.00	.03	7.	*	19 OCT 1520	201	.00	.00	.00	0.
18 OCT 1430	52	.03	.00	.03	7.	*	19 OCT 1530	202	.00	.00	.00	0.
18 OCT 1440	53	.04	.00	.04	9.	*	19 OCT 1540	203	.00	.00	.00	0.
18 OCT 1450	54	.04	.00	.04	9.	*	19 OCT 1550	204	.00	.00	.00	0.
18 OCT 1500	55	.04	.00	.04	9.	*	19 OCT 1600	205	.00	.00	.00	0.
18 OCT 1510	56	.04	.00	.04	10.	*	19 OCT 1610	206	.00	.00	.00	0.
18 OCT 1520	57	.04	.00	.04	10.	*	19 OCT 1620	207	.00	.00	.00	0.
18 OCT 1530	58	.04	.00	.04	10.	*	19 OCT 1630	208	.00	.00	.00	0.
18 OCT 1540	59	.05	.00	.05	13.	*	19 OCT 1640	209	.00	.00	.00	0.
18 OCT 1550	60	.05	.00	.05	13.	*	19 OCT 1650	210	.00	.00	.00	0.
18 OCT 1600	61	.05	.00	.05	13.	*	19 OCT 1700	211	.00	.00	.00	0.
18 OCT 1610	62	.07	.00	.07	17.	*	19 OCT 1710	212	.00	.00	.00	0.
18 OCT 1620	63	.07	.00	.07	18.	*	19 OCT 1720	213	.00	.00	.00	0.
18 OCT 1630	64	.07	.00	.07	18.	*	19 OCT 1730	214	.00	.00	.00	0.
18 OCT 1640	65	.11	.00	.11	26.	*	19 OCT 1740	215	.00	.00	.00	0.
18 OCT 1650	66	.11	.00	.11	28.	*	19 OCT 1750	216	.00	.00	.00	0.
18 OCT 1700	67	.11	.00	.11	28.	*	19 OCT 1800	217	.00	.00	.00	0.
18 OCT 1710	68	.87	.01	.86	174.	*	19 OCT 1810	218	.00	.00	.00	0.
18 OCT 1720	69	.87	.00	.86	215.	*	19 OCT 1820	219	.00	.00	.00	0.
18 OCT 1730	70	.87	.00	.86	223.	*	19 OCT 1830	220	.00	.00	.00	0.
18 OCT 1740	71	.16	.00	.16	90.	*	19 OCT 1840	221	.00	.00	.00	0.
18 OCT 1750	72	.16	.00	.16	52.	*	19 OCT 1850	222	.00	.00	.00	0.
18 OCT 1800	73	.16	.00	.16	44.	*	19 OCT 1900	223	.00	.00	.00	0.
18 OCT 1810	74	.08	.00	.08	27.	*	19 OCT 1910	224	.00	.00	.00	0.
18 OCT 1820	75	.08	.00	.08	23.	*	19 OCT 1920	225	.00	.00	.00	0.
18 OCT 1830	76	.08	.00	.08	22.	*	19 OCT 1930	226	.00	.00	.00	0.

18 OCT 1840	77	.06	.00	.06	18.	*	19 OCT 1940	227	.00	.00	.00	0.
18 OCT 1850	78	.06	.00	.06	16.	*	19 OCT 1950	228	.00	.00	.00	0.
18 OCT 1900	79	.06	.00	.06	16.	*	19 OCT 2000	229	.00	.00	.00	0.
18 OCT 1910	80	.05	.00	.05	13.	*	19 OCT 2010	230	.00	.00	.00	0.
18 OCT 1920	81	.05	.00	.05	13.	*	19 OCT 2020	231	.00	.00	.00	0.
18 OCT 1930	82	.05	.00	.05	12.	*	19 OCT 2030	232	.00	.00	.00	0.
18 OCT 1940	83	.03	.00	.03	10.	*	19 OCT 2040	233	.00	.00	.00	0.
18 OCT 1950	84	.03	.00	.03	9.	*	19 OCT 2050	234	.00	.00	.00	0.
18 OCT 2000	85	.03	.00	.03	9.	*	19 OCT 2100	235	.00	.00	.00	0.
18 OCT 2010	86	.03	.00	.03	9.	*	19 OCT 2110	236	.00	.00	.00	0.
18 OCT 2020	87	.03	.00	.03	9.	*	19 OCT 2120	237	.00	.00	.00	0.
18 OCT 2030	88	.03	.00	.03	9.	*	19 OCT 2130	238	.00	.00	.00	0.
18 OCT 2040	89	.03	.00	.03	9.	*	19 OCT 2140	239	.00	.00	.00	0.
18 OCT 2050	90	.03	.00	.03	9.	*	19 OCT 2150	240	.00	.00	.00	0.
18 OCT 2100	91	.03	.00	.03	9.	*	19 OCT 2200	241	.00	.00	.00	0.
18 OCT 2110	92	.03	.00	.03	9.	*	19 OCT 2210	242	.00	.00	.00	0.
18 OCT 2120	93	.03	.00	.03	9.	*	19 OCT 2220	243	.00	.00	.00	0.
18 OCT 2130	94	.03	.00	.03	9.	*	19 OCT 2230	244	.00	.00	.00	0.
18 OCT 2140	95	.02	.00	.02	6.	*	19 OCT 2240	245	.00	.00	.00	0.
18 OCT 2150	96	.02	.00	.02	6.	*	19 OCT 2250	246	.00	.00	.00	0.
18 OCT 2200	97	.02	.00	.02	5.	*	19 OCT 2300	247	.00	.00	.00	0.
18 OCT 2210	98	.02	.00	.02	5.	*	19 OCT 2310	248	.00	.00	.00	0.
18 OCT 2220	99	.02	.00	.02	5.	*	19 OCT 2320	249	.00	.00	.00	0.
18 OCT 2230	100	.02	.00	.02	5.	*	19 OCT 2330	250	.00	.00	.00	0.
18 OCT 2240	101	.02	.00	.02	5.	*	19 OCT 2340	251	.00	.00	.00	0.
18 OCT 2250	102	.02	.00	.02	5.	*	19 OCT 2350	252	.00	.00	.00	0.
18 OCT 2300	103	.02	.00	.02	5.	*	20 OCT 0000	253	.00	.00	.00	0.
18 OCT 2310	104	.02	.00	.02	5.	*	20 OCT 0010	254	.00	.00	.00	0.
18 OCT 2320	105	.02	.00	.02	5.	*	20 OCT 0020	255	.00	.00	.00	0.
18 OCT 2330	106	.02	.00	.02	5.	*	20 OCT 0030	256	.00	.00	.00	0.
18 OCT 2340	107	.02	.00	.02	5.	*	20 OCT 0040	257	.00	.00	.00	0.
18 OCT 2350	108	.02	.00	.02	5.	*	20 OCT 0050	258	.00	.00	.00	0.
19 OCT 0000	109	.02	.00	.02	5.	*	20 OCT 0100	259	.00	.00	.00	0.
19 OCT 0010	110	.02	.00	.02	5.	*	20 OCT 0110	260	.00	.00	.00	0.
19 OCT 0020	111	.02	.00	.02	5.	*	20 OCT 0120	261	.00	.00	.00	0.
19 OCT 0030	112	.02	.00	.02	5.	*	20 OCT 0130	262	.00	.00	.00	0.
19 OCT 0040	113	.02	.00	.02	5.	*	20 OCT 0140	263	.00	.00	.00	0.
19 OCT 0050	114	.02	.00	.02	5.	*	20 OCT 0150	264	.00	.00	.00	0.
19 OCT 0100	115	.02	.00	.02	5.	*	20 OCT 0200	265	.00	.00	.00	0.
19 OCT 0110	116	.02	.00	.02	5.	*	20 OCT 0210	266	.00	.00	.00	0.
19 OCT 0120	117	.02	.00	.02	5.	*	20 OCT 0220	267	.00	.00	.00	0.
19 OCT 0130	118	.02	.00	.02	5.	*	20 OCT 0230	268	.00	.00	.00	0.
19 OCT 0140	119	.01	.00	.01	4.	*	20 OCT 0240	269	.00	.00	.00	0.
19 OCT 0150	120	.01	.00	.01	4.	*	20 OCT 0250	270	.00	.00	.00	0.
19 OCT 0200	121	.01	.00	.01	4.	*	20 OCT 0300	271	.00	.00	.00	0.
19 OCT 0210	122	.01	.00	.01	4.	*	20 OCT 0310	272	.00	.00	.00	0.
19 OCT 0220	123	.01	.00	.01	4.	*	20 OCT 0320	273	.00	.00	.00	0.
19 OCT 0230	124	.01	.00	.01	4.	*	20 OCT 0330	274	.00	.00	.00	0.
19 OCT 0240	125	.01	.00	.01	4.	*	20 OCT 0340	275	.00	.00	.00	0.
19 OCT 0250	126	.01	.00	.01	4.	*	20 OCT 0350	276	.00	.00	.00	0.
19 OCT 0300	127	.01	.00	.01	4.	*	20 OCT 0400	277	.00	.00	.00	0.
19 OCT 0310	128	.01	.00	.01	4.	*	20 OCT 0410	278	.00	.00	.00	0.

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      19 OCT 0320  129     .01     .00     .01         4.       *       20 OCT 0420  279     .00     .00     .00         0.
      19 OCT 0330  130     .01     .00     .01         4.       *       20 OCT 0430  280     .00     .00     .00         0.
      19 OCT 0340  131     .01     .00     .01         4.       *       20 OCT 0440  281     .00     .00     .00         0.
      19 OCT 0350  132     .01     .00     .01         4.       *       20 OCT 0450  282     .00     .00     .00         0.
      19 OCT 0400  133     .01     .00     .01         4.       *       20 OCT 0500  283     .00     .00     .00         0.
      19 OCT 0410  134     .01     .00     .01         4.       *       20 OCT 0510  284     .00     .00     .00         0.
      19 OCT 0420  135     .01     .00     .01         4.       *       20 OCT 0520  285     .00     .00     .00         0.
      19 OCT 0430  136     .01     .00     .01         4.       *       20 OCT 0530  286     .00     .00     .00         0.
      19 OCT 0440  137     .01     .00     .01         4.       *       20 OCT 0540  287     .00     .00     .00         0.
      19 OCT 0450  138     .01     .00     .01         4.       *       20 OCT 0550  288     .00     .00     .00         0.
      19 OCT 0500  139     .01     .00     .01         4.       *       20 OCT 0600  289     .00     .00     .00         0.
      19 OCT 0510  140     .01     .00     .01         4.       *       20 OCT 0610  290     .00     .00     .00         0.
      19 OCT 0520  141     .01     .00     .01         4.       *       20 OCT 0620  291     .00     .00     .00         0.
      19 OCT 0530  142     .01     .00     .01         4.       *       20 OCT 0630  292     .00     .00     .00         0.
      19 OCT 0540  143     .00     .00     .00         1.       *       20 OCT 0640  293     .00     .00     .00         0.
      19 OCT 0550  144     .00     .00     .00         0.       *       20 OCT 0650  294     .00     .00     .00         0.
      19 OCT 0600  145     .00     .00     .00         0.       *       20 OCT 0700  295     .00     .00     .00         0.
      19 OCT 0610  146     .00     .00     .00         0.       *       20 OCT 0710  296     .00     .00     .00         0.
      19 OCT 0620  147     .00     .00     .00         0.       *       20 OCT 0720  297     .00     .00     .00         0.
      19 OCT 0630  148     .00     .00     .00         0.       *       20 OCT 0730  298     .00     .00     .00         0.
      19 OCT 0640  149     .00     .00     .00         0.       *       20 OCT 0740  299     .00     .00     .00         0.
      19 OCT 0650  150     .00     .00     .00         0.       *       20 OCT 0750  300     .00     .00     .00         0.
                                                                 *
 ************************************************************************************************************************************

     TOTAL RAINFALL =    6.80, TOTAL LOSS =     .24, TOTAL EXCESS =    6.56

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     49.83-HR
+   (CFS)       (HR)
                          (CFS)
+     223.     11.50                35.         12.          6.           6.
                        (INCHES)    4.773       6.561       6.561        6.561
                         (AC-FT)     17.         24.         24.          24.

                         CUMULATIVE AREA =     .07 SQ MI



 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   25 KK    *     COMB1  *
            *            *
            **************
                            Combine Subbasins 1 and 2.

   27 HC          HYDROGRAPH COMBINATION
                        ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE
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HYDROGRAPH AT STATION COMB1
SUM OF 2 HYDROGRAPHS

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
18	OCT	0600	1	0.	18	OCT	1830	76	93.	19	OCT	0700	151	0.	19	OCT	1930	226	0.
18	OCT	0610	2	0.	18	OCT	1840	77	74.	19	OCT	0710	152	0.	19	OCT	1940	227	0.
18	OCT	0620	3	0.	18	OCT	1850	78	63.	19	OCT	0720	153	0.	19	OCT	1950	228	0.
18	OCT	0630	4	0.	18	OCT	1900	79	56.	19	OCT	0730	154	0.	19	OCT	2000	229	0.
18	OCT	0640	5	0.	18	OCT	1910	80	49.	19	OCT	0740	155	0.	19	OCT	2010	230	0.
18	OCT	0650	6	1.	18	OCT	1920	81	44.	19	OCT	0750	156	0.	19	OCT	2020	231	0.
18	OCT	0700	7	1.	18	OCT	1930	82	41.	19	OCT	0800	157	0.	19	OCT	2030	232	0.
18	OCT	0710	8	1.	18	OCT	1940	83	36.	19	OCT	0810	158	0.	19	OCT	2040	233	0.
18	OCT	0720	9	1.	18	OCT	1950	84	32.	19	OCT	0820	159	0.	19	OCT	2050	234	0.
18	OCT	0730	10	1.	18	OCT	2000	85	30.	19	OCT	0830	160	0.	19	OCT	2100	235	0.
18	OCT	0740	11	2.	18	OCT	2010	86	28.	19	OCT	0840	161	0.	19	OCT	2110	236	0.
18	OCT	0750	12	2.	18	OCT	2020	87	28.	19	OCT	0850	162	0.	19	OCT	2120	237	0.
18	OCT	0800	13	2.	18	OCT	2030	88	27.	19	OCT	0900	163	0.	19	OCT	2130	238	0.
18	OCT	0810	14	2.	18	OCT	2040	89	27.	19	OCT	0910	164	0.	19	OCT	2140	239	0.
18	OCT	0820	15	2.	18	OCT	2050	90	27.	19	OCT	0920	165	0.	19	OCT	2150	240	0.
18	OCT	0830	16	2.	18	OCT	2100	91	27.	19	OCT	0930	166	0.	19	OCT	2200	241	0.
18	OCT	0840	17	3.	18	OCT	2110	92	27.	19	OCT	0940	167	0.	19	OCT	2210	242	0.
18	OCT	0850	18	3.	18	OCT	2120	93	27.	19	OCT	0950	168	0.	19	OCT	2220	243	0.
18	OCT	0900	19	3.	18	OCT	2130	94	27.	19	OCT	1000	169	0.	19	OCT	2230	244	0.
18	OCT	0910	20	3.	18	OCT	2140	95	24.	19	OCT	1010	170	0.	19	OCT	2240	245	0.
18	OCT	0920	21	3.	18	OCT	2150	96	21.	19	OCT	1020	171	0.	19	OCT	2250	246	0.
18	OCT	0930	22	3.	18	OCT	2200	97	19.	19	OCT	1030	172	0.	19	OCT	2300	247	0.
18	OCT	0940	23	4.	18	OCT	2210	98	17.	19	OCT	1040	173	0.	19	OCT	2310	248	0.
18	OCT	0950	24	4.	18	OCT	2220	99	17.	19	OCT	1050	174	0.	19	OCT	2320	249	0.
18	OCT	1000	25	4.	18	OCT	2230	100	17.	19	OCT	1100	175	0.	19	OCT	2330	250	0.
18	OCT	1010	26	5.	18	OCT	2240	101	16.	19	OCT	1110	176	0.	19	OCT	2340	251	0.
18	OCT	1020	27	5.	18	OCT	2250	102	16.	19	OCT	1120	177	0.	19	OCT	2350	252	0.
18	OCT	1030	28	5.	18	OCT	2300	103	16.	19	OCT	1130	178	0.	20	OCT	0000	253	0.
18	OCT	1040	29	5.	18	OCT	2310	104	16.	19	OCT	1140	179	0.	20	OCT	0010	254	0.
18	OCT	1050	30	6.	18	OCT	2320	105	16.	19	OCT	1150	180	0.	20	OCT	0020	255	0.
18	OCT	1100	31	6.	18	OCT	2330	106	16.	19	OCT	1200	181	0.	20	OCT	0030	256	0.
18	OCT	1110	32	6.	18	OCT	2340	107	16.	19	OCT	1210	182	0.	20	OCT	0040	257	0.
18	OCT	1120	33	6.	18	OCT	2350	108	16.	19	OCT	1220	183	0.	20	OCT	0050	258	0.
18	OCT	1130	34	7.	19	OCT	0000	109	16.	19	OCT	1230	184	0.	20	OCT	0100	259	0.
18	OCT	1140	35	8.	19	OCT	0010	110	16.	19	OCT	1240	185	0.	20	OCT	0110	260	0.
18	OCT	1150	36	8.	19	OCT	0020	111	16.	19	OCT	1250	186	0.	20	OCT	0120	261	0.
18	OCT	1200	37	9.	19	OCT	0030	112	16.	19	OCT	1300	187	0.	20	OCT	0130	262	0.
18	OCT	1210	38	9.	19	OCT	0040	113	16.	19	OCT	1310	188	0.	20	OCT	0140	263	0.
18	OCT	1220	39	10.	19	OCT	0050	114	16.	19	OCT	1320	189	0.	20	OCT	0150	264	0.
18	OCT	1230	40	10.	19	OCT	0100	115	16.	19	OCT	1330	190	0.	20	OCT	0200	265	0.

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          *            *
 28 KK    *      RES1  *
          *            *
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                         Reservoir Routing Operation

             HYDROGRAPH ROUTING DATA

 30 RS          STORAGE ROUTING
                      NSTPS           1  NUMBER OF SUBREACHES
                       ITYP        ELEV  TYPE OF INITIAL CONDITION
                      RSVRIC      670.00  INITIAL CONDITION
                           X         .00 WORKING R AND D COEFFICIENT

 31 SA               AREA         6.5       8.0      13.0      20.6      28.7      39.5

 32 SE          ELEVATION      670.00    672.00    675.00    678.00    680.00    682.00

 33 SQ          DISCHARGE          0.       16.       45.      176.      357.      499.      656.

 34 SE          ELEVATION      670.00    671.00    672.00    675.00    678.00    680.00    682.00
                                                                  ***

                                                COMPUTED STORAGE-ELEVATION DATA

          STORAGE        .00     14.49     45.73     95.82    144.96    212.91
        ELEVATION     670.00    672.00    675.00    678.00    680.00    682.00

                                                COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE        .00      6.88     14.49     45.73     95.82    144.96    212.91
          OUTFLOW        .00     15.80     44.60    176.40    357.10    499.00    656.00
        ELEVATION     670.00    671.00    672.00    675.00    678.00    680.00    682.00
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                                                HYDROGRAPH AT STATION     RES1
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                                        *                                        *
 DA MON HRMN ORD  OUTFLOW  STORAGE   STAGE * DA MON HRMN ORD  OUTFLOW  STORAGE   STAGE * DA MON HRMN ORD  OUTFLOW  STORAGE   STAGE
                                        *                                        *
 18 OCT 0600   1       0.       .0   670.0 * 18 OCT 2240 101      49.     15.5   672.1 * 19 OCT 1520 201       3.      1.1   670.2
 18 OCT 0610   2       0.       .0   670.0 * 18 OCT 2250 102      47.     15.1   672.1 * 19 OCT 1530 202       3.      1.1   670.2
 18 OCT 0620   3       0.       .0   670.0 * 18 OCT 2300 103      45.     14.7   672.0 * 19 OCT 1540 203       2.      1.1   670.2
 18 OCT 0630   4       0.       .0   670.0 * 18 OCT 2310 104      44.     14.3   672.0 * 19 OCT 1550 204       2.      1.0   670.2
 18 OCT 0640   5       0.       .0   670.0 * 18 OCT 2320 105      42.     13.9   671.9 * 19 OCT 1600 205       2.      1.0   670.1
 18 OCT 0650   6       0.       .0   670.0 * 18 OCT 2330 106      41.     13.6   671.9 * 19 OCT 1610 206       2.      1.0   670.1
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18	OCT	0700	7	0.	.0	670.0	*	18	OCT	2340	107	40.	13.2	671.8	*	19	OCT	1620	207	2.	.9	670.1
18	OCT	0710	8	0.	.0	670.0	*	18	OCT	2350	108	39.	12.9	671.8	*	19	OCT	1630	208	2.	.9	670.1
18	OCT	0720	9	0.	.0	670.0	*	19	OCT	0000	109	37.	12.6	671.8	*	19	OCT	1640	209	2.	.9	670.1
18	OCT	0730	10	0.	.1	670.0	*	19	OCT	0010	110	36.	12.3	671.7	*	19	OCT	1650	210	2.	.9	670.1
18	OCT	0740	11	0.	.1	670.0	*	19	OCT	0020	111	35.	12.1	671.7	*	19	OCT	1700	211	2.	.8	670.1
18	OCT	0750	12	0.	.1	670.0	*	19	OCT	0030	112	34.	11.8	671.6	*	19	OCT	1710	212	2.	.8	670.1
18	OCT	0800	13	0.	.1	670.0	*	19	OCT	0040	113	34.	11.6	671.6	*	19	OCT	1720	213	2.	.8	670.1
18	OCT	0810	14	0.	.2	670.0	*	19	OCT	0050	114	33.	11.3	671.6	*	19	OCT	1730	214	2.	.8	670.1
18	OCT	0820	15	0.	.2	670.0	*	19	OCT	0100	115	32.	11.1	671.6	*	19	OCT	1740	215	2.	.7	670.1
18	OCT	0830	16	0.	.2	670.0	*	19	OCT	0110	116	31.	10.9	671.5	*	19	OCT	1750	216	2.	.7	670.1
18	OCT	0840	17	1.	.2	670.0	*	19	OCT	0120	117	30.	10.7	671.5	*	19	OCT	1800	217	2.	.7	670.1
18	OCT	0850	18	1.	.3	670.0	*	19	OCT	0130	118	30.	10.5	671.5	*	19	OCT	1810	218	2.	.7	670.1
18	OCT	0900	19	1.	.3	670.0	*	19	OCT	0140	119	29.	10.3	671.5	*	19	OCT	1820	219	1.	.6	670.1
18	OCT	0910	20	1.	.3	670.0	*	19	OCT	0150	120	28.	10.1	671.4	*	19	OCT	1830	220	1.	.6	670.1
18	OCT	0920	21	1.	.4	670.1	*	19	OCT	0200	121	27.	9.9	671.4	*	19	OCT	1840	221	1.	.6	670.1
18	OCT	0930	22	1.	.4	670.1	*	19	OCT	0210	122	27.	9.7	671.4	*	19	OCT	1850	222	1.	.6	670.1
18	OCT	0940	23	1.	.4	670.1	*	19	OCT	0220	123	26.	9.5	671.3	*	19	OCT	1900	223	1.	.6	670.1
18	OCT	0950	24	1.	.5	670.1	*	19	OCT	0230	124	25.	9.3	671.3	*	19	OCT	1910	224	1.	.5	670.1
18	OCT	1000	25	1.	.5	670.1	*	19	OCT	0240	125	24.	9.1	671.3	*	19	OCT	1920	225	1.	.5	670.1
18	OCT	1010	26	1.	.5	670.1	*	19	OCT	0250	126	24.	8.9	671.3	*	19	OCT	1930	226	1.	.5	670.1
18	OCT	1020	27	1.	.6	670.1	*	19	OCT	0300	127	23.	8.8	671.2	*	19	OCT	1940	227	1.	.5	670.1
18	OCT	1030	28	1.	.6	670.1	*	19	OCT	0310	128	22.	8.6	671.2	*	19	OCT	1950	228	1.	.5	670.1
18	OCT	1040	29	2.	.7	670.1	*	19	OCT	0320	129	22.	8.5	671.2	*	19	OCT	2000	229	1.	.5	670.1
18	OCT	1050	30	2.	.8	670.1	*	19	OCT	0330	130	21.	8.3	671.2	*	19	OCT	2010	230	1.	.5	670.1
18	OCT	1100	31	2.	.8	670.1	*	19	OCT	0340	131	21.	8.2	671.2	*	19	OCT	2020	231	1.	.4	670.1
18	OCT	1110	32	2.	.9	670.1	*	19	OCT	0350	132	20.	8.0	671.2	*	19	OCT	2030	232	1.	.4	670.1
18	OCT	1120	33	2.	.9	670.1	*	19	OCT	0400	133	20.	7.9	671.1	*	19	OCT	2040	233	1.	.4	670.1
18	OCT	1130	34	2.	1.0	670.1	*	19	OCT	0410	134	19.	7.8	671.1	*	19	OCT	2050	234	1.	.4	670.1
18	OCT	1140	35	2.	1.0	670.2	*	19	OCT	0420	135	19.	7.7	671.1	*	19	OCT	2100	235	1.	.4	670.1
18	OCT	1150	36	3.	1.1	670.2	*	19	OCT	0430	136	18.	7.6	671.1	*	19	OCT	2110	236	1.	.4	670.1
18	OCT	1200	37	3.	1.2	670.2	*	19	OCT	0440	137	18.	7.5	671.1	*	19	OCT	2120	237	1.	.4	670.1
18	OCT	1210	38	3.	1.3	670.2	*	19	OCT	0450	138	18.	7.4	671.1	*	19	OCT	2130	238	1.	.4	670.1
18	OCT	1220	39	3.	1.4	670.2	*	19	OCT	0500	139	17.	7.3	671.1	*	19	OCT	2140	239	1.	.3	670.0
18	OCT	1230	40	3.	1.5	670.2	*	19	OCT	0510	140	17.	7.2	671.0	*	19	OCT	2150	240	1.	.3	670.0
18	OCT	1240	41	4.	1.6	670.2	*	19	OCT	0520	141	17.	7.1	671.0	*	19	OCT	2200	241	1.	.3	670.0
18	OCT	1250	42	4.	1.6	670.2	*	19	OCT	0530	142	16.	7.0	671.0	*	19	OCT	2210	242	1.	.3	670.0
18	OCT	1300	43	4.	1.7	670.3	*	19	OCT	0540	143	16.	6.9	671.0	*	19	OCT	2220	243	1.	.3	670.0
18	OCT	1310	44	4.	1.8	670.3	*	19	OCT	0550	144	16.	6.8	671.0	*	19	OCT	2230	244	1.	.3	670.0
18	OCT	1320	45	4.	1.9	670.3	*	19	OCT	0600	145	15.	6.6	671.0	*	19	OCT	2240	245	1.	.3	670.0
18	OCT	1330	46	5.	2.0	670.3	*	19	OCT	0610	146	15.	6.5	670.9	*	19	OCT	2250	246	1.	.3	670.0
18	OCT	1340	47	5.	2.1	670.3	*	19	OCT	0620	147	14.	6.3	670.9	*	19	OCT	2300	247	1.	.3	670.0
18	OCT	1350	48	5.	2.2	670.3	*	19	OCT	0630	148	14.	6.1	670.9	*	19	OCT	2310	248	1.	.3	670.0
18	OCT	1400	49	5.	2.4	670.3	*	19	OCT	0640	149	14.	5.9	670.9	*	19	OCT	2320	249	1.	.2	670.0
18	OCT	1410	50	6.	2.5	670.4	*	19	OCT	0650	150	13.	5.7	670.8	*	19	OCT	2330	250	1.	.2	670.0
18	OCT	1420	51	6.	2.6	670.4	*	19	OCT	0700	151	13.	5.5	670.8	*	19	OCT	2340	251	1.	.2	670.0
18	OCT	1430	52	6.	2.8	670.4	*	19	OCT	0710	152	12.	5.4	670.8	*	19	OCT	2350	252	1.	.2	670.0
18	OCT	1440	53	7.	2.9	670.4	*	19	OCT	0720	153	12.	5.2	670.8	*	20	OCT	0000	253	1.	.2	670.0
18	OCT	1450	54	7.	3.1	670.4	*	19	OCT	0730	154	12.	5.0	670.7	*	20	OCT	0010	254	0.	.2	670.0
18	OCT	1500	55	7.	3.3	670.5	*	19	OCT	0740	155	11.	4.9	670.7	*	20	OCT	0020	255	0.	.2	670.0
18	OCT	1510	56	8.	3.4	670.5	*	19	OCT	0750	156	11.	4.7	670.7	*	20	OCT	0030	256	0.	.2	670.0
18	OCT	1520	57	8.	3.6	670.5	*	19	OCT	0800	157	11.	4.6	670.7	*	20	OCT	0040	257	0.	.2	670.0
18	OCT	1530	58	9.	3.8	670.6	*	19	OCT	0810	158	10.	4.4	670.6	*	20	OCT	0050	258	0.	.2	670.0

