ALLIANT ENERGY
Interstate Power and Light Company
Ottumwa Generating Station

CCR SURFACE IMPOUNDMENT

HISTORY OF CONSTRUCTION

Report Issued: September 29, 2016
Revision 0

HARD HAT SERVICES™
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EXECUTIVE SUMMARY

This History of Construction (Report) is prepared in accordance with the requirements of the United States Environmental Protection Agency (USEPA) published Final Rule for Hazardous and Solid Waste Management System – Disposal of Coal Combustion Residual (CCR) from Electric Utilities (40 CFR Parts 257 and 261, also known as the CCR Rule) published on April 17, 2015 and effective October 19, 2015.

This Report documents the construction history of each CCR unit at the Ottumwa Generating Station in Ottumwa, Iowa in accordance with §257.73(c) of the CCR Rule. For purposes of this Report, the term "CCR unit" refers to existing and inactive CCR surface impoundments.

Primarily, this Report is focused on providing history of construction information for each CCR surface impoundment to the extent feasible, provided that such information is reasonably and readily available.

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1 INTRODUCTION

The owner/operator of the CCR units must provide a history of construction for the existing and inactive CCR surface impoundments at the Ottumwa Generating Station (OGS) in Ottumwa, Iowa in accordance with §257.73(c)(1) of the CCR Rule. Hard Hat Services, on behalf of Interstate Power and Light Company, has provided history of construction information for the CCR surface impoundments to the extent feasible, provided that such information is reasonably and readily available.

1.1 CCR Rule Applicability

The CCR Rule requires that an owner/operator of a CCR unit must provide a history of construction for CCR surface impoundments with a height of 5 feet or more and a storage volume of 20 acre-feet or more (§257.73(b)(1)); or for CCR surface impoundments with a height of 20 feet or more (§257.73(b)(2)).

1.2 History of Construction Applicability

OGS has one existing CCR surface impoundment and one inactive CCR surface impoundment, which meet the requirements of §257.73(b)(1) and/or §257.73(b)(2), identified as follows:

- Existing CCR surface impoundment: OGS Ash Pond
- Inactive CCR surface impoundment: OGS Zero Liquid Discharge Pond

2 FACILITY DESCRIPTION

The following sub-sections provide a general facility description.

2.1 Name and Address - §257.73(c)(1)(i)

Included below is the name and address of the owner/operator of the CCR units, name of each CCR unit, and state identification numbers for each CCR Unit (if one has been assigned by the state).

Owner/Operator Name and Address:

Interstate Power and Light Company (*an Alliant Energy Company*)
Ottumwa Generating Station
20775 Power Plant Road
Ottumwa, IA 52501

The names of the CCR Units located at OGS are identified as follows:

- Existing CCR surface impoundment: OGS Ash Pond
- Inactive CCR surface impoundment: OGS Zero Liquid Discharge Pond

The state identification numbers that have been assigned to the CCR Units at OGS, by the Iowa Department of Natural Resources (DNR), are as follows:

- OGS Ash Pond: 90-UDP-01-15
- OGS Zero Liquid Discharge Pond: 90-UDP-01-15

2.2 General Facility History

OGS is located northwest of the City of Ottumwa on the western shore of the Des Moines River in Wapello County. Figure 1 provides both a topographic map and an aerial photograph of the OGS facility location, with the approximate property boundary of the facility identified.

OGS, originally owned/operated by the Iowa Southern Utilities Company and Iowa Electric, initiated construction of the generating plant in 1977. OGS initiated facility operations in 1981. At the time of initial facility operations OGS was a fossil–fueled electric generating station that consisted of one steam electric generating unit (Unit 1).

The initial steam electric generating unit at OGS had a nameplate rating of 675 Megawatts (MW). At the time of initial operations Unit 1 burned coal as its primary fuel source. The coal was transported to and received by the facility via rail car.

The original CCR surface impoundments at OGS were constructed between 1977 and 1981 at the same time as the generating plant. The CCR surface impoundments were initially identified within historical drawings as Ash Pond 1 (presently the OGS Ash Pond) and Ash Pond 2 (presently the OGS Zero Liquid Discharge Pond, also identified as the OGS ZLD Pond). The two CCR surface impoundments were separated by an embankment that consisted of the facility's coal railway spur. The Ash Pond 1 was located to the east of the generating plant and south of the coal railway spur embankment while the Ash Pond 2 was located to the northeast of the generating plant and north of the coal railway spur embankment. Historical drawings that identify the layout of the original CCR surface impoundments are provided in Appendix A. Additional discussions on the construction of the original CCR surface impoundments, as well as modifications to the CCR surface impoundments, are provided in further detail throughout Section 3.

Unit 1 at OGS was constructed with a tangential fired boiler for burning coal. The CCR that was produced from the burning of coal included bottom ash, economizer ash, and precipitator fly ash. The bottom ash that was produced was hydraulically conveyed (sluiced) to the Ash Pond 1 via pipes within an ash trench located between the north end of the generating plant and the northwest corner of the CCR surface impoundment. The bottom ash originally discharged into the northwest corner of the Ash Pond 1. The economizer ash that was produced was collected in an economizer hopper prior to being sluiced to the Ash Pond 1 via the same ash trench as the sluiced bottom ash. The economizer ash, similar to the bottom ash, originally discharged into the northwest corner of the Ash Pond 1. The fly ash that was produced was carried as particulate matter by the flue gases into the electrostatic precipitators, which were installed at the time of initial facility operations. The fly ash would be electrostatically precipitated, collected,

and pneumatically conveyed to a fly ash storage silo. The fly ash that was collected within the fly ash storage silo would be loaded into over-the-road haul trucks and either transported off-site for beneficial reuse or stockpiled along the west side of the Ash Pond 2. Additional discussions on historical operations and handling of the CCR at OGS is provided in further detail throughout Section 3.

In addition to the sluiced CCR, the Ash Pond 1 was also a primary receiver of process water flows from the generating plant. As identified in a Wastewater Reclaim Discharge and Treatment Report[1] dated September 1976, the process water flows that originally discharged into the Ash Pond 1 included flows from an oil separation basin (inclusive of miscellaneous plant floor drains, flash evaporator blowdown, sodium softener regeneration waste, condensate polisher regeneration waste), an ash water pit (inclusive of steam cycle blowdown), cooling tower blowdown, boiler blowdown, sluiced pyrites from the pyrites hopper, activated sludge sanitary wastewater treatment system, as well as other miscellaneous flows. In addition to the process water flows, the Ash Pond 1 was capable of receiving influent flow from the Ash Pond 2 via two 48-inch diameter reinforced concrete pipes (RCPs) located within the embankment that separated the two CCR surface impoundments (See Appendix A). The water within the Ash Pond 2, if high enough in elevation, would overflow into the two 48-inch diameter RCPs and flow to the southwest approximately 88 feet where it would discharge into the northern portion of the Ash Pond 1. The Ash Pond 1 was also a receiver of storm water runoff from the surrounding embankments, as well as storm water collected by the generating plant roof drains and drains located around the generating plant yard.

The process water flows, storm water drainage, and CCR sluice water that accumulated in the Ash Pond 1 flowed to the east and discharged through the facility's National Pollutant Discharge Elimination System (NPDES) Outfall 001 located in the northeast corner of the CCR surface impoundment. The original hydraulic structure consisted of a

[1] Wastewater Reclaim Discharge and Treatment Report, Iowa Southern Utilities Company, Ottumwa Generating Station, September 23, 1976, Black & Veatch Consulting Engineers

14 feet deep cast-in-place concrete structure, a Parshall flume for monitoring flow, and two 66-inch diameter RCPs. The water within the Ash Pond 1 would flow into the concrete structure, through the Parshall flume, and into the two 66-inch diameter RCPs. The water would then flow to the east approximately 180 feet through the two RCPs and discharge into an unnamed creek. The unnamed creek flows into the Des Moines River downstream of the water intake structure and before the confluence of Middle Avery Creek.

The Ash Pond 2, also referred to as a fly ash basin in historical documents, was utilized for storing dry fly ash along the west side of the CCR surface impoundment. The dry fly ash that was not transported off-site for beneficial reuse was stored within the footprint of the Ash Pond 2. Aside from storing dry fly ash, the Ash Pond 2 was used to collect storm water runoff from the dry fly ash, as well as storm water runoff from the surrounding embankments. Additionally, the Ash Pond 2 was capable of receiving influent flow from the Ash Pond 1. Discussions with facility personnel with knowledge of historical operations at OGS confirmed that water within the Ash Pond 1 could be routed into Ash Pond 2 via a hydraulic structure with a control valve. The hydraulic structure was stated to be located within the northwest corner of the Ash Pond 1. The size of the hydraulic structure is not known. The Ash Pond 2 didn't have an outfall discharge structure and therefore the water within the pond either exfiltrated into the ground or evaporated. If the water elevation within the Ash Pond 2 was high enough it had the capability of draining into the Ash Pond 1 via the two 48-inch diameter RCPs. Additional discussions on the historical operation and use of the Ash Pond 2 is provided in further detail in Section 3.

In 1991, the Iowa Southern Utilities Company merged with Iowa Electric to create IES Industries. In 1998, a three-way merger was completed between IES Industries, Interstate Power Company, and Wisconsin Power and Light Company forming Interstate Energy Corporation. In 1999, Interstate Energy Corporation changed its name to Alliant Energy Corporation. Presently, the ownership of OGS includes Mid American Energy and

Interstate Power and Light Company. Interstate Power and Light Company operates the facility.

As OGS exists today, the generating plant consists of one steam electric generating unit. The original generating unit was upgraded in 2014 from 675 MW capacity to 725 MW capacity. Sub-bituminous coal remains the primary fuel for producing steam. The burning of coal at OGS produces three types of CCR, which include bottom ash, economizer ash, and precipitator fly ash. Current CCR operations at OGS include bottom ash and economizer ash being sluiced to the western half of the OGS Ash Pond (formerly identified as the Ash Pond 1). The fly ash produced at OGS is collected by the electrostatic precipitators and pneumatically conveyed to the on-site fly ash storage silo or an on-site fly ash storage building. The fly ash produced is transported off-site via over-the-road haul trucks for beneficial reuse. The OGS ZLD Pond is no longer a primary receiver of CCR or process water flows. Presently, the OGS ZLD Pond acts as a storm water detention pond with the only influent sources being precipitation and storm water runoff from the adjacent hydrated fly ash pile, emergency overflow from the coal pile runoff pond via a 24-inch high density polyethylene (HDPE) pipe, and storm water runoff from the surrounding embankments. The water within the OGS ZLD Pond either exfiltrates into the ground or evaporates. In addition, the Air Quality Control System (AQCS), which consists of a dry scrubber and baghouse, produces scrubber byproducts. The scrubber byproduct is a CCR that is loaded into over-the-road haul trucks and transported to an off-site permitted landfill for disposal. Additional information on the current operations of the two CCR surface impoundments are discussed in further detail throughout Section 3.

3 HISTORY OF CONSTRUCTION - §257.73(c)(1)

This Report documents the history of construction information for each existing and inactive CCR surface impoundment to the extent feasible, provided that such information is reasonably and readily available. The following activities were completed in order to reasonably collect and assemble the readily available history of construction information:

- File review at the local regulatory agency;
- Historical aerial photography review;
- Historical topography review;
- Onsite design drawing, specification, and report review;
- Electronic design drawing, specification, and report review; and
- Interview(s) with onsite personnel with historical knowledge of the existing and inactive CCR surface impoundments.

3.1 OGS Ash Pond

The following subsections are intended to meet the requirements of the CCR Rule §257.73(c)(1) for the OGS Ash Pond.

3.1.1 CCR Unit Location - §257.73(c)(1)(ii)

The OGS Ash Pond is located east of the generating plant on the eastern portion of the site. The location of the OGS Ash Pond, in reference to the surrounding topography, is identified on both a USGS 7 ½ minute topographic quadrangle map and aerial photograph on Figure 1. The location of the OGS Ash Pond, in reference to the immediate surroundings within the OGS property, is identified on Figure 2.

3.1.2 Statement of Purpose - §257.73(c)(1)(iii)

The OGS Ash Pond is the primary receiver of sluiced bottom ash and economizer ash. The CCR is sluiced from the generating plant and discharges into the west side of the OGS Ash Pond. The sluiced CCR is discharged into a collection pad area where the majority of CCR is recovered. A dozer is utilized to scrape the collection pad and push the CCR into a stockpile for dewatering. The stockpile is located within the CCR surface impoundment. The water used to sluice the CCR drains into a narrow treatment channel that flows into the southwest portion of the OGS Ash Pond. Routine maintenance

dredging of the narrow treatment channel occurs as the remaining CCR settles out in the channel.

In addition to sluiced CCR, the OGS Ash Pond is also the primary receiver of process water flows from the generating plant. Current process water flows include boiler blowdown water, solid contact unit (SCU) sludge, water from the oil/water separator, recirculating media sanitary treatment plant, and miscellaneous plant floor drains. Additionally, the OGS Ash Pond receives precipitation and storm water runoff from the surrounding area.

The process water flows, storm water runoff, and CCR sluice water that discharges into the western half of the OGS Ash Pond flows to the northeast towards the facility's NPDES Outfall 001. The water within the OGS Ash Pond flows through a pre-cast concrete mixing channel which then discharges into a small area identified as a polishing pond. The mixing channel provides the ability for chemical addition, if necessary, in order to meet NPDES discharge requirements. The water in the polishing pond discharges through the facility's NPDES Outfall 001. NPDES Outfall 001, similar to its original configuration, consists of a 14 feet deep cast-in-place concrete structure along with a Parshall flume and instrumentation to measure the flow of the discharged water. The water flows into the concrete structure, through the Parshall flume, and through the two 66-inch diameter RCPs. The water then flows to the east approximately 180 feet through the two RCPs and discharges into an unnamed creek. The unnamed creek flows into the Des Moines River downstream of the water intake structure and before the confluence of Middle Avery Creek.

3.1.3 Physical Layout Information - §257.73(c)(1)(iv)

As identified in an Inflow Flood Control Plan[2] prepared for OGS in accordance with §257.82 of the CCR Rule, the OGS Ash Pond has a watershed of approximately 76 acres.

[2] Inflow Flood Control Plan, Ottumwa Generating Station, 2016, Hard Hat Services

The drainage area of the watershed includes 18 acres of level power plant, 18 acres of water surface and embankment, and 40 acres of open low ground.

As discussed in an Annual Inspection Report[3] prepared for OGS in accordance with §257.83 of the CCR Rule, the OGS Ash Pond is incised along the west side of the CCR unit. The north embankment of the OGS Ash Pond separates the CCR surface impoundment from the OGS ZLD Pond. The crest of the north embankment of the OGS Ash Pond consists of the facility's coal railway spur and has an elevation of approximately 681 feet (all elevations provided in feet above mean sea level). The south/east embankment of the OGS Ash Pond has a height of approximately 26 feet from the crest to the toe of the downstream slope of the embankment at its greatest height. The crest of the south/east embankment of the OGS Ash Pond has an elevation of 682 feet. The maximum interior storage depth of the OGS Ash Pond is approximately 25 feet. Currently, the total volume of impounded CCR and water within the OGS Ash Pond is approximately 556,000 cubic yards.

3.1.4 Foundation and Abutment Properties - §257.73(c)(1)(v)

As identified in a Safety Factor Assessment[4] prepared for OGS in accordance with §257.73(e) of the CCR Rule, the embankments of the OGS Ash Pond are constructed of stiff compacted clay from the site overlying the medium stiff native clay which overlies very dense sand of the Des Moines River.

During the construction of OGS in 1974, the native clay was sampled and tested for Atterberg limits, unconfined compressive strength and both consolidated undrained (CU) and unconsolidated undrain (UU) triaxial strength. The test results are shown in Appendix D and indicated that the native clay under the embankments is a low plasticity clay (CL) with unconfined compression values from 1,500 to 2,500 psf. Triaxial UU tests indicated a range of 750 to 2,000 psf for cohesion and the CU tests indicated 29˚ to 34˚ for

[3] Annual Inspection Report, Ottumwa Generating Station, 2016, Hard Hat Services
[4] Safety Factor Assessment, Ottumwa Generating Station, 2016, Hard Hat Services

friction angle and 0 to 600 psf cohesion. The CU test results imply the clay is normally consolidated.

3.1.5 Historical Construction and Use - §257.73(c)(1)(vi)

The OGS Ash Pond (formerly identified as Ash Pond 1 in historical drawings) was constructed between 1977 and 1981 in an area located east of the generating plant. Historical drawings that identify the initial layout of the OGS Ash Pond are provided in Appendix A. Historical aerial photographs that confirm the presence of the OGS Ash Pond at the time of initial facility operations are provided in Appendix B.

There are no known reasonably and readily available documents that detail the method of site preparation and construction of each zone of the OGS Ash Pond. As identified in a General Construction Specification Document[5] dated July 1977, as well as an Ash Pond Slope Stability Report[6] dated October 2010, earthwork specifications for embankments were provided. The specifications stated that to the maximum extent available, suitable earth materials obtained from excavation shall be used for the construction of embankments. Additional material shall be obtained from borrow pits as necessary. The subgrade shall be scarified, leveled, and rolled so that surface materials of the subgrade were compact and well bonded with the first layer of the embankment. All material shall be free from rocks or stones, brush, stumps, logs, roots, debris, and organic or other objectionable materials. Embankments shall be constructed in horizontal layers not exceeding 8 inches in un-compacted thickness. Each layer shall be compacted by rolling or other acceptable methods. The compacted density of each layer shall be at least 95 percent of the maximum density at optimum moisture content as determined by ASTM D698 (or 70 percent of relative density as determined by ASTM D2049).

[5] General Construction (1 of 2) Specification: 6713 C6C, Ottumwa Generating Station, July 1977, Black & Veatch Consulting Engineers

[6] Ash Pond 1 and 2 Slope Stability Report, Interstate Power and Light Ottumwa Power Generating Station, October 22, 2010 Revision 0, Black & Veatch

In-situ soil properties of the CCR unit were identified in a Safety Factor Assessment[7] prepared for OGS in accordance with §257.73(e) of the CCR Rule. As discussed in the Safety Factor Assessment, soil borings were installed in 2016 along the north and south/east embankments of the OGS Ash Pond (See Appendix E). The soil borings installed along the crest of the north embankment and toe of the south/east embankment were completed as part of the CCR surface impoundment monitoring well construction by SCS Engineers. The soil boring installed along the crest of the south/east embankment was completed by Hard Hat Services. Soil samples were collected from the soil boring installed along the crest of the south/east embankment in order to determine water content, Atterberg limits, and grain size (Appendix E). The soil boring data, along with soil sample laboratory analytical results, indicated that the embankments were constructed of stiff compacted clay.

Historical use of the OGS Ash Pond consisted of being the primary receiver of sluiced bottom ash and economizer ash. The bottom ash that was produced was sluiced to the OGS Ash Pond via pipes within an ash trench located between the north end of the generating plant and the northwest corner of the CCR surface impoundment. The bottom ash originally discharged into the northwest corner of the OGS Ash Pond. The economizer ash that was produced was collected in an economizer hopper prior to being sluiced to the OGS Ash Pond via the same ash trench as the sluiced bottom ash. The economizer ash, similar to the bottom ash, originally discharged into the northwest corner of the OGS Ash Pond.

In addition to the sluiced CCR, the OGS Ash Pond was also a primary receiver of process water flows from the generating plant. As identified in a Wastewater Reclaim Discharge and Treatment Report[8] dated September 1976, the process water flows that discharged into the OGS Ash Pond included flows from an oil separation basin (inclusive of

[7] Safety Factor Assessment, Ottumwa Generating Station, 2016, Hard Hat Services
[8] Wastewater Reclaim Discharge and Treatment Report, Iowa Southern Utilities Company, Ottumwa Generating Station, September 23, 1976, Black & Veatch Consulting Engineers

miscellaneous plant floor drains, flash evaporator blowdown, sodium softener regeneration waste, condensate polisher regeneration waste), an ash water pit (inclusive of steam cycle blowdown), cooling tower blowdown, boiler blowdown, sluiced pyrites from the pyrites hopper, as well as other miscellaneous flows. In addition to the process water flows, the OGS Ash Pond was capable of receiving influent flow from the OGS ZLD Pond via two 48-inch diameter RCPs located within the embankment that separates the two CCR surface impoundments (See Appendix A). The water within the OGS ZLD Pond, if high enough in elevation, would overflow into the two 48-inch diameter RCPs and flow to the southwest approximately 88 feet where it would discharge into the northern portion of the OGS Ash Pond. The OGS Ash Pond was also a receiver of storm water runoff from the surrounding embankments, as well as storm water collected by the generating plant roof drains and drains located around the generating plant yard.

The process water flows, storm water drainage, and CCR sluice water that discharged into the OGS Ash Pond flowed to the east and discharged through the facility's NPDES Outfall 001 located in the northeast corner of the CCR surface impoundment. The original hydraulic structure consisted of a 14 feet deep cast-in-place concrete structure, a Parshall flume for monitoring flow, and two 66-inch diameter RCPs. The water within the OGS Ash Pond would flow into the concrete structure, through the Parshall flume, and into the two 66-inch diameter RCPs. The water would then flow to the east approximately 180 feet through the two RCPs and discharge into an unnamed creek. The unnamed creek flows into the Des Moines River downstream of the water intake structure and before the confluence of Middle Avery Creek.

After review of readily available historical documents, there is no readily available information that discusses known modifications to the embankments of the OGS Ash Pond since initial construction of the CCR surface impoundment. The following list provides a general overview of the known modifications associated with the OGS Ash Pond since initial facility operations:

- The Ash Pond 1 was re-identified as the OGS Ash Pond. The timeframe of this modification has not been documented.

- The bottom ash and economizer ash pipes were rerouted from discharging in the northwest corner of the OGS Ash Pond via the ash trench to discharging along the west side of the OGS Ash Pond. The timeframe of this modification has not been documented.

- The two 48-inch diameter RCPs that allowed water from the OGS ZLD Pond to flow into the OGS Ash Pond were permanently sealed. The inlet ends of the two RCPs were sealed with concrete. The timeframe of this modification has not been documented.

- In 2005, an ultrasonic level indicator was installed at NPDES Outfall 001. The ultrasonic level indicator was mounted over the Parshall flume hydraulic structure in order to collect flow data in accordance with the requirements of the facility's NPDES permit for NPDES Outfall 001.

- In 2008, the polishing pond was constructed in the northeast corner of the OGS Ash Pond. The polishing pond, which included the construction of an isolation berm and a pre-cast concrete mixing channel, allowed for the water in the OGS Ash Pond to be routed through a mixing channel prior to discharging through the NPDES Outfall 001. The mixing channel provided OGS the ability to add chemical to the OGS Ash Pond, if necessary, in order to meet NPDES discharge requirements.

Historical aerial photographs (See Appendix B) and historical topographic maps (See Appendix C) identify the topographic changes to the OGS Ash Pond that have occurred since the time of initial facility operations.

3.1.6 Structures, Appurtenances, and Operations- §257.73(c)(1)(vii)

Detailed dimensional drawings of the OGS Ash Pond that were reasonably and readily available are identified below. The detailed dimensional drawings were obtained from various designs, plans, and reports that were assembled during the historical information review.

- Site Work Drawings (1976) – Drawings prepared by Black & Veatch Consulting Engineers provides details of the original design of the OGS Ash Pond at the time of plant construction prior to placement of CCR. Drawings identify original design contours of the OGS Ash Pond, detailed cross-sections of the embankments, and detailed information of the initial hydraulic structure. (Appendix A).

- Field Investigation Soil Borings (1976) – Drawings provide historical soil boring locations and soil boring logs that were completed at OGS in the area of the OGS Ash Pond (Appendix D)

- Process Flow Diagrams (1976) – Figures prepared by Black & Veatch Consulting Engineers provide layout of plant drainage system to the OGS Ash Pond, as well as the bottom ash and economizer ash system to the OGS Ash Pond (Appendix F)

- Effluent Discharge Diagram (1979) – Figure prepared by Iowa Southern Utilities Company provides flow diagram of OGS Ash Pond, OGS ZLD Pond, and coal pile runoff pond (Appendix F).

- Ash Handling System Water Requirements (1984) – Figure provides chart of required flow and required time for flushing of various CCR processes at OGS (Appendix F).

- OGS Water Usage (1995) – Figure provides flow chart of various process flows at OGS (Appendix F).

- OGS Water Usage (2003) – Figure provides flow chart of various process flows at OGS (Appendix F).

- NPDES Outfall 001 Upgrade (2005) – Drawing prepared by Hard Hat Services provides location of new instrumentation to be installed for NPDES Outfall 001 (Appendix F).

- Settling Pond Maintenance Plan (2006) – Drawings prepared by Hard Hat Services provides facility layout, historical settling pond boundaries, and topographic survey with pond volumes (Appendix F).

- Settling Pond Reconfiguration (2007) – Drawings prepared by Hard Hat Services provides modifications to the OGS Ash Pond with the construction of the polishing pond and installation of the mixing channel (Appendix F).

- Monitoring Well Location Map (2016) – Drawing prepared by SCS Engineers provides location of monitoring well installation locations, as well as soil boring logs (Appendix E).

- OGS Ash Pond Soil Borings (2016) – Drawings prepared by Hard Hat Services provides location of soil borings, as well as soil boring logs (Appendix E).

3.1.7 Instrumentation - §257.73(c)(1)(viii)

Instrumentation used to support the operation of the OGS Ash Pond consists of an ultrasonic level indicator mounted over a Parshall flume hydraulic structure in the northeast corner of the OGS Ash Pond. The ultrasonic level indicator was installed in 2005 and replaced the former instrumentation that was used with the hydraulic structure. The ultrasonic level indicator collects flow data in accordance with the requirements of the facility's NPDES permit for NPDES Outfall 001.

3.1.8 Area-Capacity Curve - §257.73(c)(1)(ix)

An area-capacity curve identifies the relationship between the surface area of the existing CCR surface impoundment and an elevation, which corresponds to an available storage capacity. After review of readily available historical documents, there is no readily available information regarding area-capacity curves for the OGS Ash Pond.