18	OCT	1540	59	9.	4.1	670.6	*	19	OCT	0820	159	10.	4.3	670.6	*	20	OCT	0100	259	0.	.2	670.0
18	OCT	1550	60	10.	4.3	670.6	*	19	OCT	0830	160	10.	4.2	670.6	*	20	OCT	0110	260	0.	.2	670.0
18	OCT	1600	61	11.	4.6	670.7	*	19	OCT	0840	161	9.	4.0	670.6	*	20	OCT	0120	261	0.	.2	670.0
18	OCT	1610	62	11.	4.9	670.7	*	19	OCT	0850	162	9.	3.9	670.6	*	20	OCT	0130	262	0.	.2	670.0
18	OCT	1620	63	12.	5.3	670.8	*	19	OCT	0900	163	9.	3.8	670.6	*	20	OCT	0140	263	0.	.2	670.0
18	OCT	1630	64	13.	5.7	670.8	*	19	OCT	0910	164	8.	3.7	670.5	*	20	OCT	0150	264	0.	.2	670.0
18	OCT	1640	65	14.	6.1	670.9	*	19	OCT	0920	165	8.	3.6	670.5	*	20	OCT	0200	265	0.	.2	670.0
18	OCT	1650	66	15.	6.7	671.0	*	19	OCT	0930	166	8.	3.4	670.5	*	20	OCT	0210	266	0.	.1	670.0
18	OCT	1700	67	18.	7.4	671.1	*	19	OCT	0940	167	8.	3.3	670.5	*	20	OCT	0220	267	0.	.1	670.0
18	OCT	1710	68	25.	9.3	671.3	*	19	OCT	0950	168	7.	3.2	670.5	*	20	OCT	0230	268	0.	.1	670.0
18	OCT	1720	69	40.	13.4	671.9	*	19	OCT	1000	169	7.	3.1	670.5	*	20	OCT	0240	269	0.	.1	670.0
18	OCT	1730	70	64.	19.0	672.4	*	19	OCT	1010	170	7.	3.0	670.4	*	20	OCT	0250	270	0.	.1	670.0
18	OCT	1740	71	87.	24.5	673.0	*	19	OCT	1020	171	7.	2.9	670.4	*	20	OCT	0300	271	0.	.1	670.0
18	OCT	1750	72	102.	28.2	673.3	*	19	OCT	1030	172	7.	2.8	670.4	*	20	OCT	0310	272	0.	.1	670.0
18	OCT	1800	73	112.	30.5	673.5	*	19	OCT	1040	173	6.	2.8	670.4	*	20	OCT	0320	273	0.	.1	670.0
18	OCT	1810	74	117.	31.6	673.6	*	19	OCT	1050	174	6.	2.7	670.4	*	20	OCT	0330	274	0.	.1	670.0
18	OCT	1820	75	118.	31.8	673.7	*	19	OCT	1100	175	6.	2.6	670.4	*	20	OCT	0340	275	0.	.1	670.0
18	OCT	1830	76	117.	31.7	673.6	*	19	OCT	1110	176	6.	2.5	670.4	*	20	OCT	0350	276	0.	.1	670.0
18	OCT	1840	77	115.	31.2	673.6	*	19	OCT	1120	177	6.	2.4	670.4	*	20	OCT	0400	277	0.	.1	670.0
18	OCT	1850	78	113.	30.6	673.5	*	19	OCT	1130	178	5.	2.4	670.3	*	20	OCT	0410	278	0.	.1	670.0
18	OCT	1900	79	110.	29.9	673.5	*	19	OCT	1140	179	5.	2.3	670.3	*	20	OCT	0420	279	0.	.1	670.0
18	OCT	1910	80	106.	29.1	673.4	*	19	OCT	1150	180	5.	2.2	670.3	*	20	OCT	0430	280	0.	.1	670.0
18	OCT	1920	81	103.	28.3	673.3	*	19	OCT	1200	181	5.	2.1	670.3	*	20	OCT	0440	281	0.	.1	670.0
18	OCT	1930	82	99.	27.5	673.2	*	19	OCT	1210	182	5.	2.1	670.3	*	20	OCT	0450	282	0.	.1	670.0
18	OCT	1940	83	96.	26.7	673.2	*	19	OCT	1220	183	5.	2.0	670.3	*	20	OCT	0500	283	0.	.1	670.0
18	OCT	1950	84	93.	25.9	673.1	*	19	OCT	1230	184	4.	1.9	670.3	*	20	OCT	0510	284	0.	.1	670.0
18	OCT	2000	85	89.	25.0	673.0	*	19	OCT	1240	185	4.	1.9	670.3	*	20	OCT	0520	285	0.	.1	670.0
18	OCT	2010	86	86.	24.2	672.9	*	19	OCT	1250	186	4.	1.8	670.3	*	20	OCT	0530	286	0.	.1	670.0
18	OCT	2020	87	82.	23.5	672.9	*	19	OCT	1300	187	4.	1.8	670.3	*	20	OCT	0540	287	0.	.1	670.0
18	OCT	2030	88	79.	22.7	672.8	*	19	OCT	1310	188	4.	1.7	670.2	*	20	OCT	0550	288	0.	.1	670.0
18	OCT	2040	89	76.	22.0	672.7	*	19	OCT	1320	189	4.	1.7	670.2	*	20	OCT	0600	289	0.	.1	670.0
18	OCT	2050	90	74.	21.4	672.7	*	19	OCT	1330	190	4.	1.6	670.2	*	20	OCT	0610	290	0.	.1	670.0
18	OCT	2100	91	71.	20.7	672.6	*	19	OCT	1340	191	4.	1.6	670.2	*	20	OCT	0620	291	0.	.1	670.0
18	OCT	2110	92	68.	20.2	672.5	*	19	OCT	1350	192	3.	1.5	670.2	*	20	OCT	0630	292	0.	.1	670.0
18	OCT	2120	93	66.	19.6	672.5	*	19	OCT	1400	193	3.	1.5	670.2	*	20	OCT	0640	293	0.	.1	670.0
18	OCT	2130	94	64.	19.1	672.4	*	19	OCT	1410	194	3.	1.4	670.2	*	20	OCT	0650	294	0.	.1	670.0
18	OCT	2140	95	62.	18.6	672.4	*	19	OCT	1420	195	3.	1.4	670.2	*	20	OCT	0700	295	0.	.1	670.0
18	OCT	2150	96	60.	18.0	672.3	*	19	OCT	1430	196	3.	1.3	670.2	*	20	OCT	0710	296	0.	.1	670.0
18	OCT	2200	97	57.	17.5	672.3	*	19	OCT	1440	197	3.	1.3	670.2	*	20	OCT	0720	297	0.	.1	670.0
18	OCT	2210	98	55.	17.0	672.2	*	19	OCT	1450	198	3.	1.3	670.2	*	20	OCT	0730	298	0.	.1	670.0
18	OCT	2220	99	53.	16.5	672.2	*	19	OCT	1500	199	3.	1.2	670.2	*	20	OCT	0740	299	0.	.1	670.0
18	OCT	2230	100	51.	16.0	672.1	*	19	OCT	1510	200	3.	1.2	670.2	*	20	OCT	0750	300	0.	.0	670.0
							*								*							

****

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	49.83-HR
+ (CFS)	(HR)					
		(CFS)				
+ 118.	12.33		80.	31.	16.	16.
		(INCHES)	3.531	5.549	5.767	5.767
		(AC-FT)	40.	62.	65.	65.

```
 PEAK STORAGE   TIME                        MAXIMUM AVERAGE STORAGE
                                       6-HR       24-HR       72-HR     49.83-HR
+  (AC-FT)      (HR)
       32.     12.33                    23.         10.          5.           5.

  PEAK STAGE    TIME                        MAXIMUM AVERAGE STAGE
                                       6-HR       24-HR       72-HR     49.83-HR
+   (FEET)      (HR)
    673.67     12.33                 672.80      671.34      670.68       670.68

                        CUMULATIVE AREA =     .21 SQ MI

1
                                                          RUNOFF SUMMARY
                                                     FLOW IN CUBIC FEET PER SECOND
                                                   TIME IN HOURS,  AREA IN SQUARE MILES

                                       PEAK   TIME OF     AVERAGE FLOW FOR MAXIMUM PERIOD      BASIN     MAXIMUM     TIME OF
          OPERATION       STATION      FLOW     PEAK                                          AREA      STAGE     MAX STAGE
+                                                                 6-HOUR     24-HOUR     72-HOUR

          HYDROGRAPH AT
+                           SUB1        331.   11.67          65.         21.         10.        .14

          HYDROGRAPH AT
+                           SUB2        223.   11.50          35.         12.          6.        .07

          2 COMBINED AT
+                           COMB1       521.   11.50          99.         33.         16.        .21

          ROUTED TO
+                            RES1       118.   12.33          80.         31.         16.        .21
+                                                                                                 673.67       12.33


 *** NORMAL END OF HEC-1 ***
```

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1****************************************                                                    ****************************************
 *                                      *                                                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                                    *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                                    *    HYDROLOGIC ENGINEERING CENTER     *
 *           VERSION 4.1                *                                                    *          609 SECOND STREET           *
 *                                      *                                                    *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   19OCT10  TIME  10:48:55  *                                                    *           (916) 756-1104             *
 *                                      *                                                    *                                      *
 ****************************************                                                    ****************************************


                                                X     X  XXXXXXX   XXXXX           X
                                                X     X  X        X     X         XX
                                                X     X  X        X               X
                                                XXXXXXX  XXXX     X        XXXXX   X
                                                X     X  X        X                X
                                                X     X  X        X     X          X
                                                X     X  XXXXXXX   XXXXX          XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


1                                                   HEC-1 INPUT                                                   PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

             1          ID   Alliant Energy - Ottumwa Generating Station
             2          ID   HEC-1 Analysis of Ash Settling Pond and Site Contributing to Pond
             3          ID   100-YR - 24 HR Precipitation Event  W/NO DISCHARGE
             4          ID   Black & Veatch Project No. 169664
             5          ID   Input File: OTTUMWA2.IN   Output File:  OTTUMWA2.OUT
             6          IT      10 19OCT10    0600     300
             7          IO       0       0
             8          IN      30
                        * **********

             9          KK   SUB1
            10          KM   Runoff From Site Contributing Area
            11          BA  0.1427
            12          PB     6.8
```

```
13          PC   0.005   0.011   0.017   0.022   0.029   0.035   0.042   0.048   0.056   0.064
14          PC   0.072   0.080   0.090   0.100   0.110   0.120   0.134   0.147   0.163   0.181
15          PC   0.204   0.235   0.283   0.663   0.735   0.772   0.799   0.820   0.835   0.850
16          PC   0.865   0.880   0.889   0.898   0.907   0.916   0.925   0.934   0.943   0.952
17          PC   0.958   0.964   0.970   0.976   0.982   0.988   0.994   1.000
18          LS       0      88       0
19          UD   0.323
            * **********

20          KK   SUB2
21          KM   Precipitation on Ash Settling Pond at Elevation 682
22          BA  0.0673
23          LS       0      98       0
24          UD   0.001
            * **********

25          KK   COMB1
26          KM   Combine Subbasins 1 and 2.
27          HC       2
            * **********

28          KK    RES1
29          KM   Reservoir Routing Operation
30          RS       1    ELEV   670.0
31          SA    6.52    8.00   13.03   20.65   28.71   39.53
32          SE   670.0   672.0   675.0   678.0   680.0   682.0
33          SQ       0       0       0       0       0       0       0
34          SE   670.0   671.0   672.0   675.0   678.0   680.0   682.0
            * **********
            *DIAGRAM
35          ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     9       SUB1
                 .
                 .
    20           .       SUB2
                 .           .
                 .           .
    25       COMB1...........
                 V
                 V
    28        RES1

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1*****************************************                                    ****************************************
 *                                       *                                    *                                      *
```

```
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                    *    U.S. ARMY CORPS OF ENGINEERS     *
*               JUN   1998              *                                    *    HYDROLOGIC ENGINEERING CENTER    *
*            VERSION 4.1                *                                    *          609 SECOND STREET          *
*                                       *                                    *       DAVIS, CALIFORNIA 95616       *
*  RUN DATE   19OCT10  TIME  10:48:55   *                                    *           (916) 756-1104            *
*                                       *                                    *                                     *
*****************************************                                    *****************************************


                         Alliant Energy - Ottumwa Generating Station
                         HEC-1 Analysis of Ash Settling Pond and Site Contributing to Pond
                         100-YR - 24 HR Precipitation Event  W/NO DISCHARGE
                         Black & Veatch Project No. 169664
                         Input File: OTTUMWA2.IN   Output File:  OTTUMWA2.OUT

   7 IO          OUTPUT CONTROL VARIABLES
                       IPRNT           0  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                        NMIN          10  MINUTES IN COMPUTATION INTERVAL
                       IDATE     19OCT10  STARTING DATE
                       ITIME        0600  STARTING TIME
                          NQ         300  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE     21OCT10  ENDING DATE
                      NDTIME        0750  ENDING TIME
                      ICENT           19  CENTURY MARK

                  COMPUTATION INTERVAL     .17 HOURS
                       TOTAL TIME BASE   49.83 HOURS

         ENGLISH UNITS
              DRAINAGE AREA         SQUARE MILES
              PRECIPITATION DEPTH   INCHES
              LENGTH, ELEVATION     FEET
              FLOW                  CUBIC FEET PER SECOND
              STORAGE VOLUME        ACRE-FEET
              SURFACE AREA          ACRES
              TEMPERATURE           DEGREES FAHRENHEIT


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   9 KK     *     SUB1   *
```

```
*            *
**************
                Runoff From Site Contributing Area

 8 IN          TIME DATA FOR INPUT TIME SERIES
                    JXMIN          30  TIME INTERVAL IN MINUTES
                   JXDATE     19OCT10  STARTING DATE
                   JXTIME         600  STARTING TIME

             SUBBASIN RUNOFF DATA

11 BA          SUBBASIN CHARACTERISTICS
                    TAREA         .14  SUBBASIN AREA

               PRECIPITATION DATA

12 PB               STORM        6.80  BASIN TOTAL PRECIPITATION

13 PI            INCREMENTAL PRECIPITATION PATTERN
                   .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                   .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                   .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                   .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                   .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                   .00       .01       .01       .01       .01       .01       .01       .01       .01       .01
                   .01       .01       .01       .02       .02       .02       .13       .13       .13       .02
                   .02       .02       .01       .01       .01       .01       .01       .01       .01       .01
                   .01       .00       .00       .00       .00       .01       .00       .00       .00       .00
                   .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                   .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                   .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                   .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                   .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                   .00

18 LS          SCS LOSS RATE
                    STRTL         .27  INITIAL ABSTRACTION
                   CRVNBR       88.00  CURVE NUMBER
                    RTIMP         .00  PERCENT IMPERVIOUS AREA

19 UD          SCS DIMENSIONLESS UNITGRAPH
                     TLAG         .32  LAG

                                                                  ***

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

                                                     UNIT HYDROGRAPH
                                                 12 END-OF-PERIOD ORDINATES
              56.      161.      155.       89.       45.       23.       12.        6.        3.        2.
               1.        0.
```

HYDROGRAPH AT STATION SUB1

DA MON HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q	DA MON HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q
19 OCT 0600	1	.00	.00	.00	0.	20 OCT 0700	151	.00	.00	.00	0.
19 OCT 0610	2	.01	.01	.00	0.	20 OCT 0710	152	.00	.00	.00	0.
19 OCT 0620	3	.01	.01	.00	0.	20 OCT 0720	153	.00	.00	.00	0.
19 OCT 0630	4	.01	.01	.00	0.	20 OCT 0730	154	.00	.00	.00	0.
19 OCT 0640	5	.01	.01	.00	0.	20 OCT 0740	155	.00	.00	.00	0.
19 OCT 0650	6	.01	.01	.00	0.	20 OCT 0750	156	.00	.00	.00	0.
19 OCT 0700	7	.01	.01	.00	0.	20 OCT 0800	157	.00	.00	.00	0.
19 OCT 0710	8	.01	.01	.00	0.	20 OCT 0810	158	.00	.00	.00	0.
19 OCT 0720	9	.01	.01	.00	0.	20 OCT 0820	159	.00	.00	.00	0.
19 OCT 0730	10	.01	.01	.00	0.	20 OCT 0830	160	.00	.00	.00	0.
19 OCT 0740	11	.02	.02	.00	0.	20 OCT 0840	161	.00	.00	.00	0.
19 OCT 0750	12	.02	.02	.00	0.	20 OCT 0850	162	.00	.00	.00	0.
19 OCT 0800	13	.02	.02	.00	0.	20 OCT 0900	163	.00	.00	.00	0.
19 OCT 0810	14	.01	.01	.00	0.	20 OCT 0910	164	.00	.00	.00	0.
19 OCT 0820	15	.01	.01	.00	0.	20 OCT 0920	165	.00	.00	.00	0.
19 OCT 0830	16	.01	.01	.00	0.	20 OCT 0930	166	.00	.00	.00	0.
19 OCT 0840	17	.02	.02	.00	0.	20 OCT 0940	167	.00	.00	.00	0.
19 OCT 0850	18	.02	.02	.00	0.	20 OCT 0950	168	.00	.00	.00	0.
19 OCT 0900	19	.02	.02	.00	0.	20 OCT 1000	169	.00	.00	.00	0.
19 OCT 0910	20	.01	.01	.00	0.	20 OCT 1010	170	.00	.00	.00	0.
19 OCT 0920	21	.01	.01	.00	0.	20 OCT 1020	171	.00	.00	.00	0.
19 OCT 0930	22	.01	.01	.00	0.	20 OCT 1030	172	.00	.00	.00	0.
19 OCT 0940	23	.02	.02	.00	0.	20 OCT 1040	173	.00	.00	.00	0.
19 OCT 0950	24	.02	.02	.00	0.	20 OCT 1050	174	.00	.00	.00	0.
19 OCT 1000	25	.02	.02	.00	0.	20 OCT 1100	175	.00	.00	.00	0.
19 OCT 1010	26	.02	.02	.00	1.	20 OCT 1110	176	.00	.00	.00	0.
19 OCT 1020	27	.02	.02	.00	1.	20 OCT 1120	177	.00	.00	.00	0.
19 OCT 1030	28	.02	.02	.00	1.	20 OCT 1130	178	.00	.00	.00	0.
19 OCT 1040	29	.02	.01	.00	1.	20 OCT 1140	179	.00	.00	.00	0.
19 OCT 1050	30	.02	.01	.00	2.	20 OCT 1150	180	.00	.00	.00	0.
19 OCT 1100	31	.02	.01	.00	2.	20 OCT 1200	181	.00	.00	.00	0.
19 OCT 1110	32	.02	.01	.00	2.	20 OCT 1210	182	.00	.00	.00	0.
19 OCT 1120	33	.02	.01	.00	2.	20 OCT 1220	183	.00	.00	.00	0.
19 OCT 1130	34	.02	.01	.00	2.	20 OCT 1230	184	.00	.00	.00	0.
19 OCT 1140	35	.02	.02	.01	3.	20 OCT 1240	185	.00	.00	.00	0.
19 OCT 1150	36	.02	.02	.01	3.	20 OCT 1250	186	.00	.00	.00	0.
19 OCT 1200	37	.02	.02	.01	3.	20 OCT 1300	187	.00	.00	.00	0.
19 OCT 1210	38	.02	.01	.01	4.	20 OCT 1310	188	.00	.00	.00	0.
19 OCT 1220	39	.02	.01	.01	4.	20 OCT 1320	189	.00	.00	.00	0.
19 OCT 1230	40	.02	.01	.01	4.	20 OCT 1330	190	.00	.00	.00	0.
19 OCT 1240	41	.02	.01	.01	4.	20 OCT 1340	191	.00	.00	.00	0.
19 OCT 1250	42	.02	.01	.01	5.	20 OCT 1350	192	.00	.00	.00	0.
19 OCT 1300	43	.02	.01	.01	5.	20 OCT 1400	193	.00	.00	.00	0.
19 OCT 1310	44	.02	.01	.01	5.	20 OCT 1410	194	.00	.00	.00	0.

19 OCT 1320	45	.02	.01	.01	5.	*	20 OCT 1420	195	.00	.00	.00	0.
19 OCT 1330	46	.02	.01	.01	5.	*	20 OCT 1430	196	.00	.00	.00	0.
19 OCT 1340	47	.03	.02	.02	6.	*	20 OCT 1440	197	.00	.00	.00	0.
19 OCT 1350	48	.03	.02	.02	7.	*	20 OCT 1450	198	.00	.00	.00	0.
19 OCT 1400	49	.03	.02	.02	8.	*	20 OCT 1500	199	.00	.00	.00	0.
19 OCT 1410	50	.03	.01	.02	8.	*	20 OCT 1510	200	.00	.00	.00	0.
19 OCT 1420	51	.03	.01	.02	9.	*	20 OCT 1520	201	.00	.00	.00	0.
19 OCT 1430	52	.03	.01	.02	9.	*	20 OCT 1530	202	.00	.00	.00	0.
19 OCT 1440	53	.04	.02	.02	9.	*	20 OCT 1540	203	.00	.00	.00	0.
19 OCT 1450	54	.04	.02	.02	10.	*	20 OCT 1550	204	.00	.00	.00	0.
19 OCT 1500	55	.04	.01	.02	11.	*	20 OCT 1600	205	.00	.00	.00	0.
19 OCT 1510	56	.04	.02	.03	12.	*	20 OCT 1610	206	.00	.00	.00	0.
19 OCT 1520	57	.04	.02	.03	12.	*	20 OCT 1620	207	.00	.00	.00	0.
19 OCT 1530	58	.04	.01	.03	13.	*	20 OCT 1630	208	.00	.00	.00	0.
19 OCT 1540	59	.05	.02	.03	14.	*	20 OCT 1640	209	.00	.00	.00	0.
19 OCT 1550	60	.05	.02	.04	16.	*	20 OCT 1650	210	.00	.00	.00	0.
19 OCT 1600	61	.05	.02	.04	18.	*	20 OCT 1700	211	.00	.00	.00	0.
19 OCT 1610	62	.07	.02	.05	19.	*	20 OCT 1710	212	.00	.00	.00	0.
19 OCT 1620	63	.07	.02	.05	22.	*	20 OCT 1720	213	.00	.00	.00	0.
19 OCT 1630	64	.07	.02	.05	25.	*	20 OCT 1730	214	.00	.00	.00	0.
19 OCT 1640	65	.11	.03	.08	28.	*	20 OCT 1740	215	.00	.00	.00	0.
19 OCT 1650	66	.11	.03	.08	34.	*	20 OCT 1750	216	.00	.00	.00	0.
19 OCT 1700	67	.11	.02	.09	40.	*	20 OCT 1800	217	.00	.00	.00	0.
19 OCT 1710	68	.87	.14	.73	79.	*	20 OCT 1810	218	.00	.00	.00	0.
19 OCT 1720	69	.87	.09	.78	187.	*	20 OCT 1820	219	.00	.00	.00	0.
19 OCT 1730	70	.87	.06	.80	297.	*	20 OCT 1830	220	.00	.00	.00	0.
19 OCT 1740	71	.16	.01	.15	331.	*	20 OCT 1840	221	.00	.00	.00	0.
19 OCT 1750	72	.16	.01	.16	264.	*	20 OCT 1850	222	.00	.00	.00	0.
19 OCT 1800	73	.16	.01	.16	183.	*	20 OCT 1900	223	.00	.00	.00	0.
19 OCT 1810	74	.08	.00	.08	131.	*	20 OCT 1910	224	.00	.00	.00	0.
19 OCT 1820	75	.08	.00	.08	95.	*	20 OCT 1920	225	.00	.00	.00	0.
19 OCT 1830	76	.08	.00	.08	71.	*	20 OCT 1930	226	.00	.00	.00	0.
19 OCT 1840	77	.06	.00	.06	57.	*	20 OCT 1940	227	.00	.00	.00	0.
19 OCT 1850	78	.06	.00	.06	47.	*	20 OCT 1950	228	.00	.00	.00	0.
19 OCT 1900	79	.06	.00	.06	40.	*	20 OCT 2000	229	.00	.00	.00	0.
19 OCT 1910	80	.05	.00	.05	35.	*	20 OCT 2010	230	.00	.00	.00	0.
19 OCT 1920	81	.05	.00	.05	31.	*	20 OCT 2020	231	.00	.00	.00	0.
19 OCT 1930	82	.05	.00	.05	28.	*	20 OCT 2030	232	.00	.00	.00	0.
19 OCT 1940	83	.03	.00	.03	26.	*	20 OCT 2040	233	.00	.00	.00	0.
19 OCT 1950	84	.03	.00	.03	23.	*	20 OCT 2050	234	.00	.00	.00	0.
19 OCT 2000	85	.03	.00	.03	21.	*	20 OCT 2100	235	.00	.00	.00	0.
19 OCT 2010	86	.03	.00	.03	19.	*	20 OCT 2110	236	.00	.00	.00	0.
19 OCT 2020	87	.03	.00	.03	19.	*	20 OCT 2120	237	.00	.00	.00	0.
19 OCT 2030	88	.03	.00	.03	18.	*	20 OCT 2130	238	.00	.00	.00	0.
19 OCT 2040	89	.03	.00	.03	18.	*	20 OCT 2140	239	.00	.00	.00	0.
19 OCT 2050	90	.03	.00	.03	18.	*	20 OCT 2150	240	.00	.00	.00	0.
19 OCT 2100	91	.03	.00	.03	18.	*	20 OCT 2200	241	.00	.00	.00	0.
19 OCT 2110	92	.03	.00	.03	18.	*	20 OCT 2210	242	.00	.00	.00	0.
19 OCT 2120	93	.03	.00	.03	18.	*	20 OCT 2220	243	.00	.00	.00	0.
19 OCT 2130	94	.03	.00	.03	18.	*	20 OCT 2230	244	.00	.00	.00	0.
19 OCT 2140	95	.02	.00	.02	17.	*	20 OCT 2240	245	.00	.00	.00	0.
19 OCT 2150	96	.02	.00	.02	15.	*	20 OCT 2250	246	.00	.00	.00	0.

19 OCT 2200	97	.02	.00	.02	13.	*	20 OCT 2300	247	.00	.00	.00	0.
19 OCT 2210	98	.02	.00	.02	12.	*	20 OCT 2310	248	.00	.00	.00	0.
19 OCT 2220	99	.02	.00	.02	12.	*	20 OCT 2320	249	.00	.00	.00	0.
19 OCT 2230	100	.02	.00	.02	11.	*	20 OCT 2330	250	.00	.00	.00	0.
19 OCT 2240	101	.02	.00	.02	11.	*	20 OCT 2340	251	.00	.00	.00	0.
19 OCT 2250	102	.02	.00	.02	11.	*	20 OCT 2350	252	.00	.00	.00	0.
19 OCT 2300	103	.02	.00	.02	11.	*	21 OCT 0000	253	.00	.00	.00	0.
19 OCT 2310	104	.02	.00	.02	11.	*	21 OCT 0010	254	.00	.00	.00	0.
19 OCT 2320	105	.02	.00	.02	11.	*	21 OCT 0020	255	.00	.00	.00	0.
19 OCT 2330	106	.02	.00	.02	11.	*	21 OCT 0030	256	.00	.00	.00	0.
19 OCT 2340	107	.02	.00	.02	11.	*	21 OCT 0040	257	.00	.00	.00	0.
19 OCT 2350	108	.02	.00	.02	11.	*	21 OCT 0050	258	.00	.00	.00	0.
20 OCT 0000	109	.02	.00	.02	11.	*	21 OCT 0100	259	.00	.00	.00	0.
20 OCT 0010	110	.02	.00	.02	11.	*	21 OCT 0110	260	.00	.00	.00	0.
20 OCT 0020	111	.02	.00	.02	11.	*	21 OCT 0120	261	.00	.00	.00	0.
20 OCT 0030	112	.02	.00	.02	11.	*	21 OCT 0130	262	.00	.00	.00	0.
20 OCT 0040	113	.02	.00	.02	11.	*	21 OCT 0140	263	.00	.00	.00	0.
20 OCT 0050	114	.02	.00	.02	11.	*	21 OCT 0150	264	.00	.00	.00	0.
20 OCT 0100	115	.02	.00	.02	11.	*	21 OCT 0200	265	.00	.00	.00	0.
20 OCT 0110	116	.02	.00	.02	11.	*	21 OCT 0210	266	.00	.00	.00	0.
20 OCT 0120	117	.02	.00	.02	11.	*	21 OCT 0220	267	.00	.00	.00	0.
20 OCT 0130	118	.02	.00	.02	11.	*	21 OCT 0230	268	.00	.00	.00	0.
20 OCT 0140	119	.01	.00	.01	11.	*	21 OCT 0240	269	.00	.00	.00	0.
20 OCT 0150	120	.01	.00	.01	10.	*	21 OCT 0250	270	.00	.00	.00	0.
20 OCT 0200	121	.01	.00	.01	8.	*	21 OCT 0300	271	.00	.00	.00	0.
20 OCT 0210	122	.01	.00	.01	8.	*	21 OCT 0310	272	.00	.00	.00	0.
20 OCT 0220	123	.01	.00	.01	8.	*	21 OCT 0320	273	.00	.00	.00	0.
20 OCT 0230	124	.01	.00	.01	7.	*	21 OCT 0330	274	.00	.00	.00	0.
20 OCT 0240	125	.01	.00	.01	7.	*	21 OCT 0340	275	.00	.00	.00	0.
20 OCT 0250	126	.01	.00	.01	7.	*	21 OCT 0350	276	.00	.00	.00	0.
20 OCT 0300	127	.01	.00	.01	7.	*	21 OCT 0400	277	.00	.00	.00	0.
20 OCT 0310	128	.01	.00	.01	7.	*	21 OCT 0410	278	.00	.00	.00	0.
20 OCT 0320	129	.01	.00	.01	7.	*	21 OCT 0420	279	.00	.00	.00	0.
20 OCT 0330	130	.01	.00	.01	7.	*	21 OCT 0430	280	.00	.00	.00	0.
20 OCT 0340	131	.01	.00	.01	7.	*	21 OCT 0440	281	.00	.00	.00	0.
20 OCT 0350	132	.01	.00	.01	7.	*	21 OCT 0450	282	.00	.00	.00	0.
20 OCT 0400	133	.01	.00	.01	7.	*	21 OCT 0500	283	.00	.00	.00	0.
20 OCT 0410	134	.01	.00	.01	7.	*	21 OCT 0510	284	.00	.00	.00	0.
20 OCT 0420	135	.01	.00	.01	7.	*	21 OCT 0520	285	.00	.00	.00	0.
20 OCT 0430	136	.01	.00	.01	7.	*	21 OCT 0530	286	.00	.00	.00	0.
20 OCT 0440	137	.01	.00	.01	7.	*	21 OCT 0540	287	.00	.00	.00	0.
20 OCT 0450	138	.01	.00	.01	7.	*	21 OCT 0550	288	.00	.00	.00	0.
20 OCT 0500	139	.01	.00	.01	7.	*	21 OCT 0600	289	.00	.00	.00	0.
20 OCT 0510	140	.01	.00	.01	7.	*	21 OCT 0610	290	.00	.00	.00	0.
20 OCT 0520	141	.01	.00	.01	7.	*	21 OCT 0620	291	.00	.00	.00	0.
20 OCT 0530	142	.01	.00	.01	7.	*	21 OCT 0630	292	.00	.00	.00	0.
20 OCT 0540	143	.00	.00	.00	7.	*	21 OCT 0640	293	.00	.00	.00	0.
20 OCT 0550	144	.00	.00	.00	4.	*	21 OCT 0650	294	.00	.00	.00	0.
20 OCT 0600	145	.00	.00	.00	2.	*	21 OCT 0700	295	.00	.00	.00	0.
20 OCT 0610	146	.00	.00	.00	1.	*	21 OCT 0710	296	.00	.00	.00	0.
20 OCT 0620	147	.00	.00	.00	1.	*	21 OCT 0720	297	.00	.00	.00	0.
20 OCT 0630	148	.00	.00	.00	0.	*	21 OCT 0730	298	.00	.00	.00	0.

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       20 OCT 0640  149     .00     .00     .00         0.       *       21 OCT 0740  299     .00     .00     .00         0.
       20 OCT 0650  150     .00     .00     .00         0.       *       21 OCT 0750  300     .00     .00     .00         0.
                                                                 *
*****************************************************************************************************************************

    TOTAL RAINFALL =    6.80, TOTAL LOSS =    1.40, TOTAL EXCESS =    5.40

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     49.83-HR
+   (CFS)       (HR)
                          (CFS)
+     331.     11.67                  65.         21.         10.          10.
                        (INCHES)     4.218       5.399       5.399        5.399
                         (AC-FT)      32.         41.         41.          41.

                         CUMULATIVE AREA =     .14 SQ MI



*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   20 KK    *     SUB2   *
            *            *
            **************
                           Precipitation on Ash Settling Pond at Elevation 682

              SUBBASIN RUNOFF DATA

   22 BA        SUBBASIN CHARACTERISTICS
                      TAREA         .07  SUBBASIN AREA

                PRECIPITATION DATA

   12 PB              STORM        6.80  BASIN TOTAL PRECIPITATION

   13 PI          INCREMENTAL PRECIPITATION PATTERN
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .01       .01       .01       .01       .01       .01       .01       .01       .01
                      .01       .01       .01       .02       .02       .02       .13       .13       .13       .02
                      .02       .02       .01       .01       .01       .01       .01       .01       .01       .01
                      .01       .00       .00       .00       .00       .01       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
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                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00

  23 LS          SCS LOSS RATE
                      STRTL         .04  INITIAL ABSTRACTION
                     CRVNBR       98.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

  24 UD          SCS DIMENSIONLESS UNITGRAPH
                       TLAG         .00  LAG

                                                                  ***

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

                                                        UNIT HYDROGRAPH
                                                    5 END-OF-PERIOD ORDINATES
               194.       54.       11.        2.        0.
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HYDROGRAPH AT STATION SUB2

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DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q	*	DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q
19	OCT	0600	1	.00	.00	.00	0.	*	20	OCT	0700	151	.00	.00	.00	0.
19	OCT	0610	2	.01	.01	.00	0.	*	20	OCT	0710	152	.00	.00	.00	0.
19	OCT	0620	3	.01	.01	.00	0.	*	20	OCT	0720	153	.00	.00	.00	0.
19	OCT	0630	4	.01	.01	.00	0.	*	20	OCT	0730	154	.00	.00	.00	0.
19	OCT	0640	5	.01	.01	.00	0.	*	20	OCT	0740	155	.00	.00	.00	0.
19	OCT	0650	6	.01	.01	.00	1.	*	20	OCT	0750	156	.00	.00	.00	0.
19	OCT	0700	7	.01	.01	.00	1.	*	20	OCT	0800	157	.00	.00	.00	0.
19	OCT	0710	8	.01	.01	.00	1.	*	20	OCT	0810	158	.00	.00	.00	0.
19	OCT	0720	9	.01	.01	.00	1.	*	20	OCT	0820	159	.00	.00	.00	0.
19	OCT	0730	10	.01	.01	.01	1.	*	20	OCT	0830	160	.00	.00	.00	0.
19	OCT	0740	11	.02	.01	.01	2.	*	20	OCT	0840	161	.00	.00	.00	0.
19	OCT	0750	12	.02	.01	.01	2.	*	20	OCT	0850	162	.00	.00	.00	0.
19	OCT	0800	13	.02	.01	.01	2.	*	20	OCT	0900	163	.00	.00	.00	0.
19	OCT	0810	14	.01	.01	.01	2.	*	20	OCT	0910	164	.00	.00	.00	0.
19	OCT	0820	15	.01	.00	.01	2.	*	20	OCT	0920	165	.00	.00	.00	0.
19	OCT	0830	16	.01	.00	.01	2.	*	20	OCT	0930	166	.00	.00	.00	0.
19	OCT	0840	17	.02	.00	.01	3.	*	20	OCT	0940	167	.00	.00	.00	0.
19	OCT	0850	18	.02	.00	.01	3.	*	20	OCT	0950	168	.00	.00	.00	0.
19	OCT	0900	19	.02	.00	.01	3.	*	20	OCT	1000	169	.00	.00	.00	0.
19	OCT	0910	20	.01	.00	.01	3.	*	20	OCT	1010	170	.00	.00	.00	0.
19	OCT	0920	21	.01	.00	.01	3.	*	20	OCT	1020	171	.00	.00	.00	0.
19	OCT	0930	22	.01	.00	.01	3.	*	20	OCT	1030	172	.00	.00	.00	0.
19	OCT	0940	23	.02	.00	.01	4.	*	20	OCT	1040	173	.00	.00	.00	0.
19	OCT	0950	24	.02	.00	.01	4.	*	20	OCT	1050	174	.00	.00	.00	0.

19 OCT 1000	25	.02	.00	.02	4.	*	20 OCT 1100	175	.00	.00	.00	0.
19 OCT 1010	26	.02	.00	.02	4.	*	20 OCT 1110	176	.00	.00	.00	0.
19 OCT 1020	27	.02	.00	.02	4.	*	20 OCT 1120	177	.00	.00	.00	0.
19 OCT 1030	28	.02	.00	.02	4.	*	20 OCT 1130	178	.00	.00	.00	0.
19 OCT 1040	29	.02	.00	.02	4.	*	20 OCT 1140	179	.00	.00	.00	0.
19 OCT 1050	30	.02	.00	.02	4.	*	20 OCT 1150	180	.00	.00	.00	0.
19 OCT 1100	31	.02	.00	.02	4.	*	20 OCT 1200	181	.00	.00	.00	0.
19 OCT 1110	32	.02	.00	.02	4.	*	20 OCT 1210	182	.00	.00	.00	0.
19 OCT 1120	33	.02	.00	.02	4.	*	20 OCT 1220	183	.00	.00	.00	0.
19 OCT 1130	34	.02	.00	.02	4.	*	20 OCT 1230	184	.00	.00	.00	0.
19 OCT 1140	35	.02	.00	.02	5.	*	20 OCT 1240	185	.00	.00	.00	0.
19 OCT 1150	36	.02	.00	.02	5.	*	20 OCT 1250	186	.00	.00	.00	0.
19 OCT 1200	37	.02	.00	.02	5.	*	20 OCT 1300	187	.00	.00	.00	0.
19 OCT 1210	38	.02	.00	.02	5.	*	20 OCT 1310	188	.00	.00	.00	0.
19 OCT 1220	39	.02	.00	.02	6.	*	20 OCT 1320	189	.00	.00	.00	0.
19 OCT 1230	40	.02	.00	.02	6.	*	20 OCT 1330	190	.00	.00	.00	0.
19 OCT 1240	41	.02	.00	.02	6.	*	20 OCT 1340	191	.00	.00	.00	0.
19 OCT 1250	42	.02	.00	.02	6.	*	20 OCT 1350	192	.00	.00	.00	0.
19 OCT 1300	43	.02	.00	.02	6.	*	20 OCT 1400	193	.00	.00	.00	0.
19 OCT 1310	44	.02	.00	.02	6.	*	20 OCT 1410	194	.00	.00	.00	0.
19 OCT 1320	45	.02	.00	.02	6.	*	20 OCT 1420	195	.00	.00	.00	0.
19 OCT 1330	46	.02	.00	.02	6.	*	20 OCT 1430	196	.00	.00	.00	0.
19 OCT 1340	47	.03	.00	.03	7.	*	20 OCT 1440	197	.00	.00	.00	0.
19 OCT 1350	48	.03	.00	.03	8.	*	20 OCT 1450	198	.00	.00	.00	0.
19 OCT 1400	49	.03	.00	.03	8.	*	20 OCT 1500	199	.00	.00	.00	0.
19 OCT 1410	50	.03	.00	.03	8.	*	20 OCT 1510	200	.00	.00	.00	0.
19 OCT 1420	51	.03	.00	.03	7.	*	20 OCT 1520	201	.00	.00	.00	0.
19 OCT 1430	52	.03	.00	.03	7.	*	20 OCT 1530	202	.00	.00	.00	0.
19 OCT 1440	53	.04	.00	.04	9.	*	20 OCT 1540	203	.00	.00	.00	0.
19 OCT 1450	54	.04	.00	.04	9.	*	20 OCT 1550	204	.00	.00	.00	0.
19 OCT 1500	55	.04	.00	.04	9.	*	20 OCT 1600	205	.00	.00	.00	0.
19 OCT 1510	56	.04	.00	.04	10.	*	20 OCT 1610	206	.00	.00	.00	0.
19 OCT 1520	57	.04	.00	.04	10.	*	20 OCT 1620	207	.00	.00	.00	0.
19 OCT 1530	58	.04	.00	.04	10.	*	20 OCT 1630	208	.00	.00	.00	0.
19 OCT 1540	59	.05	.00	.05	13.	*	20 OCT 1640	209	.00	.00	.00	0.
19 OCT 1550	60	.05	.00	.05	13.	*	20 OCT 1650	210	.00	.00	.00	0.
19 OCT 1600	61	.05	.00	.05	13.	*	20 OCT 1700	211	.00	.00	.00	0.
19 OCT 1610	62	.07	.00	.07	17.	*	20 OCT 1710	212	.00	.00	.00	0.
19 OCT 1620	63	.07	.00	.07	18.	*	20 OCT 1720	213	.00	.00	.00	0.
19 OCT 1630	64	.07	.00	.07	18.	*	20 OCT 1730	214	.00	.00	.00	0.
19 OCT 1640	65	.11	.00	.11	26.	*	20 OCT 1740	215	.00	.00	.00	0.
19 OCT 1650	66	.11	.00	.11	28.	*	20 OCT 1750	216	.00	.00	.00	0.
19 OCT 1700	67	.11	.00	.11	28.	*	20 OCT 1800	217	.00	.00	.00	0.
19 OCT 1710	68	.87	.01	.86	174.	*	20 OCT 1810	218	.00	.00	.00	0.
19 OCT 1720	69	.87	.00	.86	215.	*	20 OCT 1820	219	.00	.00	.00	0.
19 OCT 1730	70	.87	.00	.86	223.	*	20 OCT 1830	220	.00	.00	.00	0.
19 OCT 1740	71	.16	.00	.16	90.	*	20 OCT 1840	221	.00	.00	.00	0.
19 OCT 1750	72	.16	.00	.16	52.	*	20 OCT 1850	222	.00	.00	.00	0.
19 OCT 1800	73	.16	.00	.16	44.	*	20 OCT 1900	223	.00	.00	.00	0.
19 OCT 1810	74	.08	.00	.08	27.	*	20 OCT 1910	224	.00	.00	.00	0.
19 OCT 1820	75	.08	.00	.08	23.	*	20 OCT 1920	225	.00	.00	.00	0.
19 OCT 1830	76	.08	.00	.08	22.	*	20 OCT 1930	226	.00	.00	.00	0.

19 OCT 1840	77	.06	.00	.06	18.	*	20 OCT 1940	227	.00	.00	.00	0.
19 OCT 1850	78	.06	.00	.06	16.	*	20 OCT 1950	228	.00	.00	.00	0.
19 OCT 1900	79	.06	.00	.06	16.	*	20 OCT 2000	229	.00	.00	.00	0.
19 OCT 1910	80	.05	.00	.05	13.	*	20 OCT 2010	230	.00	.00	.00	0.
19 OCT 1920	81	.05	.00	.05	13.	*	20 OCT 2020	231	.00	.00	.00	0.
19 OCT 1930	82	.05	.00	.05	12.	*	20 OCT 2030	232	.00	.00	.00	0.
19 OCT 1940	83	.03	.00	.03	10.	*	20 OCT 2040	233	.00	.00	.00	0.
19 OCT 1950	84	.03	.00	.03	9.	*	20 OCT 2050	234	.00	.00	.00	0.
19 OCT 2000	85	.03	.00	.03	9.	*	20 OCT 2100	235	.00	.00	.00	0.
19 OCT 2010	86	.03	.00	.03	9.	*	20 OCT 2110	236	.00	.00	.00	0.
19 OCT 2020	87	.03	.00	.03	9.	*	20 OCT 2120	237	.00	.00	.00	0.
19 OCT 2030	88	.03	.00	.03	9.	*	20 OCT 2130	238	.00	.00	.00	0.
19 OCT 2040	89	.03	.00	.03	9.	*	20 OCT 2140	239	.00	.00	.00	0.
19 OCT 2050	90	.03	.00	.03	9.	*	20 OCT 2150	240	.00	.00	.00	0.
19 OCT 2100	91	.03	.00	.03	9.	*	20 OCT 2200	241	.00	.00	.00	0.
19 OCT 2110	92	.03	.00	.03	9.	*	20 OCT 2210	242	.00	.00	.00	0.
19 OCT 2120	93	.03	.00	.03	9.	*	20 OCT 2220	243	.00	.00	.00	0.
19 OCT 2130	94	.03	.00	.03	9.	*	20 OCT 2230	244	.00	.00	.00	0.
19 OCT 2140	95	.02	.00	.02	6.	*	20 OCT 2240	245	.00	.00	.00	0.
19 OCT 2150	96	.02	.00	.02	6.	*	20 OCT 2250	246	.00	.00	.00	0.
19 OCT 2200	97	.02	.00	.02	5.	*	20 OCT 2300	247	.00	.00	.00	0.
19 OCT 2210	98	.02	.00	.02	5.	*	20 OCT 2310	248	.00	.00	.00	0.
19 OCT 2220	99	.02	.00	.02	5.	*	20 OCT 2320	249	.00	.00	.00	0.
19 OCT 2230	100	.02	.00	.02	5.	*	20 OCT 2330	250	.00	.00	.00	0.
19 OCT 2240	101	.02	.00	.02	5.	*	20 OCT 2340	251	.00	.00	.00	0.
19 OCT 2250	102	.02	.00	.02	5.	*	20 OCT 2350	252	.00	.00	.00	0.
19 OCT 2300	103	.02	.00	.02	5.	*	21 OCT 0000	253	.00	.00	.00	0.
19 OCT 2310	104	.02	.00	.02	5.	*	21 OCT 0010	254	.00	.00	.00	0.
19 OCT 2320	105	.02	.00	.02	5.	*	21 OCT 0020	255	.00	.00	.00	0.
19 OCT 2330	106	.02	.00	.02	5.	*	21 OCT 0030	256	.00	.00	.00	0.
19 OCT 2340	107	.02	.00	.02	5.	*	21 OCT 0040	257	.00	.00	.00	0.
19 OCT 2350	108	.02	.00	.02	5.	*	21 OCT 0050	258	.00	.00	.00	0.
20 OCT 0000	109	.02	.00	.02	5.	*	21 OCT 0100	259	.00	.00	.00	0.
20 OCT 0010	110	.02	.00	.02	5.	*	21 OCT 0110	260	.00	.00	.00	0.
20 OCT 0020	111	.02	.00	.02	5.	*	21 OCT 0120	261	.00	.00	.00	0.
20 OCT 0030	112	.02	.00	.02	5.	*	21 OCT 0130	262	.00	.00	.00	0.
20 OCT 0040	113	.02	.00	.02	5.	*	21 OCT 0140	263	.00	.00	.00	0.
20 OCT 0050	114	.02	.00	.02	5.	*	21 OCT 0150	264	.00	.00	.00	0.
20 OCT 0100	115	.02	.00	.02	5.	*	21 OCT 0200	265	.00	.00	.00	0.
20 OCT 0110	116	.02	.00	.02	5.	*	21 OCT 0210	266	.00	.00	.00	0.
20 OCT 0120	117	.02	.00	.02	5.	*	21 OCT 0220	267	.00	.00	.00	0.
20 OCT 0130	118	.02	.00	.02	5.	*	21 OCT 0230	268	.00	.00	.00	0.
20 OCT 0140	119	.01	.00	.01	4.	*	21 OCT 0240	269	.00	.00	.00	0.
20 OCT 0150	120	.01	.00	.01	4.	*	21 OCT 0250	270	.00	.00	.00	0.
20 OCT 0200	121	.01	.00	.01	4.	*	21 OCT 0300	271	.00	.00	.00	0.
20 OCT 0210	122	.01	.00	.01	4.	*	21 OCT 0310	272	.00	.00	.00	0.
20 OCT 0220	123	.01	.00	.01	4.	*	21 OCT 0320	273	.00	.00	.00	0.
20 OCT 0230	124	.01	.00	.01	4.	*	21 OCT 0330	274	.00	.00	.00	0.
20 OCT 0240	125	.01	.00	.01	4.	*	21 OCT 0340	275	.00	.00	.00	0.
20 OCT 0250	126	.01	.00	.01	4.	*	21 OCT 0350	276	.00	.00	.00	0.
20 OCT 0300	127	.01	.00	.01	4.	*	21 OCT 0400	277	.00	.00	.00	0.
20 OCT 0310	128	.01	.00	.01	4.	*	21 OCT 0410	278	.00	.00	.00	0.

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      20 OCT 0320  129     .01     .00     .01         4.       *       21 OCT 0420  279     .00     .00     .00         0.
      20 OCT 0330  130     .01     .00     .01         4.       *       21 OCT 0430  280     .00     .00     .00         0.
      20 OCT 0340  131     .01     .00     .01         4.       *       21 OCT 0440  281     .00     .00     .00         0.
      20 OCT 0350  132     .01     .00     .01         4.       *       21 OCT 0450  282     .00     .00     .00         0.
      20 OCT 0400  133     .01     .00     .01         4.       *       21 OCT 0500  283     .00     .00     .00         0.
      20 OCT 0410  134     .01     .00     .01         4.       *       21 OCT 0510  284     .00     .00     .00         0.
      20 OCT 0420  135     .01     .00     .01         4.       *       21 OCT 0520  285     .00     .00     .00         0.
      20 OCT 0430  136     .01     .00     .01         4.       *       21 OCT 0530  286     .00     .00     .00         0.
      20 OCT 0440  137     .01     .00     .01         4.       *       21 OCT 0540  287     .00     .00     .00         0.
      20 OCT 0450  138     .01     .00     .01         4.       *       21 OCT 0550  288     .00     .00     .00         0.
      20 OCT 0500  139     .01     .00     .01         4.       *       21 OCT 0600  289     .00     .00     .00         0.
      20 OCT 0510  140     .01     .00     .01         4.       *       21 OCT 0610  290     .00     .00     .00         0.
      20 OCT 0520  141     .01     .00     .01         4.       *       21 OCT 0620  291     .00     .00     .00         0.
      20 OCT 0530  142     .01     .00     .01         4.       *       21 OCT 0630  292     .00     .00     .00         0.
      20 OCT 0540  143     .00     .00     .00         1.       *       21 OCT 0640  293     .00     .00     .00         0.
      20 OCT 0550  144     .00     .00     .00         0.       *       21 OCT 0650  294     .00     .00     .00         0.
      20 OCT 0600  145     .00     .00     .00         0.       *       21 OCT 0700  295     .00     .00     .00         0.
      20 OCT 0610  146     .00     .00     .00         0.       *       21 OCT 0710  296     .00     .00     .00         0.
      20 OCT 0620  147     .00     .00     .00         0.       *       21 OCT 0720  297     .00     .00     .00         0.
      20 OCT 0630  148     .00     .00     .00         0.       *       21 OCT 0730  298     .00     .00     .00         0.
      20 OCT 0640  149     .00     .00     .00         0.       *       21 OCT 0740  299     .00     .00     .00         0.
      20 OCT 0650  150     .00     .00     .00         0.       *       21 OCT 0750  300     .00     .00     .00         0.
                                                                 *
 ************************************************************************************************************************************

     TOTAL RAINFALL =    6.80, TOTAL LOSS =     .24, TOTAL EXCESS =    6.56

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     49.83-HR
+   (CFS)       (HR)
                          (CFS)
+     223.     11.50                35.         12.          6.           6.
                        (INCHES)    4.773       6.561       6.561        6.561
                         (AC-FT)     17.         24.         24.          24.

                         CUMULATIVE AREA =     .07 SQ MI



 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   25 KK    *     COMB1  *
            *            *
            **************
                            Combine Subbasins 1 and 2.

   27 HC          HYDROGRAPH COMBINATION
                        ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE
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HYDROGRAPH AT STATION COMB1
SUM OF 2 HYDROGRAPHS

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
19	OCT	0600	1	0.	19	OCT	1830	76	93.	20	OCT	0700	151	0.	20	OCT	1930	226	0.
19	OCT	0610	2	0.	19	OCT	1840	77	74.	20	OCT	0710	152	0.	20	OCT	1940	227	0.
19	OCT	0620	3	0.	19	OCT	1850	78	63.	20	OCT	0720	153	0.	20	OCT	1950	228	0.
19	OCT	0630	4	0.	19	OCT	1900	79	56.	20	OCT	0730	154	0.	20	OCT	2000	229	0.
19	OCT	0640	5	0.	19	OCT	1910	80	49.	20	OCT	0740	155	0.	20	OCT	2010	230	0.
19	OCT	0650	6	1.	19	OCT	1920	81	44.	20	OCT	0750	156	0.	20	OCT	2020	231	0.
19	OCT	0700	7	1.	19	OCT	1930	82	41.	20	OCT	0800	157	0.	20	OCT	2030	232	0.
19	OCT	0710	8	1.	19	OCT	1940	83	36.	20	OCT	0810	158	0.	20	OCT	2040	233	0.
19	OCT	0720	9	1.	19	OCT	1950	84	32.	20	OCT	0820	159	0.	20	OCT	2050	234	0.
19	OCT	0730	10	1.	19	OCT	2000	85	30.	20	OCT	0830	160	0.	20	OCT	2100	235	0.
19	OCT	0740	11	2.	19	OCT	2010	86	28.	20	OCT	0840	161	0.	20	OCT	2110	236	0.
19	OCT	0750	12	2.	19	OCT	2020	87	28.	20	OCT	0850	162	0.	20	OCT	2120	237	0.
19	OCT	0800	13	2.	19	OCT	2030	88	27.	20	OCT	0900	163	0.	20	OCT	2130	238	0.
19	OCT	0810	14	2.	19	OCT	2040	89	27.	20	OCT	0910	164	0.	20	OCT	2140	239	0.
19	OCT	0820	15	2.	19	OCT	2050	90	27.	20	OCT	0920	165	0.	20	OCT	2150	240	0.
19	OCT	0830	16	2.	19	OCT	2100	91	27.	20	OCT	0930	166	0.	20	OCT	2200	241	0.
19	OCT	0840	17	3.	19	OCT	2110	92	27.	20	OCT	0940	167	0.	20	OCT	2210	242	0.
19	OCT	0850	18	3.	19	OCT	2120	93	27.	20	OCT	0950	168	0.	20	OCT	2220	243	0.
19	OCT	0900	19	3.	19	OCT	2130	94	27.	20	OCT	1000	169	0.	20	OCT	2230	244	0.
19	OCT	0910	20	3.	19	OCT	2140	95	24.	20	OCT	1010	170	0.	20	OCT	2240	245	0.
19	OCT	0920	21	3.	19	OCT	2150	96	21.	20	OCT	1020	171	0.	20	OCT	2250	246	0.
19	OCT	0930	22	3.	19	OCT	2200	97	19.	20	OCT	1030	172	0.	20	OCT	2300	247	0.
19	OCT	0940	23	4.	19	OCT	2210	98	17.	20	OCT	1040	173	0.	20	OCT	2310	248	0.
19	OCT	0950	24	4.	19	OCT	2220	99	17.	20	OCT	1050	174	0.	20	OCT	2320	249	0.
19	OCT	1000	25	4.	19	OCT	2230	100	17.	20	OCT	1100	175	0.	20	OCT	2330	250	0.
19	OCT	1010	26	5.	19	OCT	2240	101	16.	20	OCT	1110	176	0.	20	OCT	2340	251	0.
19	OCT	1020	27	5.	19	OCT	2250	102	16.	20	OCT	1120	177	0.	20	OCT	2350	252	0.
19	OCT	1030	28	5.	19	OCT	2300	103	16.	20	OCT	1130	178	0.	21	OCT	0000	253	0.
19	OCT	1040	29	5.	19	OCT	2310	104	16.	20	OCT	1140	179	0.	21	OCT	0010	254	0.
19	OCT	1050	30	6.	19	OCT	2320	105	16.	20	OCT	1150	180	0.	21	OCT	0020	255	0.
19	OCT	1100	31	6.	19	OCT	2330	106	16.	20	OCT	1200	181	0.	21	OCT	0030	256	0.
19	OCT	1110	32	6.	19	OCT	2340	107	16.	20	OCT	1210	182	0.	21	OCT	0040	257	0.
19	OCT	1120	33	6.	19	OCT	2350	108	16.	20	OCT	1220	183	0.	21	OCT	0050	258	0.
19	OCT	1130	34	7.	20	OCT	0000	109	16.	20	OCT	1230	184	0.	21	OCT	0100	259	0.
19	OCT	1140	35	8.	20	OCT	0010	110	16.	20	OCT	1240	185	0.	21	OCT	0110	260	0.
19	OCT	1150	36	8.	20	OCT	0020	111	16.	20	OCT	1250	186	0.	21	OCT	0120	261	0.
19	OCT	1200	37	9.	20	OCT	0030	112	16.	20	OCT	1300	187	0.	21	OCT	0130	262	0.
19	OCT	1210	38	9.	20	OCT	0040	113	16.	20	OCT	1310	188	0.	21	OCT	0140	263	0.
19	OCT	1220	39	10.	20	OCT	0050	114	16.	20	OCT	1320	189	0.	21	OCT	0150	264	0.
19	OCT	1230	40	10.	20	OCT	0100	115	16.	20	OCT	1330	190	0.	21	OCT	0200	265	0.

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          *            *
 28 KK    *      RES1  *
          *            *
          **************
                         Reservoir Routing Operation

             HYDROGRAPH ROUTING DATA

 30 RS          STORAGE ROUTING
                      NSTPS           1  NUMBER OF SUBREACHES
                       ITYP        ELEV  TYPE OF INITIAL CONDITION
                      RSVRIC      670.00  INITIAL CONDITION
                           X         .00 WORKING R AND D COEFFICIENT

 31 SA                AREA         6.5       8.0      13.0      20.6      28.7      39.5

 32 SE          ELEVATION      670.00    672.00    675.00    678.00    680.00    682.00

 33 SQ          DISCHARGE          0.        0.        0.        0.        0.        0.        0.

 34 SE          ELEVATION      670.00    671.00    672.00    675.00    678.00    680.00    682.00
                                                                  ***

                                                COMPUTED STORAGE-ELEVATION DATA

          STORAGE        .00     14.49     45.73     95.82    144.96    212.91
        ELEVATION     670.00    672.00    675.00    678.00    680.00    682.00

                                              COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE        .00      6.88     14.49     45.73     95.82    144.96    212.91
          OUTFLOW        .00       .00       .00       .00       .00       .00       .00
        ELEVATION     670.00    671.00    672.00    675.00    678.00    680.00    682.00
*****************************************************************************************************************************************

                                                HYDROGRAPH AT STATION     RES1
*****************************************************************************************************************************************
                                        *                                        *
 DA MON HRMN ORD  OUTFLOW  STORAGE   STAGE * DA MON HRMN ORD  OUTFLOW  STORAGE   STAGE * DA MON HRMN ORD  OUTFLOW  STORAGE   STAGE
                                        *                                        *
 19 OCT 0600   1       0.       .0   670.0 * 19 OCT 2240 101       0.     56.8   675.7 * 20 OCT 1520 201       0.     64.6   676.1
 19 OCT 0610   2       0.       .0   670.0 * 19 OCT 2250 102       0.     57.0   675.7 * 20 OCT 1530 202       0.     64.6   676.1
 19 OCT 0620   3       0.       .0   670.0 * 19 OCT 2300 103       0.     57.2   675.7 * 20 OCT 1540 203       0.     64.6   676.1
 19 OCT 0630   4       0.       .0   670.0 * 19 OCT 2310 104       0.     57.4   675.7 * 20 OCT 1550 204       0.     64.6   676.1
 19 OCT 0640   5       0.       .0   670.0 * 19 OCT 2320 105       0.     57.7   675.7 * 20 OCT 1600 205       0.     64.6   676.1
 19 OCT 0650   6       0.       .0   670.0 * 19 OCT 2330 106       0.     57.9   675.7 * 20 OCT 1610 206       0.     64.6   676.1
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19	OCT	0700	7	0.	.0	670.0	*	19	OCT	2340	107	0.	58.1	675.7	*	20	OCT	1620	207	0.	64.6	676.1
19	OCT	0710	8	0.	.0	670.0	*	19	OCT	2350	108	0.	58.3	675.8	*	20	OCT	1630	208	0.	64.6	676.1
19	OCT	0720	9	0.	.0	670.0	*	20	OCT	0000	109	0.	58.6	675.8	*	20	OCT	1640	209	0.	64.6	676.1
19	OCT	0730	10	0.	.1	670.0	*	20	OCT	0010	110	0.	58.8	675.8	*	20	OCT	1650	210	0.	64.6	676.1
19	OCT	0740	11	0.	.1	670.0	*	20	OCT	0020	111	0.	59.0	675.8	*	20	OCT	1700	211	0.	64.6	676.1
19	OCT	0750	12	0.	.1	670.0	*	20	OCT	0030	112	0.	59.2	675.8	*	20	OCT	1710	212	0.	64.6	676.1
19	OCT	0800	13	0.	.1	670.0	*	20	OCT	0040	113	0.	59.5	675.8	*	20	OCT	1720	213	0.	64.6	676.1
19	OCT	0810	14	0.	.2	670.0	*	20	OCT	0050	114	0.	59.7	675.8	*	20	OCT	1730	214	0.	64.6	676.1
19	OCT	0820	15	0.	.2	670.0	*	20	OCT	0100	115	0.	59.9	675.8	*	20	OCT	1740	215	0.	64.6	676.1
19	OCT	0830	16	0.	.2	670.0	*	20	OCT	0110	116	0.	60.1	675.9	*	20	OCT	1750	216	0.	64.6	676.1
19	OCT	0840	17	0.	.3	670.0	*	20	OCT	0120	117	0.	60.4	675.9	*	20	OCT	1800	217	0.	64.6	676.1
19	OCT	0850	18	0.	.3	670.0	*	20	OCT	0130	118	0.	60.6	675.9	*	20	OCT	1810	218	0.	64.6	676.1
19	OCT	0900	19	0.	.4	670.1	*	20	OCT	0140	119	0.	60.8	675.9	*	20	OCT	1820	219	0.	64.6	676.1
19	OCT	0910	20	0.	.4	670.1	*	20	OCT	0150	120	0.	61.0	675.9	*	20	OCT	1830	220	0.	64.6	676.1
19	OCT	0920	21	0.	.4	670.1	*	20	OCT	0200	121	0.	61.2	675.9	*	20	OCT	1840	221	0.	64.6	676.1
19	OCT	0930	22	0.	.5	670.1	*	20	OCT	0210	122	0.	61.3	675.9	*	20	OCT	1850	222	0.	64.6	676.1
19	OCT	0940	23	0.	.5	670.1	*	20	OCT	0220	123	0.	61.5	675.9	*	20	OCT	1900	223	0.	64.6	676.1
19	OCT	0950	24	0.	.6	670.1	*	20	OCT	0230	124	0.	61.6	676.0	*	20	OCT	1910	224	0.	64.6	676.1
19	OCT	1000	25	0.	.6	670.1	*	20	OCT	0240	125	0.	61.8	676.0	*	20	OCT	1920	225	0.	64.6	676.1
19	OCT	1010	26	0.	.7	670.1	*	20	OCT	0250	126	0.	61.9	676.0	*	20	OCT	1930	226	0.	64.6	676.1
19	OCT	1020	27	0.	.8	670.1	*	20	OCT	0300	127	0.	62.1	676.0	*	20	OCT	1940	227	0.	64.6	676.1
19	OCT	1030	28	0.	.8	670.1	*	20	OCT	0310	128	0.	62.2	676.0	*	20	OCT	1950	228	0.	64.6	676.1
19	OCT	1040	29	0.	.9	670.1	*	20	OCT	0320	129	0.	62.4	676.0	*	20	OCT	2000	229	0.	64.6	676.1
19	OCT	1050	30	0.	1.0	670.1	*	20	OCT	0330	130	0.	62.5	676.0	*	20	OCT	2010	230	0.	64.6	676.1
19	OCT	1100	31	0.	1.1	670.2	*	20	OCT	0340	131	0.	62.7	676.0	*	20	OCT	2020	231	0.	64.6	676.1
19	OCT	1110	32	0.	1.1	670.2	*	20	OCT	0350	132	0.	62.8	676.0	*	20	OCT	2030	232	0.	64.6	676.1
19	OCT	1120	33	0.	1.2	670.2	*	20	OCT	0400	133	0.	63.0	676.0	*	20	OCT	2040	233	0.	64.6	676.1
19	OCT	1130	34	0.	1.3	670.2	*	20	OCT	0410	134	0.	63.1	676.0	*	20	OCT	2050	234	0.	64.6	676.1
19	OCT	1140	35	0.	1.4	670.2	*	20	OCT	0420	135	0.	63.3	676.1	*	20	OCT	2100	235	0.	64.6	676.1
19	OCT	1150	36	0.	1.5	670.2	*	20	OCT	0430	136	0.	63.4	676.1	*	20	OCT	2110	236	0.	64.6	676.1
19	OCT	1200	37	0.	1.6	670.2	*	20	OCT	0440	137	0.	63.6	676.1	*	20	OCT	2120	237	0.	64.6	676.1
19	OCT	1210	38	0.	1.8	670.3	*	20	OCT	0450	138	0.	63.7	676.1	*	20	OCT	2130	238	0.	64.6	676.1
19	OCT	1220	39	0.	1.9	670.3	*	20	OCT	0500	139	0.	63.9	676.1	*	20	OCT	2140	239	0.	64.6	676.1
19	OCT	1230	40	0.	2.0	670.3	*	20	OCT	0510	140	0.	64.0	676.1	*	20	OCT	2150	240	0.	64.6	676.1
19	OCT	1240	41	0.	2.2	670.3	*	20	OCT	0520	141	0.	64.2	676.1	*	20	OCT	2200	241	0.	64.6	676.1
19	OCT	1250	42	0.	2.3	670.3	*	20	OCT	0530	142	0.	64.3	676.1	*	20	OCT	2210	242	0.	64.6	676.1
19	OCT	1300	43	0.	2.5	670.4	*	20	OCT	0540	143	0.	64.5	676.1	*	20	OCT	2220	243	0.	64.6	676.1
19	OCT	1310	44	0.	2.6	670.4	*	20	OCT	0550	144	0.	64.5	676.1	*	20	OCT	2230	244	0.	64.6	676.1
19	OCT	1320	45	0.	2.7	670.4	*	20	OCT	0600	145	0.	64.6	676.1	*	20	OCT	2240	245	0.	64.6	676.1
19	OCT	1330	46	0.	2.9	670.4	*	20	OCT	0610	146	0.	64.6	676.1	*	20	OCT	2250	246	0.	64.6	676.1
19	OCT	1340	47	0.	3.1	670.4	*	20	OCT	0620	147	0.	64.6	676.1	*	20	OCT	2300	247	0.	64.6	676.1
19	OCT	1350	48	0.	3.3	670.5	*	20	OCT	0630	148	0.	64.6	676.1	*	20	OCT	2310	248	0.	64.6	676.1
19	OCT	1400	49	0.	3.5	670.5	*	20	OCT	0640	149	0.	64.6	676.1	*	20	OCT	2320	249	0.	64.6	676.1
19	OCT	1410	50	0.	3.7	670.5	*	20	OCT	0650	150	0.	64.6	676.1	*	20	OCT	2330	250	0.	64.6	676.1
19	OCT	1420	51	0.	3.9	670.6	*	20	OCT	0700	151	0.	64.6	676.1	*	20	OCT	2340	251	0.	64.6	676.1
19	OCT	1430	52	0.	4.1	670.6	*	20	OCT	0710	152	0.	64.6	676.1	*	20	OCT	2350	252	0.	64.6	676.1
19	OCT	1440	53	0.	4.4	670.6	*	20	OCT	0720	153	0.	64.6	676.1	*	21	OCT	0000	253	0.	64.6	676.1
19	OCT	1450	54	0.	4.6	670.7	*	20	OCT	0730	154	0.	64.6	676.1	*	21	OCT	0010	254	0.	64.6	676.1
19	OCT	1500	55	0.	4.9	670.7	*	20	OCT	0740	155	0.	64.6	676.1	*	21	OCT	0020	255	0.	64.6	676.1
19	OCT	1510	56	0.	5.2	670.8	*	20	OCT	0750	156	0.	64.6	676.1	*	21	OCT	0030	256	0.	64.6	676.1
19	OCT	1520	57	0.	5.5	670.8	*	20	OCT	0800	157	0.	64.6	676.1	*	21	OCT	0040	257	0.	64.6	676.1
19	OCT	1530	58	0.	5.8	670.8	*	20	OCT	0810	158	0.	64.6	676.1	*	21	OCT	0050	258	0.	64.6	676.1

19	OCT	1540	59	0.	6.1	670.9	*	20	OCT	0820	159	0.	64.6	676.1	*	21	OCT	0100	259	0.	64.6	676.1
19	OCT	1550	60	0.	6.5	670.9	*	20	OCT	0830	160	0.	64.6	676.1	*	21	OCT	0110	260	0.	64.6	676.1
19	OCT	1600	61	0.	6.9	671.0	*	20	OCT	0840	161	0.	64.6	676.1	*	21	OCT	0120	261	0.	64.6	676.1
19	OCT	1610	62	0.	7.4	671.1	*	20	OCT	0850	162	0.	64.6	676.1	*	21	OCT	0130	262	0.	64.6	676.1
19	OCT	1620	63	0.	7.9	671.1	*	20	OCT	0900	163	0.	64.6	676.1	*	21	OCT	0140	263	0.	64.6	676.1
19	OCT	1630	64	0.	8.5	671.2	*	20	OCT	0910	164	0.	64.6	676.1	*	21	OCT	0150	264	0.	64.6	676.1
19	OCT	1640	65	0.	9.2	671.3	*	20	OCT	0920	165	0.	64.6	676.1	*	21	OCT	0200	265	0.	64.6	676.1
19	OCT	1650	66	0.	10.0	671.4	*	20	OCT	0930	166	0.	64.6	676.1	*	21	OCT	0210	266	0.	64.6	676.1
19	OCT	1700	67	0.	10.9	671.5	*	20	OCT	0940	167	0.	64.6	676.1	*	21	OCT	0220	267	0.	64.6	676.1
19	OCT	1710	68	0.	13.1	671.8	*	20	OCT	0950	168	0.	64.6	676.1	*	21	OCT	0230	268	0.	64.6	676.1
19	OCT	1720	69	0.	17.6	672.3	*	20	OCT	1000	169	0.	64.6	676.1	*	21	OCT	0240	269	0.	64.6	676.1
19	OCT	1730	70	0.	23.9	672.9	*	20	OCT	1010	170	0.	64.6	676.1	*	21	OCT	0250	270	0.	64.6	676.1
19	OCT	1740	71	0.	30.4	673.5	*	20	OCT	1020	171	0.	64.6	676.1	*	21	OCT	0300	271	0.	64.6	676.1
19	OCT	1750	72	0.	35.5	674.0	*	20	OCT	1030	172	0.	64.6	676.1	*	21	OCT	0310	272	0.	64.6	676.1
19	OCT	1800	73	0.	39.2	674.4	*	20	OCT	1040	173	0.	64.6	676.1	*	21	OCT	0320	273	0.	64.6	676.1
19	OCT	1810	74	0.	41.9	674.6	*	20	OCT	1050	174	0.	64.6	676.1	*	21	OCT	0330	274	0.	64.6	676.1
19	OCT	1820	75	0.	43.8	674.8	*	20	OCT	1100	175	0.	64.6	676.1	*	21	OCT	0340	275	0.	64.6	676.1
19	OCT	1830	76	0.	45.2	675.0	*	20	OCT	1110	176	0.	64.6	676.1	*	21	OCT	0350	276	0.	64.6	676.1
19	OCT	1840	77	0.	46.4	675.0	*	20	OCT	1120	177	0.	64.6	676.1	*	21	OCT	0400	277	0.	64.6	676.1
19	OCT	1850	78	0.	47.3	675.1	*	20	OCT	1130	178	0.	64.6	676.1	*	21	OCT	0410	278	0.	64.6	676.1
19	OCT	1900	79	0.	48.1	675.1	*	20	OCT	1140	179	0.	64.6	676.1	*	21	OCT	0420	279	0.	64.6	676.1
19	OCT	1910	80	0.	48.9	675.2	*	20	OCT	1150	180	0.	64.6	676.1	*	21	OCT	0430	280	0.	64.6	676.1
19	OCT	1920	81	0.	49.5	675.2	*	20	OCT	1200	181	0.	64.6	676.1	*	21	OCT	0440	281	0.	64.6	676.1
19	OCT	1930	82	0.	50.1	675.3	*	20	OCT	1210	182	0.	64.6	676.1	*	21	OCT	0450	282	0.	64.6	676.1
19	OCT	1940	83	0.	50.6	675.3	*	20	OCT	1220	183	0.	64.6	676.1	*	21	OCT	0500	283	0.	64.6	676.1
19	OCT	1950	84	0.	51.1	675.3	*	20	OCT	1230	184	0.	64.6	676.1	*	21	OCT	0510	284	0.	64.6	676.1
19	OCT	2000	85	0.	51.5	675.3	*	20	OCT	1240	185	0.	64.6	676.1	*	21	OCT	0520	285	0.	64.6	676.1
19	OCT	2010	86	0.	51.9	675.4	*	20	OCT	1250	186	0.	64.6	676.1	*	21	OCT	0530	286	0.	64.6	676.1
19	OCT	2020	87	0.	52.3	675.4	*	20	OCT	1300	187	0.	64.6	676.1	*	21	OCT	0540	287	0.	64.6	676.1
19	OCT	2030	88	0.	52.7	675.4	*	20	OCT	1310	188	0.	64.6	676.1	*	21	OCT	0550	288	0.	64.6	676.1
19	OCT	2040	89	0.	53.0	675.4	*	20	OCT	1320	189	0.	64.6	676.1	*	21	OCT	0600	289	0.	64.6	676.1
19	OCT	2050	90	0.	53.4	675.5	*	20	OCT	1330	190	0.	64.6	676.1	*	21	OCT	0610	290	0.	64.6	676.1
19	OCT	2100	91	0.	53.8	675.5	*	20	OCT	1340	191	0.	64.6	676.1	*	21	OCT	0620	291	0.	64.6	676.1
19	OCT	2110	92	0.	54.2	675.5	*	20	OCT	1350	192	0.	64.6	676.1	*	21	OCT	0630	292	0.	64.6	676.1
19	OCT	2120	93	0.	54.5	675.5	*	20	OCT	1400	193	0.	64.6	676.1	*	21	OCT	0640	293	0.	64.6	676.1
19	OCT	2130	94	0.	54.9	675.5	*	20	OCT	1410	194	0.	64.6	676.1	*	21	OCT	0650	294	0.	64.6	676.1
19	OCT	2140	95	0.	55.3	675.6	*	20	OCT	1420	195	0.	64.6	676.1	*	21	OCT	0700	295	0.	64.6	676.1
19	OCT	2150	96	0.	55.6	675.6	*	20	OCT	1430	196	0.	64.6	676.1	*	21	OCT	0710	296	0.	64.6	676.1
19	OCT	2200	97	0.	55.8	675.6	*	20	OCT	1440	197	0.	64.6	676.1	*	21	OCT	0720	297	0.	64.6	676.1
19	OCT	2210	98	0.	56.1	675.6	*	20	OCT	1450	198	0.	64.6	676.1	*	21	OCT	0730	298	0.	64.6	676.1
19	OCT	2220	99	0.	56.3	675.6	*	20	OCT	1500	199	0.	64.6	676.1	*	21	OCT	0740	299	0.	64.6	676.1
19	OCT	2230	100	0.	56.5	675.6	*	20	OCT	1510	200	0.	64.6	676.1	*	21	OCT	0750	300	0.	64.6	676.1
							*								*							

****

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	49.83-HR
+ (CFS)	(HR)					
		(CFS)				
+ 0.	.00		0.	0.	0.	0.
		(INCHES)	.000	.000	.000	.000
		(AC-FT)	0.	0.	0.	0.