3.1.9 Spillway and Diversion Features - §257.73(c)(1)(x)

The OGS Ash Pond is equipped with one hydraulic structure, which is located in the northeast corner of the OGS Ash Pond. The hydraulic structure is identified as NPDES Outfall 001 at OGS. The hydraulic structure consists of a 14 feet deep concrete structure which allows water from the OGS Ash Pond to flow into prior to flowing through a Parshall flume. The water flows through the Parshall flume and into two 66-inch diameter RCPs. The water flows through the two RCPs approximately 180 feet to the east where it discharges into an unnamed creek. The water in the unnamed creek flows to the east where it discharges into the Des Moines River.

3.1.10 Construction Specifications, Surveillance, Maintenance, and Repair - §257.73(c)(1)(xi)

OGS implements a Site-Specific Inspection and Maintenance (I&M) Plan[9], in accordance with an Alliant Energy I&M Plan[10]. The Site-Specific I&M Plan has been implemented at OGS in order to identify the factors which may affect the long-term stability of the existing CCR surface impoundment. The Site-Specific I&M Plan identifies existing operation and maintenance activities, and identifies the inspection, monitoring, maintenance, and recordkeeping requirements as outlined in the Alliant Energy I&M Plan in order to maintain the integrity of the existing CCR surface impoundment.

Visual inspections of the OGS Ash Pond are completed in accordance with §257.83 of the CCR Rule. At intervals not exceeding seven days, the OGS Ash Pond is visually inspected for any appearances of structural weakness or other conditions which are disrupting or have the potential to disrupt the operation or safety of the existing CCR surface

[9] Inspection and Maintenance (I&M) Plan, Ottumwa Generating Station, October 2015, Version 2.0-Revision 0.0
[10] Inspection and Maintenance (I&M) Plan, Alliant Energy, September 2015, Version 2.0-Revision 0.0

impoundment. At intervals not exceeding thirty days, instrumentation serving the OGS Ash Pond is visually inspected to confirm proper working condition. In addition to the seven-day and thirty-day inspections, OGS conducts event-related inspections which may include inspections following storm events, seismic events, major maintenance activities, as well as other unusual events. Annual inspections are conducted by a qualified PE who is familiar with the requirements of the CCR Rule, the Alliant Energy I&M Plan, the OGS Site-Specific I&M Plan, and other facility specific information pertaining to the existing CCR surface impoundment.

Maintenance activities that are completed at OGS may include routine maintenance, event-related maintenance, and long-term maintenance. Routine maintenance activities may include management of vegetation (or other forms of slope protection), tree and sapling removal, reseeding of disturbed vegetated areas, removal of debris from collection and diversion channels, and repair of eroded areas. Event-related maintenance activities may include maintenance after unusual events such as heavy rainfall, periods of very high winds, or seismic activity. Maintenance may include repair of eroded areas or removal of damaged vegetation. Long-term maintenance activities are identified as part of the ongoing inspection program, through the annual inspections, or through other engineering evaluations and may include larger remediation activities.

3.1.11 Structural Instability Records - §257.73(c)(1)(xii)

After review of readily available historical documents there are no known records of structural instability associated with the OGS Ash Pond that were identified.

3.2 OGS Zero Liquid Discharge Pond

The following subsections are intended to meet the requirements of the CCR Rule §257.73(c)(1) for the OGS ZLD Pond.

3.2.1 CCR Unit Location - §257.73(c)(1)(ii)

The OGS ZLD Pond is located northeast of the generating plant and north of the OGS Ash Pond. The location of the OGS ZLD Pond, in reference to the surrounding

topography, is identified on both a USGS 7 ½ minute topographic quadrangle map and aerial photograph on Figure 1. The location of the OGS ZLD Pond, in reference to the immediate surroundings within the OGS property, is identified on Figure 2.

3.2.2 Statement of Purpose - §257.73(c)(1)(iii)

Presently, the OGS ZLD Pond acts as a storm water detention pond with the only influent sources being precipitation and storm water runoff from the surrounding area. The storm water runoff includes the hydrated fly ash pile located along the northwestern side of the CCR surface impoundment, as well as occasional storm water runoff from the coal pile storage area via a 24-inch diameter HDPE pipe located within the north embankment of the OGS ZLD Pond. The OGS ZLD Pond generally operates as a zero liquid discharge pond as the water within the OGS ZLD Pond either exfiltrates into the ground or evaporates.

3.2.3 Physical Layout Information - §257.73(c)(1)(iv)

As identified in an Inflow Flood Control Plan[11] prepared for OGS in accordance with §257.82 of the CCR Rule, the OGS ZLD Pond has a watershed of approximately 44 acres. The OGS ZLD Pond receives storm water from the plant site that was previously used for the production and storing of hydrated fly ash and emergency overflow storm water from the coal pile runoff pond.

The OGZ ZLD Pond is incised along the west side of the CCR unit. The south embankment of the OGS ZLD Pond shares an embankment with the OGS Ash Pond. The crest of the south embankment of the OGS ZLD Pond consists of the facility's coal railway spur and has an elevation of 681 feet. The east embankment of the OGS ZLD Pond also consists of the facility's coal railway spur and has a height of approximately 29 feet from the crest to the toe of the downstream slope of the embankment at its greatest height. The maximum interior storage depth of the OGS ZLD Pond is approximately 25 feet.

[11] Inflow Flood Control Plan, Ottumwa Generating Station, 2016, Hard Hat Services

Currently, the total volume of impounded CCR and water within the OGS ZLD Pond is approximately 515,000 cubic yards.

3.2.4 Foundation and Abutment Properties - §257.73(c)(1)(v)

As identified in a Safety Factor Assessment[12] prepared for OGS in accordance with §257.73(e) of the CCR Rule, the embankments of the OGS ZLD Pond are constructed of stiff compacted clay from the site overlying the medium stiff native clay which overlies very dense sand of the Des Moines River.

During the construction of OGS in 1974, the native clay was sampled and tested for Atterberg limits, unconfined compressive strength and both consolidated undrained (CU) and unconsolidated undrain (UU) triaxial strength. The test results are shown in Appendix D and indicated that the native clay under the embankments is a low plasticity clay (CL) with unconfined compression values from 1,500 to 2,500 psf. Triaxial UU tests indicated a range of 750 to 2,000 psf for cohesion and the CU tests indicated 29˚ to 34˚ for friction angle and 0 to 600 psf cohesion. The CU test results imply the clay is normally consolidated.

In 2016, borings were installed throughout the interior of the OGS ZLD Pond (See Appendix E). The borings within the CCR surface impoundment identified clay beneath the silt or ash sediment layers.

3.2.5 Historical Construction and Use - §257.73(c)(1)(vi)

The OGS ZLD Pond (formerly identified as the Ash Pond 2 in historical drawings) was constructed between 1977 and 1981 in an area located northeast of the generating plant. Historical drawings that identify the initial layout of the OGS ZLD Pond are provided in Appendix A. Historical aerial photographs that confirm the presence of the OGS ZLD Pond at the time of initial facility operations are provided in Appendix B.

[12] Safety Factor Assessment, Ottumwa Generating Station, 2016, Hard Hat Environmental Services

There are no known reasonably and readily available documents that detail the method of site preparation and construction of each zone of the OGS ZLD Pond. As identified in a General Construction Specification Document[13] dated July 1977, as well as an Ash Pond Slope Stability Report[14] dated October 2010, earthwork specifications for embankments were provided. The specifications stated that to the maximum extent available, suitable earth materials obtained from excavation shall be used for the construction of embankments. Additional material shall be obtained from borrow pits as necessary. The subgrade shall be scarified, leveled, and rolled so that surface materials of the subgrade were compact and well bonded with the first layer of the embankment. All material shall be free from rocks or stones, brush, stumps, logs, roots, debris, and organic or other objectionable materials. Embankments shall be constructed in horizontal layers not exceeding 8 inches in un-compacted thickness. Each layer shall be compacted by rolling or other acceptable methods. The compacted density of each layer shall be at least 95 percent of the maximum density at optimum moisture content as determined by ASTM D698 (or 70 percent of relative density as determined by ASTM D2049).

In-situ soil properties of the CCR unit were identified in a Safety Factor Assessment[15] prepared for OGS in accordance with §257.73(e) of the CCR Rule. As discussed in the Safety Factor Assessment, soil borings were installed in 2016 along the south embankment of the OGS ZLD Pond, as well as along the top of the hydrated fly ash pile (See Appendix E). The soil borings installed along the crest of the south embankment were completed as part of the CCR surface impoundment monitoring well construction by SCS Engineers. The soil borings installed along the top of the hydrated fly ash pile were completed by Hard Hat Services. The soil boring data indicated that the embankments were constructed of stiff compacted clay.

[13] General Construction (1 of 2) Specification: 6713 C6C, Ottumwa Generating Station, July 1977, Black & Veatch
[14] Ash Pond 1 and 2 Slope Stability Report, Interstate Power and Light Ottumwa Power Generating Station, October 22, 2010 Revision 0, Black & Veatch Consulting Engineers
[15] Safety Factor Assessment, Ottumwa Generating Station, 2016, Hard Hat Services

Historical use of the OGS ZLD Pond consisted of storing dry fly ash along the west side of the CCR surface impoundment. The dry fly ash that was not transported off-site for beneficial reuse was stored within the footprint of the OGS ZLD Pond. Aside from storing dry fly ash, the OGS ZLD Pond was used to collect storm water runoff from the dry fly ash, as well as storm water runoff from the surrounding embankments. Additionally, the OGS ZLD Pond was capable of receiving influent flow from the OGS Ash Pond. Discussions with facility personnel with knowledge of historical operations at OGS confirmed that water within the OGS Ash Pond could be routed into the OGS ZLD Pond via underground piping which could be isolated with a control valve. The piping was stated to be located within the northwest corner of the OGS Ash Pond. The size of the piping is not known. The OGS ZLD Pond didn't have an outfall discharge structure and therefore the water within the pond either exfiltrated into the ground or evaporated. If the water elevation within the OGS ZLD Pond was high enough it had the capability of draining into the OGS Ash Pond.

After review of readily available historical documents, there is no readily available information that discusses known modifications to the embankments of the OGS Ash Pond since initial construction of the CCR surface impoundment. The following list provides a general overview of the known modifications associated with the OGS ZLD Pond since initial facility operations:

- The Ash Pond 2 was re-identified as the OGS ZLD Pond. The timeframe of this modification has not been documented.

- The two 48-inch diameter RCPs that connected the OGS ZLD Pond to the OGS Ash Pond were permanently sealed. The inlet ends of the two RCPs were sealed with concrete. The timeframe of this modification has not been documented.

- Additional use of the OGS ZLD Pond included receiving runoff from the existing hydrated fly ash pile located along the northwestern side of the CCR surface

impoundment. The hydrated fly ash pile consists of an aggregate-like material produced from Class C fly ash that has been hydrated and hardened. Fly ash, when not transported off-site, was previously hauled from the generating plant to the OGS ZLD Pond where it was hydrated, hardened, and eventually reclaimed for beneficial reuse. The timeframe of this modification has not been documented, however, as of 2015 hydrated fly ash is no longer produced at OGS and the remainder of the existing hydrated fly ash pile is in the process of being reclaimed for beneficial reuse. The hydrated fly ash pile is not located within the current footprint of the OGS ZLD Pond and is not considered to be part of the inactive CCR surface impoundment.

- A 24-inch diameter HDPE emergency overflow pipe was installed in the north embankment of the OGS ZLD Pond. The hydraulic structure was installed in order to allow water within the coal pile runoff pond to overflow into the OGS ZLD Pond, if necessary, in order to control the water elevation within the coal pile runoff pond. The timeframe of this modification has not been documented.

Historical aerial photographs (See Appendix B) and historical topographic maps (See Appendix C) identify the topographic changes to the OGS ZLD Pond that have occurred since the time of initial facility operations.

3.2.6 Structures, Appurtenances, and Operations- §257.73(c)(1)(vii)

Detailed dimensional drawings of the OGS ZLD Pond that were reasonably and readily available are identified below. The detailed dimensional drawings were obtained from various designs, plans, and reports that were assembled during the historical information review.

- Site Work Drawings (1976) – Drawings prepared by Black & Veatch Consulting Engineers provides details of the original design of the OGS ZLD Pond at the time of plant construction prior to placement of CCR. Drawings identify original

design contours of the OGS ZLD Pond, as well as detailed cross-sections of the embankments. (Appendix A).

- Field Investigation Soil Borings (1976) – Drawings provide historical soil boring locations and soil boring logs that were completed at OGS in the area of the OGS ZLD Pond (Appendix D)

- Process Flow Diagrams (1976) – Figures prepared by Black & Veatch Consulting Engineers provide layout of plant drainage system to the OGS ZLD Pond (Appendix F)

- Effluent Discharge Diagram (1979) – Figure prepared by Iowa Southern Utilities Company provides flow diagram of OGS Ash Pond, OGS ZLD Pond, and coal pile runoff pond (Appendix F).

- OGS Water Usage (1995) – Figure provides flow chart of various process flows at OGS (Appendix F).

- OGS Water Usage (2003) – Figure provides flow chart of various process flows at OGS (Appendix F).

- Fly Ash Storage Building (2006) – Drawing prepared by Garden & Associates identifies location of the fly ash storage building constructed at OGS west of the generating plant (Appendix F).

- Settling Pond Maintenance Plan (2006) – Drawings prepared by Hard Hat Services provides facility layout and topographic survey with pond volumes (Appendix F).

- OGS ZLD Pond Bathymetric Survey (2015) – Drawing prepared by Hard Hat Services provides a bathymetric surface of the OGS ZLD Pond (Appendix F)

- Monitoring Well Location Map (2016) – Drawing prepared by SCS Engineers provides location of monitoring well installation locations, as well as soil boring logs (Appendix E).

- OGS ZLD Pond Borings (2016) – Drawings prepared by Hard Hat Services provides location of borings, as well as boring logs (Appendix E).

3.2.7 Instrumentation - §257.73(c)(1)(viii)

The OGS ZLD Pond does not have existing instrumentation that supports the operation of the CCR unit. Additionally, review of readily available historical documents has not identified any past instrumentation that was used to support the operation of the OGS ZLD Pond.

3.2.8 Area-Capacity Curve - §257.73(c)(1)(ix)

An area-capacity curve identifies the relationship between the surface area of the existing CCR surface impoundment and an elevation, which corresponds to an available storage capacity. After review of readily available historical documents, there is no readily available information regarding area-capacity curves for the OGS ZLD Pond.

3.2.9 Spillway and Diversion Features - §257.73(c)(1)(x)

The OGS ZLD Pond does not discharge through any permitted outfall and thus the water within the CCR surface impoundment either exfiltrates into the ground or evaporates. Two 48-inch diameter RCPs, located along the south embankment, previously allowed water to flow from the OGS ZLD Pond into the OGS Ash Pond prior to being permanently sealed with concrete.

3.2.10 Construction Specifications, Surveillance, Maintenance, and Repair - §257.73(c)(1)(xi)

OGS implements a Site-Specific Inspection and Maintenance (I&M) Plan[16], in accordance with an Alliant Energy I&M Plan[17]. The Site-Specific I&M Plan has been implemented at OGS in order to identify the factors which may affect the long-term stability of the

[16] Inspection and Maintenance (I&M) Plan, Ottumwa Generating Station, October 2015, Version 2.0-Revision 0.0
[17] Inspection and Maintenance (I&M) Plan, Alliant Energy, September 2015, Version 2.0-Revision 0.0

existing CCR surface impoundment. The Site-Specific I&M Plan identifies existing operation and maintenance activities, and identifies the inspection, monitoring, maintenance, and recordkeeping requirements as outlined in the Alliant Energy I&M Plan in order to maintain the integrity of the existing CCR surface impoundment.

OGS conducts event-related inspections which may include inspections following storm events, seismic events, major maintenance activities, as well as other unusual events. Visual inspections at intervals not exceeding seven days will be initiated in accordance with amendments to §257.83 of the CCR Rule (i.e., the Extension Rule). Annual inspections are conducted by a qualified PE who is familiar with the requirements of the CCR Rule, the Alliant Energy I&M Plan, the OGS Site-Specific I&M Plan, and other facility specific information pertaining to the existing CCR surface impoundment.

Maintenance activities that are completed at OGS may include routine maintenance, event-related maintenance, and long-term maintenance. Routine maintenance activities may include management of vegetation (or other forms of slope protection), tree and sapling removal, reseeding of disturbed vegetated areas, removal of debris from collection and diversion channels, and repair of eroded areas. Event-related maintenance activities may include maintenance after unusual events such as heavy rainfall, periods of very high winds, or seismic activity. Maintenance may include repair of eroded areas or removal of damaged vegetation. Long-term maintenance activities are identified as part of the ongoing inspection program, through the annual inspections, or through other engineering evaluations and may include larger remediation activities.

3.2.11 Structural Instability Records - §257.73(c)(1)(xii)

After review of readily available historical documents, there are no known records of structural instability associated with the OGS ZLD Pond that were identified.

4 CHANGES TO THE HISTORY OF CONSTRUCTION

If there is a significant change to any information compiled within the Report, the owner or operator of the CCR unit must update the relevant information and place into the facility's operating record as required by §257.105(f)(g).

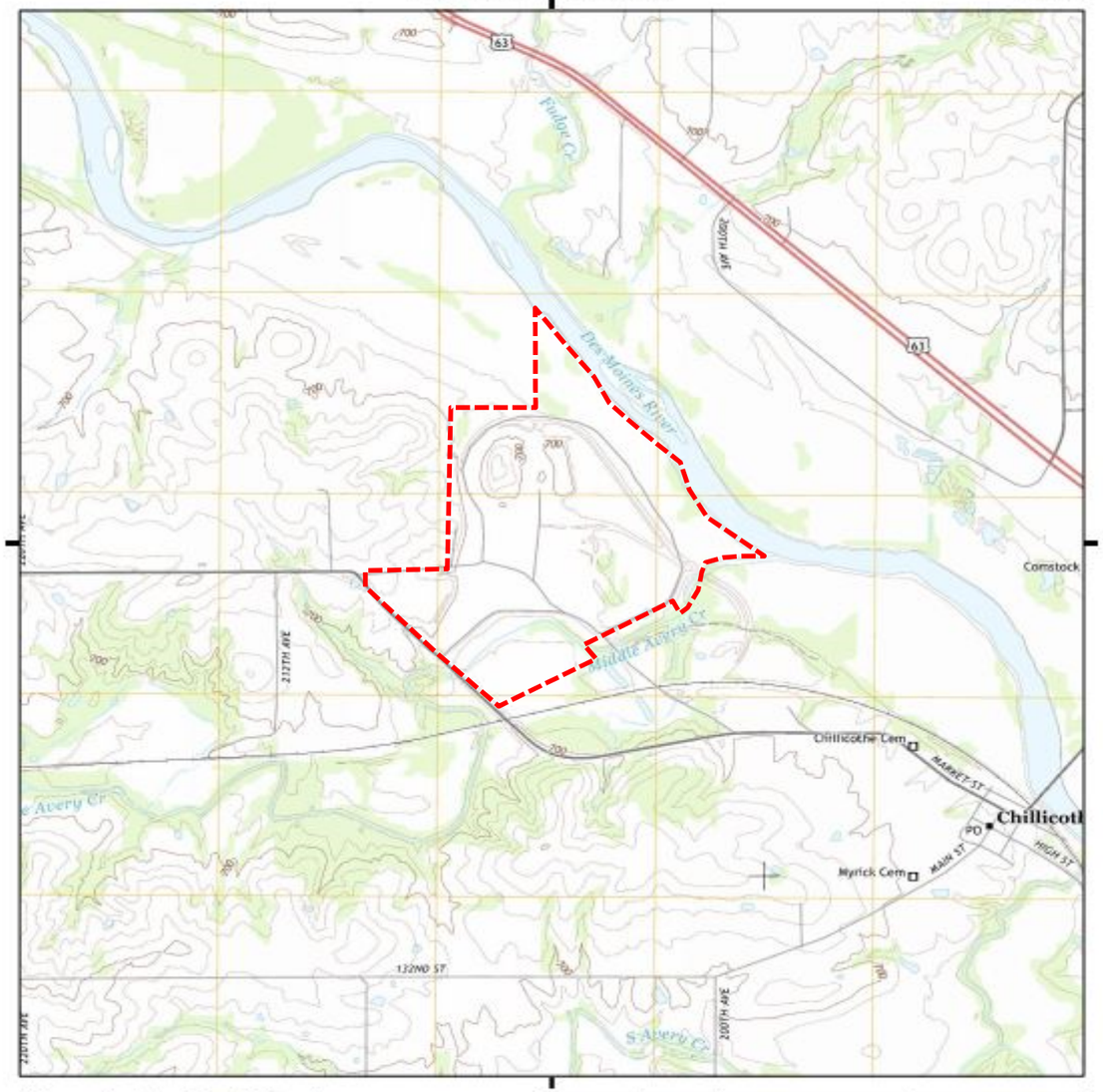
FIGURES

Alliant Energy
Interstate Power and Light Company
Ottumwa Generating Station
Ottumwa, Iowa

History of Construction

Historical Topo Map

2013



This report includes information from the following map sheet(s).

TP, Chillicothe, 2013, 7.5-minute

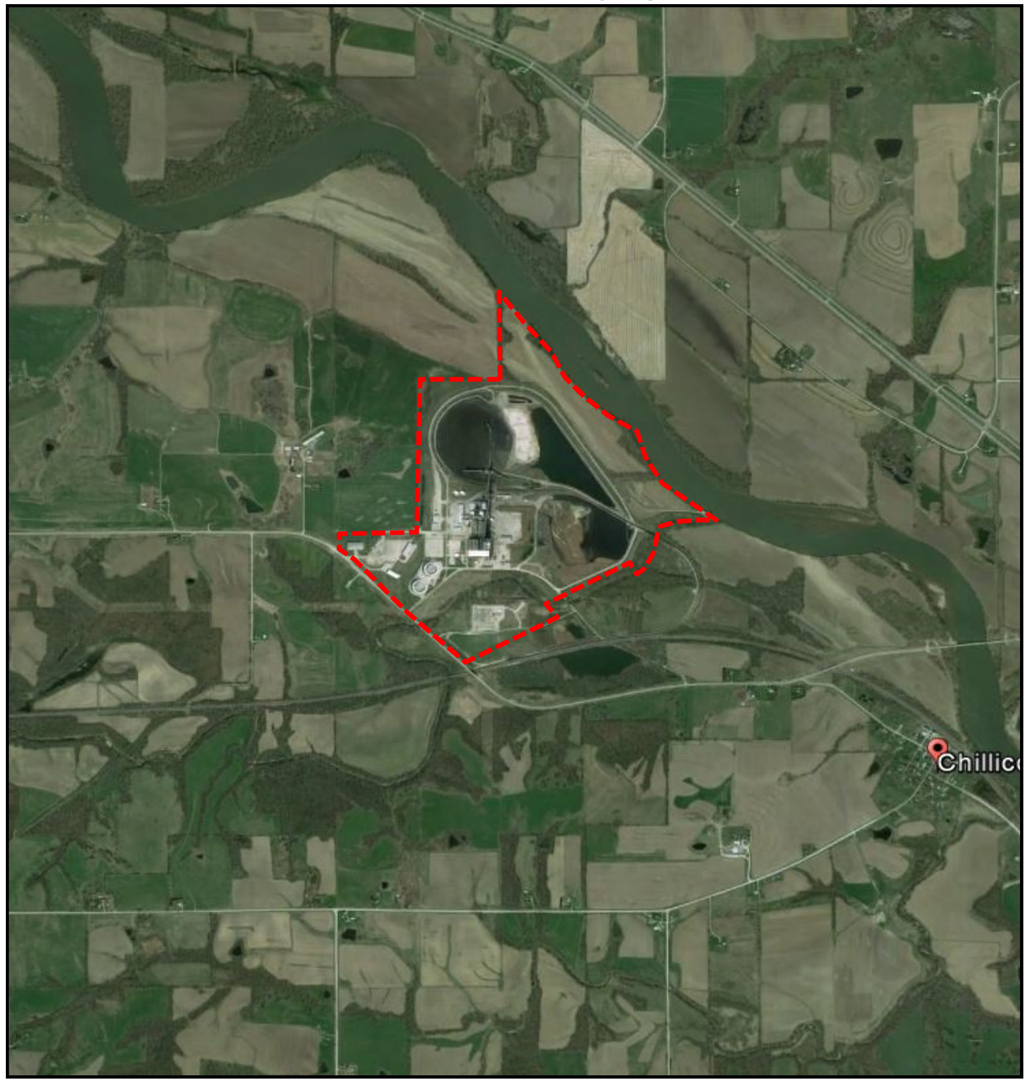
Miles 0.25 0.5 1 1.5

SITE NAME: Ottumwa Generating Station
ADDRESS: 20775 Power Plant Road
Ottumwa, IA 52501
CLIENT: Environmental Site Assessors

N

4555570 - 5 page 4

Historical Aerial Photo 4/13/2016

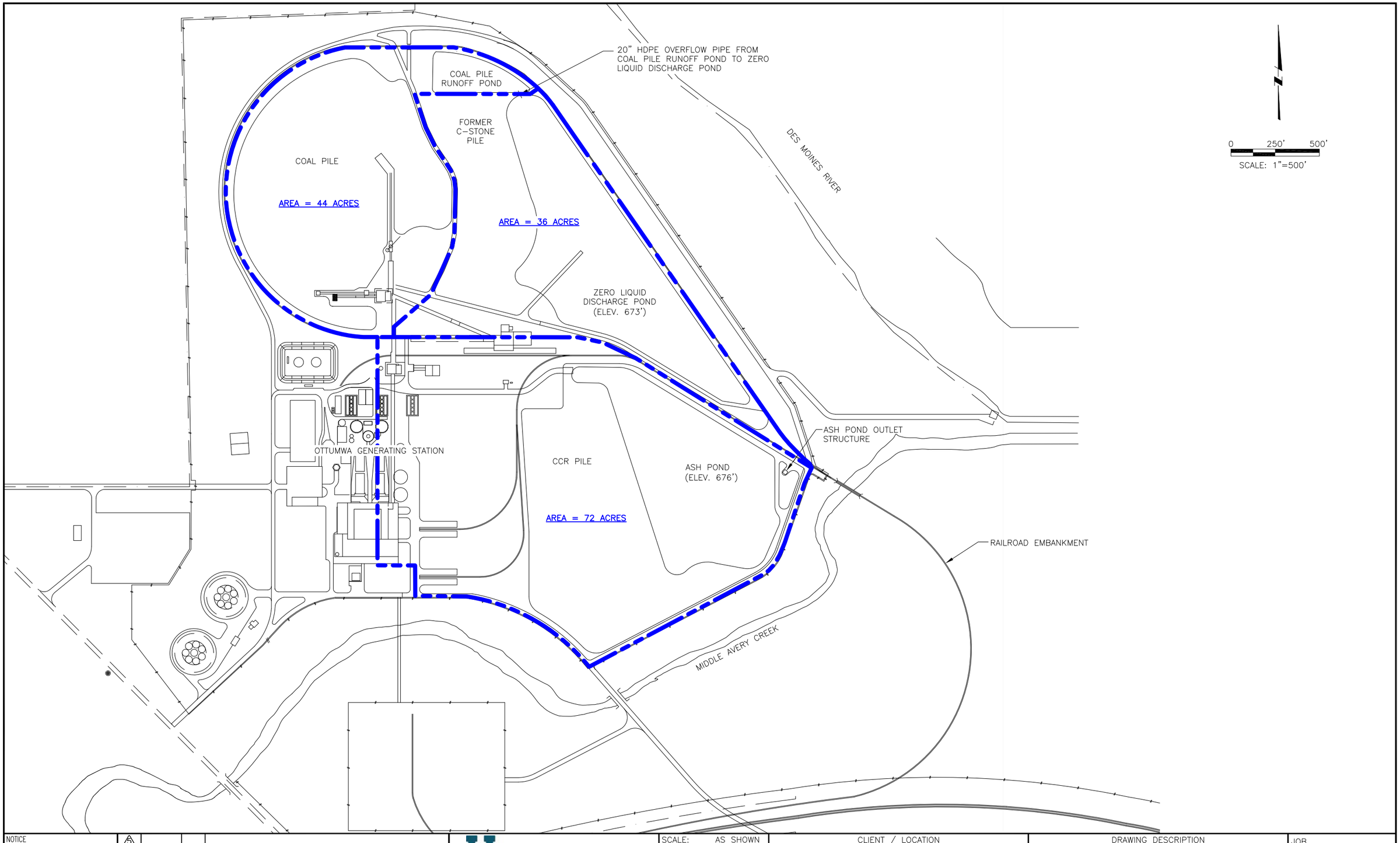


Approximate Property Boundary

HARD HAT SERVICES™
Engineering, Construction and Management Solutions

Site Location
Ottumwa Generating Station
Intersate Power and Light Company

Drawing: Figure 1
Date: 7/12/2016



REV	DATE	BY	DESCRIPTION
5			
4			
3			
2			
1			

hard hat SERVICES
solutions and action

SCALE:	AS SHOWN
DATE:	8-29-16
DRAWN BY:	JFD
CHKD BY:	THJ
APRVD BY:	MWL

CLIENT / LOCATION

INTERSTATE POWER AND LIGHT (IPL)
OTTUMWA GENERATING STATION
OTTUMWA, IA

DRAWING DESCRIPTION

History of Construction

JOB 154.018.002.003

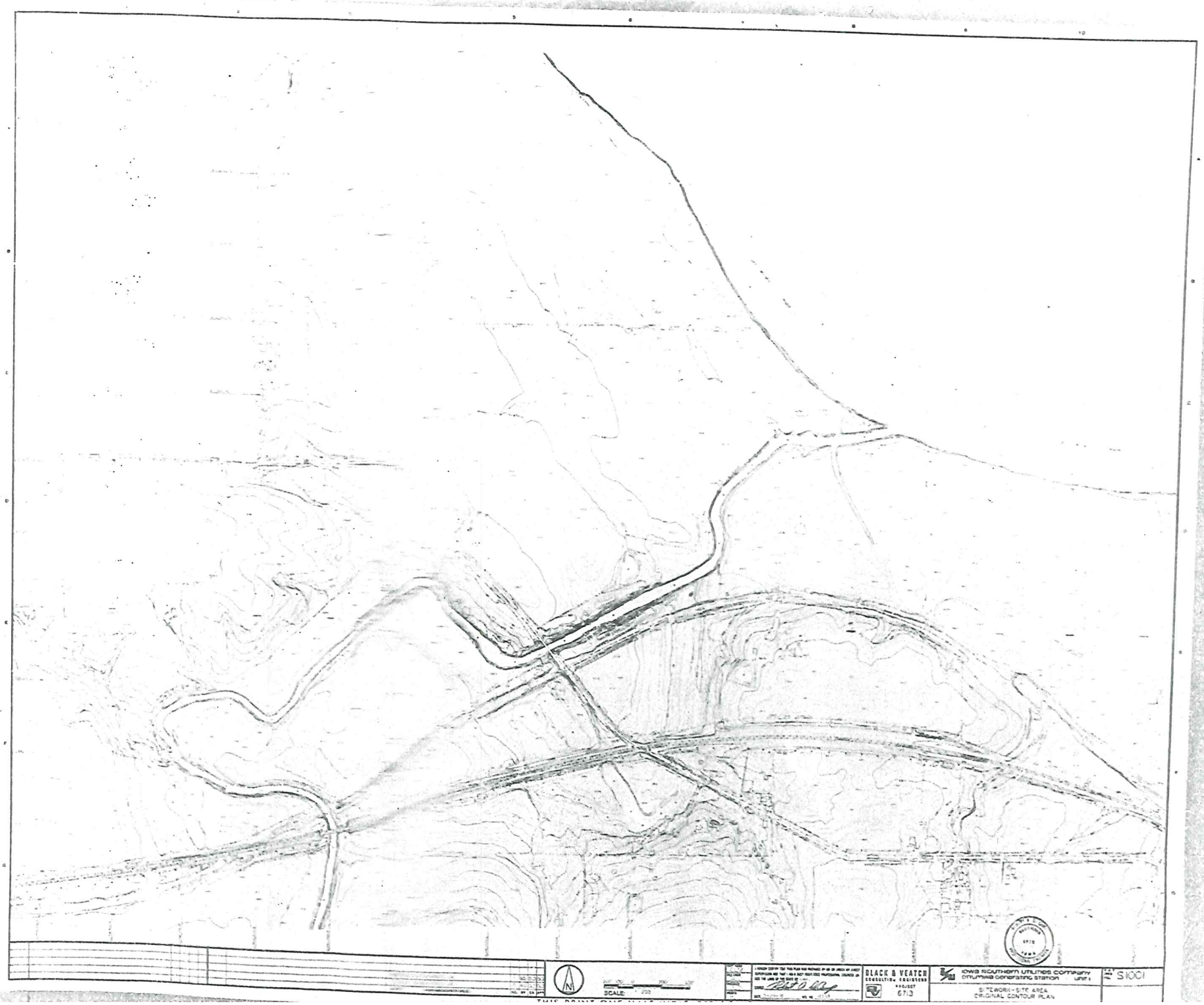
SHT. FIGURE 2

DWG. 154.018.002.003-D2

APPENDIX A – Iowa Southern Utilities Company Historical Site Drawings – 1976

Alliant Energy
Interstate Power and Light Company
Ottumwa Generating Station
Ottumwa, Iowa

History of Construction


SCALE:
BLACK & VEATCH
CONSULTING ENGINEERS
PROJECT
6713
IOWA SOUTHERN UTILITIES COMPANY
CENTERVILLE GENERATING STATION UNIT 1
SITEWORK - SITE AREA
ORIGINAL CONTOUR PLAN
S1001

P.I. CURVE 8	
401,845.34 N	2,261,925.30 E
D = 6°-47'-48"	
Δ = 20°-12'-48"	
R = 843.01'	
T = 150.26'	
L = 297.40'	

ROAD CURVE DATA

P.I. CURVE 9	
400,425 N	2,261,410 E
D=6°-00'-00"	
Δ=:0°-00'-00"	
R= 954.93'	
T= 1 3.23'	
L = 666.67'	

RAILROAD CURVE DATA

P.I. CURVE D, TRACK I	
401,261.27 N	2,262,866.28 E
D=7°-30'-00"	
Δ=24°-28'-28"	
R=763.94'	
T=165.69'	
L=326.33'	

RAILROAD CURVE DATA

P.I. CURVE A, TEMP TK. I	
401,719.41 N	2,261,300 E
D=18°-00'-00"	
Δ=82°-50'-50"	
R=318.31'	
T=280.86'	
L =460.26'	

P.I. CURVE 10	
400,580.00 N	2,262,780.00 E
D=18°00'-00"	
Δ=43°00'-00"	
R=318.31'	
T=125.39'	
L=238.89'	

P.I. CURVE H, TRACK I	
401,865 N	2,261,842.94 E
D= 7°-00' -00"	
Δ= 31°-121-48"	
R=818.51'	
T= 2 28.64'	
L = 445.90'	

P.I. CURVE B, TEMP. TK. I	
400 804 N	2,261,300 E
D=18°-00'-00"	
Δ=90°-00'-00"	
R= 318.31'	
T= 318.31'	
L = 500.00'	

P.I. CURVE 11	
401,136.72 N	2,2263,074.48 E
D=33°00'-00"	
Δ=45°00'-00"	
R=175.00'	
T=72.49'	
L=136.36'	

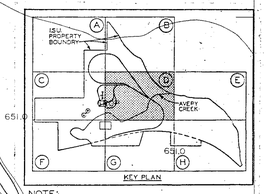
P.I. CURVE A, TRACK II	
400,765 N	2,261,962.67 E
D=14°-00'-00"	
Δ=26°-00'-30"	
R=409.26'	
T=94.52'	
L=185.07'	

P.I. CURVE A, TEMP. TK. II	
400,535 N	2,261,402.28 E
D=18°-00'-00"	
Δ=97°-03'-10"	
R=318.31'	
T=360.75'	
L=539.73'	

P.I. CURVE I, TRACK I	
401,203.18 N	2,262,935.13 E
D=7°-00'-00"	
Δ=59°-12'-18"	
R=818.51'	
T=37.20'	
L=74.36'	

P.I. CURVE C, TRACK I	
399,567.22 N	2,265,662.02 E
D=6° 53'-19"	
Δ=142°-30' 54"	
R=831.75'	
T=2452.38'	
L = 2068.81'	

P.I. CURVE J, TRACK I	
399,576.67 N	2,265,619.52 E
D= 7°00'-24"	
Δ=142°-30'-44"	
R=817.75'	
T=2409.85'	
L=2033.99'	



NOTE:
SEE DWG S1003 FOR LEGEND AND GENERAL NOTES.

REV	DATE	DESCRIPTION	APPRV
0	07/07/04	DIGITIZED DWG	JP
Ottumwa Generating Station			Unit 1
SITEWORK - AREA D GRADING PLAN			
1-2035-1-D-C1005			

TOPOGRAPHIC MAPPING NOTES AND LEGEND

PHOTOGRAPHED MAR 19, 1975
BY
K. B. MacKICHAN & ASSOCIATES, INC.
Grand Forks, N. D.

LEGEND

INDEX CONTOUR	670	INTERMEDIATE CONTOUR		ROAD (PAVED)	
PLOTTER ELEVATION	671.4	FIELD ELEVATION	671.44	BUILDING	
FENCE		CULVERT		FIELD LINE	FL
TREES		RIVER, LAKE, STREAM		SWAMP, SLOUGH	
				ROAD (UNPAVED)	
				POLE	
				SIGN	
				WATER	

NOTES
1. CONTOURS CROSSING WATER ARE ON TOP OF THE WATER
2. THE PLOTTER ELEVATION DECIMAL IS THE SPOT WHERE THE READING WAS TAKEN OTHERWISE AN "X" WILL MARK THE SPOT
3. THE GRIDS ARE BASED ON THE IOWA STATE PLAIN COORDINATE SYSTEM, SOUTHERN ZONE
4. ELEVATION DATUM, MEAN SEA LEVEL

SCALE 1"= 100'
CONTOUR INTERVAL 2'

NO.	BY	CK	APP	REVISIONS AND RECORD OF ISSUE	DATE
3	BD	LWC	VEA	ISSUED FOR CONSTRUCTION, SPEC S-30A	8-6-76
2	BD	DLD	DLD	ISSUED FOR BID, SPEC S-30A	4-15-76
1	BD	DLD	DLD	ISSUED FOR CONTRACT C-6A	9-29-76
0	BD	DLD	DLD	ISSUED FOR BID, SPEC C-6A	2-2-76
5				CONFORMED TO CONSTRUCTION RECORDS	3-30-82
4				REFERENCE ISSUE NO. 1	12-23-77
3	BD	LWC	VEA	REVISED R.R. FOR FIELD MODIFICATION & MISC. REVISION	8-6-76

SCALE: 1"=100'

DEPT HEAD	CLM
DES ENGR	DLD
CHECKED	DLD
DRAWN	MEF/BD

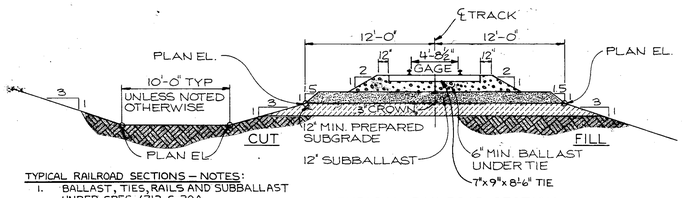
I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF IOWA.
SIGNED _____ DATE 3-29-76 REG. NO. 4938

BLACK & VEATCH CONSULTING ENGINEERS
PROJECT 6713

IOWA SOUTHERN UTILITIES COMPANY
OTTUMWA GENERATING STATION · UNIT 1

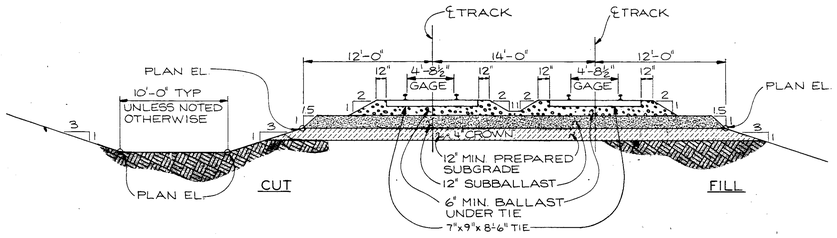
SITEWORK - AREA D
GRADING PLAN

B & V DWG NO. S1005

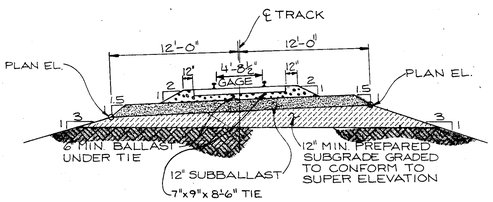


TYPICAL RAILROAD SECTIONS – NOTES:
1. BALLAST, TIES, RAILS AND SUBBALLAST UNDER SPEC. 6713 S-30A

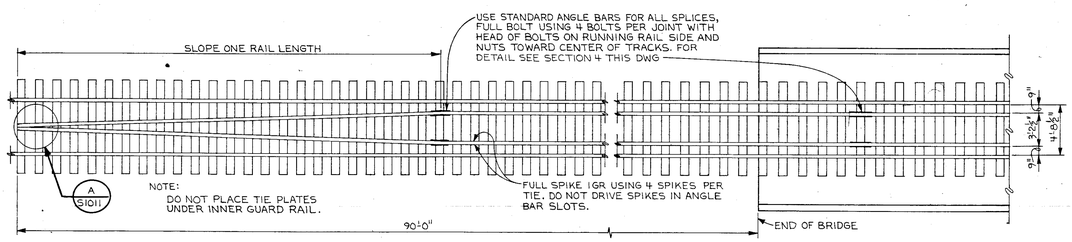
TYPICAL RAILROAD SECTION
SINGLE TRACK
SCALE: 3/16" = 1'-0"



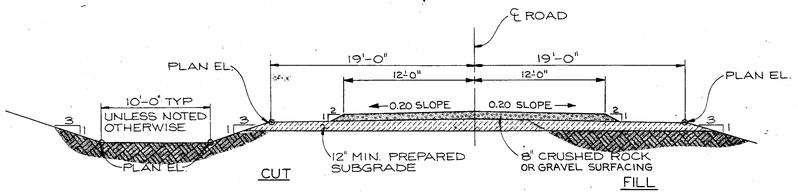
TYPICAL RAILROAD SECTION
DOUBLE TRACK
SCALE: 3/16" = 1'-0"



SUPERELEVATED TRACK SECTION
SCALE: 3/16" = 1'-0"

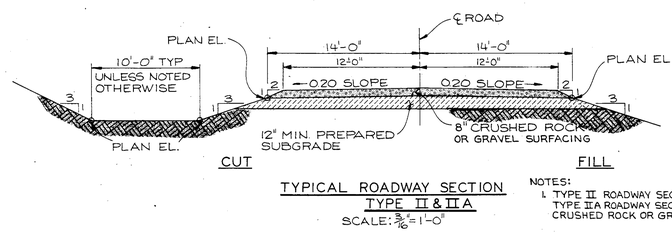


PLAN OF INNER GUARD RAIL ON BRIDGE
SCALE: 3/16" = 1'-0"



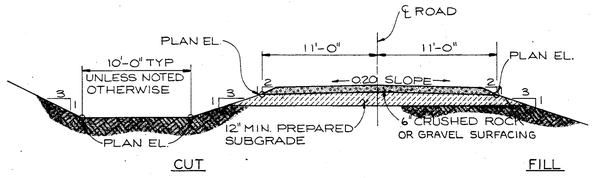
TYPICAL ROADWAY SECTION
TYPE I & IA
SCALE: 3/16" = 1'-0"

NOTES:
1. TYPE I ROADWAY SECTION AS SHOWN, TYPE IA ROADWAY SECTION WITHOUT CRUSHED ROCK OR GRAVEL SURFACING



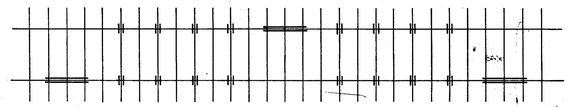
TYPICAL ROADWAY SECTION
TYPE II & IIA
SCALE: 3/16" = 1'-0"

NOTES:
1. TYPE II ROADWAY SECTION AS SHOWN TYPE IIA ROADWAY SECTION WITHOUT CRUSHED ROCK OR GRAVEL SURFACING



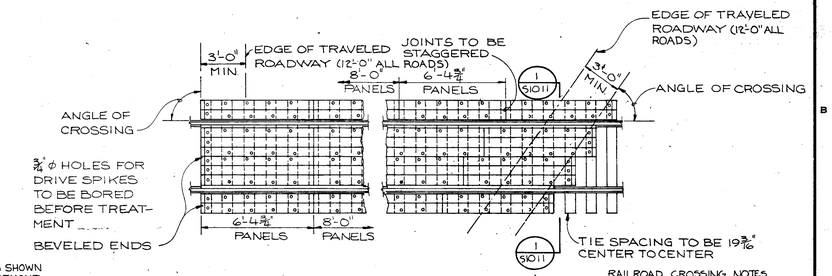
TYPICAL ROADWAY SECTION
TYPE III & III A
SCALE: 3/16" = 1'-0"

NOTES:
1. TYPE III ROADWAY SECTION AS SHOWN TYPE III A ROADWAY SECTION WITHOUT CRUSHED ROCK OR GRAVEL SURFACING



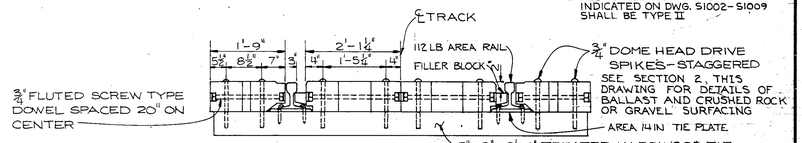
8 FORWARD AND 8 BACK UP RAIL ANCHORS PER RAIL LENGTH.

TYPICAL RAIL ANCHOR DETAIL
NO SCALE

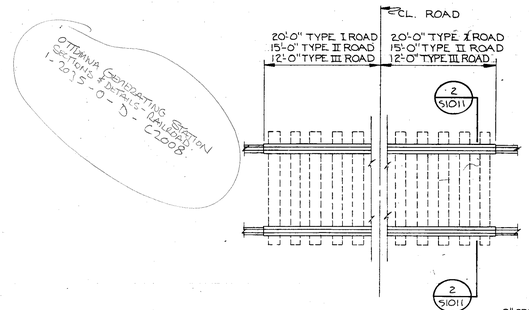


TYPE I RAILROAD CROSSING
NO SCALE

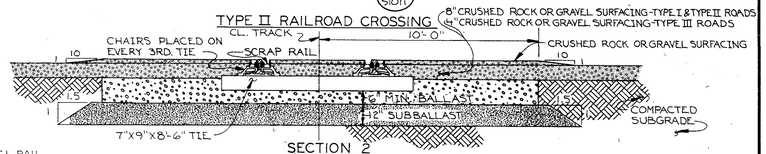
RAILROAD CROSSING NOTES
1. CROSSING (COMPLETE) UNDER SPEC. 6713 S-30A
2. SEE DWGS S1002-S1010 FOR LOCATIONS OF RAILROAD CROSSINGS
3. ALL STRAIGHT TRACK CROSSING INDICATED ON DWG. S1002-S1010 SHALL BE TYPE I
4. ALL CURVED TRACK CROSSINGS INDICATED ON DWG. S1002-S1009 SHALL BE TYPE II



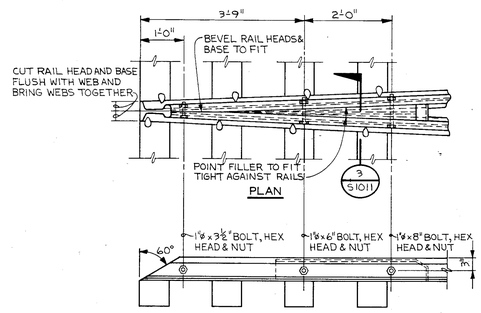
SECTION 1
NO SCALE



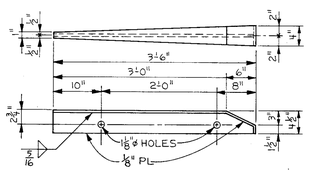
TYPE II RAILROAD CROSSING



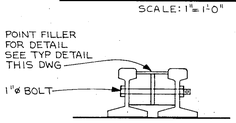
SECTION 2
NO SCALE



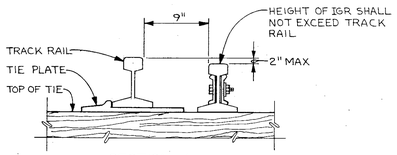
POINT DETAIL A
SCALE: 3/4" = 1'-0"



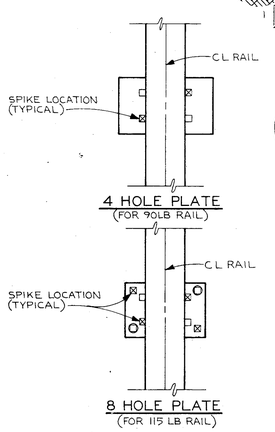
TYPICAL POINT FILLER DETAIL
SCALE: 1" = 1'-0"

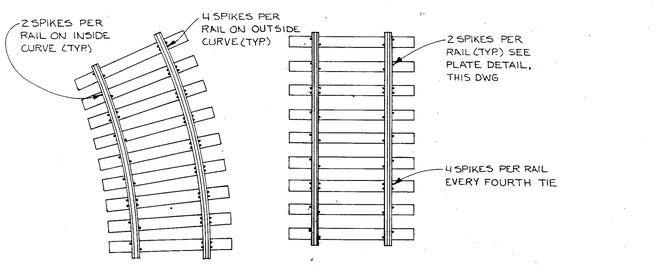


SECTION 3
NO SCALE



SECTION 4
NO SCALE





WOOD TIE SPIKING DETAIL
NO SCALE

NO.	DATE	DESCRIPTION	APPRV
3	07/07/94	DIGITIZED DWG	MP MP
REV	DATE	DESCRIPTION	APPRV

Ottumwa Generating Station Unit 1
SITEWORK - SITE AREA
SECTIONS AND DETAILS
1-2035-1-D-C1011

ROBERT A. DE CAMP
REGISTERED
4938
IOWA
PROFESSIONAL ENGINEER

DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK	APP
8-6-76	ISSUED FOR CONSTRUCTION, SPEC. S-30A	3	BD	LWC	VEA
4-15-76	ISSUED FOR BID, SPEC S-30A	2	BD	DLD	DLD
3-29-76	ISSUED FOR CONTRACT C-6A	1	BD	DLD	DLD
2-2-76	ISSUED FOR BID, SPEC. G6A	0	BD	DLD	DLD
2-22-82	CONFORM TO CONSTRUCTION RECORDS	4			

SCALE: AS NOTED

DEPT HEAD CLM
DES ENGR DLD
CHECKED DLD
DRAWN MEF/BD

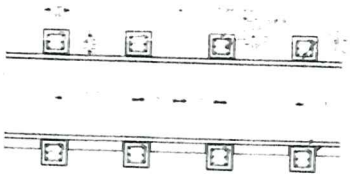
I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF IOWA.
SIGNED Robert A. DeCamp
DATE 3-29-76 REG. NO. 4938