```
 PEAK STORAGE   TIME                        MAXIMUM AVERAGE STORAGE
                                       6-HR       24-HR       72-HR     49.83-HR
+  (AC-FT)      (HR)
       65.     25.17                    65.         65.         48.          48.

  PEAK STAGE    TIME                        MAXIMUM AVERAGE STAGE
                                       6-HR       24-HR       72-HR     49.83-HR
+   (FEET)      (HR)
    676.13     25.17                 676.13      676.13      674.68       674.68

                        CUMULATIVE AREA =     .21 SQ MI

1
                                                          RUNOFF SUMMARY
                                                     FLOW IN CUBIC FEET PER SECOND
                                                   TIME IN HOURS,  AREA IN SQUARE MILES

                                       PEAK   TIME OF     AVERAGE FLOW FOR MAXIMUM PERIOD      BASIN     MAXIMUM     TIME OF
          OPERATION       STATION      FLOW     PEAK                                          AREA      STAGE     MAX STAGE
+                                                                 6-HOUR     24-HOUR     72-HOUR

          HYDROGRAPH AT
+                           SUB1        331.   11.67          65.         21.         10.        .14

          HYDROGRAPH AT
+                           SUB2        223.   11.50          35.         12.          6.        .07

          2 COMBINED AT
+                           COMB1       521.   11.50          99.         33.         16.        .21

          ROUTED TO
+                            RES1         0.     .00           0.          0.          0.        .21
+                                                                                                 676.13       25.17


 *** NORMAL END OF HEC-1 ***
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CONFIDENTIAL BUSINESS INFORMATION

Interstate Power and Light
Ottumwa Power Generating Station

Ash Pond 1 and 2
Slope Stability Report

B&V Project 169664
B&V File No. 41.0401

October 22, 2010
Revision 0

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1.0 Introduction

This report presents the site conditions, subsurface conditions, and slope stability evaluation for the Interstate Power and Light – Ottumwa Generating Station's ash ponds. The ash ponds include a settling pond (Ash Pond 1) and a zero discharge pond (Ash Pond 2). Current survey information for the ponds was provided by Hard Hat Services in a 2006 report. Geotechnical information for the generation station was provided by Atec Associates in a 1975 report.

The purpose of the slope stability evaluation was to determine the factor of safety and critical slip surface for each pond for varying stability conditions, including long-term, rapid drawdown, and seismic. The computer modeling program Slope/w was used for the slope stability analysis.

This report presents the general site conditions, including the preconstruction, post construction, and 2006 contour data for the ash ponds. Also included is the geotechnical data for the in-situ soil conditions or berm foundation conditions, berm fill material and ash stability properties, and seismic conditions. The slope stability evaluation is included with the factor of safety and critical slip surface, along with recommendations based on the slope stability evaluation.