BLACK & VEATCH
CONSULTING ENGINEERS
PROJECT 6713

IOWA SOUTHERN UTILITIES COMPANY
OTTUMWA GENERATING STATION - UNIT 1

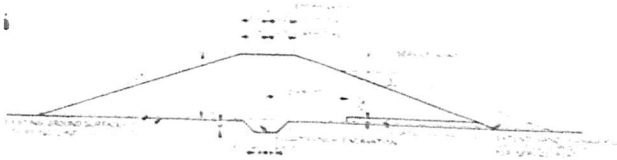
SITEWORK-SITE AREA
SECTIONS AND DETAILS

B & V DWG NO. S 1011

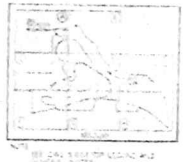


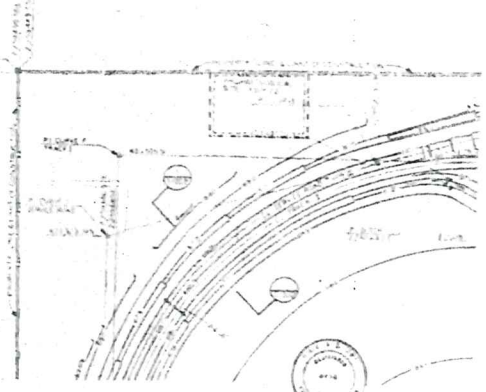
TYPICAL SEEPAGE COLLAR SECTION 3

TYPICAL RIPRAP TOE DETAIL
ASH POND 2



EMBANKMENT SECTION





TOPOGRAPHIC MAPPING NOTES AND LEGEND

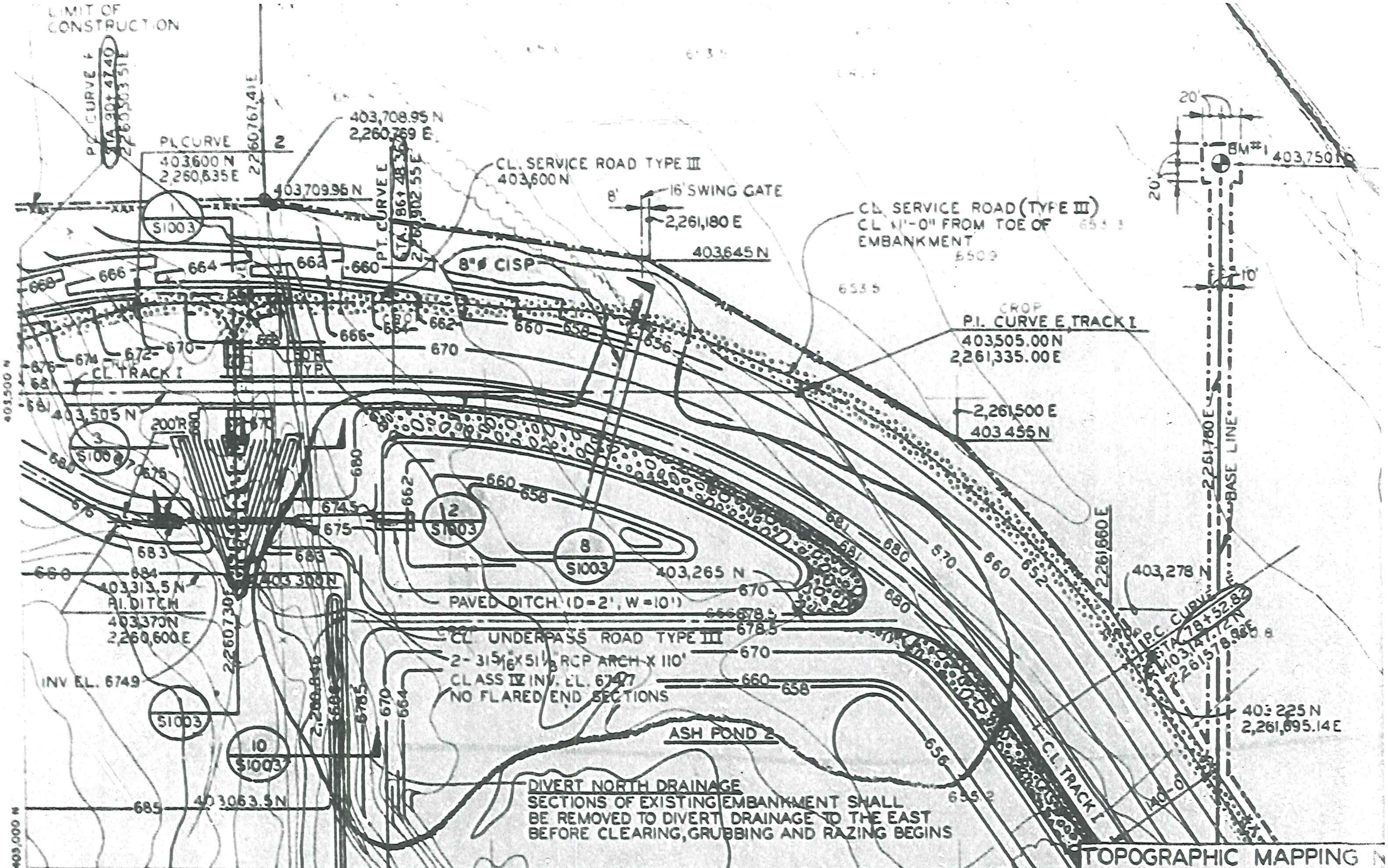
SCALE

BLACK & VEATCH
ENGINEERING ARCHITECTURE

IOWA SOUTHERN UTILITIES COMPANY
OTTUMWA GENERATING STATION UNIT 1

SITEWORK - AREA 4
GRADING PLAN

S100.2

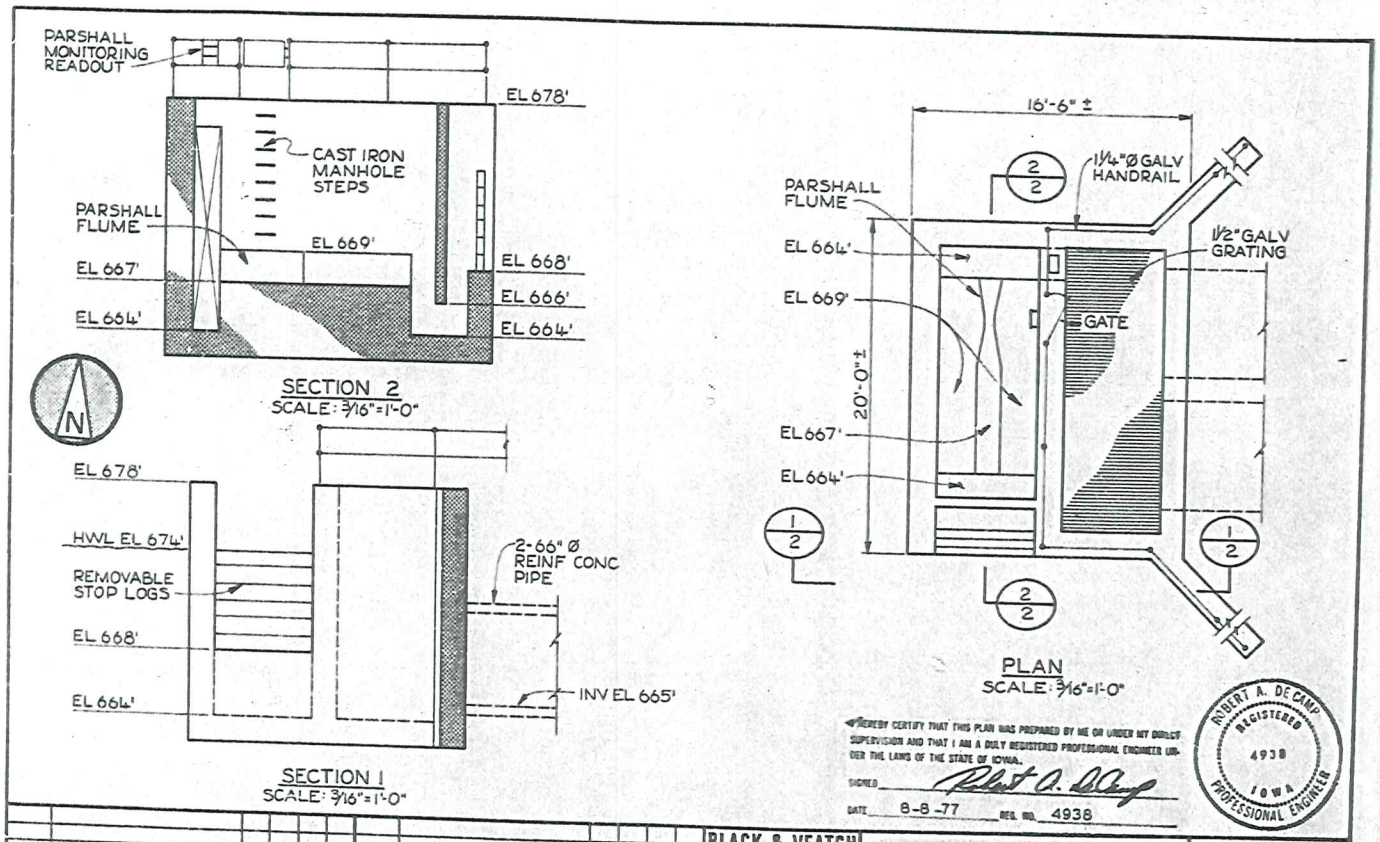


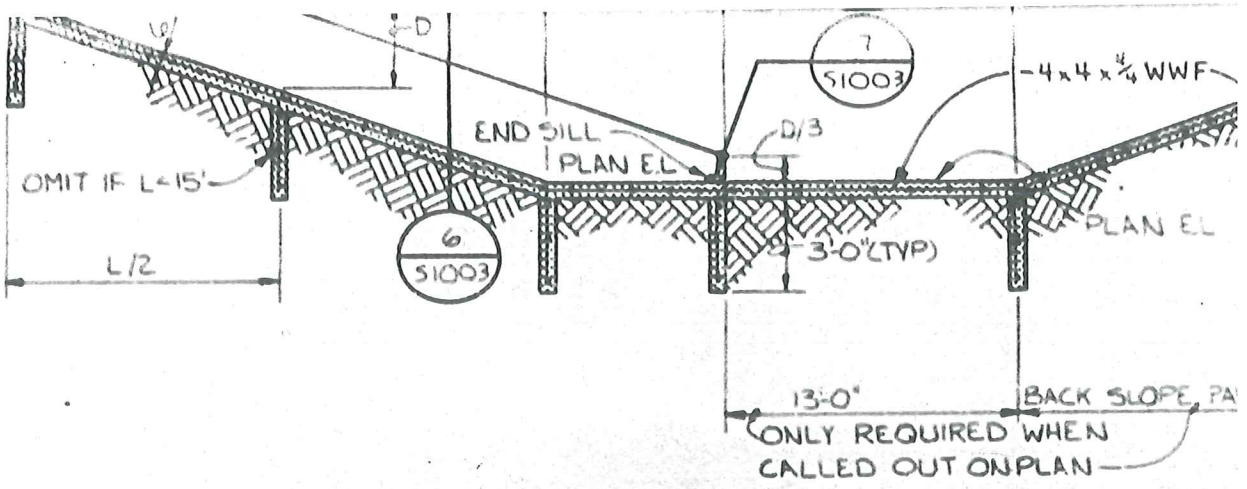
PHOTOGRAPHED MAR. 19, 1975
BY
K.B. MacKICHAN & ASSOCIATES, INC.
Grand Forks, N.D.

LEGEND

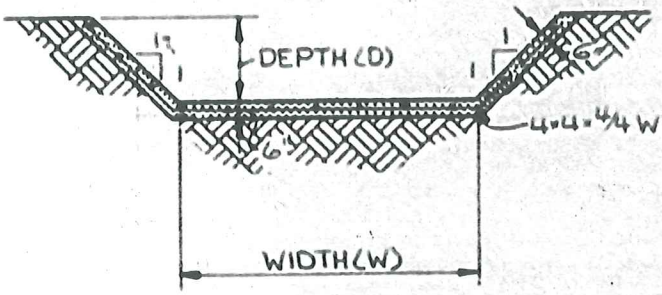
INDEX CONTOUR	— 670 —	INTERMEDIATE CONTOUR		ROAD (PAVED)	ROAD (UNPAVED)
PLOTTER ELEVATION	671.4	FIELD ELEVATION	671.4+	BUILDING	POLE
FENCE	— x —	CULVERT		FIELD LINE — FL —	SIGN
TREES		RIVER LAKE, STREAM		SWAMP, SLOUGH	WATER

			8-6-76	ISSUED FO
			4-15-76	ISSUED FO
			3-29-76	ISSUED FO
			2-2-76	ISSUED FO
8-6-76	ADDED COAL YARD CATCH BASIN & PROPERTY LINE	3 BD LWC VEA	DATE	

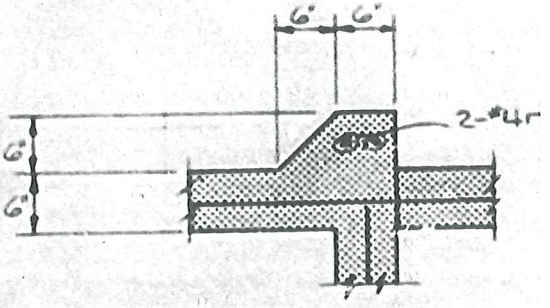

PARSHALL MONITORING READOUT
EL 678'
CAST IRON MANHOLE STEPS
PARSHALL FLUME
EL 669'
EL 667'
EL 668'
EL 666'
EL 664'
SECTION 2
SCALE: 3/16"=1'-0"
N
EL 678'
HWL EL 674'
REMOVABLE STOP LOGS
EL 668'
EL 664'
2-66" Ø REINF CONC PIPE
INV EL 665'
SECTION 1
SCALE: 3/16"=1'-0"
16'-6" ±
1¼"Ø GALV HANDRAIL
PARSHALL FLUME
EL 664'
EL 669'
1½" GALV GRATING
GATE
20'-0" ±
EL 667'
EL 664'
PLAN
SCALE: 3/16"=1'-0"
I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF IOWA.
SIGNED
DATE 8-8-77 REG. NO. 4938
ROBERT A. DE CAMP REGISTERED 4938 IOWA PROFESSIONAL ENGINEER
DATE REVISION OR ISSUE NO. BY CK APP
BLACK & VEATCH CONSULTING ENGINEERS
PROJECT 6713
IOWA SOUTHERN UTILITIES COMPANY
OTTUMWA GENERATING STATION - UNIT 1
ASH POND OUTFALL STRUCTURE
SK-S-080877-2



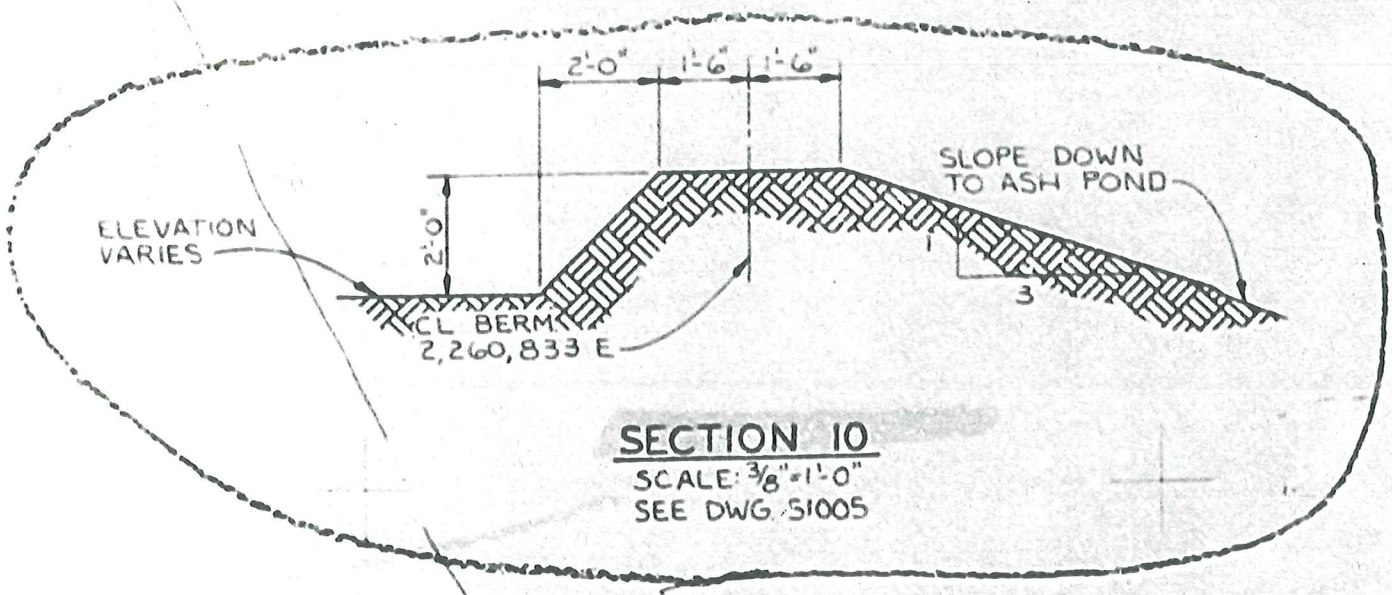
SECTION 5
SCALE: 3/16"=1'-0"



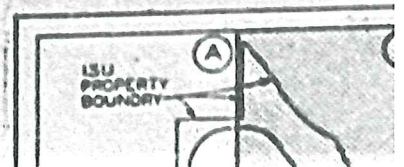
SECTION 6
SCALE: 3/16"=1'-0"

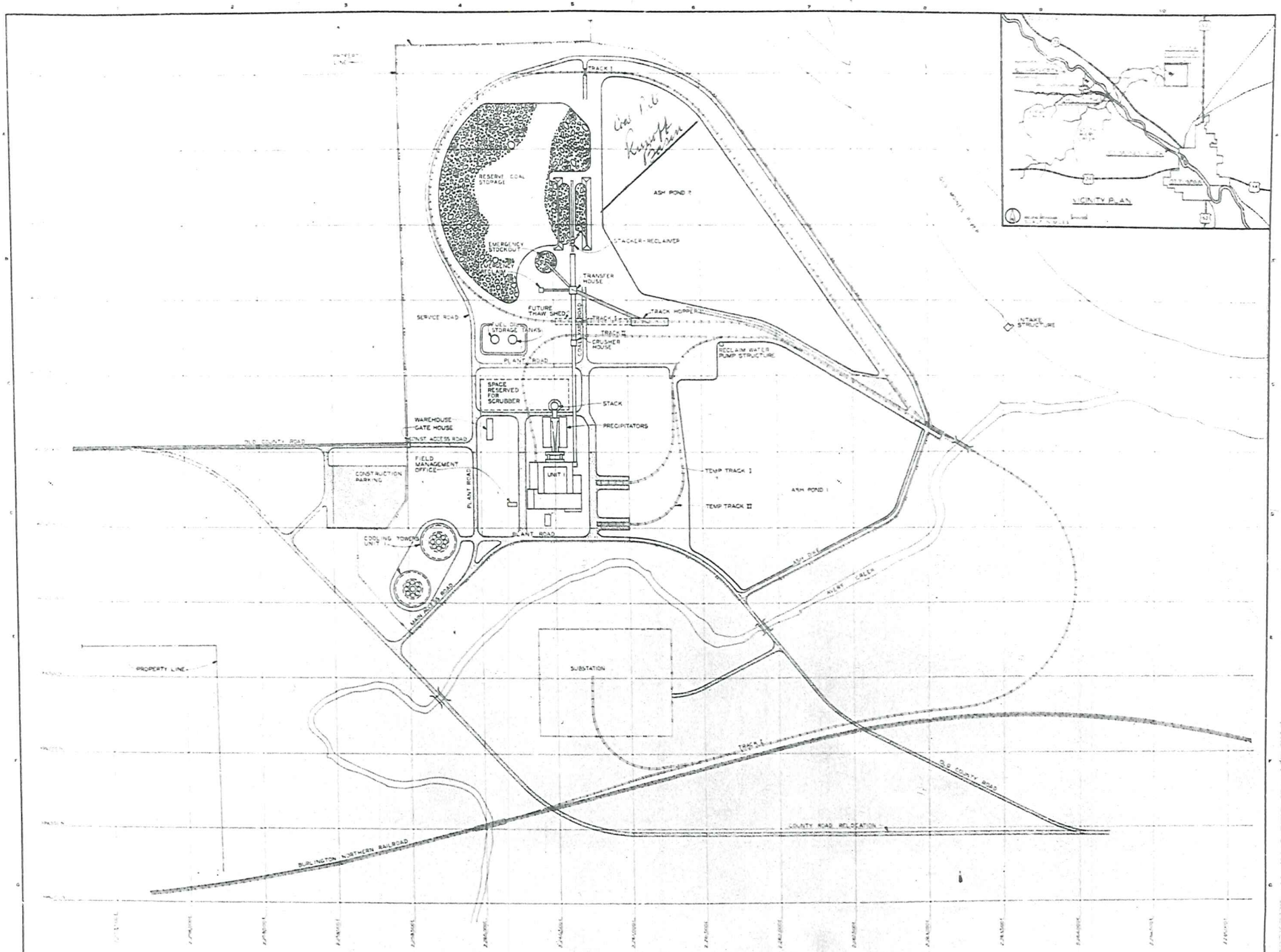


DETAIL 7
SCALE: 3/4"=1'-0"



SECTION 10
SCALE: 3/8"=1'-0"
SEE DWG. S1005





THIS PRINT ONE-HALF INDICATED SCALE

BLACK & VEATCH CONSULTING ENGINEERS

Iowa Southern Utilities Company
Ottumwa Generating Station Unit 1

ARRANGEMENT - SITE AREA

DWG. NO. A0001

PARTIAL STACKER-RECLAIMER RUNWAY PLAN
SCALE: 1"=50'-0"

MATCH LINE SEE PARTIAL PLAN THIS DWG

MATCH LINE SEE THIS DWG

NOTE: FOR COAL PILE RUNOFF POND DETAILS, SEE DETAILS T & U, DWG S1022.

EMERGENCY RECLAIM STRUCTURE

CONV 4 DRIVE HOUSE

TRANSFER HOUSE

CRUSHER HOUSE

DUMPER HOUSE

FUEL OIL PUMPING STATION

E.O. TANKS

SEWAGE TREATMENT PLANT

RECYCLE WATER PUMP STRUCTURE

AGGREGATE SURFACING (DET A S1022)

HIGH POINT 6840
402,095.76 N
2,260,853.36 E

LONGITUDINAL JOINT SEE DTL. B S1021

EJ INDICATES EXPANSION JOINT SEE DTL. C S1021

CJ INDICATES CONTRACTION JOINT, SEE DTL. D S1021

CONC. PAVING

EJ INDICATES EXPANSION JOINT (TYP)

CJ INDICATES CONTRACTION JOINT (TYP)

1-19"x 30" RCP ARCH CLASS IV W/FLARED END SECTIONS INV EL 677.75'

EXTEND 26"x 43" RCP ARCH PIPE 102' TO THE WEST

12" THICK QUARRY RUN RIPRAP

SIDE CHANNEL SLOPE MAY BE NO GREATER THAN 2:1

FOR CROSSING DETAILS SEE SECTION 5 DWG S1022

END OF PAVING TO MEET EXIST ROAD SURFACING APPROX 2,261,600 E (FIELD CHECK)

TOP OF CATCH BASIN EL 677.75

INVERT EL 674.17'

INV EL 677.43'

402,640.62 N
2,261,550.75 E

402,274.00 N
2,261,744.60 E

401,972.38 N
2,261,958.50 E

402,130.26 N
2,260,719.0 E

402,094.25 N

402,103 N

402,090.26 N

401,909.87 N

401,883.47 N

402,349 N

401,865 N

401,702 N

401,670 N

401,575 N

2,261,035 E

2,261,550 E

2,261,594

2,261,700 E

2,261,290 E

EL 683.5

EL 683.50'

EL 683.83'

EL 684.00'

75.0'

72.0'

REV	DATE	DESCRIPTION	APPRV
1	2/20/84	DIGITIZED DWG	HP

Ottumwa Generating Station — Unit 1
SITEWORK - NORTH YARD
FINISH GRADING AND PAVING PLAN
1-2035-1-D-C1018

NO.	DATE	REVISIONS AND RECORD OF ISSUE	BY	CK	APP
3	2-22-82	CONFORM TO CONSTRUCTION RECORDS			
2	4-9-79	GENERAL REVISIONS, SPEC C-6C	DEG	DRN	VSJ
1	12-23-77	ISSUED FOR CONSTRUCTION, SPEC. C-6C	RS	LC	FH
0	9-6-77	ISSUED FOR BIDS, SPEC C-6C			

SCALE: 1"=50'

DEPT HEAD VHS
DES ENGR VEA
CHECKED BRS
DRAWN MSS

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF IOWA.
SIGNED Robert A. DeGarmo
DATE 12-23-77 REG. NO. 4938

ROBERT A. DE GARMO REGISTERED 4938 IOWA PROFESSIONAL ENGINEER

BLACK & VEATCH CONSULTING ENGINEERS
PROJECT 6713

IOWA SOUTHERN UTILITIES COMPANY
OTTUMWA GENERATING STATION - UNIT 1

SITEWORK-NORTH YARD
FINISH GRADING AND PAVING PLAN

B&V DWG NO. S1018

401,750 N
END PAVING

EXTEND EXISTING 18"x 28½" RCP PIPE AN ADDITIONAL 10'

FOR CROSSING DETAILS SEE SECTION 5 DWG S1022

CHIMNEY

2,260,509 E

2,260,715 E
401,320 N

CONDENSATE TANK

401,320 N

401,250 N

401,280 N

AGGREGATE SURFACING (DETAIL A S1022)

AGGREGATE SURFACE (DETAIL A S1022)

401,250 N

401,155 N

FLY ASH SILO
2,260,315 E

4" EXP JT MATL BETWEEN SLAB AND ROAD

SLOPES

HIGH POINT EL 684.0'

PRECIPITATOR

SURGE TANK

SOLIDS CONTACT UNIT 2

401,105 N

WASTE SUMP

SOLIDS CONTACT UNIT 1

401,045 N

SLAB FURNISHED UNDER SEPARATE SPECIFICATIONS

401,010 N

TOP OF CB EL 683.5'
684.83
400,976.16 N

RR TRACK FURNISHED AND INSTALLED UNDER SPEC. C-6C

TYP 7 PLACES

INTERCEPT EXIST PIPE AT INV EL 678.0' (FIELD CHECK)
400,950 N

2,260,150 E

400,910 N

TOP OF CURB EL 684.67'
TOP OF CB EL 683.67'
TOP OF PAVING EL 684.17'
TOP OF CROWN EL 684.0'