1.1 Limitations

The data, analysis, conclusions, and recommendations in this report were based on site conditions existing at the time of the investigations and on the assumption that the information obtained from the investigations is representative of the subsurface conditions throughout the site. Unanticipated conditions may be encountered during construction because of variations that were not detected during the investigation program. The construction process may also alter ground conditions. Therefore, experienced geotechnical engineering personnel are required to observe and document the conditions encountered and ensure that proper construction procedures are used. If, during construction, conditions differ as a result of natural or manmade causes, this report should be reviewed by qualified geotechnical engineers to determine the applicability of the conclusions and recommendations concerning the differences in conditions.

This report was prepared solely for the benefit of Alliant Energy ("Client") by Black & Veatch Corporation ("B&V") under the terms and conditions of the Engineering Services Agreement made effective 14th day of February, 2008 (Client Contract 32589) between Client and B&V ("the Agreement") and is based on information not within the control of the Client or B&V. Neither the Client nor B&V has made an analysis, verified data, or rendered an independent judgment of the validity of the information provided by

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2.0 Executive Summary

The Ottumwa Generating Station contains an ash settling and an ash zero discharge pond positioned east of the generation area. This report provides the slope stability evaluation for the containment berms under long-term, rapid drawdown, and seismic conditions. For all these conditions, the factor of safety for slope stability exceeds 1.5.

3.0 Site Conditions

3.1 Site Location

The Ottumwa Generating Station is located in northwestern Wapello County, Iowa, approximately 1.5 miles northwest of Chillicothe, Iowa. The station is located west of the Des Moines River, and the surrounding area includes wildlife areas and agricultural land.

3.2 Site Description

The Ottumwa Generating Station is a coal fired facility with a nominal generation capacity of 675 megawatts. The coal yard is positioned north of the generation area, and the ash ponds are positioned east of the generation area.

The ash ponds include Ash Pond 1, which is defined as a settling pond, and Ash Pond 2, which is defined as a zero discharge pond. The ash ponds are adjacent to the Des Moines River and separated by a coal railway spur berm with Ash Pond 1 to the south and Ash Pond 2 to the north. Ash Pond 1 consists of four discharge points from the generation facility into the pond: 1) a 42 inch plant drain line discharge, 2) a 12 inch chemical drain line discharge, 3) a bottom ash trench discharge, and 4) an economizer ash discharge; all of which are located on the west side of the pond. Ash Pond 1 also consists of a National Pollutant Discharge Elimination system (NPDES) outfall located on the east side of the pond. Ash Pond 2 has no discharge points or outfall locations. Figure 3-1, provided from Reference 2, shows the location of the generation area, ponds, and discharge/outfall locations.

3.3 Site Contour Description

The original and grading site contour information was provided by drawings S1001 through S1005 dated February and March 1982, References 1 through 5. Ash pond bathymetry survey contours were provided in the Pond Maintenance Plan produced in 2006, Reference 6.

The site area is subdivided into higher and lower ground areas. The generation area, coal storage area, substation area, and the Burlington Northern Railway along the southern part of the site area are located within the higher ground areas. The ash ponds are located within the lower ground areas; the Avery Creek, which runs from the southwest to the northeast into the Des Moines River, is the lowest point across the site.

3.3.1 Ash Pond 1

The grading plan as provided in 1982 for Ash Pond 1 indicated that the pond area ranged in bottom elevation from 656 to 682 feet, with a note that the maximum depth of the borrow excavation was at an elevation of 670 feet. The grading plan also indicated the trench for the 42 and 12 inch discharge lines located in the northwest corner of Ash Pond 1 reached a bottom elevation of 658 feet.

The 2006 Pond Maintenance Plan indicated that the pond area ranged in bottom elevation from 662 to 680 feet, with the depth of ash material ranging from 2 to 13 feet across the pond area. The 2006 data indicated that the ash level at the discharge trench was 671 feet, indicating depth of ash material to be 13 feet.

3.3.2 Ash Pond 2

The 1982 grading plan for Ash Pond 2 indicated that the pond area ranged in bottom elevation from 654 to 680 feet, with no specific grading work within this pond area. As indicated above, this pond has no discharge or outfall points.

The 2006 Pond Maintenance Plan as indicated that the pond area ranged in bottom elevation from 659 to 670 feet, with the depth of ash material ranging from 2 to 9 feet across the pond area. The 2006 data indicated that a “separation” berm was constructed dividing Ash Pond 2 into two equal halves with a top elevation of 668 feet.

4.0 Subsurface Conditions

4.1 Local Geology

The regional geology for the area lies within the extensive physiographic province known as the Central Lowlands and Plains, which comprises the large central region of the United States between the Appalachian Mountains to the east and the Great Plains to the west. The site is located in the subsection known as the Dissected Loess and Till Plain.

The site area bedrock along the Des Moines River consists of older Mississippian shale, sandstone, and limestone units. Some of the limestone are shaly and contain limited chert. The bedrock units are nearly horizontal in the area.

The soil or unconsolidated material overlying the bedrock generally consists of loess soil overlying glacial till and weathered material from the parent rock. The soil is generally thinner near the Des Moines River and increases in thickness moving toward the uplands.

4.2 Groundwater Conditions

The groundwater conditions identified in 1976 were determined from eleven piezometers installed across the site area. The piezometer (boring 40) located immediately east of the Ash Pond 2 berm (lower ground area) indicated a groundwater elevation of 639 feet and a ground surface elevation of 650 feet. The groundwater in the lower ground area is primarily influenced by the water level in the Des Moines River and Avery Creek.

All of the other piezometers were located in the generation area or along the perimeter of the upper ground area. The piezometers along the perimeter of the upper ground area indicated an approximate groundwater elevation of 660 feet and an average ground surface elevation of 674 feet. The piezometers within the generation area were either dry at the highest ground surface elevations or indicated a deeper groundwater elevation of 654 feet. The groundwater elevation in the higher ground area is primarily influenced by the presence or absence of sand layers overlying the bedrock.

4.3 Ash Pond 1 Specific Subsurface Conditions

The Ash Pond 1 specific subsurface profile was generated from the borings provided in the 1976 geotechnical investigation report. Specific borings within the Ash Pond 1 area include borings 7, 20, 48, and 50. Borings 7 and 20 are located within the pond area and borings 48 and 50 are located near or beneath the constructed berm. The general subsurface conditions consist of unconsolidated material overlying bedrock with

bedrock at a higher elevation in borings 7 and 20 than in borings 48 and 50, which are located closer to the Des Moines River and Avery Creek. The specific soil and bedrock units are described in the following subsections. The plan of borings and boring logs are provided in Appendix A.

4.3.1 Stiff Clay

The surficial soil layer consists of low to high plasticity clay with a medium to stiff consistency. Standard Penetration Test (SPT) N-values ranged from 9 to 28 blows per foot (bpf). The low plasticity clay consists of material with a liquid limit between 35 and 50 percent; the high plasticity clay consists of material with a liquid limit between 50 and 60 percent. Triaxial testing consisting of unconsolidated-undrained and consolidated-undrained methods were completed for undisturbed clay samples of material similar to the borings described above and were used to develop the undrained and drained soil strength properties for the slope stability analysis.

4.3.2 Soft Clay/Loose Sand

Beneath the stiff clay material, a layer of soft clay and/or loose sand was identified from the borings above. Boring 20 identified only the loose sand material, while borings 48 and 50, which were located closer to the Des Moines River and Avery Creek, encountered both the soft clay and loose sand material.

The soft clay material is described as having a low to high plasticity, similar to the stiff clay characteristics, with N-values ranging from 4 to 6 bpf. Only one unconsolidated-undrained triaxial test was completed in this soil unit, and it is considered representative of the soft clay shear strength.

The loose sand material is described as poorly graded and containing some fines (silt and clay) ranging from 5 to 50 percent. SPT N-values ranged from 2 to 10 bpf.

4.3.3 Bedrock

The bedrock encountered in the above borings included units of weathered limestone that were drillable with auger equipment, limestone with low rock quality designation (RQD) values of 30 to 40 percent, sandstone with low RQD values of 0 to 40 percent, and limestone with high RQD values of 90 to 95 percent. Rock coring was completed 10 to 20 feet into the bedrock unit in the above borings. Unconfined compression tests were performed on core samples across the site. The unconfined compression values for the limestone bedrock samples ranged from 6,550 to 19,150 pounds per square inch (psi) and from 1,070 to 16,970 psi for the sandstone samples.

4.4 Ash Pond 2 Specific Subsurface Conditions

The Ash Pond 2 specific subsurface profile was generated from the borings provided in the 1976 geotechnical investigation report. Specific borings within the Ash Pond 2 area include borings 39, 40, and 44. Boring 40 is located within the pond area and borings 39 and 44 are located near or beneath the constructed berm. The general subsurface conditions consist of unconsolidated material overlying bedrock, with bedrock at a higher elevation in boring 40 than in borings 39 and 44, which are located closer to the Des Moines River. The specific soil and bedrock units are described in the following subsections. The plan of borings and boring logs are provided in Appendix A.

4.4.1 Stiff Clay

The surfical soil layer consists of low to high plasticity clay with a medium to stiff consistency. SPT N-values ranged from 7 to 23 bpf. The low plasticity clay consists of material with a liquid limit between 35 and 50 percent; the high plasticity clay consists of material with a liquid limit between 50 and 60 percent. Triaxial testing consisting of unconsolidated-undrained and consolidated-undrained methods were completed for undisturbed clay samples of material similar to the borings described above and were used to develop the undrained and drained soil strength properties for the slope stability analysis.

4.4.2 Soft Clay/Loose Sand

Beneath the stiff clay material a layer of soft clay and/or loose sand was identified from the borings above. Boring 40 identified only the loose sand material, while borings 39 and 44 encountered both the soft clay and loose sand material.

The soft clay material is described as having a low to high plasticity, similar to the stiff clay characteristics, with N-values ranging from 3 to 5 bpf. Only one unconsolidated-undrained triaxial test was completed in this soil unit, and it is considered representative of the soft clay shear strength.

The loose sand material is described as well to poorly graded and containing some fines (silt and clay) ranging from 5 to 50 percent. SPT N-values ranged from 3 to 19 bpf.

4.4.3 Bedrock

The bedrock encountered in the above borings included units of weathered limestone that were drillable with auger equipment and either limestone or sandstone identified by auger refusal. Rock coring was not completed in any of the above borings. Unconfined compression tests were performed on core samples across the site, and the unconfined compression values for the limestone bedrock ranged from 6,550 to 19,150 pounds per square inch (psi) and from 1,070 to 16,970 psi for the sandstone samples.

4.5 Compacted Ash Pond Berm Characteristics

Geotechnical investigation work for the ash pond berms are not within the scope of this report, and the analyses in this report are based on the material descriptions provided in the 1976 borings and the earthwork specification. The specification (Reference 8) embankment material was specified as low plasticity clay or silt (CL or ML) material compacted at 95 percent maximum dry density using the Standard Proctor laboratory compaction test. The strength characteristics are based on the laboratory testing on compacted clay material and other correlations.

4.6 Ash Characteristics

The ash characteristics that are deposited into the ash ponds consist of bottom ash (15 percent by weight of total ash), economizer fly ash (8.5 percent by weight of total ash), and precipitator fly ash (76.5 percent by weight of total ash). The bottom and economizer ash is deposited into the ash ponds, while the precipitator fly ash is placed in the fly ash storage building for commercial use.

Bottom ash grain size includes gravel composition of 10 percent by weight, sand composition of 80 percent by weight, and fines composition of 10 percent by weight. Maximum and minimum relative density is reported as 89 and 73 pounds per cubic foot, respectively. No specific composition percentages were provided for the economizer fly ash, but typically ranges from fine grained sand to silt size particles.

4.7 Site Seismic Characteristics

The site seismic characteristics were evaluated based on the borings provided in the 1976 geotechnical investigation report and the United States Geologic Service seismic hazard program.

The site class for seismic design, based on the 2006 International Building Code, was determined to by Site Class D. The site class was determined from correlation between N-values and shear wave velocity, and then the correlated shear wave velocity was used to define the site class.

The peak ground acceleration was determined based on the design spectrum generated from the United States Geological Survey (USGS) Java Ground Motion Parameter Calculator program. The Java program enables the determination of the spectral response design spectrum for the mapped maximum considered earthquake using latitude and longitude coordinates. Based on the results, the peak ground acceleration is 0.04g.

5.0 Slope Stability Evaluation

The computer software GeoStudio 2007, modeling program Slope/w, was used to complete the slope stability evaluation. All evaluation conditions were completed using the Morgenstern-Price solution method. The slope stability evaluation consisted of three conditions: 1) long-term, 2) rapid drawdown, and 3) seismic. The long-term stability was completed using the drained design soil properties. The rapid drawdown and seismic stability was completed using undrained design soil properties.

The soil design properties are provided in Table 5-1, and the layering profile is shown in the slope stability plots/results (see Figures).

Table 5-1
Ash Pond 1 - Slope Stability Design Properties

Layer Description	Undrained Properties			Drained Properties		
	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (degrees)	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (degrees)
Stiff Clay	127	1500	0	127	0	32
Soft Clay	95	740	0	95	0	29
Loose Sand	115	0	29	115	0	29
Berm	130	1500	0	130	0	30
Ash	90	0	32	90	0	32

5.1 Ash Pond 1

The location for the Ash Pond 1 slope stability evaluation was based on the original, conformed to construction records, and most current contour data. The location is from the west to the east at the east corner of Ash Pond 1, as shown on Figure 5-1.

Groundwater for the analysis was defined within the loose sand layer based on the data provided in the 1976 geotechnical investigation report. Additionally, on the upstream berm, the level of contained water was defined by data in the 2006 Pond Maintenance Plan.

The initial evaluation work indicated that the critical slip surface was contained within the ash material along the upstream side of the berm slope. Further analysis, including removing the ash material and forcing the slip surface into the berm and foundation soil, resulted in a lower factor of safety. The factor of safety for each condition is provided in Table 5-2.

Table 5-2 Ash Pond 1 - Slope Stability Evaluation Results		
Slope Stability Evaluation Condition	Critical Slip Surface Factor of Safety	Figure Number
Long-Term Stability	1.71	5-2
Rapid Drawdown Stability	2.14	5-3
Seismic Stability	2.57	5-4

5.2 Ash Pond 2

The location for the Ash Pond 2 slope stability evaluation was based on the original, conformed to construction records, and most current contour data. The location is from the west to the east along the south side of the berm for Ash Pond 2, as shown in Figure 5-5.

Groundwater for the analysis was defined at the base of the stiff clay layer based on the data provided in the 1976 geotechnical investigation report. Additionally, on the upstream berm, the level of contained water was defined by data in the 2006 Pond Maintenance Plan.

The initial evaluation work indicated that the critical slip surface was within the ash material along the upstream side of the berm slope. Further analysis, including removing the ash material and forcing the slip surface into the berm and foundation soil, resulted in a lower factor of safety. The factor of safety for each condition is provided in Table 5-3.

Table 5-3 Ash Pond 2 - Slope Stability Evaluation Results		
Slope Stability Evaluation Condition	Critical Slip Surface Factor of Safety	Figure Number
Long-Term Stability	2.14	5-6
Rapid Drawdown Stability	2.41	5-7
Seismic Stability	1.96	5-8

6.0 References

1. Black & Veatch Consulting Engineers, Iowa Southern Utilities Company, Ottumwa Generating Station – Unit 1, B&V Drawing Number S1001, Sitework – Site Area, Original Contour Plan, Revision 2, Conform to Construction Records February 22, 1982.

2. Black & Veatch Consulting Engineers, Iowa Southern Utilities Company, Ottumwa Generating Station – Unit 1, B&V Drawing Number S1002, Sitework – Area A, Grading Plan, Revision 4, Conform to Construction Records, February 22, 1982.

3. Black & Veatch Consulting Engineers, Iowa Southern Utilities Company, Ottumwa Generating Station – Unit 1, B&V Drawing Number S1003, Sitework – Area B, Grading Plan, Revision 4, Conform to Construction Records, February 22, 1982.

4. Black & Veatch Consulting Engineers, Iowa Southern Utilities Company, Ottumwa Generating Station – Unit 1, B&V Drawing Number S1004, Sitework – Area C, Grading Plan, Revision 5, Conform to Construction Records, February 22, 1982.

5. Black & Veatch Consulting Engineers, Iowa Southern Utilities Company, Ottumwa Generating Station – Unit 1, B&V Drawing Number S1005, Sitework – Area D, Grading Plan, Revision 4, Conform to Construction Records, March 30, 1982.

6. Hard Hat Services, Settling Pond Maintenance Plan, Ottumwa Generating Station, Ottumwa, Iowa, Prepared for Alliant Energy, October 2006, Revision 0.

7. Atec Associates, Geotechnical Investigation, Iowa Southern Utilities, Ottumwa Generating Station – Unit 1, Chillicothe, Iowa, Prepared for Black & Veatch, March 31, 1976.

8. Iowa Southern Utilities Company, Ottumwa Generating Station – Unit 1, Section 2B – Earthwork Specification, January 8, 1976.

Figures

CONFIDENTIAL BUSINESS INFORMATION

INTERSTATE POWER AND LIGHT - OTTUMWA GENERATING STATION
ASH POND 1 AND 2 - SLOPE STABILITY REPORT
FIGURE 3-1 (REFERENCE 6)

August 2005 aerial photo taken from the
Iowa State University Information System Support and Resource Facility website.

HARD HAT SERVICES™
Engineering, Construction and Management Solutions

INTERSTATE POWER & LIGHT OTTUMWA GENERATING STATION	FIGURE 1
FACILITY LAYOUT	DATE: OCT 2006

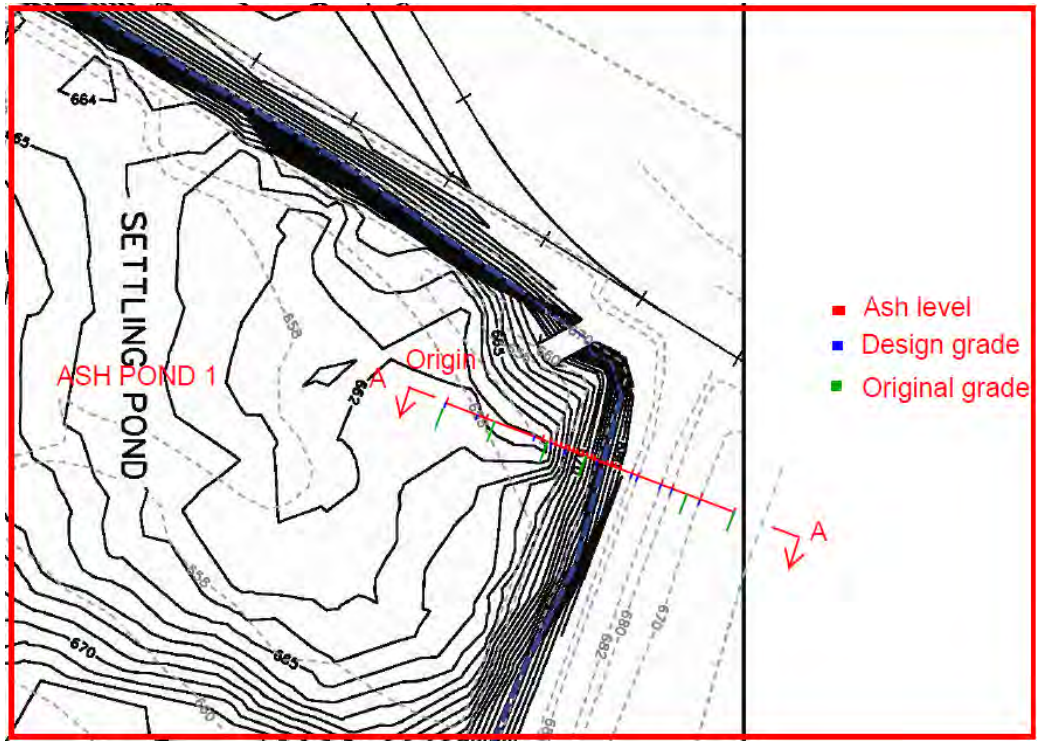


Figure 5-1
Ash Pond 1 – Slope Stability Cross Section Location

Title: 169664-AE_Ottumwa Ash Pond Stability (Pond 1 A-A)-Long term
Method: Morgenstern-Price
PWP Conditions Source: Piezometric Line
Use Staged Rapid Drawdown: No
Direction of movement: Right to Left
Slip Surface Option: Auto-Search

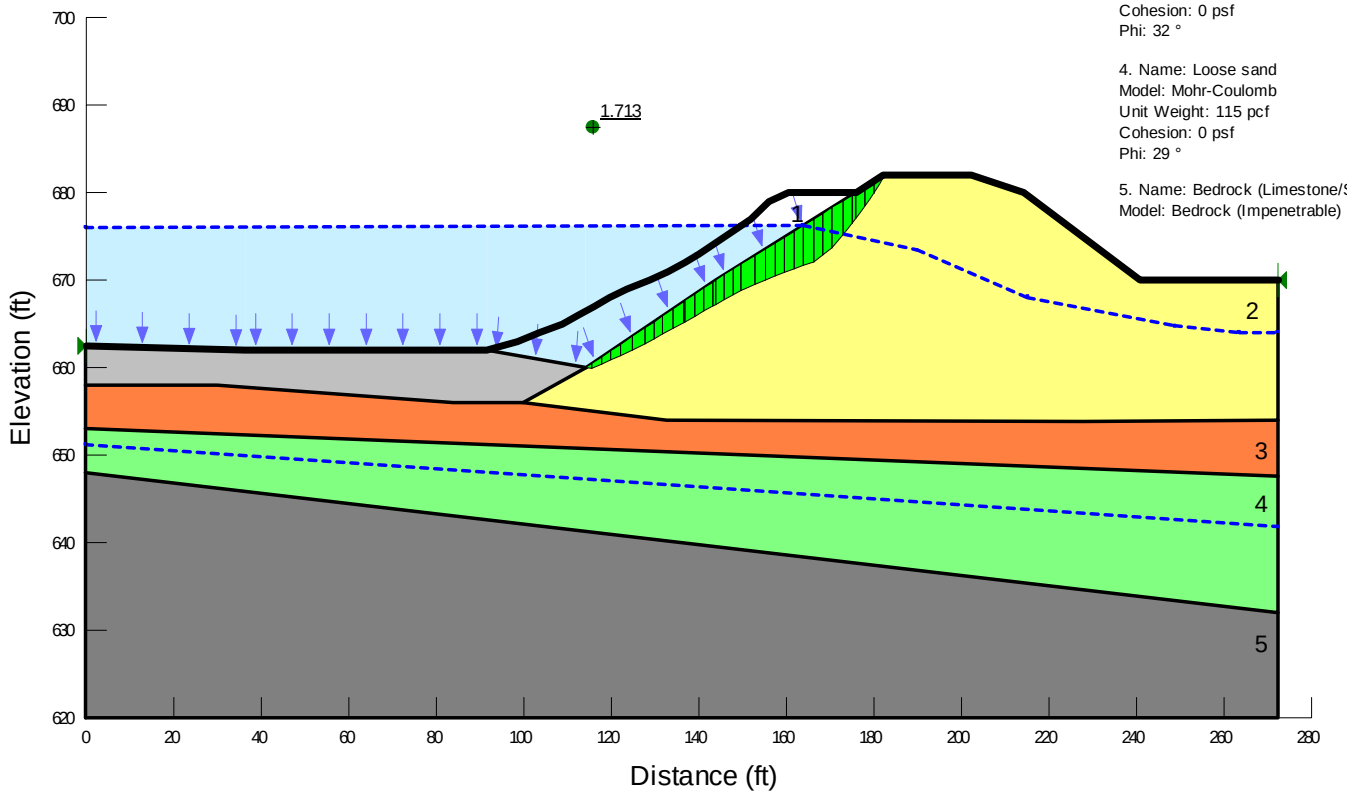
1. Name: Ash mixture
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 0 psf
Phi: 32 °