WAREHOUSE

EXISTING MH
PIPE INV EL 679.5'

FOR CURB DET. SEE DET E DWG S1022

TOP OF PAVING EL 683.83'

CONCRETE PAVING

EXISTING M.H
PIPE INV EL 679.5

EDGE OF PAVING EL 683.5'
400,770 N
2,260,325 E
TOP OF CB EL 683.5'

MAIN PLANT

400,749 N

TOP OF PAVING EL 683.83'
SIDEWALK PAVING (4' WIDTH)
FOR CURB DET. SEE DET E DWG S1022
TOP OF SIDEWALK EL 684.67'
TOP OF CROWN EL 684.0'
EDGE OF PAVING EL 683.5'
TOP OF CURB EL 684.67'

400,643 N

SIDEWALK PAVING (WIDTH OF 4'-0")

FLAG POLE. L 00611.5 N
2260.327 E DETH. DWG S1022

EXISTING M.H
PIPE INV EL 679.5

400,620 N

TOP OF CB 683.5'
2,260,445 E

400,574.5 N

C.W. PUMP BASIN

TRANSFORMER FOUND

6" GRANULAR FILL

TOP OF CURB EL 684.33'
TOP OF PAVING EL 683.83'
EDGE OF PAVING EL 683.83'

TOP OF CURB EL 684.0'

TOP OF CURB EL 684.5'

TOP OF PAVING EL 684.0'

2,260,477 E

2,259,960 E

TEMPORARY RR TRACK FURNISHED AND INSTALLED UNDER SPEC. C-6C

TYP

MATCH LINE SEE DWG S1021

TOP OF CB EL 683.67'
TOP OF CROWN EL 684.0'
TOP OF CURB EL 684.33'
SEE DETAIL E DWG S1022
EXISTING CATCH BASIN

PIPE INV 681.0'

TOP OF CROWN EL 684.0'

PIPE INV EL 681.0'

2,260,285 E

2,260,000 E

2,260,500 E

2,260,795 E

2,261,000 E

MATCH LINE-SEE DWG S1020

400,425 N

AGGREGATE SURFACING

OUTFALL STRUCTURE

400,475 N

INV EL 677.00

400,500 N

2,261,760 E

2,261,825 E

EXISTING CONTOUR (TYP)
FINISH CONTOUR (TYP)

MATCH LINE - SEE DWG S1018

TOC EL 680'-8½"

TOC EL 680'-5¼"

TOC EL 679'-9⅝"

TOC EL 679'-8¼"
401,499.974 N
2,261,390.468 E

401,501.5 N

TOC EL 679'-1¾"
2,261,379.368 E
401,494.178 N

TOC EL 678'-11¾"

401,494.206 N

TOC EL 678'-11⅛"

2,261,384.178 E

DETAIL A
SCALE: 3/16"=1'-0"

401,500 N

4'-0"

6'-0"

22.5°

2,260,761.676 E

PLAN DIM

3'-0"

3'-0"

10" PIPES BY OTHERS

3" FOR SHIMS

FOR ELEVATION SEE PLAN

24"ø PIER

8'-0"

SECTION 1
SCALE: 3/8"=1'-0"

PLAN DIM

1'-6"

#5 (TYP)

12"

#4@12

SECTION 2
SCALE: 3/8"=1'-0"

8-#5

#4@12"

SECTION 3
SCALE: 3/8"=1'-0"

3" FOR SHIMS

10" ø PIPE BY OTHERS

FOR ELEVATION SEE PLAN

30" ø PIER

8'-0"

9-#6

SEE PLAN FOR LOCATION

#4@12"

SECTION 5
SCALE: 3/8"=1'-0"

SECTION 4
SCALE: 3/8"=1'-0"

REV	DATE	DESCRIPTION	APPRV
3	010704	DIGITIZED DWG	

Ottumwa Generating Station — Unit 1

SITEWORK - CENTER YARD
FINISH GRADING AND PAVING PLAN
1-20335-1-D-C1019

ROBERT A. DE YOUNG
REGISTERED
4938
IOWA
PROFESSIONAL ENGINEER

DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK	APP
6-14-79	ADDED PIPE SUPPORTS, SPEC. C-6C	3	EMD	RNV	EA
12-23-77	ISSUED FOR CONSTRUCTION, SPEC C-6C	2	RSL	C	FH
10-6-77	ISSUED WITH ADDENDUM 1, SPEC C-6C	1			
9-6-77	ISSUED FOR BIDS, SPEC. C-6C	0			
6-29-79	GENERAL REVISIONS, SPEC C-6C	4	DES	DRN	VEA
8-15-79	GENERAL REVISIONS, SPEC C-6C	5	DES	DRN	VEA
2-22-82	CONFORM TO CONSTRUCTION RECORDS	6			

SCALE: 1"=50'

DEPT HEAD	VHS
DES ENGR	VEA
CHECKED	BRS
DRAWN	MSS

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF IOWA.
SIGNED: Robert A. DeYoung
DATE 12-23-77 REG. NO. 4938

BLACK & VEATCH CONSULTING ENGINEERS
PROJECT 6713

Iowa Southern Utilities Company
Ottumwa Generating Station - Unit 1

SITEWORK-CENTER YARD
FINISH GRADING AND PAVING PLAN

B&V DWG NO. S 1019

APPENDIX B – EDR Historical Aerial Photograph Package

Alliant Energy
Interstate Power and Light Company
Ottumwa Generating Station
Ottumwa, Iowa

History of Construction

Ottumwa Generating Station
20775 Power Plant Road
Ottumwa, IA 52501

Inquiry Number: 4555570.6
March 08, 2016

The EDR Aerial Photo Decade Package

6 Armstrong Road, 4th Floor
Shelton, Connecticut 06484
Toll Free: 800.352.0050
www.edrnet.com

EDR Aerial Photo Decade Package

Environmental Data Resources, Inc. (EDR) Aerial Photo Decade Package is a screening tool designed to assist environmental professionals in evaluating potential liability on a target property resulting from past activities. EDR's professional researchers provide digitally reproduced historical aerial photographs, and when available, provide one photo per decade.

When delivered electronically by EDR, the aerial photo images included with this report are for ONE TIME USE ONLY. Further reproduction of these aerial photo images is prohibited without permission from EDR. For more information contact your EDR Account Executive.

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

Date EDR Searched Historical Sources:
Aerial Photography March 08, 2016

Target Property:
20775 Power Plant Road
Ottumwa, IA 52501

Year	***Scale***	***Details***	***Source***
1937	Aerial Photograph. Scale: 1"=1200'	Flight Year: 1937	DOT
1951	Aerial Photograph. Scale: 1"=1200'	Flight Year: 1951	USDA
1963	Aerial Photograph. Scale: 1"=1200'	Flight Year: 1963	USDA
1972	Aerial Photograph. Scale: 1"=1200'	Flight Year: 1972	USDA
1983	Aerial Photograph. Scale: 1"=1200'	Flight Year: 1983	NHAP
1994	Aerial Photograph. Scale: 1"=500'	/DOQQ - acquisition dates: 1994	USGS/DOQQ
1994	Aerial Photograph. Scale: 1"=500'	/DOQQ - acquisition dates: 1994	USGS/DOQQ
1994	Aerial Photograph. Scale: 1"=500'	/DOQQ - acquisition dates: 1994	USGS/DOQQ
1994	Aerial Photograph. Scale: 1"=500'	/DOQQ - acquisition dates: 1994	USGS/DOQQ
1994	Aerial Photograph. Scale: 1"=500'	/DOQQ - acquisition dates: 1994	USGS/DOQQ
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Year	*Scale*	*Details*	*Source*
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APPENDIX C – EDR Historical Topographic Map Report

Alliant Energy
Interstate Power and Light Company
Ottumwa Generating Station
Ottumwa, Iowa

History of Construction

Ottumwa Generating Station
20775 Power Plant Road
Ottumwa, IA 52501

Inquiry Number: 4555570.5
March 04, 2016

EDR Historical Topo Map Report

with QuadMatch™

6 Armstrong Road, 4th floor
Shelton, CT 06484
Toll Free: 800.352.0050
www.edrnet.com

EDR Historical Topo Map Report

03/04/16

Site Name:
Ottumwa Generating Station
20775 Power Plant Road
Ottumwa, IA 52501
EDR Inquiry # 4555570.5

Client Name:
Environmental Site Assessors
932 North Wright Street, Suite 1(
Naperville, IL 60563
Contact: Mark W Loerop

EDR Topographic Map Library has been searched by EDR and maps covering the target property location as provided by Environmental Site Assessors were identified for the years listed below. EDR's Historical Topo Map Report is designed to assist professionals in evaluating potential liability on a target property resulting from past activities. EDRs Historical Topo Map Report includes a search of a collection of public and private color historical topographic maps, dating back to the late 1800s.

Search Results:

Site Name: Ottumwa Generating Station
Address: 20775 Power Plant Road
City,State,Zip: Ottumwa, IA 52501
P.O.# 154.018.012.003
Project: OGS Historical Docs

Coordinates:

Latitude: 41.09562 41° 5' 44" North
Longitude: -92.555869 -92° 33' 21" West
UTM Zone: Zone 15 North
UTM X Meters: 537298.12
UTM Y Meters: 4549466.90
Elevation: 657.91' above sea level

Maps Provided:

2013
1968

Topo Sheet Thumbnails

This EDR Topo Map Report is based upon the following USGS topographic map sheets.

2013 Source Sheets

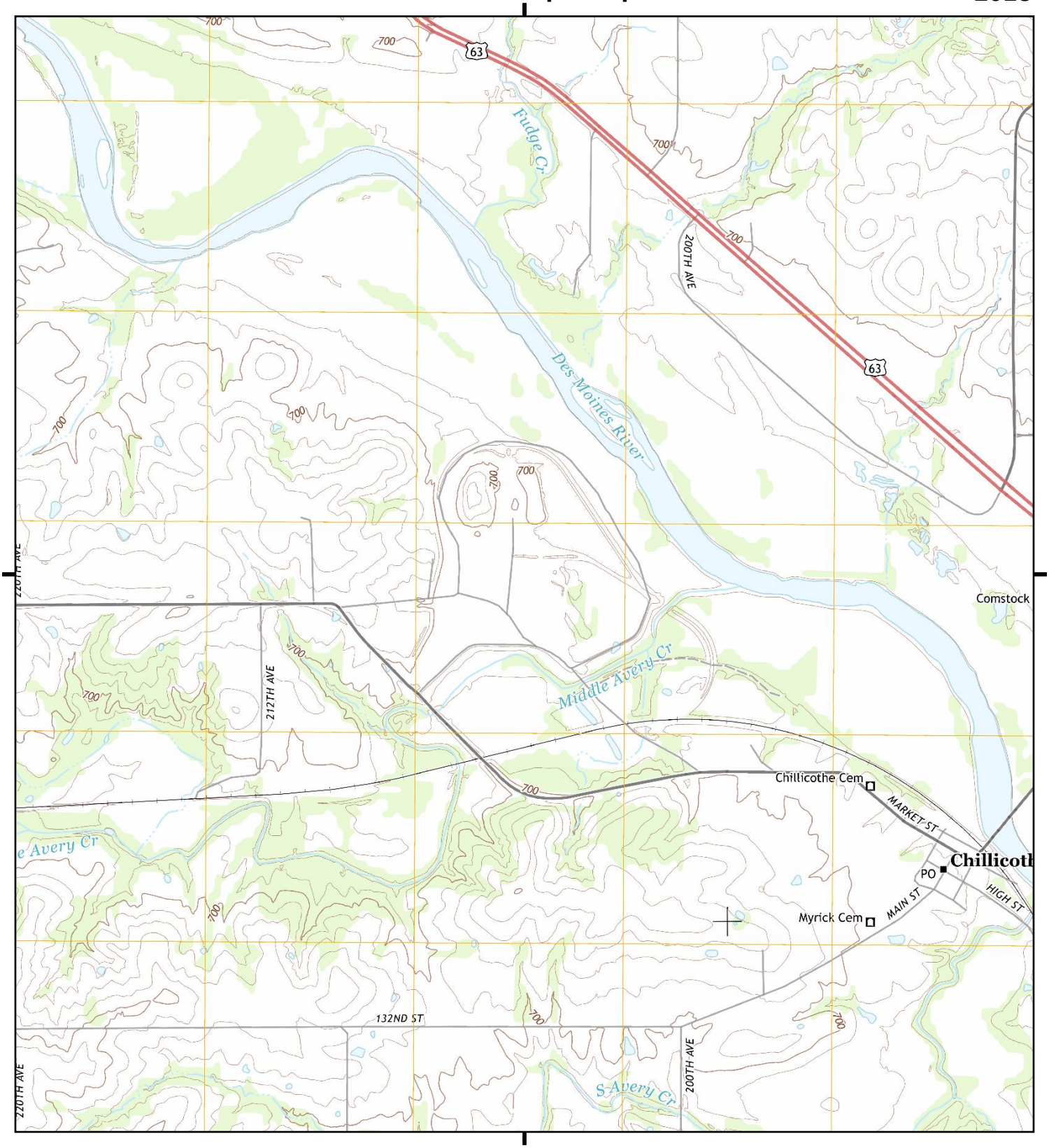
Chillicothe
2013
7.5-minute, 24000

1968 Source Sheets

Chillicothe
1968
7.5-minute, 24000
Aerial Photo Revised 1964

Historical Topo Map

2013



This report includes information from the following map sheet(s).

Miles 0.25 0.5 1 1.5

NW N NE
W E
SW S SE

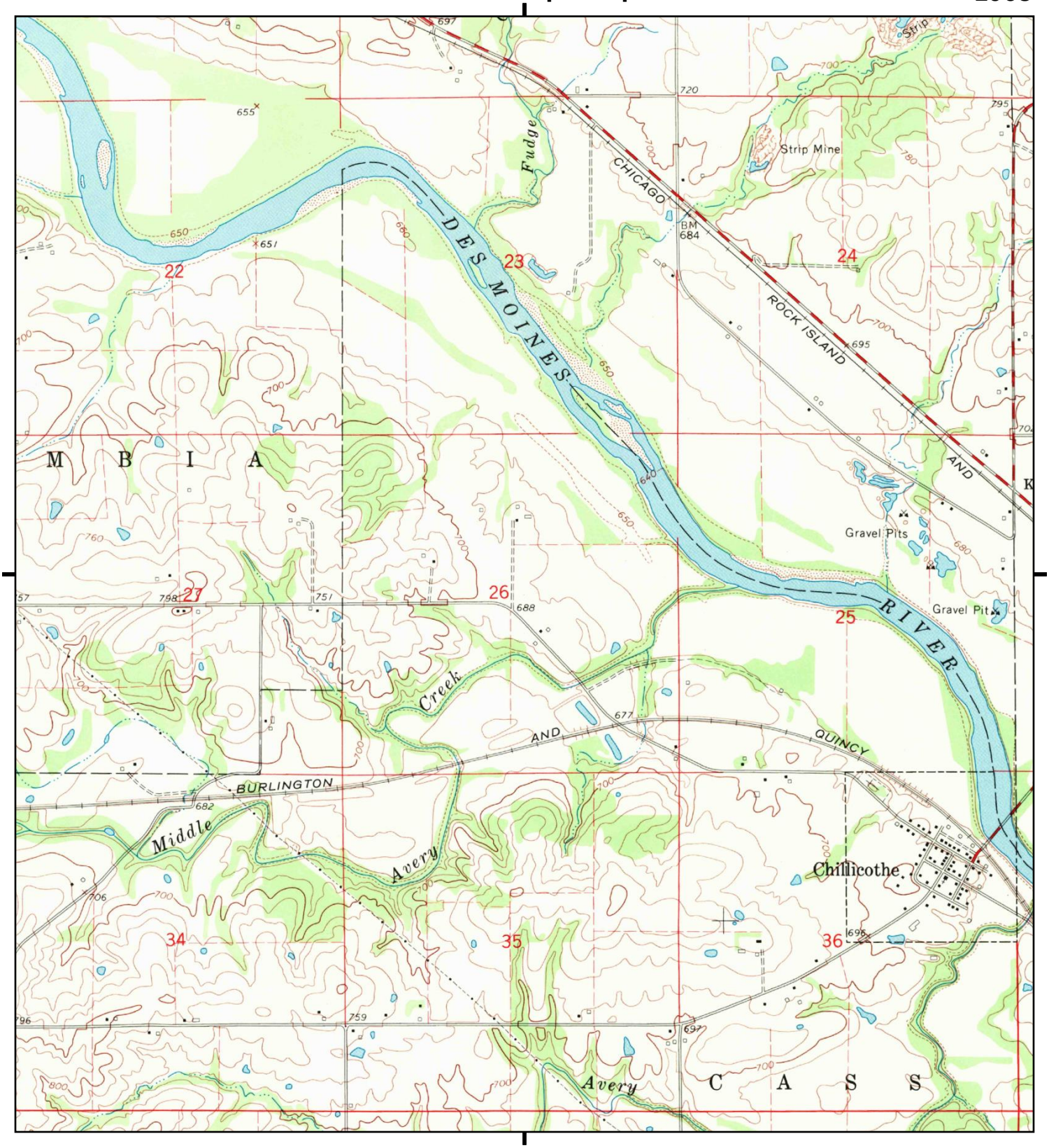
TP, Chillicothe, 2013, 7.5-minute

SITE NAME: Ottumwa Generating Station
ADDRESS: 20775 Power Plant Road
Ottumwa, IA 52501
CLIENT: Environmental Site Assessors

N

Historical Topo Map

1968



This report includes information from the following map sheet(s).

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NW N NE
W E
SW S SE

TP, Chillicothe, 1968, 7.5-minute

SITE NAME: Ottumwa Generating Station
ADDRESS: 20775 Power Plant Road
Ottumwa, IA 52501
CLIENT: Environmental Site Assessors

N

APPENDIX D –Soil Borings – 1975

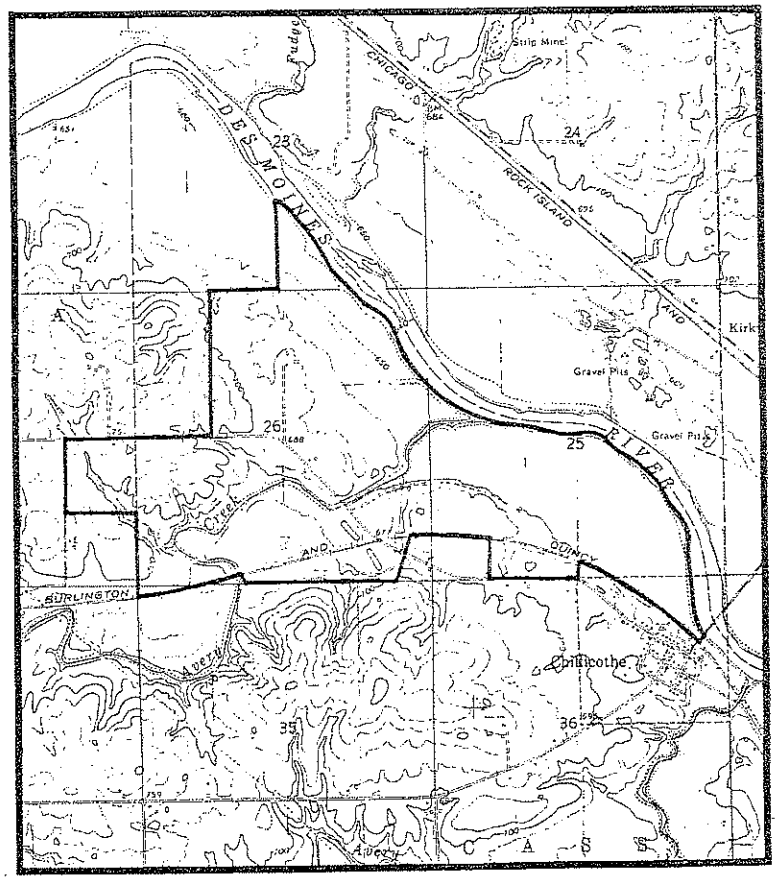
Alliant Energy
Interstate Power and Light Company
Ottumwa Generating Station
Ottumwa, Iowa

History of Construction

APPENDICES

APPENDIX A

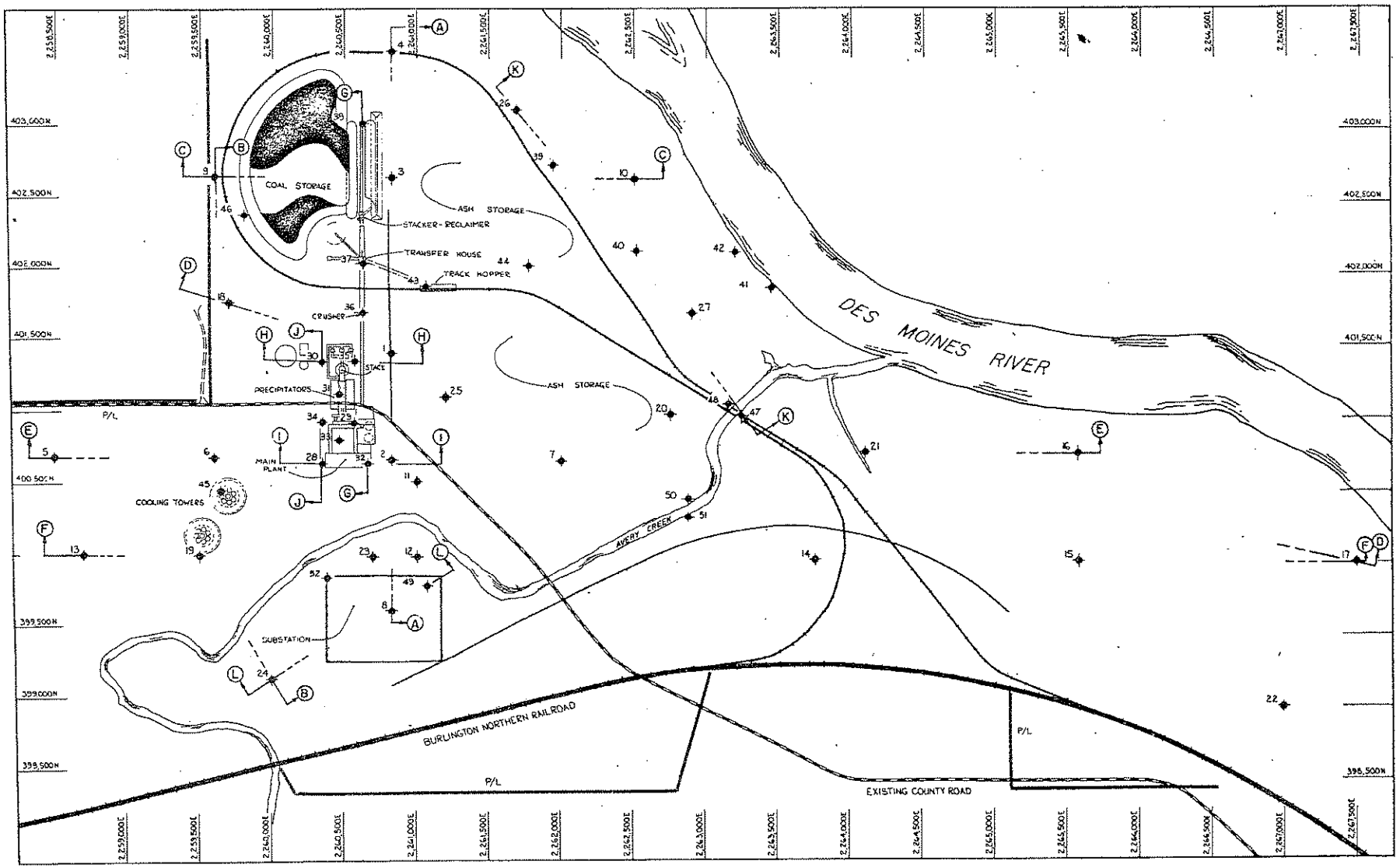
MAPS



VICINITY MAP

OTTUMWA GENERATING STATION-UNIT I
CHILLICOTHE, IOWA

FIGURE I



ATEC ASSOCIATES

SCALE 1 INCH = 600 FEET

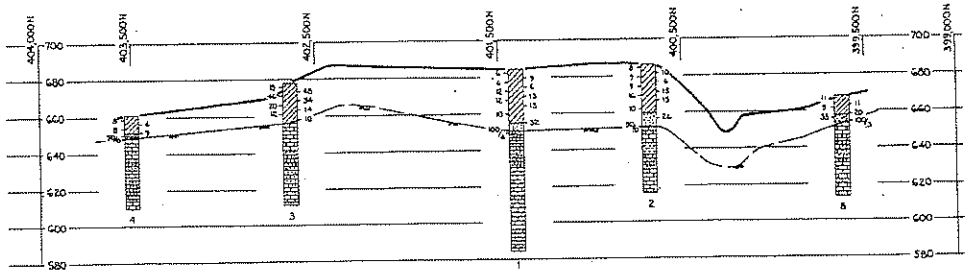
0 500 1000 1500

FEET

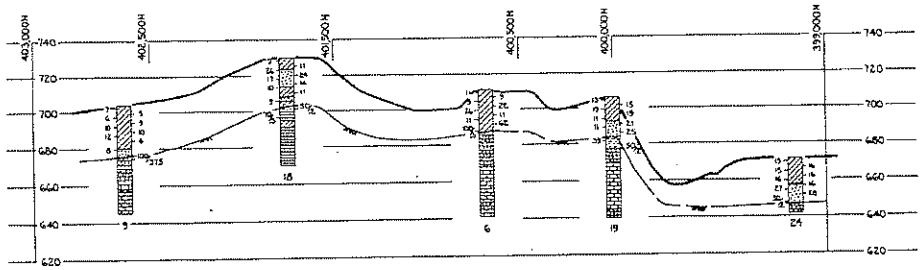
PLAN OF BORINGS

OTTUMWA GENERATING STATION-UNIT 1

CHILLICOTHE, IOWA FIGURE 2



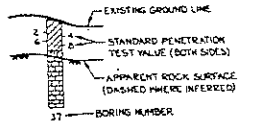
SECTION A-A



SECTION B-B

LEGEND

- CLAY, SILTY CLAY, CLAYEY SILT, SILT
- SAND, SILTY SAND, SANDY SILT
- LIMESTONE
- SANDSTONE
- SHALE
- BLACK SHALE
- DOLOMITE



EXPLANATION OF TEST BORING DATA

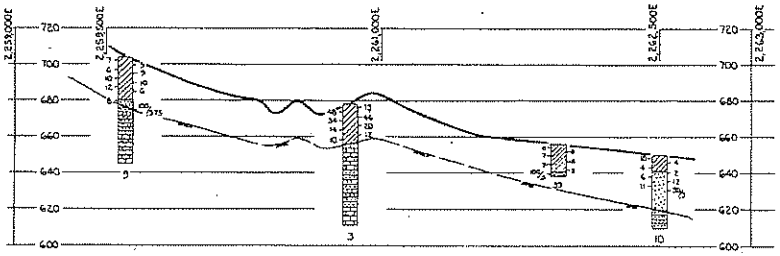
HORIZONTAL SCALE 1 INCH=600 FEET
VERTICAL EXAGGERATION 10:1

ATEC ASSOCIATES

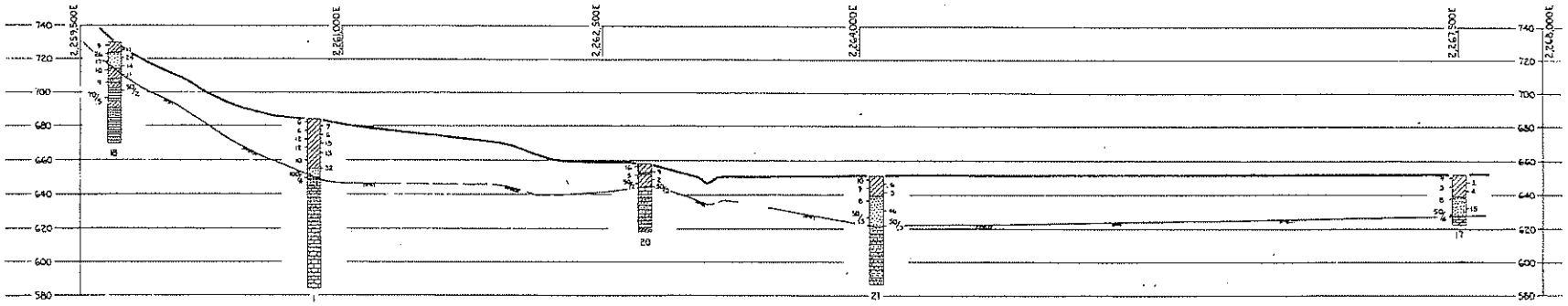
GENERALIZED SOIL AND ROCK PROFILES

OTTUMWA GENERATING STATION-UNIT 1
CHILLICOTHE, IOWA

FIGURE 3



SECTION C-C



SECTION D-D

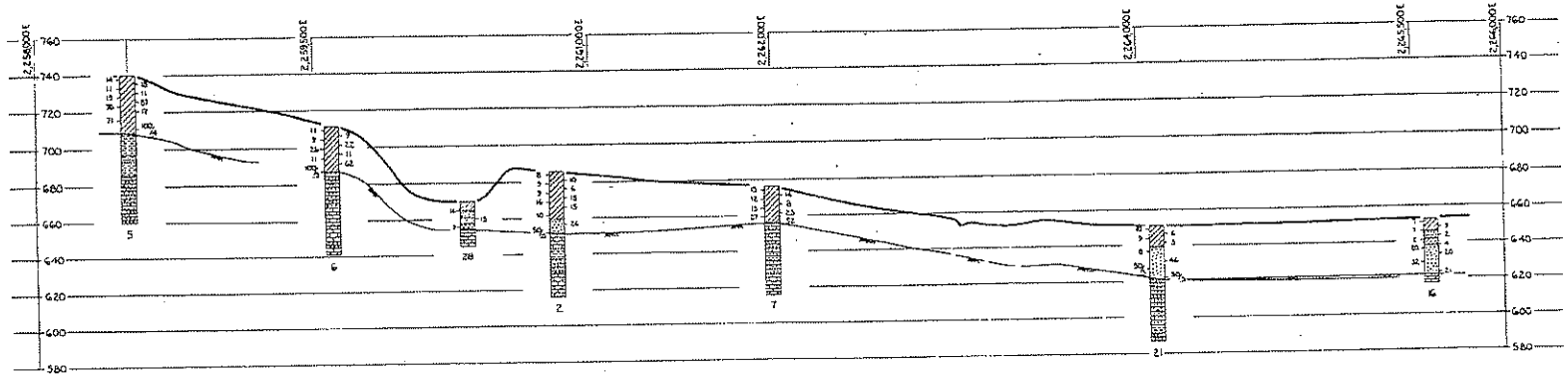
ATEC ASSOCIATES

HORIZONTAL SCALE 1 INCH=600 FEET
VERTICAL EXAGGERATION 10:1

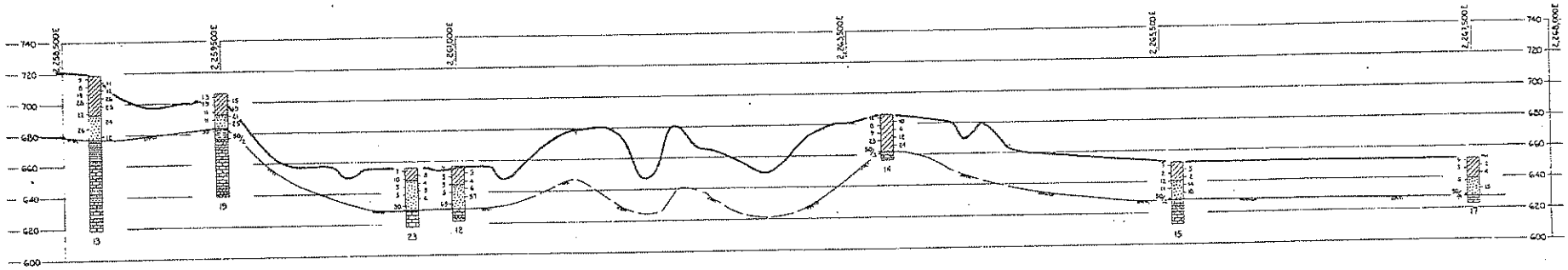
0 500 1000 1500
FEET

GENERALIZED SOIL AND ROCK PROFILES
OTTUMWA GENERATING STATION-UNIT 1
CHILLICOTHE, IOWA

FIGURE 4



SECTION E-E



SECTION F-F

HORIZONTAL SCALE 1 INCH=600 FEET
VERTICAL EXAGGERATION 10:1

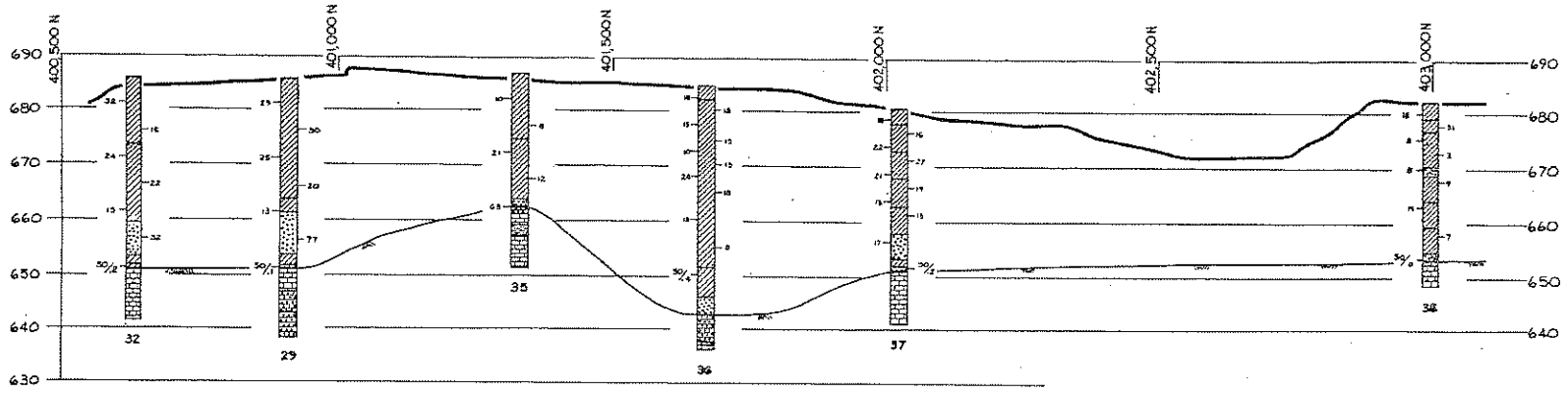
0 500 1000 1500
FEET

ATEC ASSOCIATES

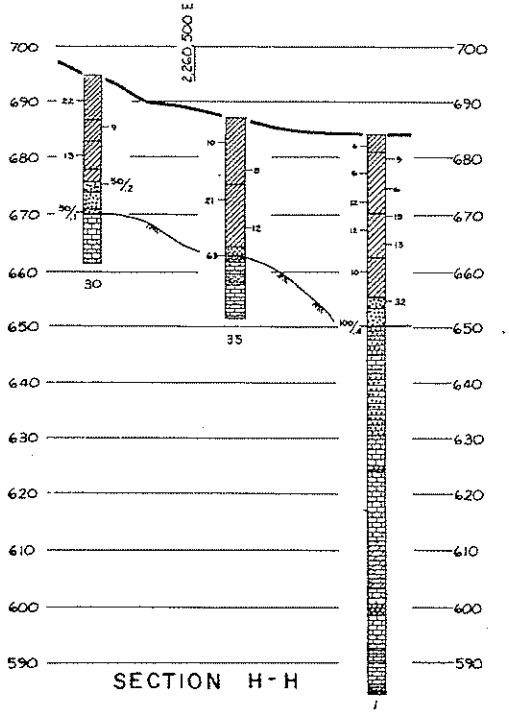
GENERALIZED SOIL AND ROCK PROFILES

OTTUMWA GENERATING STATION-UNIT 1
CHILLICOTHE, IOWA

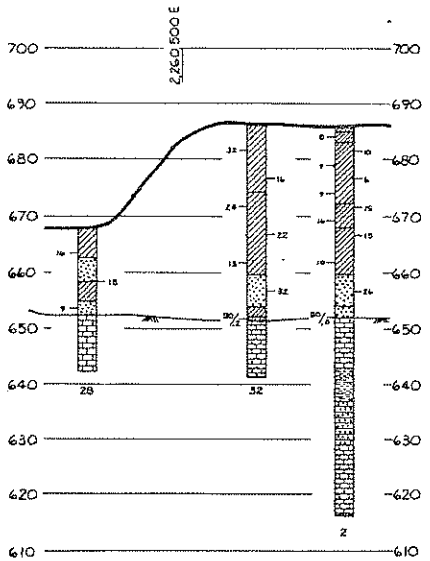
FIGURE 5



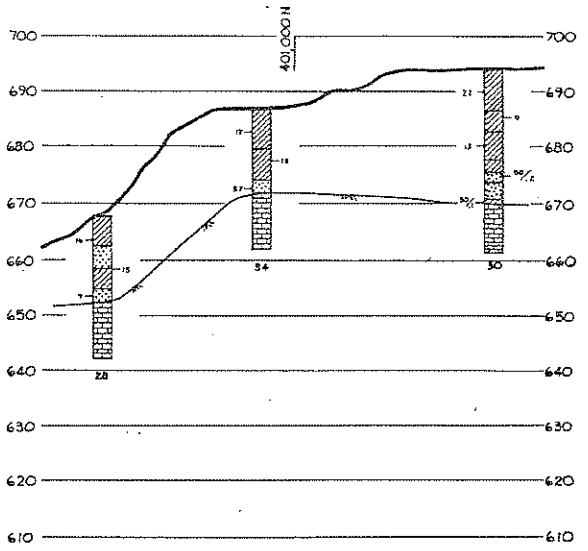
SECTION G-G



SECTION H-H



SECTION I-I



SECTION J-J

HORIZONTAL SCALE 1 INCH = 200 FEET
VERTICAL EXAGGERATION 10:1

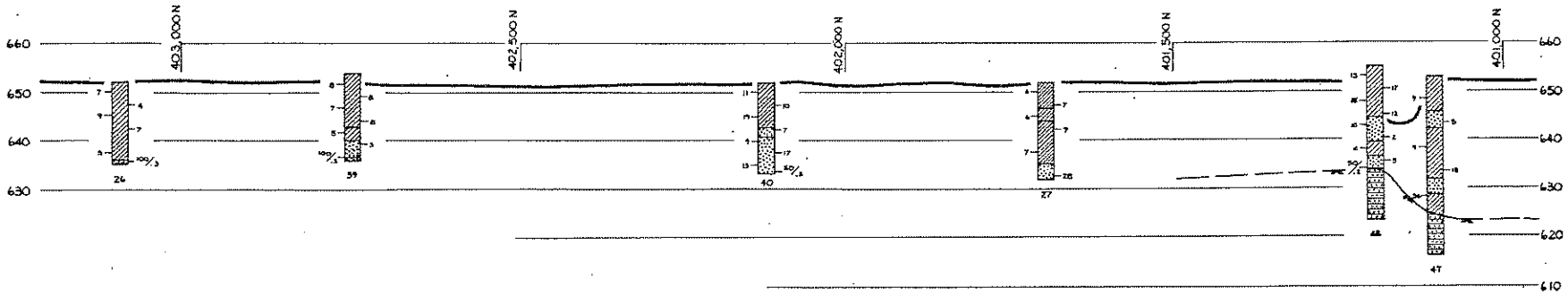
0 100 200 300 400 500

ATEC ASSOCIATES

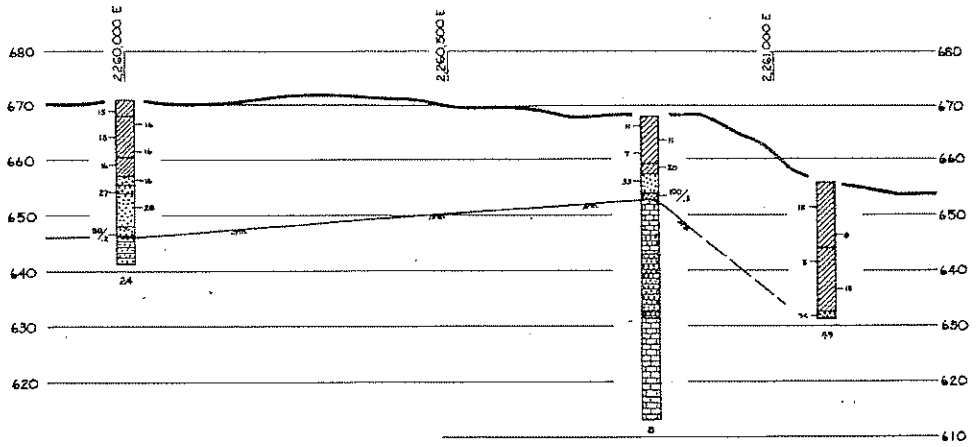
GENERALIZED SOIL AND ROCK PROFILES

OTTUMWA GENERATING STATION - UNIT 1
CHILLICOTHE, IOWA

FIGURE 6



SECTION K-K



SECTION L-L

HORIZONTAL SCALE 1 INCH = 200 FEET
VERTICAL EXAGGERATION 10:1

0 100 200 300 400 500

ATEC ASSOCIATES

GENERALIZED SOIL AND ROCK PROFILES

OTTUMWA GENERATING STATION - UNIT 1
CHILLICOTHE, IOWA

FIGURE 7

APPENDIX C

LABORATORY TESTING PROGRAM

Discussion of Laboratory Investigation

The split spoon samples were inspected and classified in accordance with the Unified Classification System and the field boring logs were edited as necessary. To aid in classifying the soils and to determine general soil characteristics, natural moisture and density determinations, Atterberg limits tests and sieve analyses were performed on selected samples. The organic contents of some samples were estimated from loss-on-ignition tests.

The undisturbed Shelby tube samples were extruded from the tubes, classified, and natural moistures and densities determined. Atterberg limits tests were performed on selected Shelby tube samples. In order to determine compressibility characteristics, twelve consolidation tests were performed on samples selected to be critical based on probable locations of structures and the results of field and laboratory tests. The conventional load increment ratio of two was employed throughout each test.

To provide undrained shear strength estimates, unconfined compression tests and unconsolidated-undrained triaxial tests were performed on some of the undisturbed samples. Consolidated-undrained triaxial tests (with pore pressure measurements) were performed to determine effective strength parameters. All consolidated-undrained triaxial samples were saturated prior to consolidation.

Compaction tests (according to both ASTM D-698 and ASTM D-1557) were performed on selected bag samples taken from potential on-site borrow areas. Strength and permeability tests were conducted on recompacted samples.

Unconfined compression tests were performed on certain of the rock core samples. Abrasion, soundness and chemical tests were conducted on some of the limestone samples from the eastern portion of the site.

The results of all tests are included in the remainder of Appendix C and Appendices D, E, F, G, H and I.

Table C-1 SUMMARY OF LABORATORY TEST RESULTS
Split-Spoon Samples

Boring No.	Depth ft	Natural Dry Density, lbs/cu.ft	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Loss-on-Ignition %
1	1.0-2.5		37.3				4.8
1	3.5-5.0	93.5	29.7				
1	6.0-7.5		28.9				
1	8.5-10.0		28.5	37	25	12	
1	11.0-12.5		25.0				
1	13.5-15.0		26.7				
1	16.0-17.5	106.3	22.6	49	23	16	
1	18.5-20.0		22.5				
1	23.5-25.0		20.9	32	20	11	
2	1.0-2.5		22.8				
2	3.5-5.0		30.0				
2	6.0-7.5		28.1				
2	8.5-10.0	98.3	30.0	41	25	16	
2	11.0-12.5		20.2				
2	13.5-15.0		21.5				
2	16.0-17.5	108.2	20.2				
2	18.5-20.0		25.9				
2	23.5-25.0		26.8				
3	1.0-2.5		23.6				
3	3.5-5.0		16.4				
3	6.0-7.5		13.2				
3	8.5-10.0		17.5				
3	11.0-12.5	113.2	17.0	45	23	19	
3	13.5-15.0		22.2				
3	16.0-17.5		20.9				
3	18.5-20.0		23.0				
4	1.0-2.5		21.3				2.8
4	3.5-5.0		24.2				
4	6.0-7.5	104.1	23.5	30	21	9	
5	1.0-2.5		21.0				
5	3.5-5.0		22.5				
5	6.0-7.5		27.3				
5	8.5-10.0		16.7				
5	11.0-12.5		13.4				
5	13.5-15.0		14.9				
5	16.0-17.5		10.3				
5	18.5-20.0		24.1				

cont'd.

Ottumwa Generating Station-Unit 1
(E-7566)

Table C-1 SUMMARY OF LABORATORY TEST RESULTS
Split-Spoon Samples (ccnt.d)

Boring No.	Depth ft	Natural Dry Density, lbs/cu.ft	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Loss-on-Ignition %
6	1.0-2.5		17.8				
6	3.5-5.0		20.6				
6	6.0-7.5		25.1				
6	8.5-10.0		13.0				
6	11.0-12.5		14.0				
6	13.5-15.0		53.3	90	33	57	
7	1.0-2.5		29.9				
7	3.5-5.0		28.9				
7	6.0-7.5		27.6				
7	8.5-10.0		26.5	33	20	13	
7	11.0-12.5		25.8				
7	13.5-15.0		25.8				
7	16.0-17.5		25.2				
8	1.0-2.5		16.7				
8	3.5-5.0		24.6				
8	6.0-7.5	98.8	27.1	37	25	12	
8	8.5-10.0		10.9				
8	11.0-12.5		11.5				
9	1.0-2.5		28.7				
9	3.5-5.0		36.8				
9	6.0-7.5		26.7	61	20	41	
9	8.5-10.0		23.9				
9	11.0-12.5		26.7				
9	13.5-15.0		18.8				
9	16.0-17.5		21.4				
9	18.5-20.0		22.6	56	21	35	
10	1.0-2.5		28.0				1.5
10	3.5-5.0		30.0				4.2
10	6.0-7.5		28.7	56	25	31	
10	8.5-10.0		36.0				
11	1.0-2.5		21.2				
11	3.5-5.0		26.1				
11	6.0-7.5		27.1				
11	8.5-10.0		21.2				
11	11.0-12.5		21.8				
11	13.5-15.0		21.5				
11	16.0-17.5		19.2				
11	18.5-20.0		20.0				

cont'd.

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Table C-1 SUMMARY OF LABORATORY TEST RESULTS
Split-Spoon Samples(cont'd.)

Boring No.	Depth ft	Natural Dry Density, lbs/cu.ft	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Loss-on-Ignition %
12	1.0-2.5		18.1				
12	3.5-5.0		19.7				
12	6.0-7.5		24.4				
12	8.5-10.0		22.6				
12	11.0-12.5		23.0				
12	13.5-15.0		21.8				
13	1.0-2.5		27.2				
13	3.5-5.0		26.1				
13	6.0-7.5		19.8				
13	18.5-20.0		18.3	57	18	39	
14	1.0-2.5		19.8				
14	3.5-5.0		23.1				
14	6.0-7.5		20.7	44	21	23	
14	8.5-10.0		26.1				
14	11.0-12.5		25.9				
14	13.5-15.0		19.5				
15	1.0-2.5		31.8				
15	3.5-5.0		26.3				
15	6.0-7.5		27.0				
15	8.5-10.0		33.2				
16	1.0-2.5		23.9				
16	3.5-5.0		27.1				
16	11.0-12.5		28.6				
16	13.5-15.0		29.4				
17	1.0-2.5		24.1				
17	3.5-5.0		22.0				
17	6.0-7.5		34.1				
17	8.5-10.0		31.2				
18	1.0-2.5		24.7				
18	3.5-5.0		24.6	57	18	39	
18	6.0-7.5		24.8				
18	16.0-17.5		18.0				
18	18.5-20.0		22.9	47	24	23	

cont'd.

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Table C-1 SUMMARY OF LABORATORY TEST RESULTS
Split-Spoon Samples (cont'd.)