2. Name: Compacted fill
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 0 psf
Phi: 30 °

3. Name: Stiff Clay
Model: Mohr-Coulomb
Unit Weight: 127 pcf
Cohesion: 0 psf
Phi: 32 °

4. Name: Loose sand
Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion: 0 psf
Phi: 29 °

5. Name: Bedrock (Limestone/Sandstone)
Model: Bedrock (Impenetrable)



Scale: H:V = 2:1

Figure 5-2
Ash Pond 1 – Long-Term Stability Evaluation Results

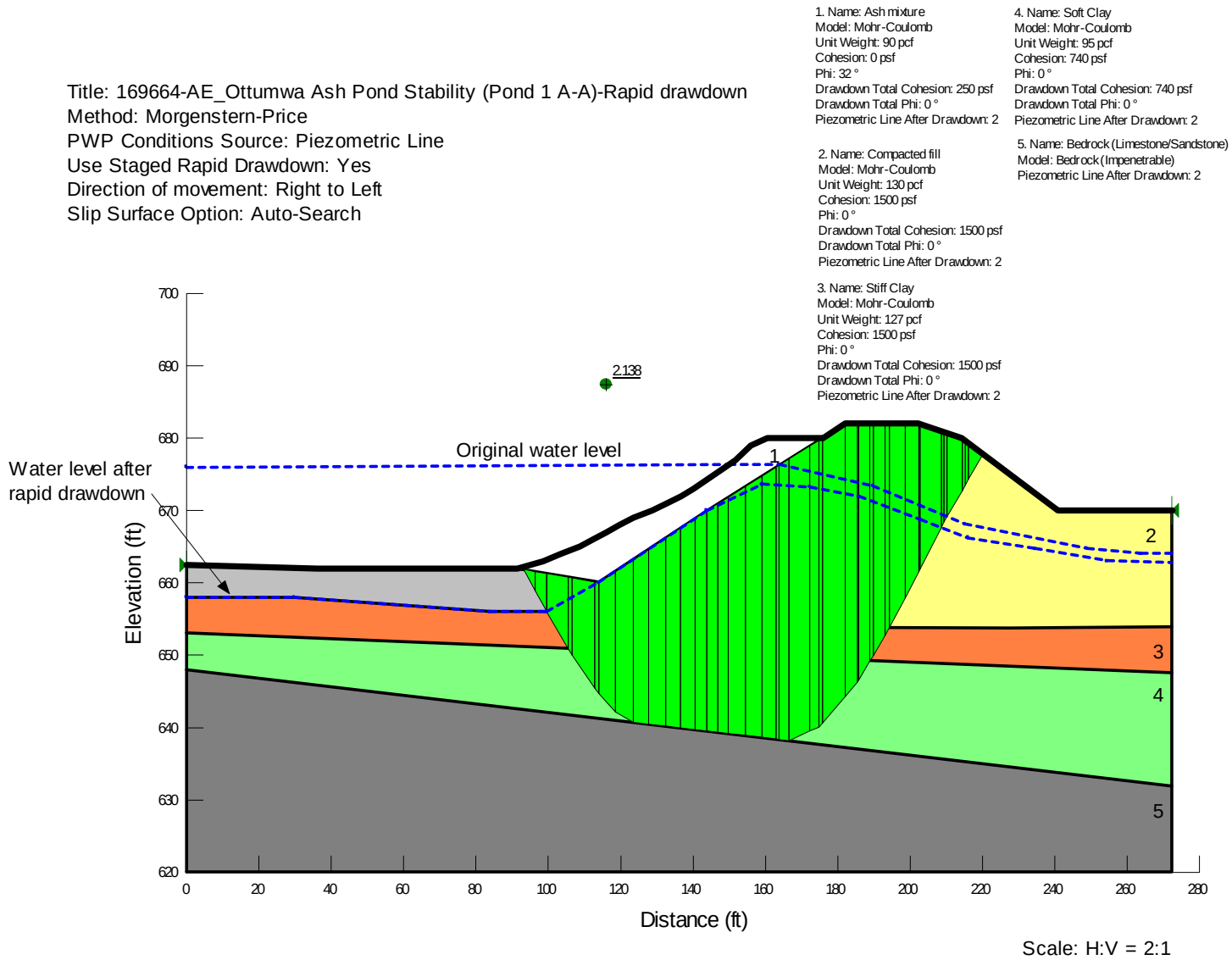
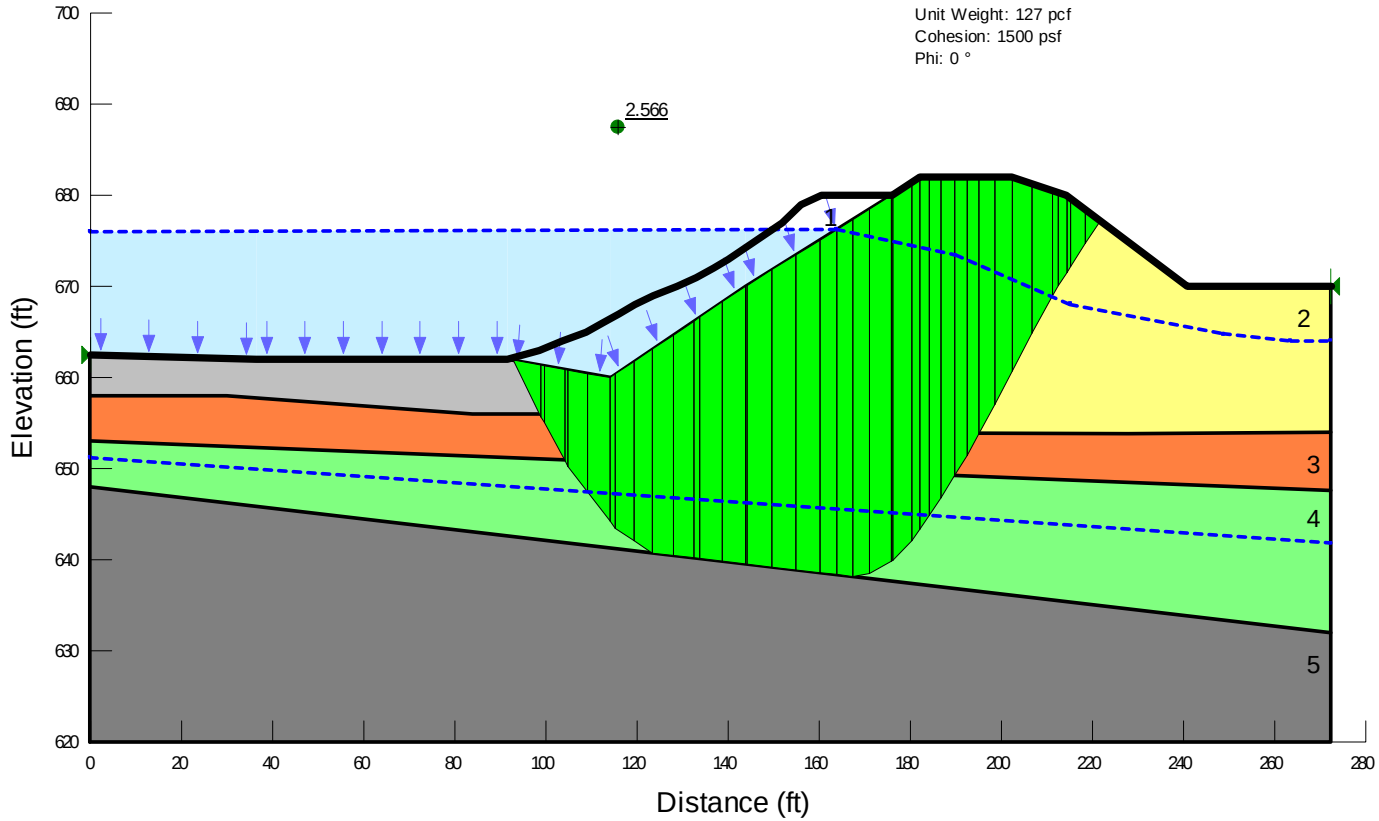


Figure 5-3

Ash Pond 1 – Rapid Drawdown Stability Evaluation Results

Title: 169664-AE_Ottumwa Ash Pond Stability (Pond 1 A-A)-Seismic
Method: Morgenstern-Price
PWP Conditions Source: Piezometric Line
Use Staged Rapid Drawdown: No
Direction of movement: Right to Left
Slip Surface Option: Auto-Search
Horz Seismic Load: 0.04

1. Name: Ash mixture
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 250 psf
Phi: 0 °
2. Name: Compacted fill
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 1500 psf
Phi: 0 °
3. Name: Stiff Clay
Model: Mohr-Coulomb
Unit Weight: 127 pcf
Cohesion: 1500 psf
Phi: 0 °
4. Name: Soft Clay
Model: Mohr-Coulomb
Unit Weight: 95 pcf
Cohesion: 740 psf
Phi: 0 °
5. Name: Bedrock (Limestone/Sandstone)
Model: Bedrock (Impenetrable)



Scale: H:V = 2:1

Figure 5-4
Ash Pond 1 – Seismic Stability Evaluation Results

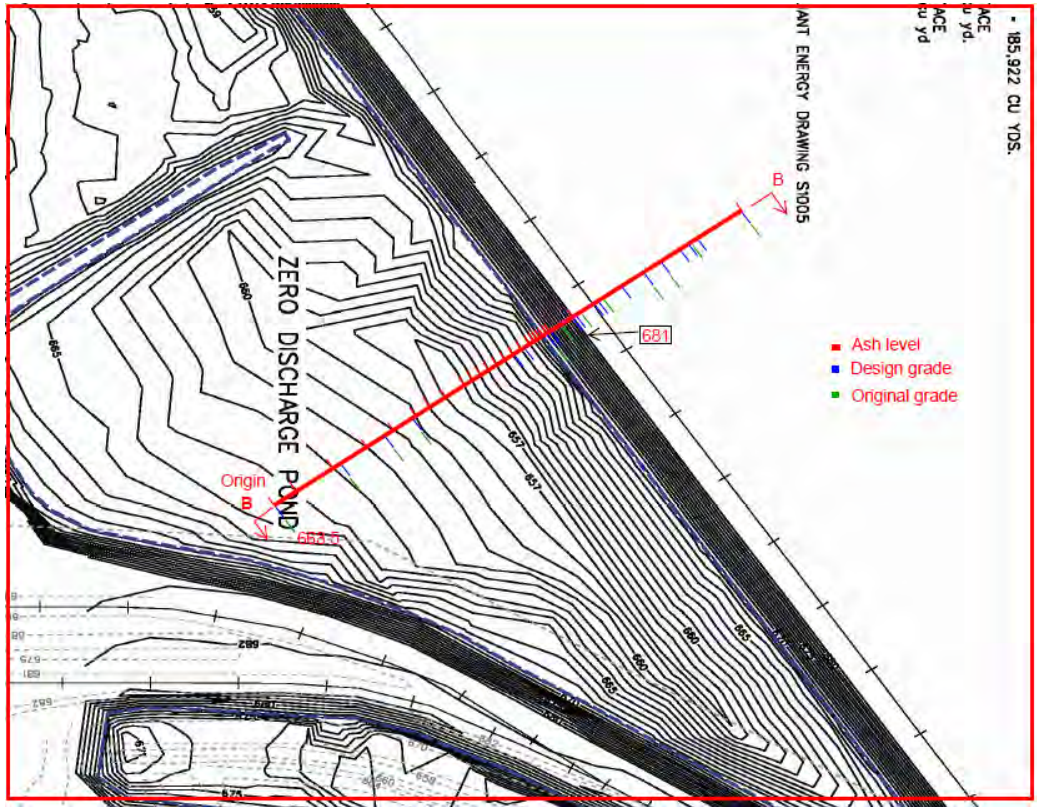
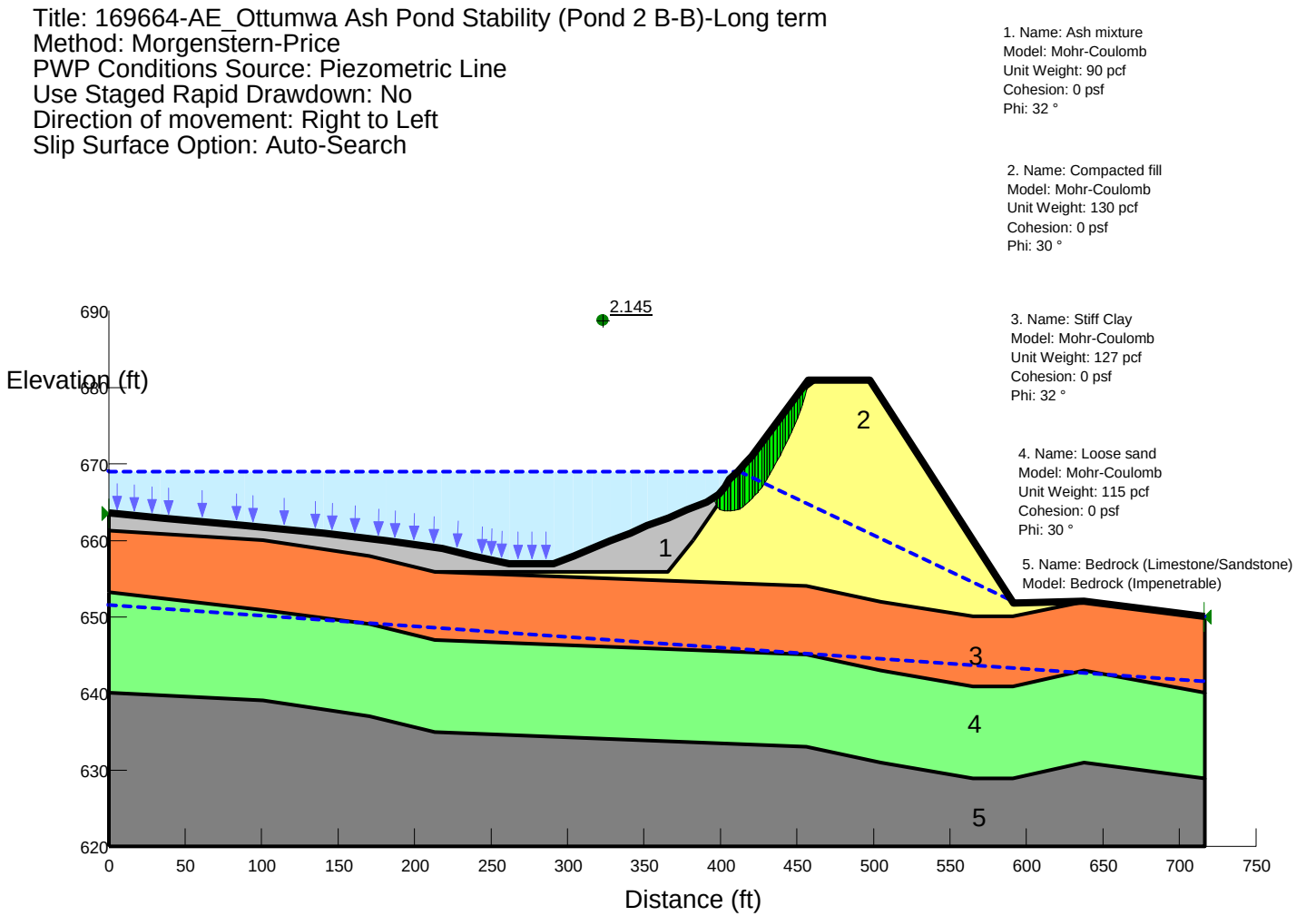


Figure 5-5
Ash Pond 2 – Slope Stability Cross Section Location



Scale: H:V = 5:1

Figure 5-6

Ash Pond 2 – Long-Term Stability Evaluation Results

Title: 169664-AE_Ottumwa Ash Pond Stability (Pond 2 B-B)-Rapid drawdown
Method: Morgenstern-Price
PWP Conditions Source: Piezometric Line
Use Staged Rapid Drawdown: Yes
Direction of movement: Right to Left
Slip Surface Option: Auto-Search

1. Name: Ash mixture
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 0 psf
Phi: 32 °
Drawdown Total Cohesion: 250 psf
Drawdown Total Phi: 0 °
Piezometric Line After Drawdown: 2
Drawdown Total Cohesion: 250 psf
Drawdown Total Phi: 0 °
Piezometric Line After Drawdown: 2

2. Name: Compacted fill
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 1500 psf
Phi: 0 °
Phi-B: 0 °
Drawdown Total Cohesion: 1500 psf
Drawdown Total Phi: 0 °
Piezometric Line: 1
Piezometric Line After Drawdown: 2
Drawdown Total Cohesion: 1500 psf
Drawdown Total Phi: 0 °
Piezometric Line After Drawdown: 2

3. Name: Stiff Clay
Model: Mohr-Coulomb
Unit Weight: 127 pcf
Cohesion: 1350 psf
Phi: 0 °
Phi-B: 0 °
Drawdown Total Cohesion: 1350 psf
Drawdown Total Phi: 0 °
Piezometric Line: 1
Piezometric Line After Drawdown: 2
Drawdown Total Cohesion: 1350 psf
Drawdown Total Phi: 0 °
Piezometric Line After Drawdown: 2

4. Name: Soft Clay
Model: Mohr-Coulomb
Unit Weight: 95 pcf
Cohesion: 740 psf
Phi: 0 °
Phi-B: 0 °
Drawdown Total Cohesion: 740 psf
Drawdown Total Phi: 0 °
Piezometric Line: 1
Piezometric Line After Drawdown: 2
Drawdown Total Cohesion: 740 psf
Drawdown Total Phi: 0 °
Piezometric Line After Drawdown: 2

5. Name: Bedrock (Limestone/Sandstone
Model: Bedrock (Impenetrable)
Piezometric Line: 1
Piezometric Line After Drawdown: 2
Piezometric Line After Drawdown: 2

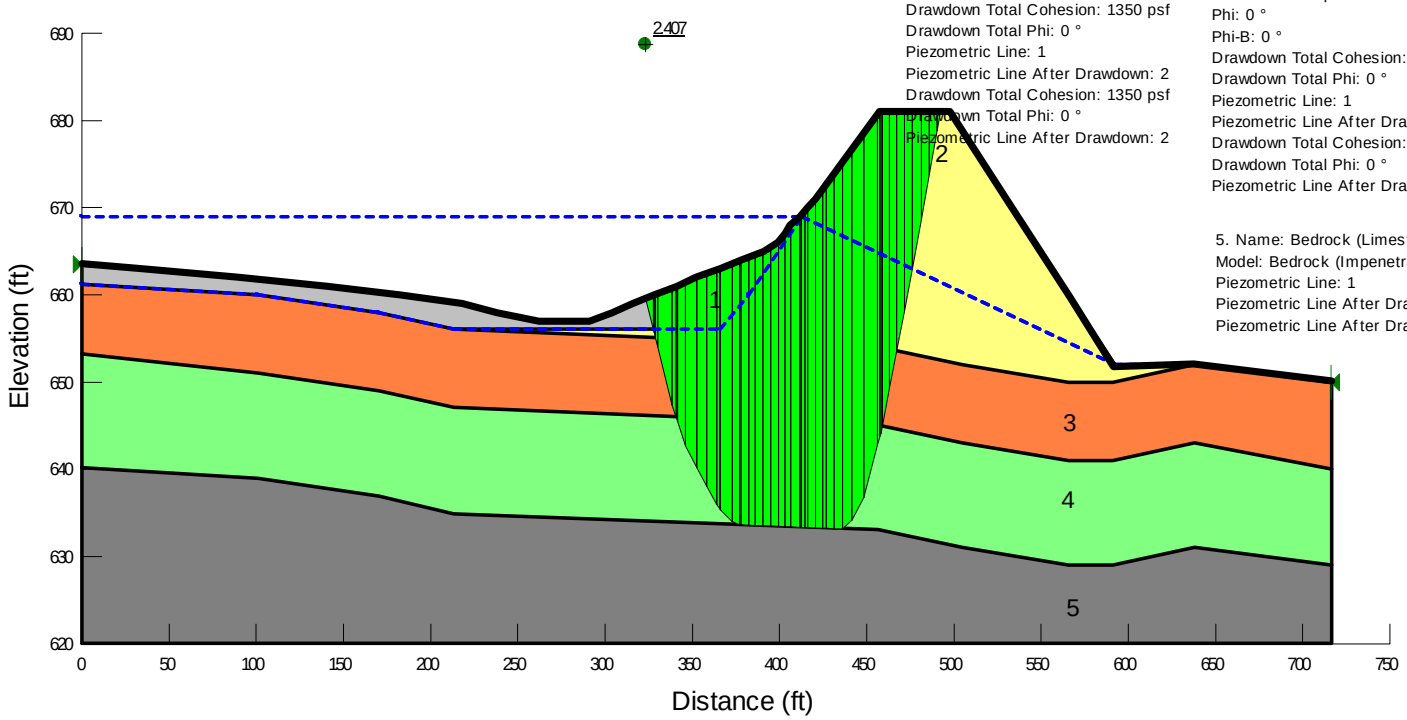


Figure 5-7

Ash Pond 2 – Rapid Drawdown Stability Evaluation Results

Scale: H:V = 5:1

Title: 169664-AE_Ottumwa Ash Pond Stability (Pond 2 B-B)-Seismic
Method: Morgenstern-Price
PWP Conditions Source: Piezometric Line
Use Staged Rapid Drawdown: No
Direction of movement: Right to Left
Slip Surface Option: Auto-Search

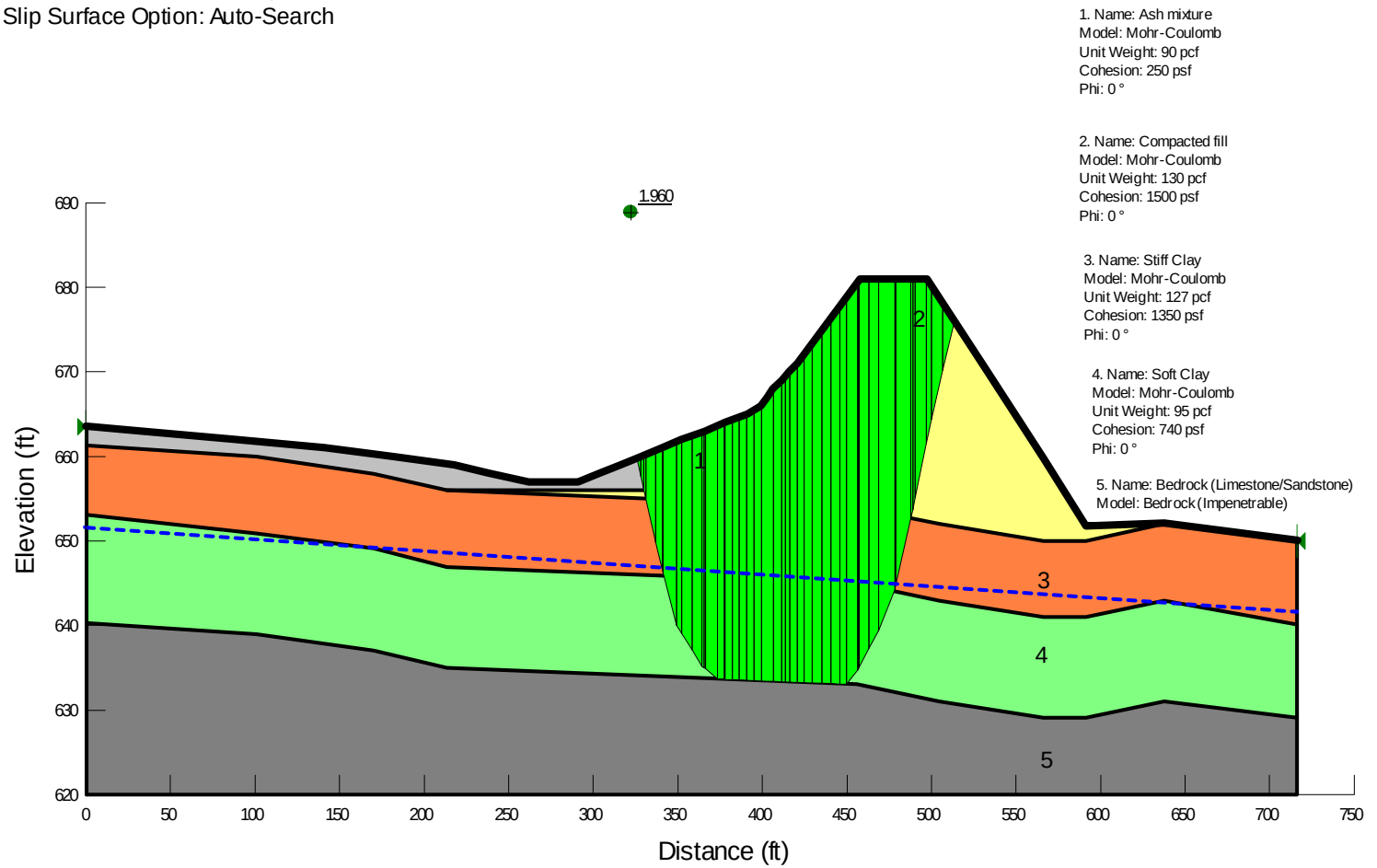


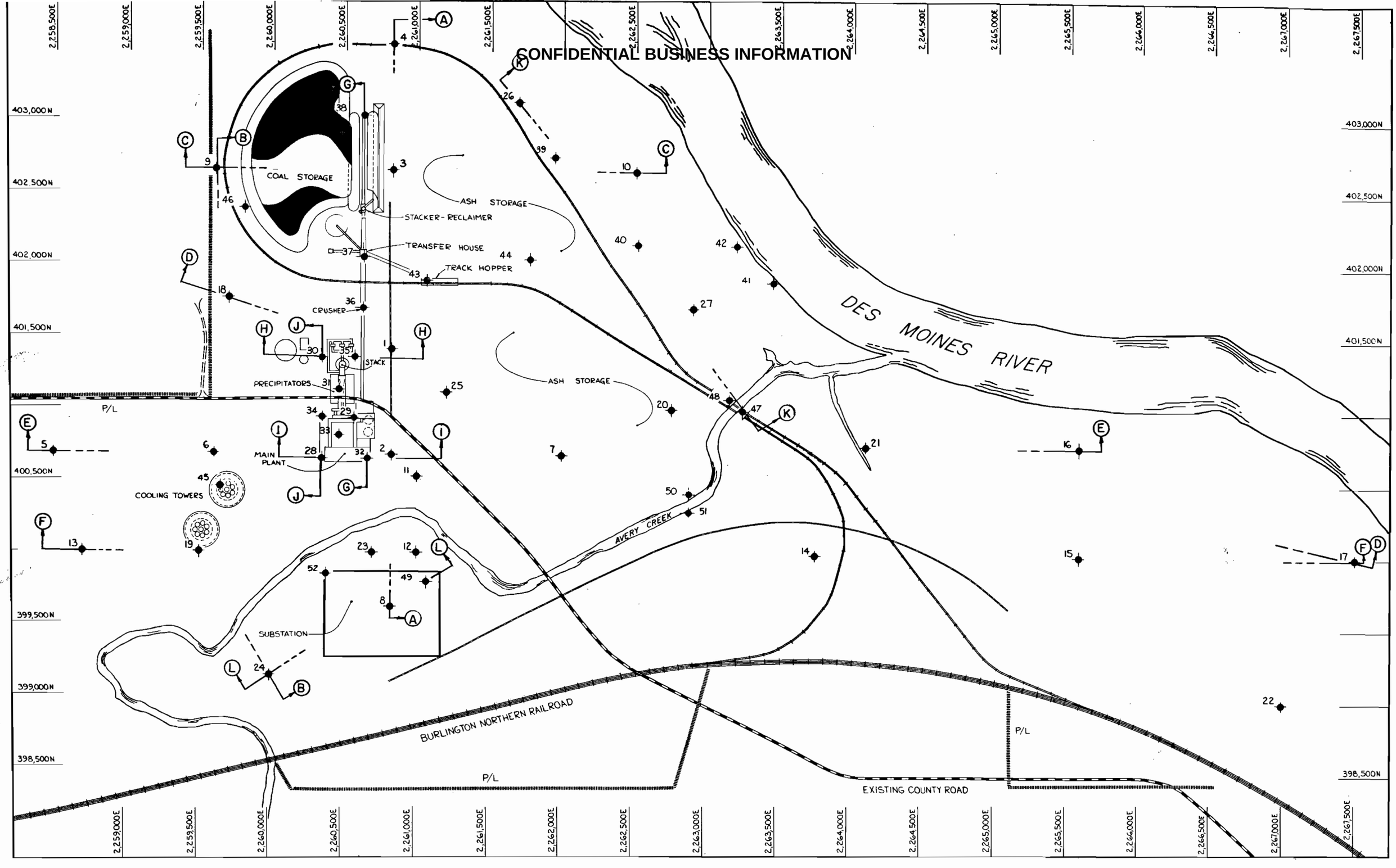
Figure 5-8

Scale: H:V = 5:1

Ash Pond 2 – Seismic Stability Evaluation Results

Appendix A
Plan of Borings and Boring Logs from Reference 7

CONFIDENTIAL BUSINESS INFORMATION



ATEC ASSOCIATES

SCALE 1 INCH=600 FEET

0 500 1000 1500

FEET

PLAN OF BORINGS

OTTUMWA GENERATING STATION-UNIT 1

CHILLICOTHE, IOWA FIGURE 2

LOG OF BORING NO. 7

CONFIDENTIAL BUSINESS INFORMATION

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 5-30-75 LOCATION: N 400,675 E 2,262,000

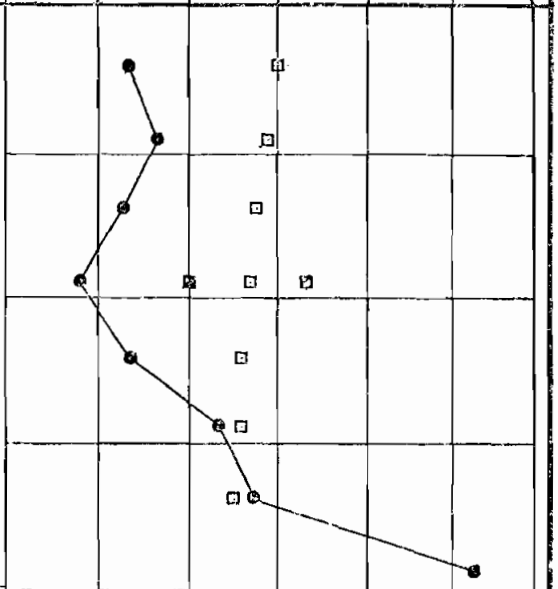
SURFACE ELEVATION-- 676

DEPTH SCALE, FT.	Description	STRATUM DEPTH FT.	SAMPLE DEPTH	BLOWS/6 in. 3—6 in. INCREMENTS	RECOVERY, %
	Dark Brown moist stiff SILTY CLAY (CL)	2.5		4 6/7	25
	Brown moist stiff SILTY CLAY (CL)			6 7/9	25
5				3 5/7	100
				3 3/5	90
10	-medium stiff			3 5/8	100
				7 11/12	90
15	-very stiff				
	-very stiff	18.0		6 9/18	100
	Brown very moist soft SILTY CLAY (CL) w/trace Sand	19.0		3 2/50	100
20	Brown wet soft SANDY CLAYEY SILT (ML)	20.3		RC 1 RQD 18	96
25	Gray fine grained LIMESTONE w/ several partings and Glauconitic Clay seams with Limestone rock fragments	28.7		RC 2 RQD 21	66
30	Gray SANDY LIMESTONE	30.3		RC 3 RQD 42	76
	Gray LIMEY SANDSTONE	34.5			
35	Gray fine to medium grained friable Quartz SANDSTONE with partially filled vugs			RC 4 RQD 38	100
40				RC 5 RQD 20	92
45		48.5			

STANDARD PENETRATION

⊗ Unconfined Compressive Strength, TSF (1, 2, 3, 4, 5)
○ Natural Dry Density, PCF (90, 100, 110, 120, 130)
□ Water Content, % ◪ Plast. Lim., % ◩ Liq. Lim., % (10, 20, 30, 40, 50)
● Standard Penetration, Blows/Ft. (10, 20, 30, 40, 50)

SHELBY TUBE



COMPLETION DEPTH: (cont'd on next page)
ROCK CORE DIAMETER: 2 1/8"

GROUND WATER: NOTED ON RODS FT. AT COMPLETION FT. AFTER HRS. FT.