Boring No.	Depth ft	Natural Dry Density, lbs/cu.ft	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Loss-on-Ignition %
19	1.0-2.5		19.3				
19	3.5-5.0		15.8				
19	6.0-7.5		22.0				
19	8.5-10.0		16.9				
19	13.5-15.0		17.4				
19	16.0-17.5		18.5				
20	1.0-2.5		23.0				
20	3.5-5.0		20.7				
21	1.0-2.5		22.2				
21	3.5-5.0		28.5				
21	6.0-7.5		26.1				
21	8.5-10.0		34.6				
22	1.0-2.5		33.2				
22	3.5-5.0		32.1				
22	6.0-7.5		30.0				
22	8.5-10.0		33.4	38	23	15	
24	1.0-2.5		23.8				
24	3.5-5.0		25.2				
24	6.0-7.5		28.3	44	22	22	
24	8.5-10.0		22.6				
25	1.0-2.5		22.2				
25	3.5-5.0		25.1				
25	6.0-7.5		29.3				
25	8.5-10.0		26.5				
26	1.0-2.5		28.2				5.3
26	3.5-5.0		27.9				3.0
26	6.0-7.5		29.3				
26	8.5-10.0		30.3				
26	13.5-15.0		31.8	54	27	27	
27	1.0-2.5		30.5				4.1
27	3.5-5.0		30.9	51	24	27	4.5
27	6.0-7.5		33.9				
27	8.5-10.0		26.0	51	28	23	
27	11.0-12.5		29.8				

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Table C-1 SUMMARY OF LABORATORY TEST RESULTS
Split-Spoon Samples

Boring No.	Depth ft	Natural Dry Density, lbs/cu.ft	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Loss-on-Ignition %
28	3.5-5.0		18.5				
29	13.5-15.0		22.0	60	20	40	
30	3.0-5.0		26.2				
30	8.5-10.0		25.3	35	21	14	
30	13.5-15.0		19.3				
31	3.5-5.0		28.7				
31	8.5-10.0		24.4				
32	3.5-5.0		22.5				
33	23.5-25.0		29.8	57	21	36	
34	3.5-5.0		23.0				
35	3.5-5.0		27.6				
35	8.5-10.0		27.6				
36	1.0-2.5		20.7				3.1
36	3.5-5.0		25.3				
36	6.0-7.5		24.2				
36	8.5-10.0		24.2				
36	11.0-12.5		23.8	36	16	20	
36	13.5-15.0		25.5				
36	28.5-30.0		22.7				
37	1.0-2.5		21.4				
37	3.5-5.0		21.0				
37	6.0-7.5		23.4				
37	8.5-10.0		21.5				
37	11.0-12.5		20.2				
37	13.5-15.0		20.7				
37	16.0-17.5		17.5				
37	18.5-20.0		22.3				
38	1.0-2.5		18.6				
38	3.5-5.0		21.1				
38	6.0-7.5		27.7				
38	8.5-10.0		27.3				
38	11.0-12.5		25.8				
38	13.5-15.0		43.2				
38	23.5-25.0		29.2	43	22	21	

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Table C-1 SUMMARY OF LABORATORY TEST RESULTS
Split-Spoon Samples

Boring No.	Depth ft	Natural Dry Density, lbs/cu.ft	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Loss-on-Ignition %
39	1.0-2.5		28.7				5.6
39	3.5-5.0		32.8				
39	6.0-7.5		26.5				
39	8.5-10.0		29.5				
39	11.0-12.5		35.9				
39	13.5-15.0		35.2				
39	16.0-17.0		11.4				
40	1.0-2.5		29.0				
40	3.5-5.0		31.5	56	18	38	
40	6.0-7.5		27.2				
40	8.5-9.0		27.4				
41	1.0-2.5		21.3				4.2
41	3.5-5.0		16.1				
41	6.0-7.5		22.2				
41	8.5-10.0		23.7				
41	11.0-11.8		25.3				
42	1.0-2.5		20.4				
42	3.5-5.0		19.9				
42	6.0-7.5		20.3				
42	8.5-10.0		26.2				
42	11.0-12.5		25.7				
43	3.5-5.0		25.4				
43	8.5-10.0		26.1				
43	13.5-15.0		21.0				
43	18.5-20.0		24.3				
44	1.0-2.5		11.9				5.0
44	3.5-5.0		11.3				
44	16.0-17.5		23.3				
45	3.5-5.0		17.0				
45	8.5-10.0		18.3				
45	13.5-15.0		18.9				
45	18.5-20.0		20.4				
45	23.5-25.0		23.2				
46	1.0-2.5		25.0				3.3
46	3.5-5.0		27.2				
46	6.0-7.5		27.4				
46	8.5-10.0		25.2	32	13	19	

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Table C-1 SUMMARY OF LABORATORY TEST RESULTS
Split-Spoon Samples

Boring No.	Depth ft	Natural Dry Density, lbs/cu.ft	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Loss-on-Ignition %
46	11.0-12.5		23.8				
46	13.5-15.0		25.4				
46	16.0-17.5		22.5				
46	18.5-20.0		27.0				
47	3.5-5.0		25.2				
47	13.5-15.0		24.2				2.8
47	18.5-20.0		30.9	40	22	18	
48	1.0-2.5		22.9				
48	3.5-5.0		25.0				
48	6.0-7.5		25.4				
48	8.5-10.0		24.6				
48	16.0-17.5		40.4				
49	3.5-5.0		22.5				
49	8.5-10.0		25.2				
49	13.5-15.0		31.2				
49	18.5-20.0		32.1				
50	3.5-5.0		18.8				
50	8.5-10.0		17.9				
50	13.5-15.0		24.3				
50	18.5-20.0		30.6				
51	3.5-5.0		13.5				
51	8.5-10.0		16.5				
51	13.5-15.0		24.1				
51	18.5-20.0		28.0	32	17	15	
52	1.0-2.5		24.4				
52	3.5-5.0		24.1	37	18	19	

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Table C-2 SUMMARY OF LABORATORY TEST RESULTS
Undisturbed Samples

Boring No.	Depth, ft	Natural Dry Density, lbs/cu.ft	Natural Moisture Content,%	Atterberg Limits % LL	PL	PI	Unconfined Compressive Strength,tsf
1A	6.0-8.0	96.4	28.2				0.71
1A	8.0-10.0	98.4	26.6				0.96 *
4A	3.0-5.0	100.2	24.8				0.63
4A	6.0-8.0	101.9	23.6				
8A	5.0-7.0	95.2	28.2				*
8A	7.0-9.0	99.5	25.2				1.15
9A	4.0-5.0	79.8	39.7				
9A	5.0-6.0	94.6	29.2				
9A	6.0-6.5		46.3				
9A	6.5-8.0	100.5	26.3				1.88
9A	13.0-14.5	106.5	22.5				**
9A	18.0-19.0	96.4	27.6				
9A	19.0-20.0	110.0	19.6				0.75
9A	22.0-24.0	99.9	25.7				0.42
10A	3.0-5.0	90.8	30.0				*
10A	5.0-7.0	94.4	28.5				**
10A	7.0-9.0	97.5	26.4				* **
12A	2.0-4.0	93.1	31.0				
12A	4.0-6.0	100.6	23.3				
12A	7.0-9.0	104.4	22.6				
14A	4.0-6.0	94.5	29.3				
14A	8.0-10.0	94.6	28.5				
14A	10.0-12.0	98.5	27.9				
15A	2.0-4.0	94.7	28.8				
15A	5.0-7.0	93.4	28.9				
15A	8.0-10.0	88.4	33.7				
15A	10.0-12.0	95.7	25.5				
18A	3.0-5.0	101.0	25.0				1.20
18A	19.0-21.0	107.8	20.6				**
26A	3.0-5.0	88.8	31.9				0.14
26A	9.0-9.5		34.4				
26A	9.5-11.0	97.3	26.9				0.97
26A	13.0-15.0	87.6	33.6				0.36 *
27	6.0-8.0	90.5	31.2				0.74 *
27A	13.0-15.0	92.6	30.9				0.91

cont'd.

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Table C-2 SUMMARY OF LABORATORY TEST RESULTS
Undisturbed Samples

Boring No.	Depth, ft	Natural Dry Density, lbs/cu.ft	Natural Moisture Content,%	Atterberg Limits % LL	PL	PI	Unconfined Compressive Strength,tsf
36	10.0-12.0	101.4	22.5				0.81
36	12.0-14.0	104.9	22.1				
36	18.0-20.0	103.3	24.1				
36	23.0-25.0	104.7	20.3				
36	28.0-29.9	95.2	27.4				1.11
38	7.0-8.9	93.3	28.5	37	20	17	0.66 *
38	9.0-11.0	88.1	30.5				
38	14.0-15.9	97.2	30.9				1.18
38	18.0-20.0	103.3	23.3				
38	23.0-25.0	107.1	19.6				
39	3.0-5.0	85.7	32.4	52	25	27	0.70 *
39	11.0-13.0	89.5	29.3				
39	13.0-15.0	82.0	38.8	42	25	17	* **
40	3.0-5.0	87.5	31.9				1.24
41	3.0-5.0	105.1	15.0				
41	8.0-10.0	99.3	22.3	41	16	25	**
42	2.0-4.0	102.1	20.1				
42	10.0-12.0	96.5	26.6	34	22	12	
43	3.0-5.0	98.3	20.8				2.89
43	8.0-10.0	99.0	26.7				1.00 **
43	13.0-15.0	104.0	23.1				1.07
43	18.0-20.0	104.1	22.1	32	15	17	**
44	3.0-5.0	106.2	12.7	29	16	13	
45	3.0-5.0	98.8	20.0				
45	9.0-11.0	111.4	17.0	35	11	24	0.97 **
45	11.0-13.0	111.9	19.5				
45	18.0-19.8	105.3	21.2				
45	28.0-30.0	109.8	19.3				
46	3.0-4.8	98.6	22.0				
46	10.0-12.0	104.3	22.9				
46	18.0-19.9	102.6	23.3				1.04 **
46	28.0-30.0	102.7	23.8				

cont'd.

Table C-2 SUMMARY OF LABORATORY TEST RESULTS
Undisturbed Samples

Boring No.	Depth, ft	Natural Dry Density, lbs/cu.ft	Natural Moisture Content,%	Atterberg Limits % LL	PL	PI	Unconfined Compressive Strength,tsf	
48	8.0-10.0	96.5	25.4				0.81	
48	16.0-17.9	82.9	37.7	53	23	30		* **
49	8.0-10.0	99.2	24.1				0.46	
49	13.0-15.0	96.5	27.5	38	18	20	0.76	*
49	18.0-20.0	96.9	28.0					
50	8.0-10.0	108.7	18.1				1.32	
50	19.0-21.0	86.5	34.5	49	25	24	0.62	* **
51	8.0-10.0	103.3	21.5				0.72	
51	19.0-21.0	96.6	23.3					
52	3.0-5.0	94.8	24.4				.85	
52	6.0-8.0	108.3	16.2					
52	8.0-10.0	111.5	15.4					

* See Appendix D for Consolidation Test Results

** See Appendix E for Triaxial Test Results

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Table C-3 SUMMARY OF COMPRESSION TEST RESULTS
Rock Samples

Boring No.	Depth ft	Sample Height, in.	Sample Diameter, in.	Unconfined Compressive Strength,psi	Rock Description
1	36.1	2.75	2.00	1350	Gray Sandstone
1	43.0	4.38	2.03	2460	Gray Sandstone
2A	38.6	4.67	2.06	14070	White Limestone
2A	44.3	4.25	2.06	7030	Gray Sandy Shale and Limestone
2A	51.3	4.44	2.06	5990	Gray Sandstone
2A	57.7	4.44	2.06	12720	White Limestone
4	20.0	4.88	2.00	1070	Green Sandstone
4	29.4	3.88	2.06	13170	White Limestone
4	46.3	4.53	2.06	5160	Gray Sandstone
6	25.0	4.97	2.03	2500	Dark Gray Shaly Sandstone
7	27.5	4.44	2.06	14520	Gray Limestone
19	29.5	3.44	1.88	2670	Gray Sandstone
23	29.4	4.88	1.88	9270	White Limestone
28	18.7	4.63	2.06	14790	Gray Limestone
29	36.1	3.69	2.06	19150	Gray Limestone
29	42.8	6.00	2.06	16970	Gray Sandstone
30	25.0	5.94	2.06	14540	White Limestone
31	29.5	6.00	2.00	8000	Gray Limestone
32	38.5	5.63	2.06	16490	Gray Limestone
33	28.7	5.25	2.06	15030	Gray Sandstone
33	36.0	4.38	2.06	5820	Gray Sandstone
34	15.7	5.69	2.06	6550	Gray Shaly Limesto
35	26.7	4.38	2.06	12850	Gray Limestone
35	28.2	6.00	2.06	16730	Green Shale
35	30.0	6.00	2.06	17460	White Limestone
41	31.8	6.00	2.06	14000	Green Sandstone
43	41.0	3.88	2.00	5150	Gray Sandstone
43	57.9	6.00	2.06	6788	White Limestone
47	31.0	4.69	2.00	6750	Gray Sandstone
48	22.0	4.13	2.06	5820	Gray Sandstone
50	26.2	5.38	2.06	4850	Gray Sandstone
51	30.5	5.06	2.06	5820	Gray Sandstone

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Table C-4 SUMMARY OF TESTS ON LIMESTONE

1. Test for Determining the Soundness of Coarse Aggregate by Freezing and Thawing
(ISHC Test Method No 211-Method A)

Sample: Boring No 15, 24.2 to 26.4 ft depth
Boring No 15, 29.9 to 31.9 ft depth
Boring No 15, 31.9 to 39.6 ft depth
Boring No 16, 31.0 to 32.4 ft depth
Boring No 16, 32.4 to 36.0 ft depth
Boring No 17, 24.3 to 29.3 ft depth
Boring No 22, 25.6 to 30.3 ft depth

Results: Loss - 16.8%

2. Resistance to Abrasion of Coarse Aggregate by use of the Los Angeles Machine (AASHTO T 96)

Sample: (Same as above)

Results: Loss - 27.8%

3. Analysis of Limestone (ASTM C 25)

Sample: Boring No 15, 31.9 to 40.0 ft depth

Results:

Insoluble matter	1.29%
Total neutralizing value in terms of Ca CO_3	98.25%
Calcium Carbonate (Ca CO_3)	97.00%
Magnesium Carbonate (Mg CO_3)	1.25%

APPENDIX D

CONSOLIDATION TESTS

Ottumwa Generating Station-Unit 1
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Table D-1 SUMMARY OF CONSOLIDATION TEST RESULTS

Boring No.	Depth, ft	Existing Effective Overburden Pressure, tsf	Compression Index	Initial Moisture Content, %	Initial Void Ratio	Initial Dry Density, lbs/cu.ft
1A	8.5	0.529	0.211	27.8	0.848	94.3
8A	6.0	0.821	0.218	26.7	0.821	90.7
10A	4.0	0.246	0.258	32.1	0.962	88.7
10A	7.5	0.462	0.261	34.9	0.971	85.1
26A	13.5	0.556	0.205	30.9	0.864	91.4
27A	7.0	0.416	0.238	31.0	0.958	88.6
38A	8.5	0.501	0.282	28.2	0.888	81.9
39A	4.5	0.262	0.235	27.8	0.875	91.2
39A	14.5	0.819	0.184	32.9	0.937	89.7
48A	17.5	0.915	0.369	37.5	1.077	84.5
49A	14.0	0.795	0.257	29.1	0.861	94.0
50A	20.0	0.945	0.304	37.1	1.064	84.8

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Table D-2 COEFFICIENT OF CONSOLIDATION SUMMARY

Boring No.	Depth, ft	Load Increment, tons/sq.ft	Coefficient of Consolidation $cm^2/sec.$	Coefficient of Compressibility, cm^2/kg	Average Void Ratio	Estimated Coefficient of Permeability, cm/sec
1A	8.5	0.25 to 0.5	1.69×10^{-3}	0.024	0.839	2.2×10^{-4}
1A	8.5	0.5 to 1.0	5.18×10^{-3}	0.030	0.829	0.85×10^{-4}
1A	8.5	1.0 to 2.0	3.78×10^{-3}	0.031	0.806	0.65×10^{-4}
1A	8.5	2.0 to 4.0	3.43×10^{-3}	0.027	0.764	0.51×10^{-4}
1A	8.5	4.0 to 8.0	4.26×10^{-3}	0.016	0.706	0.40×10^{-4}
8A	6.0	0.25 to 0.5	1.05×10^{-3}	0.016	0.816	0.92×10^{-5}
8A	6.0	0.5 to 1.0	1.31×10^{-3}	0.018	0.810	1.29×10^{-5}
8A	6.0	1.0 to 2.0	1.47×10^{-3}	0.017	0.797	1.38×10^{-5}
8A	6.0	2.0 to 4.0	1.25×10^{-3}	0.017	0.772	1.16×10^{-5}
8A	6.0	4.0 to 8.0	0.98×10^{-3}	0.015	0.725	0.96×10^{-5}
10A	4.0	0.25 to 0.5	3.95×10^{-4}	0.084	0.934	1.71×10^{-5}
10A	4.0	0.5 to 1.0	4.99×10^{-4}	0.066	0.907	1.72×10^{-5}
10A	4.0	1.0 to 2.0	3.67×10^{-4}	0.050	0.875	0.97×10^{-5}
10A	4.0	2.0 to 4.0	4.48×10^{-4}	0.035	0.805	0.86×10^{-5}
10A	4.0	4.0 to 8.0	3.35×10^{-4}	0.020	0.731	0.37×10^{-5}
10A	7.5	0.25 to 0.5	1.0×10^{-4}	0.156	0.916	8.1×10^{-6}
10A	7.5	0.5 to 1.0	0.9×10^{-4}	0.110	0.869	5.2×10^{-6}
10A	7.5	1.0 to 2.0	1.0×10^{-4}	0.069	0.807	3.8×10^{-6}
10A	7.5	2.0 to 4.0	1.0×10^{-4}	0.039	0.733	2.2×10^{-6}
10A	7.5	4.0 to 8.0	0.9×10^{-4}	0.020	0.576	1.1×10^{-6}
26A	13.5	0.25 to 0.5	1.60×10^{-4}	0.120	0.807	1.06×10^{-5}
26A	13.5	0.5 to 1.0	1.84×10^{-4}	0.084	0.771	0.85×10^{-5}
26A	13.5	1.0 to 2.0	2.01×10^{-4}	0.051	0.725	0.57×10^{-5}
26A	13.5	2.0 to 4.0	2.84×10^{-4}	0.029	0.671	0.47×10^{-5}
26A	13.5	4.0 to 8.0	2.83×10^{-4}	0.015	0.602	0.26×10^{-5}

cont'd.

COEFFICIENT OF CONSOLIDATION SUMMARY

Table D-2

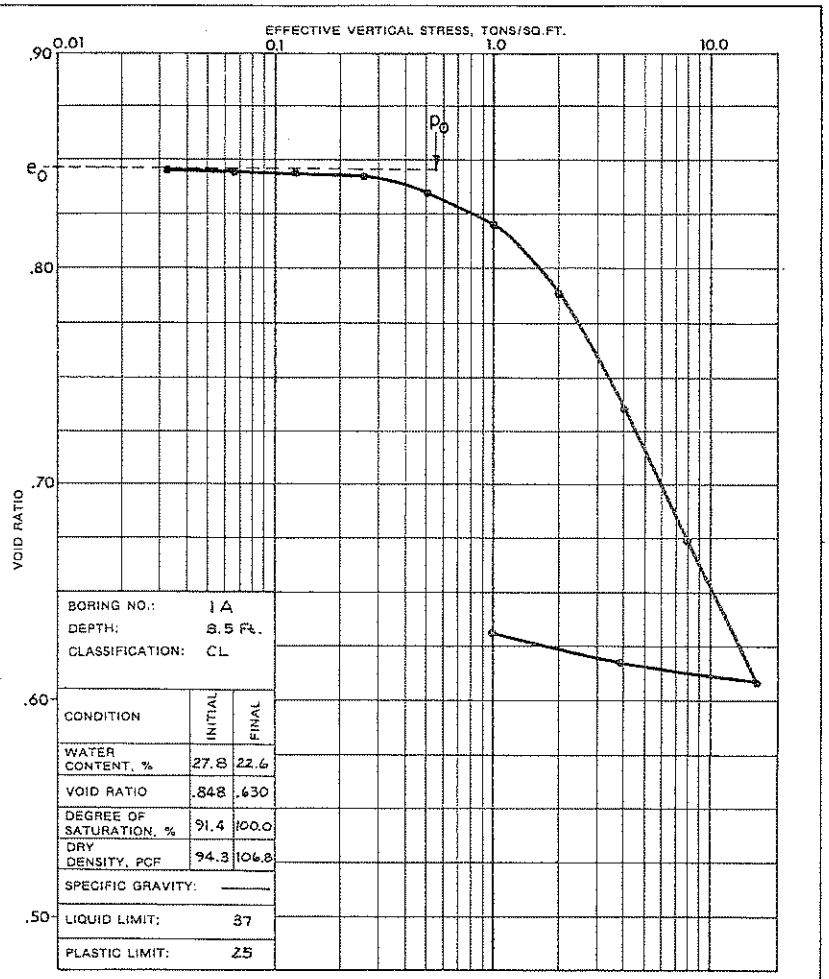
Boring No.	Depth, ft	Load Increment, tons/sq.ft	Coefficient of Consolidation $cm^2/sec.$	Coefficient of Compressibility, cm^2/kg	Average Void Ratio	Estimated Coefficient of Permeability, cm/sec
27A	7.0	0.25 to 0.5	1.55×10^{-3}	0.060	0.931	4.81×10^{-5}
27A	7.0	0.5 to 1.0	0.84×10^{-3}	0.050	0.912	2.19×10^{-5}
27A	7.0	1.0 to 2.0	0.81×10^{-3}	0.037	0.881	1.58×10^{-5}
27A	7.0	2.0 to 4.0	1.03×10^{-3}	0.028	0.834	1.48×10^{-5}
27A	7.0	4.0 to 8.0	0.78×10^{-3}	0.018	0.771	0.79×10^{-5}
38A	8.5	0.25 to 0.5	5.73×10^{-3}	0.032	0.881	3.45×10^{-4}
38A	8.5	0.5 to 1.0	7.41×10^{-3}	0.028	0.869	1.11×10^{-4}
38A	8.5	1.0 to 2.0	3.38×10^{-3}	0.026	0.848	0.48×10^{-4}
38A	8.5	2.0 to 4.0	2.42×10^{-3}	0.031	0.805	0.42×10^{-4}
38A	8.5	4.0 to 8.0	1.91×10^{-3}	0.021	0.735	0.23×10^{-4}
39A	4.5	0.25 to 0.5	2.9×10^{-4}	0.036	0.867	0.55×10^{-5}
39A	4.5	0.5 to 1.0	7.3×10^{-4}	0.054	0.848	2.13×10^{-5}
39A	4.5	1.0 to 2.0	7.6×10^{-4}	0.035	0.817	1.46×10^{-5}
39A	4.5	2.0 to 4.0	7.9×10^{-4}	0.027	0.772	1.20×10^{-5}
39A	4.5	4.0 to 8.0	6.0×10^{-4}	0.017	0.711	5.9×10^{-5}
39A	14.5	0.25 to 0.5	6.43×10^{-3}	0.064	0.908	2.2×10^{-4}
39A	14.5	0.5 to 1.0	6.29×10^{-3}	0.048	0.889	1.6×10^{-4}
39A	14.5	1.0 to 2.0	5.42×10^{-3}	0.033	0.861	0.9×10^{-4}
39A	14.5	2.0 to 4.0	7.78×10^{-3}	0.022	0.822	0.9×10^{-4}
39A	14.5	4.0 to 8.0	6.31×10^{-3}	0.013	0.773	0.5×10^{-4}
48A	17.5	0.25 to 0.5	0.65×10^{-3}	0.040	1.067	1.25×10^{-5}
48A	17.5	0.5 to 1.0	1.20×10^{-3}	0.042	1.052	2.45×10^{-5}
48A	17.5	1.0 to 2.0	0.63×10^{-3}	0.049	1.017	1.52×10^{-5}
48A	17.5	2.0 to 4.0	0.47×10^{-3}	0.050	0.942	1.21×10^{-5}
48A	17.5	4.0 to 8.0	0.32×10^{-3}	0.028	0.837	0.48×10^{-5}

cont'd.

COEFFICIENT OF CONSOLIDATION SUMMARY

Table D-2

Boring No.	Depth, ft	Load Increment, tons/sq.ft	Coefficient of Consolidation $cm^2/sec.$	Coefficient of Compressibility, cm^2/kg	Average Void Ratio	Estimated Coefficient of Permeability, cm/sec
49A	14.0	0.25 to 0.5	3.30×10^{-3}	0.056	0.847	1.00×10^{-6}
49A	14.0	0.5 to 1.0	4.27×10^{-3}	0.042	0.830	0.98×10^{-6}
49A	14.0	1.0 to 2.0	4.15×10^{-3}	0.029	0.805	0.67×10^{-6}
49A	14.0	2.0 to 4.0	4.36×10^{-3}	0.029	0.767	0.72×10^{-6}
49A	14.0	4.0 to 8.0	2.36×10^{-3}	0.016	0.713	0.22×10^{-6}
50A	20.0	0.25 to 0.5	5.78×10^{-3}	0.076	1.042	2.15×10^{-4}
50A	20.0	0.5 to 1.0	7.26×10^{-3}	0.062	1.017	2.23×10^{-4}
50A	20.0	1.0 to 2.0	3.25×10^{-3}	0.055	0.945	0.92×10^{-4}
50A	20.0	2.0-4.0	1.82×10^{-3}	0.043	0.905	0.40×10^{-4}
50A	20.0	4.0 to 8.0	2.76×10^{-3}	0.023	0.816	0.35×10^{-4}



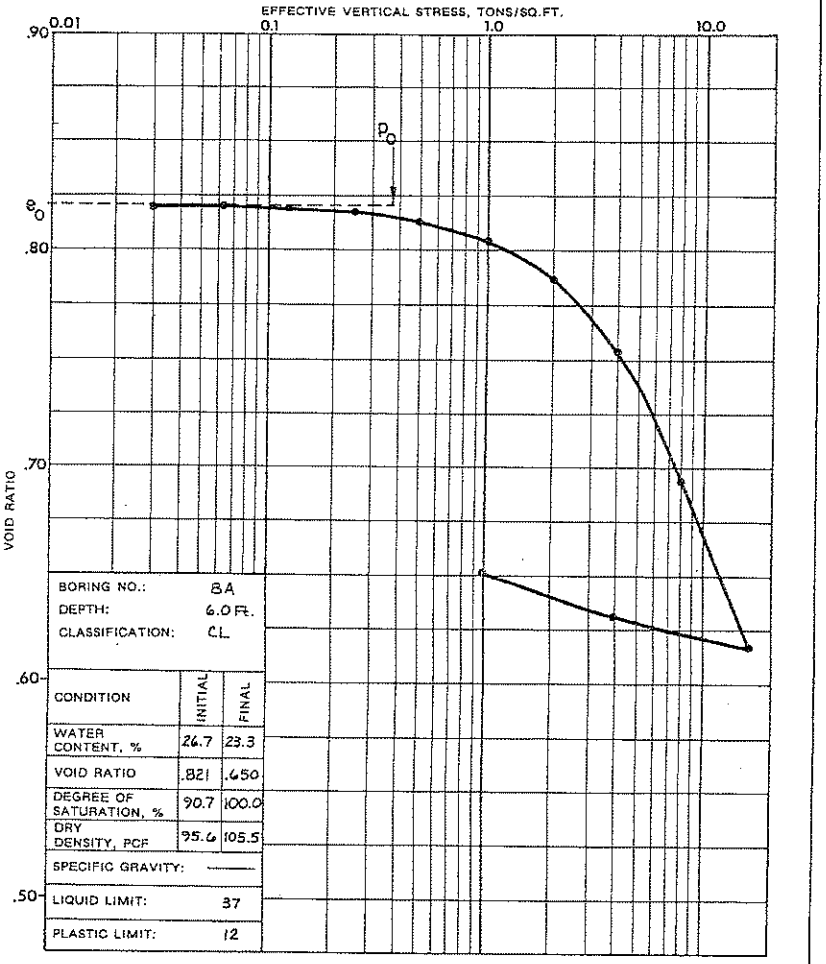
BORING NO.:	1A
DEPTH:	8.5 Ft.
CLASSIFICATION:	CL

CONDITION	INITIAL	FINAL
WATER CONTENT, %	27.8	22.6
VOID RATIO	.848	.630
DEGREE OF SATURATION, %	91.4	100.0
DRY DENSITY, PCF	94.3	106.8
SPECIFIC GRAVITY:	——	
LIQUID LIMIT:	37	
PLASTIC LIMIT:	25	