CONFIDENTIAL BUSINESS INFORMATION

LOG OF BORING NO. 7 (cont'd)

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 5-30-75 LOCATION: N 400,675 E 2,262,000

DEPTH SCALE, FT.	SURFACE ELEVATION—	STRATUM DEPTH FT.	SAMPLE DEPTH	STANDARD PENETRATION BLOWS/6 in. 3-6 in. INCREMENTS	RECOVERY, %	⊗ Unconfined Compressive Strength, TSF (1 2 3 4 5) ○ Natural Dry Density, PCF (90 100 110 120 130) □ Water Content, % ◪ Plast. Lim., % ◩ Liq. Lim., % (10 20 30 40 50) ⊕ Standard Penetration, Blows/Ft. (10 20 30 40 50)	SHELBY TUBE
	Gray fine grained LIMESTONE with Stylolites			RC 6			
	-irregular clay fillings 48.5 to 49.5'			RQD 56	97		
55	-chert nodules at 52.0, 52.3 and 59.5'						
	-lenses of shale at 55.0 and 55.9'						
60		60.3					
	Note: Piezometer installed at 20.0'						
65							

COMPLETION DEPTH: 60.3'

ROCK CORE DIAMETER: 2 1/8"

GROUND WATER: NOTED ON RODS FT. AT COMPLETION FT. AFTER HRS. FT.

CONFIDENTIAL BUSINESS INFORMATION

LOG OF BORING NO. 1

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 6-13-75 LOCATION: N 401,000 E 2,262,750

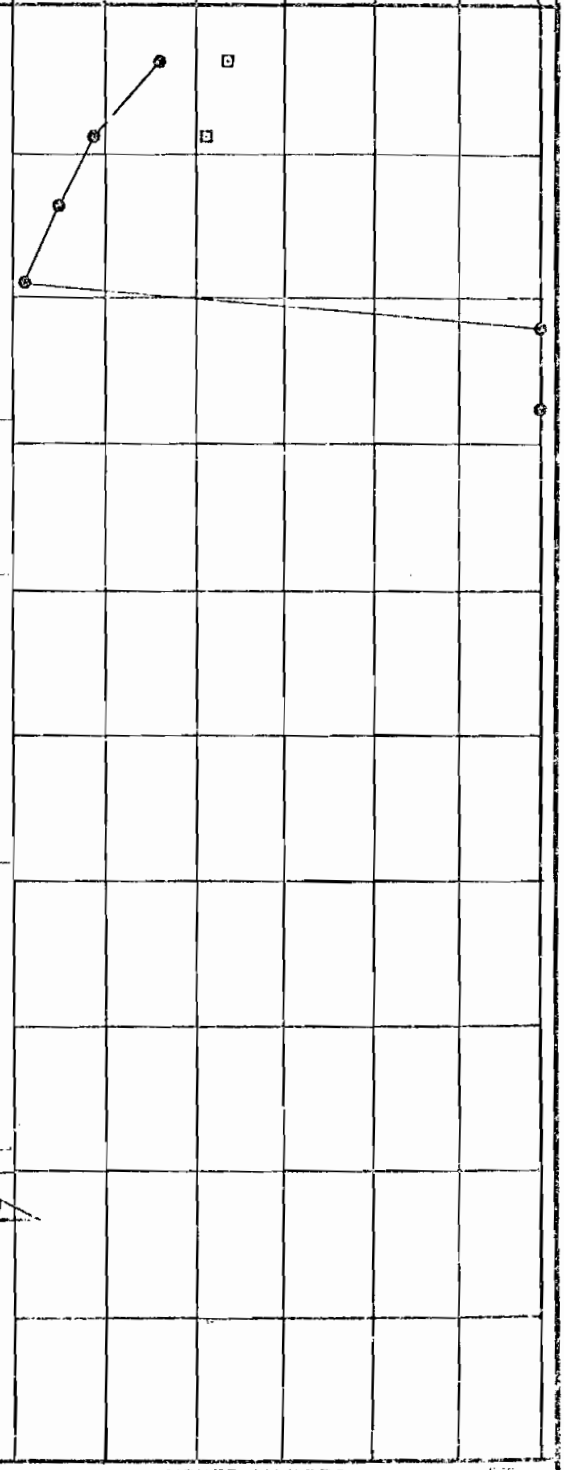
SURFACE ELEVATION— 658

DEPTH SCALE, FT.		STRATUM DEPTH FT.	SAMPLE DEPTH	BLOWS/6 in. 3—6 in. INCREMENTS	RECOVERY, %
	Brown moist very stiff SILTY CLAY (CL)			6 7/9	50
	-medium stiff	5.5		5 5/4	10
5	Brown wet loose fine to medium SAND (SP-SM) with trace Silt	10.5		2 2/3 2 1/1	100
10	Gray dry hard Calcareous CLAY with LIMESTONE fragments (weathered limestone)	14.3		50/.2 50/.3	
15	Gray fine grained LIMESTONE with interbedded Glauconitic SHALE and SANDSTONE	17.2		RC 1 RQD 36	82
20	Gray fine grained SANDSTONE (loosely cemented)			RC 2 RQD 17	77
25	-friable sandstone 29.0 to 31.8' -sand sized limestone frags. 31.2 to 31.8'				
30		31.8		RC 3 RQD 95	99
	White LIMESTONE with irregular Clay Filled seams	32.8			
35	White fine grained massive LIMESTONE with Stylolites	38.5			
40	Gray fine grained massive LIMEY SANDSTONE	40.0		RC 4 RQD	100

STANDARD PENETRATION

Unconfined Compressive Strength, TSF: 1 2 3 4 5
Natural Dry Density, PCF: 90 100 110 120 130
Water Content, % / Plast. Lim., % / Liq. Lim., %: 10 20 30 40 50
Standard Penetration, Blows/Ft.: 10 20 30 40 50

SHELBY TUBE



COMPLETION DEPTH: 40.0'
ROCK CORE DIAMETER: 1 7/8"

GROUND WATER: NOTED ON RODS 8.0 FT. AT COMPLETION FT. AFTER HRS. FT.

CONFIDENTIAL BUSINESS INFORMATION

LOG OF BORING NO. 89

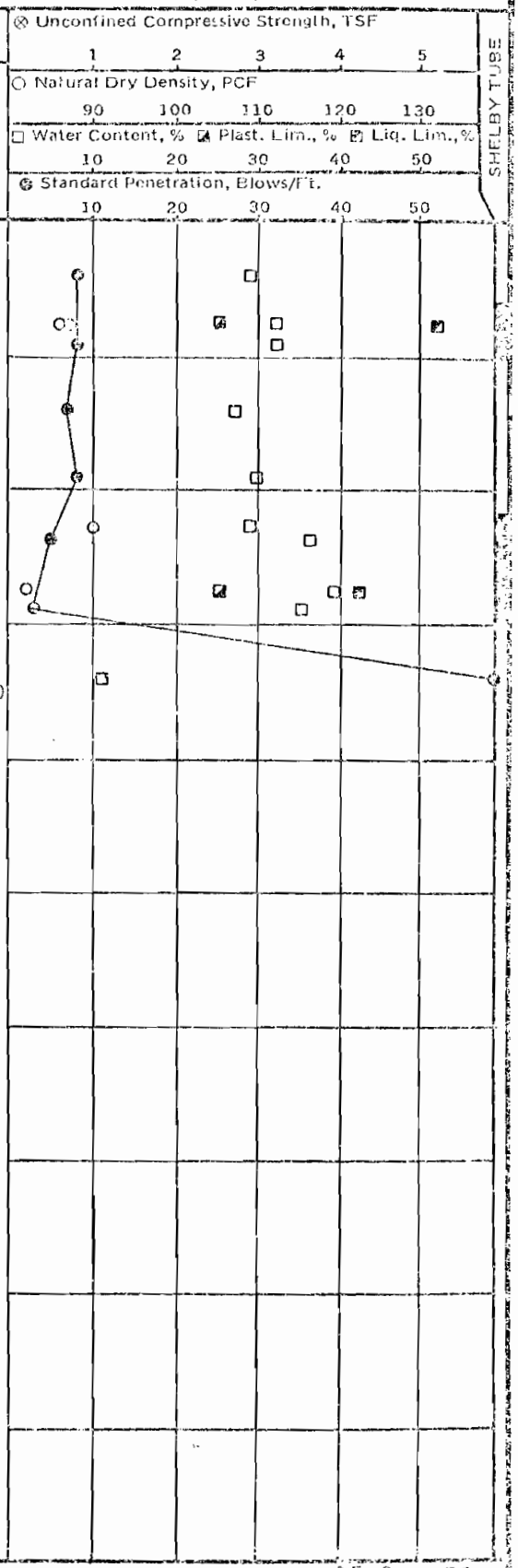
Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA | DATE: 10-3-75 | LOCATION: N 402,725 E 2,261,050

SURFACE ELEVATION-- 654

DEPTH SCALE, FT.		STRATUM DEPTH FT.	SAMPLE DEPTH	BLOWS/6 in. 3-6 in. INCREMENTS	RECOVERY, %
	Dark Gray medium stiff CLAY(CH) w/trace organic material			3 3/5	100
5				3 4/4	100
				2 3/4	100
10		10.5		3 3/5	100
	Dark Gray soft to very soft SILTY CLAY(CL) with trace Sand and fine Gravel			2 2/3	75
15		15.5		1 1/2	75
	Dark Gray wet loose to medium dense SILTY SAND(SM)w/some f-m Gravel	17.0		3/21	
	Light Gray very moist very dense SILTY SAND(SM-ML) w/soft Rock frag. (calcareous)	18.0		100/.3	100
20					

Note:
Auger refusal at 18.0 ft



COMPLETION DEPTH: 18.0'

ROCK CORE DIAMETER:

GROUND WATER: NOTED ON RODS 15.0 FT. AT COMPLETION FT. AFTER HRS. FT.

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CONFIDENTIAL BUSINESS INFORMATION

LOG OF BORING NO. 40

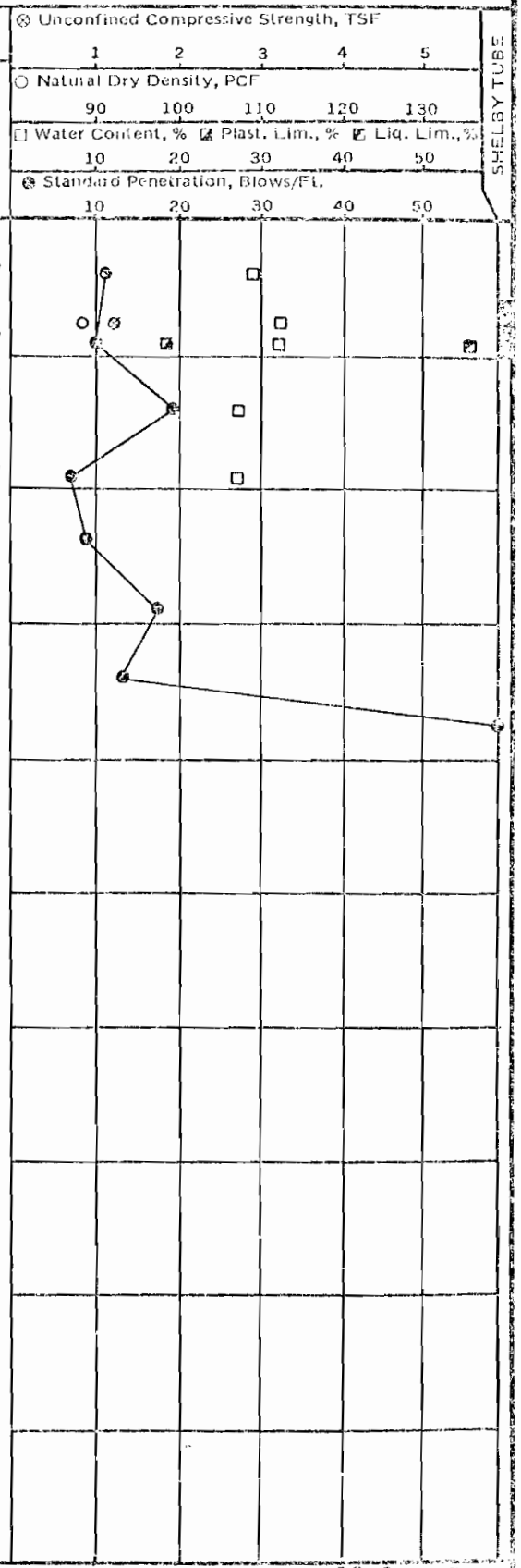
Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 10-3-75 LOCATION: N 402,130 E 2,260,530

SURFACE ELEVATION— 652

DEPTH SCALE, FT.		STRATUM DEPTH FT.	SAMPLE DEPTH	BLOWS/6 in. 3—6 in. INCREMENTS	RECOVERY, %
	Dark Gray moist stiff CLAY(CH) w/ trace organic material			2 4/7	75
5	-medium stiff			3 4/6	75
				5 8/11	100
		9.0			
10	Dark Gray very moist loose SANDY SILT(ML) w/trace Clay	11.0		3 3/4	100
	Brown wet loose to medium dense fine to medium SAND (SP) with trace Silt			4 4/5	100
15				4 9/8	100
	-trace coarse sand			6 6/7	75
		18.8		50/.3	0
20	Note: Piezometer installed at 18.5 ft				

STANDARD PENETRATION



COMPLETION DEPTH: 18.8'

ROCK CORE DIAMETER:

GROUND WATER: NOTED ON RODS 12.0 FT. AT COMPLETION FT. AFTER HRS. FT.

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CONFIDENTIAL BUSINESS INFORMATION

LOG OF BORING NO. 44

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

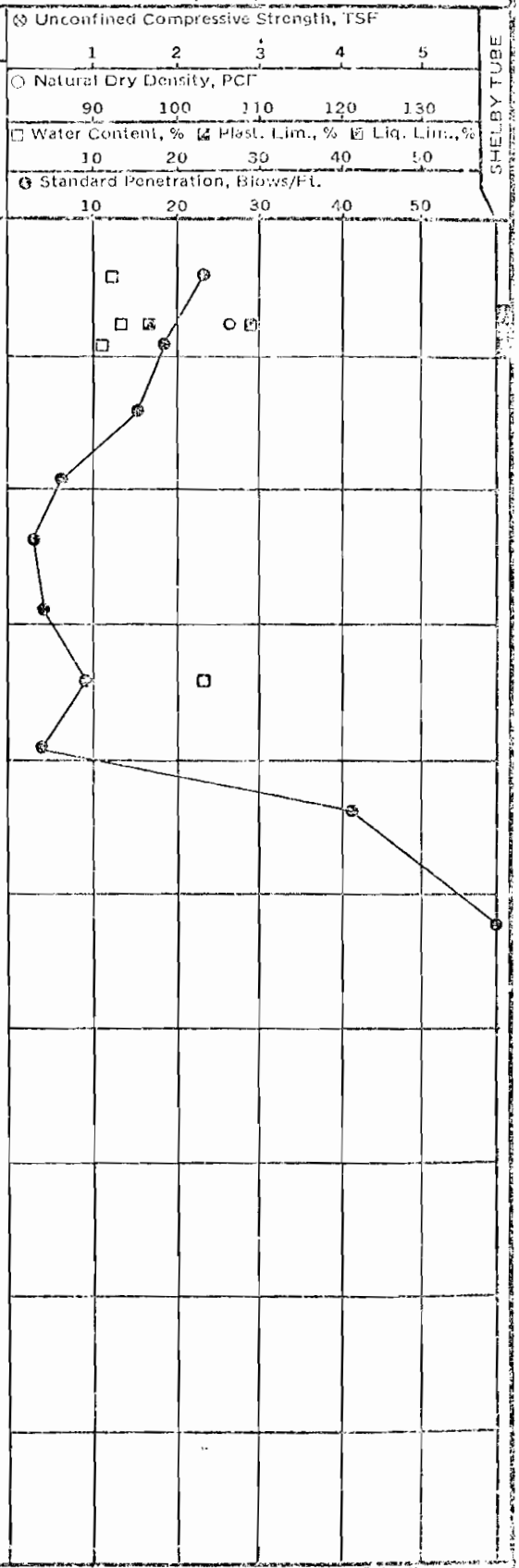
BORING METHOD: HSA DATE: 10-7-75 LOCATION: N 402,020 E 2,261,780

SURFACE ELEVATION— 662

Description	Stratum Depth Ft.	Sample Depth	Blows/6 in. 3—6 in. Increments	Recovery, %
Dark Gray slightly moist very stiff SILTY CLAY (CL)			10 11/12	
	5.0		6 8/10	
Brown moist stiff SANDY CLAY (CL-SC)	6.5		5 9/6	
Brown moist med.dense fine SAND (SP)	8.2		3 3/3	
Brown wet loose fine to medium SAND (SP) w/trace Silt -very loose	13.0		1 1/2	
Brown wet very loose CLAYEY SAND (SW-SC) w/little fine to med.Gvl	15.5		2 2/2	
Brown very moist med.stiff CLAYEY SILT (ML) w/tr.Sand & fine Gvl	18.0		2 4/5	
Brown wet very loose SANDY SILT (ML)	20.5		2 2/2	
Dark Gray very wet soft CLAY (CL-CH) with trace coarse Gravel	24.0		34 25/16	
Brown wet dense fine to coarse SAND (SW) w/trace Silt & Gravel	26.2		50/.2	
Gray very moist very dense fine SAND (SP) w/trace Silt	26.3			

Note: SPT from 23.5 to 25.0' driven on a boulder

* Caved to 11.8 ft at completion



COMPLETION DEPTH: 26.3

ROCK CORE DIAMETER:

GROUND WATER: NOTED ON RODS 10.5 FT. AT COMPLETION 8.2 FT.* AFTER HRS. FT.

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LOG OF BORING NO. 48

CONFIDENTIAL BUSINESS INFORMATION

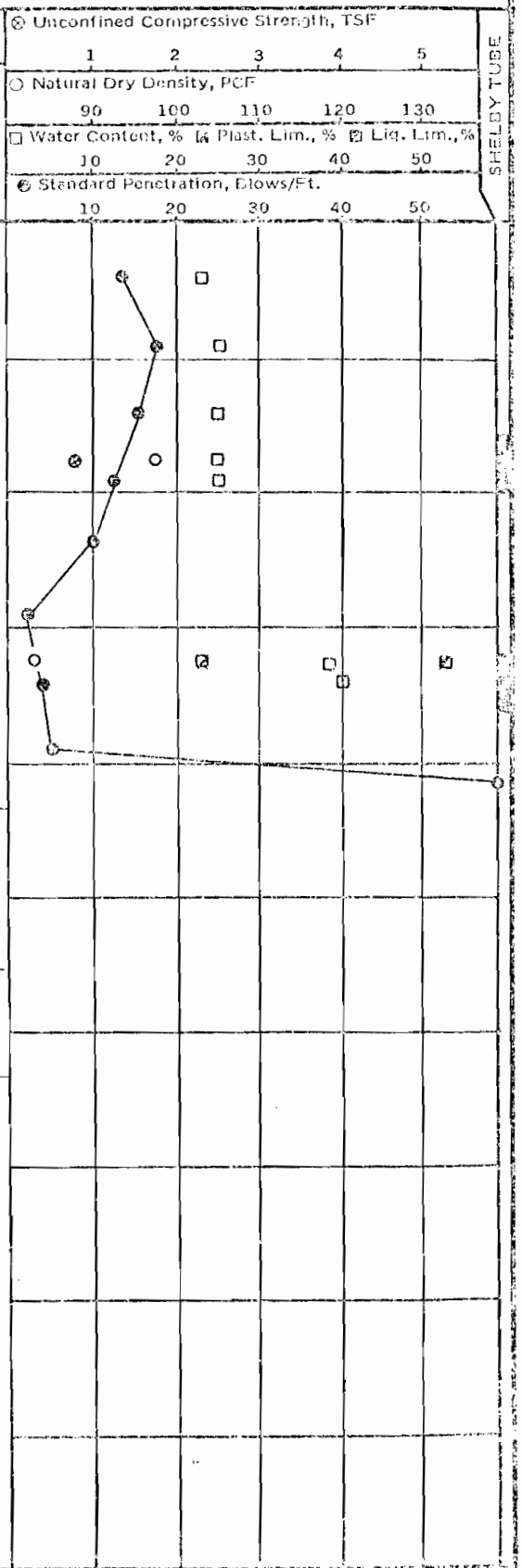
Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

N 401,070

BORING METHOD: HSA | DATE: 10-7-75 | LOCATION: E 2,263,160

SURFACE ELEVATION— 655

DEPTH SCALE, FT.		STRATUM DEPTH FT.	SAMPLE DEPTH	STANDARD PENETRATION BLOWS/6 in. 3–6 in. INCREMENTS	RECOVERY, %
	Dark Gray to Brown moist stiff CLAY (CL-CH)			6 6/7	100
5				4 7/10	100
				5 8/7	100
10		10.5		2 4/8	100
	Brown moist loose SILTY fine SAND (SM) -wet below 13.0'			2 4/6	75
15		15.5		0 1/1	50
	Dark Gray very moist soft CLAY (CH)	18.5		2 1/3	50
20	Dark Gray wet very loose SILTY fine SAND (SP-SM)	21.0		1 1/4	50
	Gray very loosely cemented fine grained LIMEY QUARTZ SANDSTONE -friable below 27.9' -limestone fragments 30.3 to 31.1' -white fine grained limestone w/ irregular clay filled seams 31.1 to 31.8'			50/.2	50
25				RC 1 RQD 0	33
30		31.8		RC 2 RQD 38	100
35	*Caved to 12.1 ft at completion				



COMPLETION DEPTH: 31.8'

ROCK CORE DIAMETER: 2 1/8"

GROUND WATER: NOTED ON RODS 13.0 FT. AT COMPLETION 12.1 FT.* AFTER HRS. FT.

ATEC ASSOCIATES

LOG OF BORING NO. 50

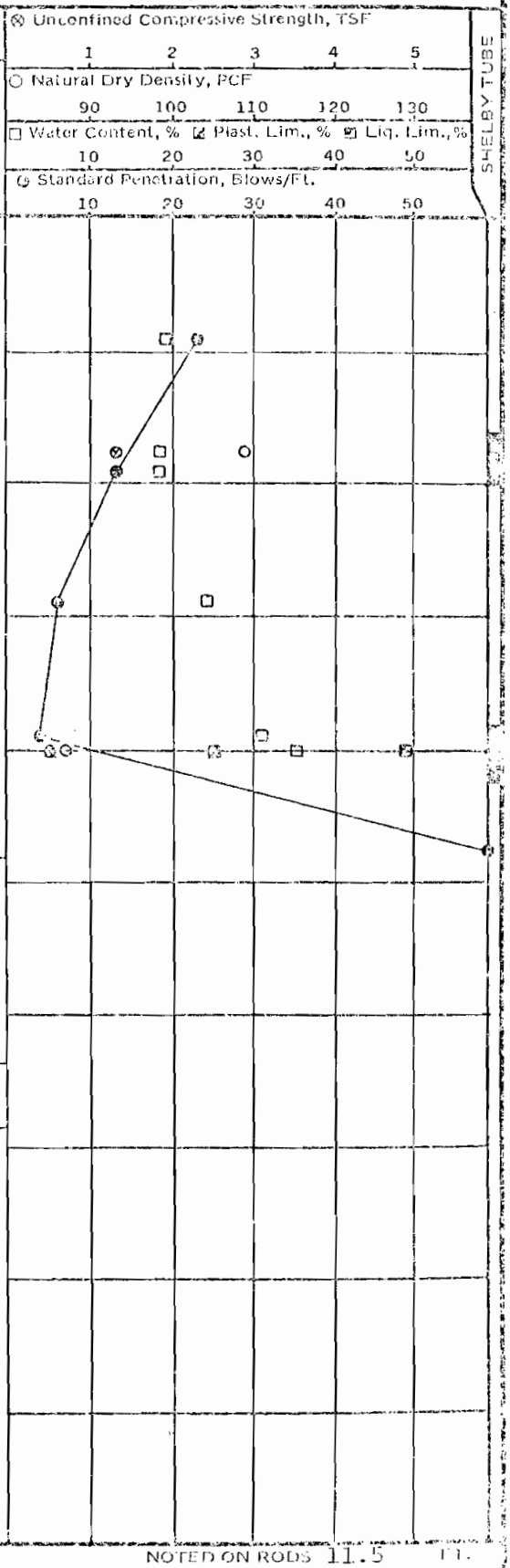
CONFIDENTIAL BUSINESS INFORMATION

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 10-8-75 LOCATION: N 400,410 E 2,262,880

SURFACE ELEVATION-- 654

DEPTH SCALE, FT.		STRATUM DEPTH FT.	SAMPLE DEPTH	STANDARD PENETRATION BLOWS/6 in. 3-6 in. INCREMENTS	RECOVERY, %
	Dark Gray slightly moist very stiff CLAY (CL-CH)				
5		6.0		9 10/13	100
	Gray and Brown (mottled) moist stiff SILTY CLAY (CL)				
10		11.5		4 6/7	100
	Dark Gray very moist medium stiff CLAY (CL) with trace Sand				
15				2 3/3	75
20	-soft	22.5		2 2/2	75
	Light Gray slightly moist very dense SANDY SILT (ML-SM) (calcareous)	24.5		18 50/.5	75
25	White friable fine grained Quartz SANDSTONE -limestone fragments 24.5 to 25.3'			RC 1 RQD 36	55
30		32.0			
	White fine grained LIMESTONE -clay fillings 32.0-33.5'	34.5		RC 2 RQD 92	100
35	*Caved to 18.4 ft at completion				



COMPLETION DEPTH: 34.5

ROCK CORE DIAMETER: 2 1/8"

GROUND WATER: NOTED ON RODS 11.5 FT. AT COMPLETION 14.8 * FT. AFTER HRS. FT.

ATEC ASSOCIATES

CONFIDENTIAL BUSINESS INFORMATION

GENCO STANDARD GUIDE FOR POND INSPECTIONS

Procedure No. GENCO-0-OP-402-01

Approved By: Paul Treangen — **Date:** 4/29/2009
Regional Director Generation West

Terry Kouba — **Date:** 4/30/2009
Regional Director Generation Central

Linda Poe — **Date:** 4/30/2009
Regional Director Generation East

TABLE OF CONTENTS

1.0 Introduction	3
2.0 Objective	3
3.0 Discussion	3
4.0 GENCO Pond Inspection Guidelines	4
4.1. Pond Inspection Periodicities	4
4.2 Pond Inspection Procedure	4
4.3 Record Retention	4
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ENCLOSURES

1. GENCO Pond Inspection Guide

GENCO STANDARD GUIDE FOR POND INSPECTIONS

1. INTRODUCTION

Alliant Energy owns numerous generating stations and other facilities that utilize engineered process water systems (ash ponds) to handle coal combustion byproducts (e.g., bottom ash, economizer ash, and fly ash) coal pile and landfill storm water runoff, and cooling ponds. In nearly every case, state mandated monitoring and water quality testing requirements are associated with the discharges of these ponds and a compromise of the structural integrity of these ponds could lead to an uncontrolled or unmonitored discharge to the environment.

2. OBJECTIVE

The purpose of this Guide is to formalize guidance regarding routine Pond inspections including frequency of inspections, management review requirements, and guidance on issue resolution. This procedure will be utilized by all GENCO power plants to establish a comprehensive and corporate-wide compliance and inspection program for ash ponds, storm water runoff ponds including coal piles and landfill ponds, and cooling ponds (if applicable). Failure to routinely inspect and document the integrity of ponds can result in unidentified structural or operational problems that if unresolved can lead to noncompliance with environmental requirements. Encl (1) provides a general overview of the inspection process as well as detailed instructions and a checklist for performing and documenting the inspections.

3. DISCUSSION

Each generating station or facility with a pond system, that may pose a risk to the environment and the company, generally has a system that is unique to their site. This guide along with Encl (1) is meant to provide general guidance to each plant manager or site director to perform routine inspections of their pond systems to allow prompt identification of problems or potential problems. Although no formal state guidelines exist in Iowa, Minnesota, or Wisconsin regarding pond inspections, each plant manager or site director is responsible to ensure that these pond systems operate properly with discharges that are within permit limits and with no breeches in structural integrity.

The GENCO inspection guidelines are a tool for plant or site management to help standardize routine pond inspections. Deficiencies that are identified during the process should be properly vetted through the environmental and engineering groups to determine what corrective actions are required and what state permitting or approvals are necessary to conduct corrective actions.

4. GENCO POND INSPECTION GUIDELINES

4.1 Pond Inspection Periodicities

1. Due to the uniqueness of each plant or site's pond systems, plant managers, site directors, environmental specialists, and engineering representatives must jointly determine inspection periodicities. Routine inspection periodicities should be determined based upon physical construction and arrangement and should also take historical environmental factors into account (e.g. spring melt and flooding). However, ponds should be inspected at a minimum of once per year in accordance with Enclosure (1). Additionally, corporate environmental will participate in site pond inspections a minimum of once a year.

2. To facilitate planning and execution of these inspections each plant should set up a task in Enviance or Maximo to ensure that the inspections are performed and documented at the desired periodicity.

4.2 Pond Inspection Procedure

1. Inspections- knowledgeable plant personnel (corporate environmental if applicable) will use Enclosure (1) as a standard checklist to perform the required pond inspections. Inspectors should review previous inspection reports to review past issues and corrective actions prior to each pond inspection. Inspectors will complete Encl (1) for each pond inspected and note any concerns on page two Encl (1). Inspectors shall take pictures of any discrepant conditions and attach them to the report to allow corporate environmental and engineering resources to better understand the exact nature of the concern.

2. Review Requirements- the Plant Manager and Environmental and Safety Specialist will review the report with the inspector(s) and sign off on the inspection form.

3. Issue Resolution- plant management will determine how to correct any deficiencies noted during the inspection process. Outside assistance may be required in some cases.

a. Prior to commencing the work, Corporate Environmental shall be contacted to review solutions; and to determine if any type of permitting or approval is required from the State, Federal, or County Agencies.

b. Engineering shall be contacted to resolve any structural concerns of a dike or levee (e.g. tree removal or erosion).

4.3 Record Retention- plants shall maintain a copy of each pond's Encl (1) inspection results for a period of five years. This requirement may be met by attaching an electronic copy of the Encl (1) pond Inspection results for each pond to the Enviance task or Maximo PM that tracks the inspections.

5.0 Revision / Review Record

Any amendments or revisions to this procedure **must** be approved by GENCO Regional Directors

Revision / Review Record				
Revision	**Reason for Revision**	**Date**	**Author**	**Approved By**
Original	Initial Issue of new GENCO Procedure	4/30/09	Buddy Hasten	Paul Treangen Terry Kouba Linda Poe

**** End of Procedure ****

APPENDIX B

DOC 14

PHOTOGRAPHS

Photograph 1: Main Ash Pond South Dike West Abutment

Photograph 2: Crest at Groin Formed by Junction of South and North Dikes and Zero Ash Pond East Dike.

Photograph 3: Main Ash Pond North Dike Crest (left side) and Zero Liquid Discharge Pond East Dike Crest (right side)

Photograph 4: Main Ash Pond South Dike West End Down-Gradient Slope

Photograph 5: Decant Water flow into Main Ash Pond Primary Spillway Structure Discharge Conduit (One of Two Parallel 66-inch Concrete Pipes)

Photograph 6: Zero Liquid Discharge Pond East Dike Crest and Down-Gradient Slope

Photograph 7: Zero Discharge Pond East Dike Down-Gradient Slope at North Groin

Photograph 8: Zero Liquid Discharge Pond East Dike Up-Gradient Slope at North End

APPENDIX C

DAM INSPECTION CHECKLIST FORM

Site Name:	**Ottumwa Generating Station**	**Date:**	**6 October 2010**
Unit Name:	**Main Ash Pond**	**Operator's Name:**	**Interstate Power & Light**
Unit I.D.:	**Ash Pond 1**	**Hazard Potential Classification:**	**High** ☐ **Significant** ☐ **Low** X
	Inspector's Name:	Mark Hoskins, P.E., Joseph P. Klein, III, 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?	Annual		18. Sloughing or bulging on slopes?		X
2. Pool elevation (operator records)?	676.5		19. Major erosion or slope deterioration?		X
3. Decant inlet elevation (operator records)?	676		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	N/A		Is water entering inlet, but not exiting outlet?		X
5. Lowest dam crest elevation (operator records)?	682		Is water exiting outlet, but not entering inlet?		X
6. If instrumentation is present, are readings recorded (operator records)?	N/A		Is water exiting outlet flowing clear?	X	
7. Is the embankment currently under construction?		X	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation, stumps, topsoil in area where embankment fill will be placed)?	X		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?	**N/A**		From downstream foundation area?	See Note 21	
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	See Note 21
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.

Issue #	Comments
8	Foundation clearing and grubbing requirements included in original project specifications reviewed on site.
9	Trees present on down gradient slope of south dike. Tree diameter generally 10 to 12 inches, some larger.
12	Primary spillway riser does not have a trash rack.
14	Primary spillway discharge free flowing and clear. Vegetation around pipe mouth should be cut back to allow full capacity flow.
21	Recent flooding of Des Moines River reached toe of embankments. Some standing water and soft surface soil areas remained at the time of the site visit.

Coal Combustion Waste (CCW)

Impoundment Inspection

Impoundment NPDES Permit IA0060909 **INSPECTOR** Mark Hoskins, P.E & Joe Klein, P.E.

Date 6 October 2010
Impoundment Name Outfall No. 001

Impoundment Company Interstate Power Company
EPA Region 7

State Agency State of Iowa Department of Natural Resources, Environmental Service Division
(Field Office) Address 502 E. 9th Street, Des Moines, IA 50319
Name of Impoundment Main Ash Pond

(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: Receives sluiced bottom ash and transport water, cooling tower blowdown, landfill leachate

Nearest Downstream Town Name: Chillicothe, IA

Distance from the impoundment: 1.6 miles

Location:

Latitude	41	Degrees	5	Minutes	48.8	Seconds	N
Longitude	92	Degrees	33	Minutes	14.0	Seconds	W

State Iowa **County** Allamakee

	Yes	No
Does a state agency regulate this impoundment?	X	☐

If So Which State Agency? Iowa Department of Natural Resources

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.

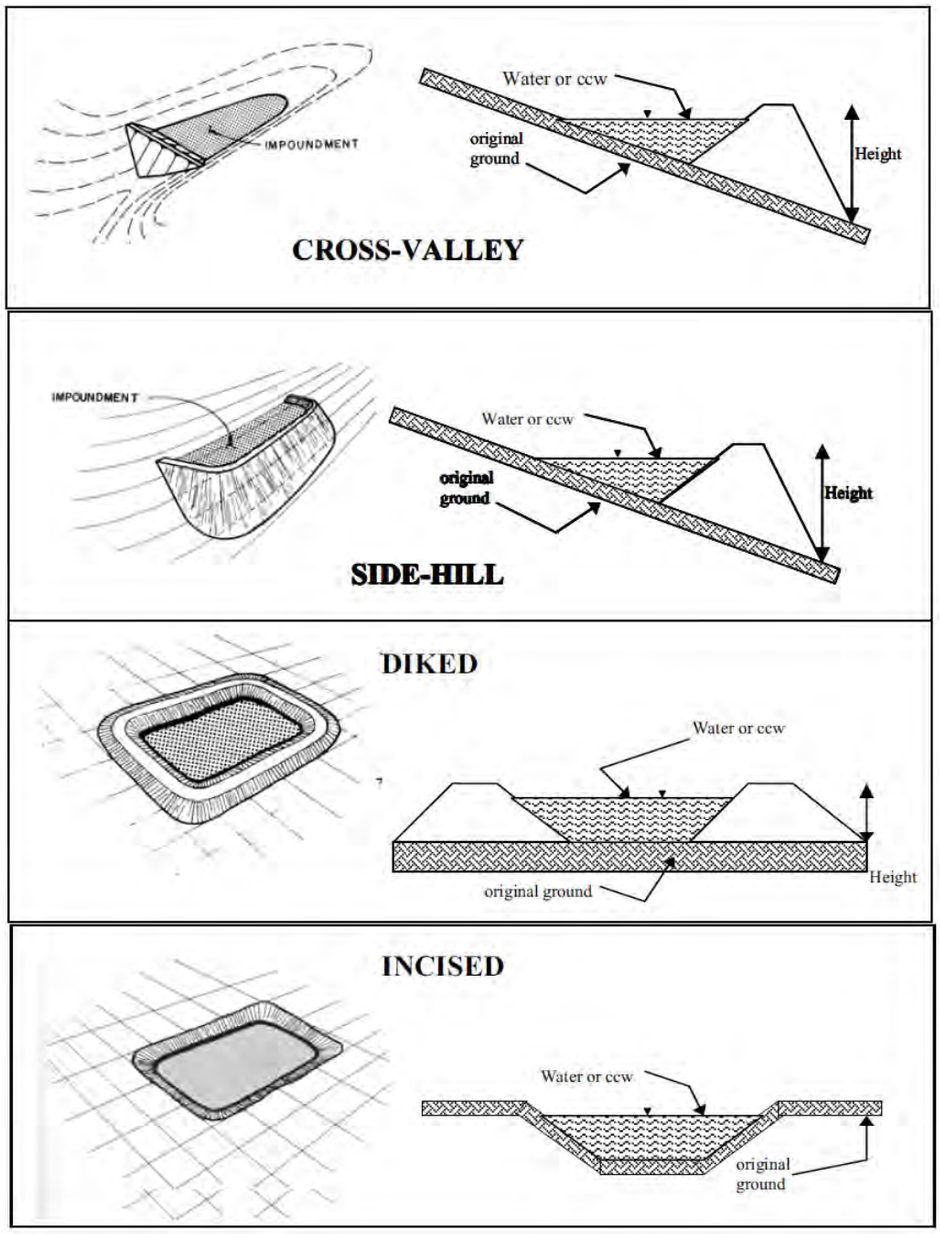
☐ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns.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

Based on the 25 ft. height of the dam the agricultural land between the impoundment and the Des Moines River failure or misoperation of the dike is not expected to result in loss of human life. The economic impact is expected to include agricultural and/or Company owned property and possible ash recovery from the Des Moines River.

CONFIGURATION:



☐ Cross-Valley **X** Side-Hill ☐ Diked

☐ Incised (form completion optional) ☐ Combination Incised/Diked

Embankment Height (ft)	25	**Embankment Material**	Clayey silt and silty clay
Pool Area (ac)	18.2	**Liner**	None documented
Current Freeboard (ft)	5.5	**Liner Permeability**	None documented

TYPE OF OUTLET (Mark all that apply)

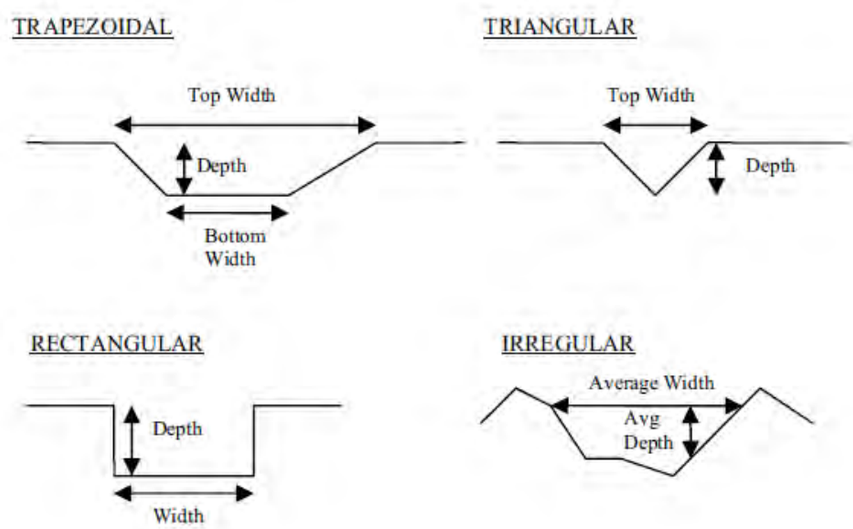
☐ **Open Channel Spillway**

- ☐ Trapezoidal
- ☐ Triangular
- ☐ Rectangular
- ☐ Irregular

depth (ft)

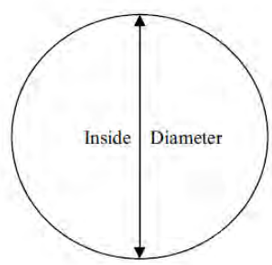
average bottom width (ft)

top width (ft)



X **Outlet**

66" inside diameter (Two each)



Material

corrugated metal

- ☐ welded steel
- ☒ concrete
- ☐ plastic (hdpe, pvc, etc.)
- ☐ other (specify):

	Yes	No
Is water flowing through the outlet?	☒	☐

☐ **No Outlet**

☐ **Other Type of Outlet** (specify):

The Impoundment was Designed By Black & Veatch

	Yes	No
Has there ever been a failure at this site?	☐	X

If So When?

If So Please Describe :

	Yes	No
Has there ever been significant seepages at this site?	☐	**X**
If So When?		

If So Please Describe :

	Yes	No
Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site?	☐	**X**
If so, which method (e.g., piezometers, gw pumping,...)?		

If So Please Describe :

ADDITIONAL INSPECTION QUESTIONS

Concerning the embankment foundation, was the embankment construction built over wet ash, slag, or other unsuitable materials? If there is no information just note that.

Construction drawings indicate embankment constructed over natural ground. Original configuration has not been altered. Drawings provided were sealed by an engineer licensed in Iowa.

Did the dam assessor meet with, or have documentation from, the design Engineer-of-Record concerning the foundation preparation?

Documentation not provided during site visit. Owner is conducting additional search for design documentation.

From the site visit or from photographic documentation, was there evidence of prior releases, failures, or patchwork on the dikes?

Neither photographic documentation nor observations during the site visit showed evidence of prior releases, failures or patchwork on the dikes.

Site Name:	**Ottumwa Generating Station**	**Date:**	**6 October 2010**
Unit Name:	**Zero Liquid Discharge Pond**	**Operator's Name:**	**Interstate Power & Light**
Unit I.D.:	**Ash Pond 2**	**Hazard Potential Classification:**	**High** ☐ **Significant** ☐ **Low** X
	Inspector's Name:	Mark Hoskins, P.E., Joseph P. Klein, III, 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?	Annual		18. Sloughing or bulging on slopes?		X
2. Pool elevation (operator records)?	669		19. Major erosion or slope deterioration?		X
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?	N/A	
5. Lowest dam crest elevation (operator records)?	682		Is water exiting outlet, but not entering inlet?	N/A	
6. If instrumentation is present, are readings recorded (operator records)?	N/A		Is water exiting outlet flowing clear?	N/A	
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)?	X		From underdrain?		N/A
9. Trees growing on embankment? (If so, indicate largest diameter below)		X	At isolated points on embankment slopes?		N/A
10. Cracks or scarps on crest?		X	At natural hillside in the embankment area?		N/A
11. Is there significant settlement along the crest?		X	Over widespread areas?		N/A
12. Are decant trashracks clear and in place?	N/A		From downstream foundation area?		N/A
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		X	"Boils" beneath stream or ponded water?		N/A
14. Clogged spillways, groin or diversion ditches?	N/A		Around the outside of the decant pipe?		N/A
15. Are spillway or ditch linings deteriorated?	N/A		22. Surface movements in valley bottom or on hillside?		X
16. Are outlets of decant or underdrains blocked?	N/A		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.

Issue #	Comments
	Ash Pond 2 does not have a spillway. In the event water level exceeds planned elevation, water is pumped into Main Ash Pond (Ash Pond 1)
9	Applies to east dike. West embankment separates Ash Ponds 1 and 2. Tress on Ash Pond 2 are discussed in east dike of Ash Pond 2
21	Recent flooding of Des Moines River reached toe of embankments. Some standing water and soft surface soil areas remained at the time of the site visit.

Coal Combustion Waste (CCW)

Impoundment Inspection

Impoundment NPDES Permit IA0060909 **INSPECTOR** Mark Hoskins, P.E & Joe Klein, P.E.

Date 6 October 2010
Impoundment Name Outfall No. 001

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State Agency State of Iowa Department of Natural Resources, Environmental Service Division
(Field Office) Address 502 E. 9th Street, Des Moines, IA 50319
Name of Impoundment Main Ash Pond

(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: Receives sluiced bottom ash and transport water, cooling tower blowdown, landfill leachate

Nearest Downstream Town Name: Chillicothe, IA

Distance from the impoundment: 1.6 miles

Location:

Latitude	41	Degrees	5	Minutes	48.8	Seconds	N
Longitude	92	Degrees	33	Minutes	14.0	Seconds	W

State Iowa **County** Allamakee

	Yes	No
Does a state agency regulate this impoundment?	X	☐

If So Which State Agency? Iowa Department of Natural Resources

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

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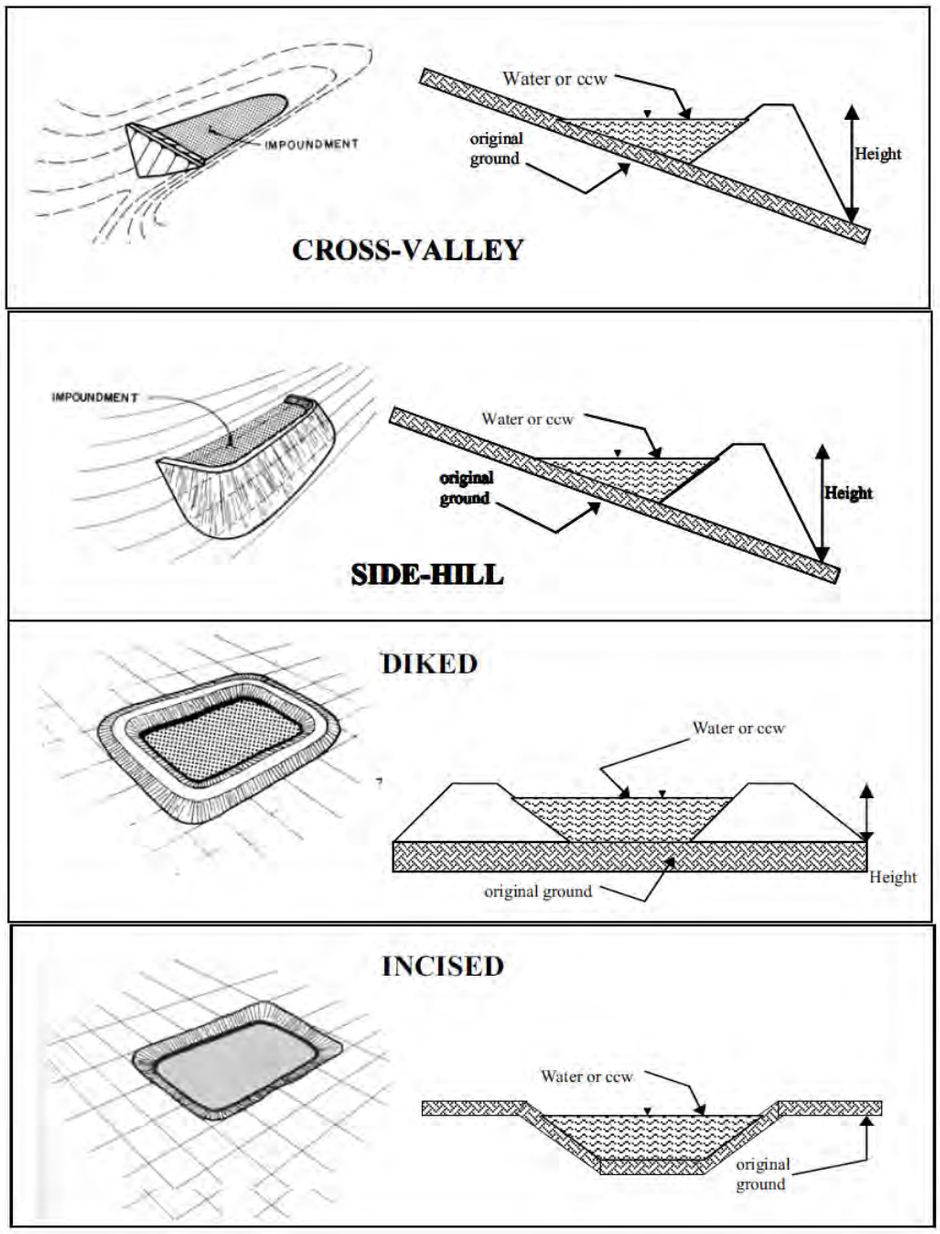
Based on the 25 ft. height of the dam the agricultural land between the impoundment and the Des Moines River failure or misoperation of the dike is not expected to result in loss of human life. The economic impact is expected to include agricultural and/or Company owned property and possible ash recovery from the Des Moines River.

CONFIGURATION:



☐ Cross-Valley **X** Side-Hill ☐ Diked

☐ Incised (form completion optional) ☐ Combination Incised/Diked

Embankment Height (ft)	25	**Embankment Material**	Silty clay and clayey silt
Pool Area (ac)	17.3	**Liner**	None documents
Current Freeboard (ft)	13	**Liner Permeability**	None documented

TYPE OF OUTLET (Mark all that apply)

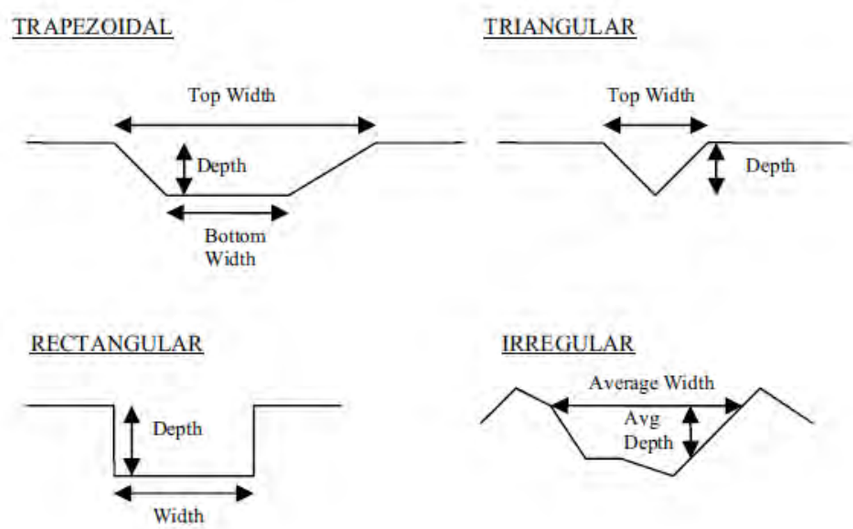
☐ **Open Channel Spillway**

- ☐ Trapezoidal
- ☐ Triangular
- ☐ Rectangular
- ☐ Irregular

depth (ft)

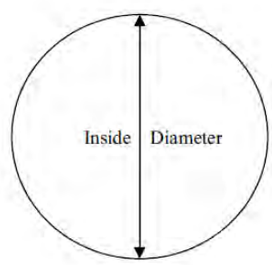
average bottom width (ft)

top width (ft)



Outlet

inside diameter



Material

corrugated metal

- ☐ welded steel
- ☐ concrete
- ☐ plastic (hdpe, pvc, etc.)
- ☐ other (specify):

	Yes	No
Is water flowing through the outlet?	☐	☐

☐ **No Outlet**

☐ **Other Type of Outlet**
(specify):

The Impoundment was Designed By Black & Veatch

	Yes	No
Has there ever been a failure at this site?	☐	X

If So When?

If So Please Describe :

	Yes	No
Has there ever been significant seepages at this site?	☐	**X**
If So When?		

If So Please Describe :

	Yes	No
Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site?	☐	**X**
If so, which method (e.g., piezometers, gw pumping,...)?		

If So Please Describe :

ADDITIONAL INSPECTION QUESTIONS

Concerning the embankment foundation, was the embankment construction built over wet ash, slag, or other unsuitable materials? If there is no information just note that.

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Documentation not provided during site visit. Owner is conducting additional search for design documentation.

From the site visit or from photographic documentation, was there evidence of prior releases, failures, or patchwork on the dikes?

Neither photographic documentation nor observations during the site visit showed evidence of prior releases, failures or patchwork on the dikes.