CONSOLIDATION TEST RESULTS

ATEC ASSOCIATES

CN-1



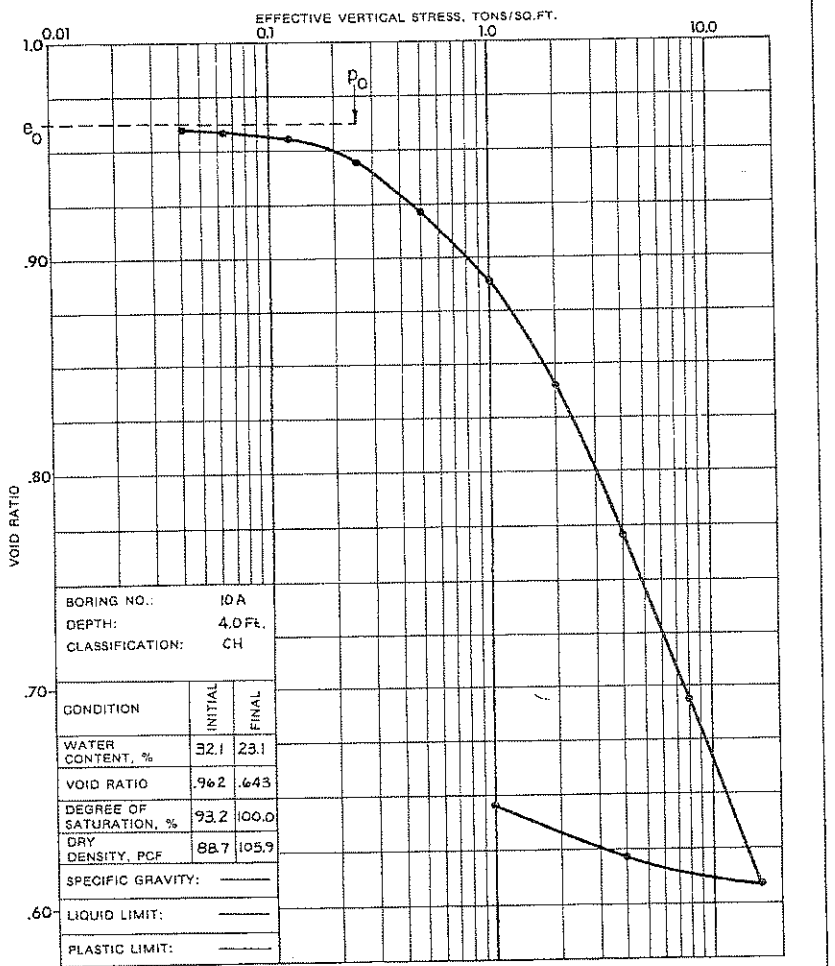
BORING NO.:	8A
DEPTH:	6.0 Ft.
CLASSIFICATION:	CL

CONDITION	INITIAL	FINAL
WATER CONTENT, %	24.7	23.3
VOID RATIO	.821	.650
DEGREE OF SATURATION, %	90.7	100.0
DRY DENSITY, PCF	95.6	105.5
SPECIFIC GRAVITY:	——	
LIQUID LIMIT:	37	
PLASTIC LIMIT:	12	

CONSOLIDATION TEST RESULTS

ATEC ASSOCIATES

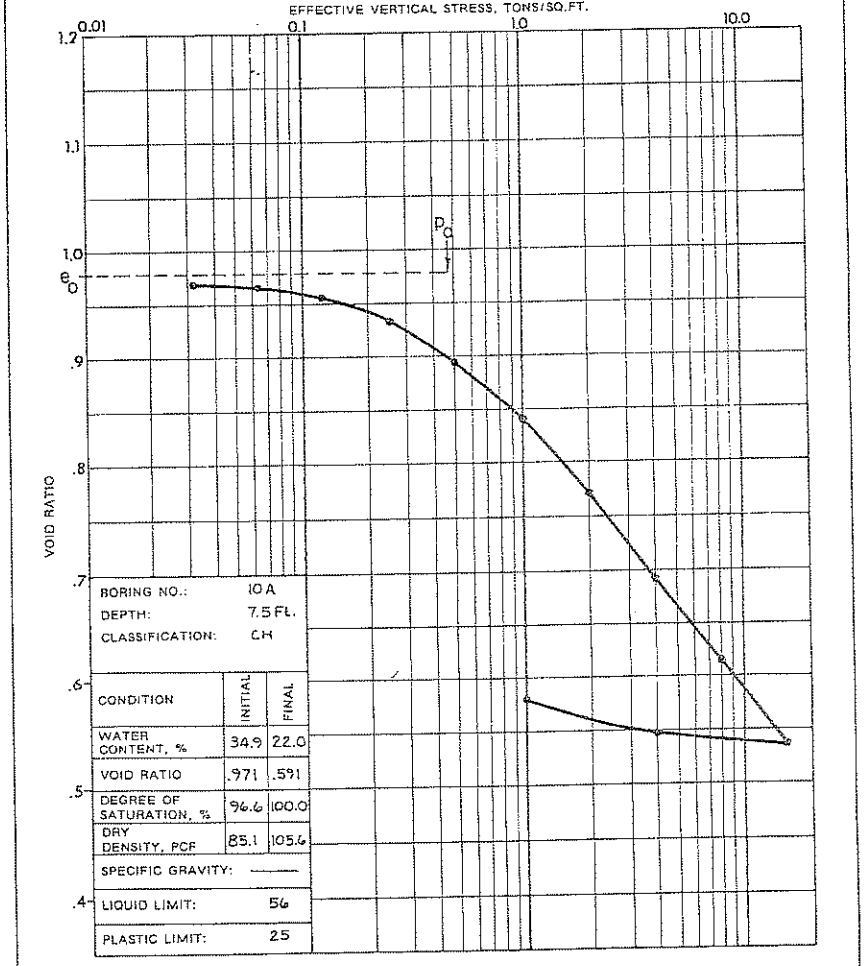
CN-1



CONSOLIDATION TEST RESULTS

ATEC ASSOCIATES

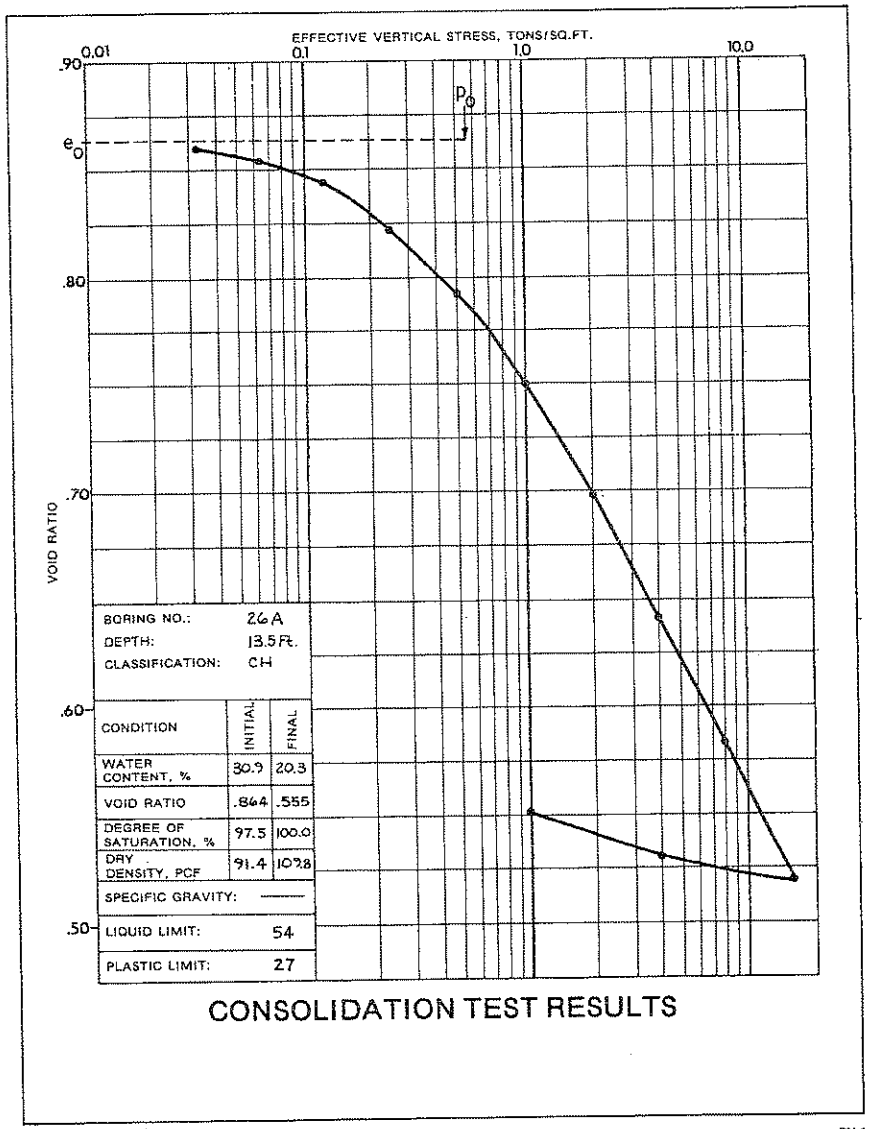
CN-1



CONSOLIDATION TEST RESULTS

ATEC ASSOCIATES

CN-1



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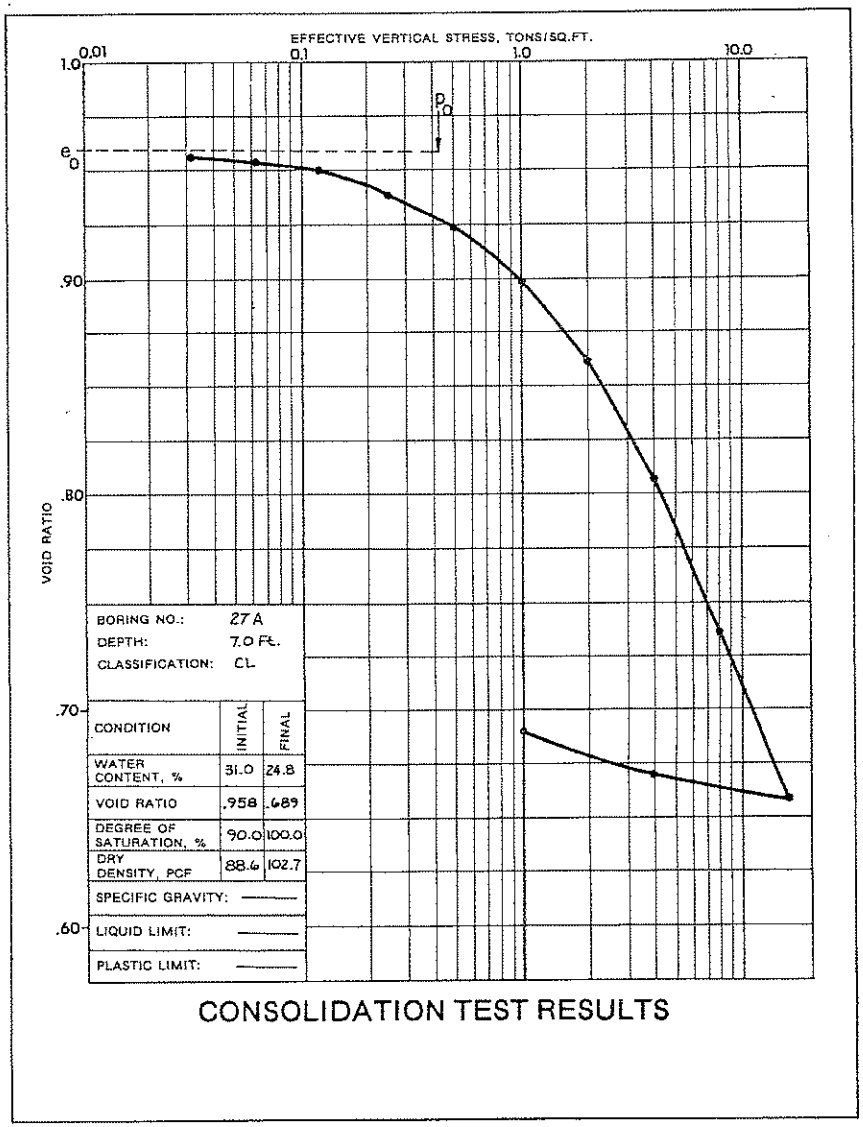

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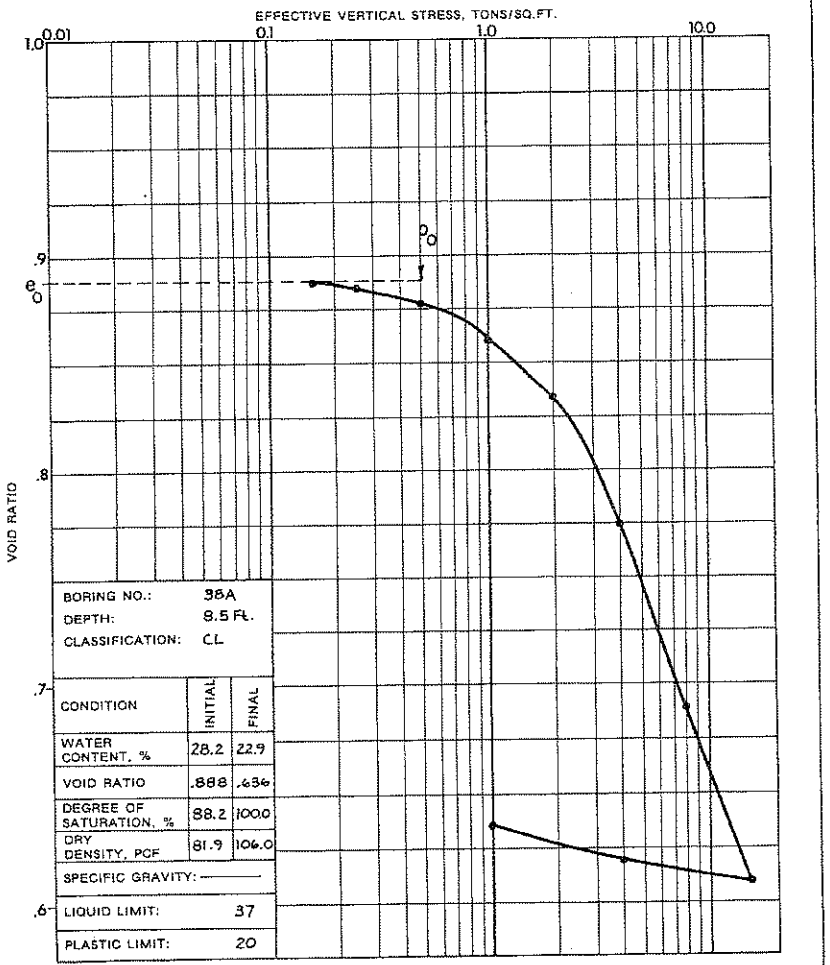


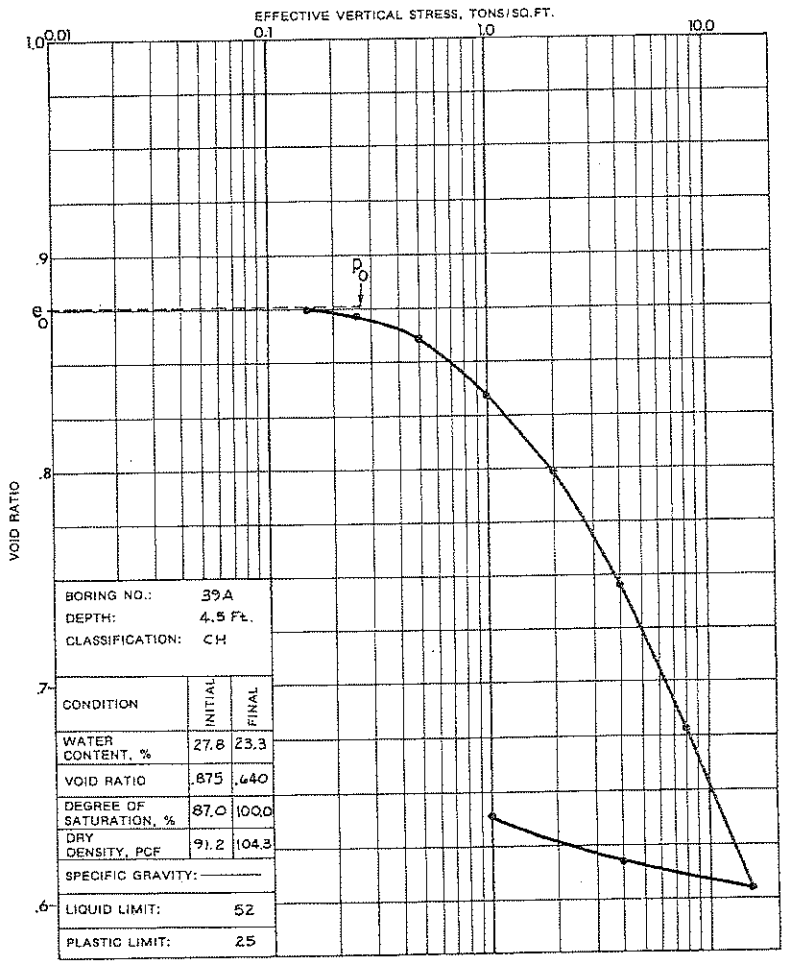
BORING NO.:	38A
DEPTH:	8.5 Ft.
CLASSIFICATION:	CL

CONDITION	INITIAL	FINAL
WATER CONTENT, %	28.2	22.9
VOID RATIO	.888	.636
DEGREE OF SATURATION, %	88.2	100.0
DRY DENSITY, PCF	81.9	106.0
SPECIFIC GRAVITY:	——	
LIQUID LIMIT:	37	
PLASTIC LIMIT:	20	

CONSOLIDATION TEST RESULTS

ATEC ASSOCIATES

CN-1



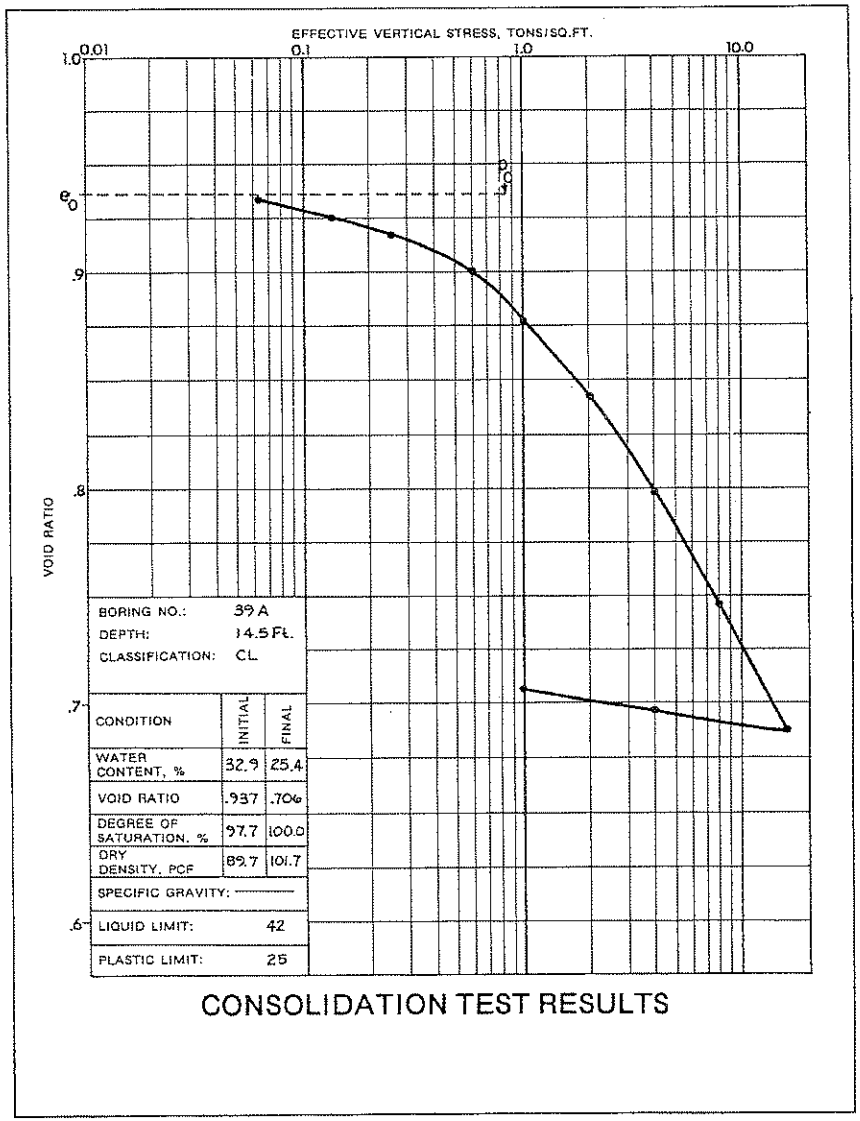
BORING NO.:	39A
DEPTH:	4.5 Ft.
CLASSIFICATION:	CH

CONDITION	INITIAL	FINAL
WATER CONTENT, %	27.8	23.3
VOID RATIO	.875	.640
DEGREE OF SATURATION, %	87.0	100.0
DRY DENSITY, PCF	91.2	104.3
SPECIFIC GRAVITY:	——	
LIQUID LIMIT:	52	
PLASTIC LIMIT:	25	

CONSOLIDATION TEST RESULTS

ATEC ASSOCIATES

CN-1



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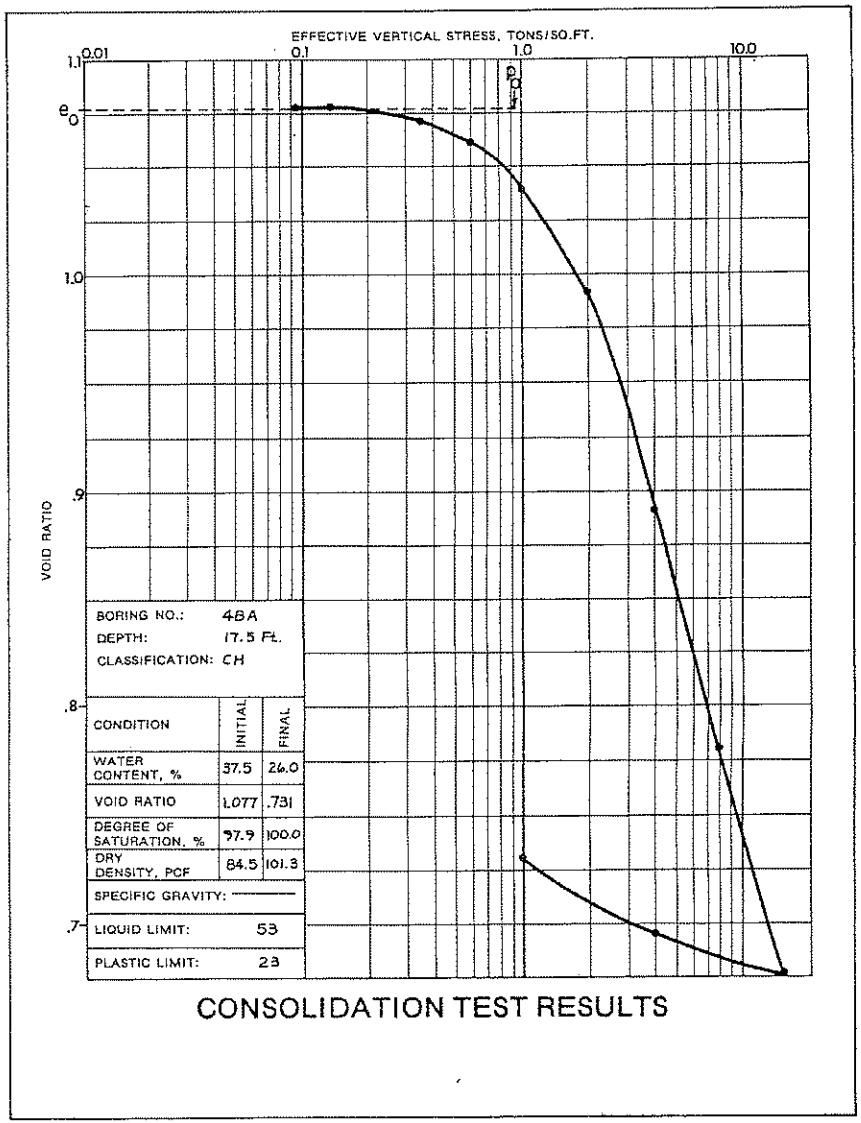

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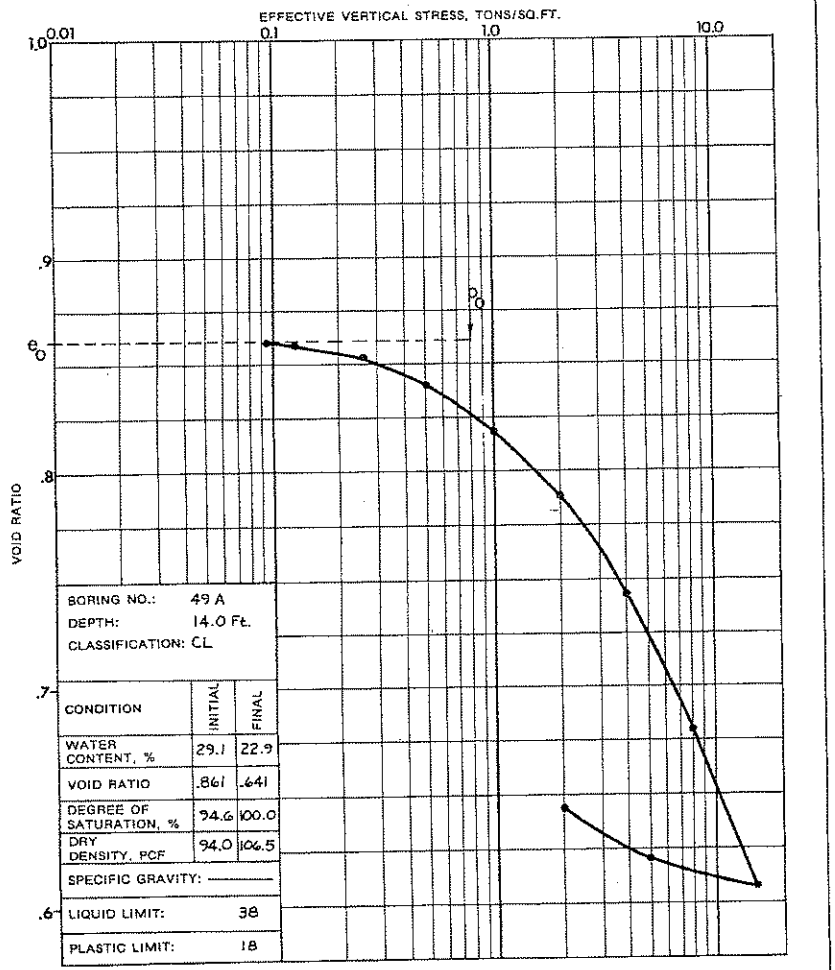
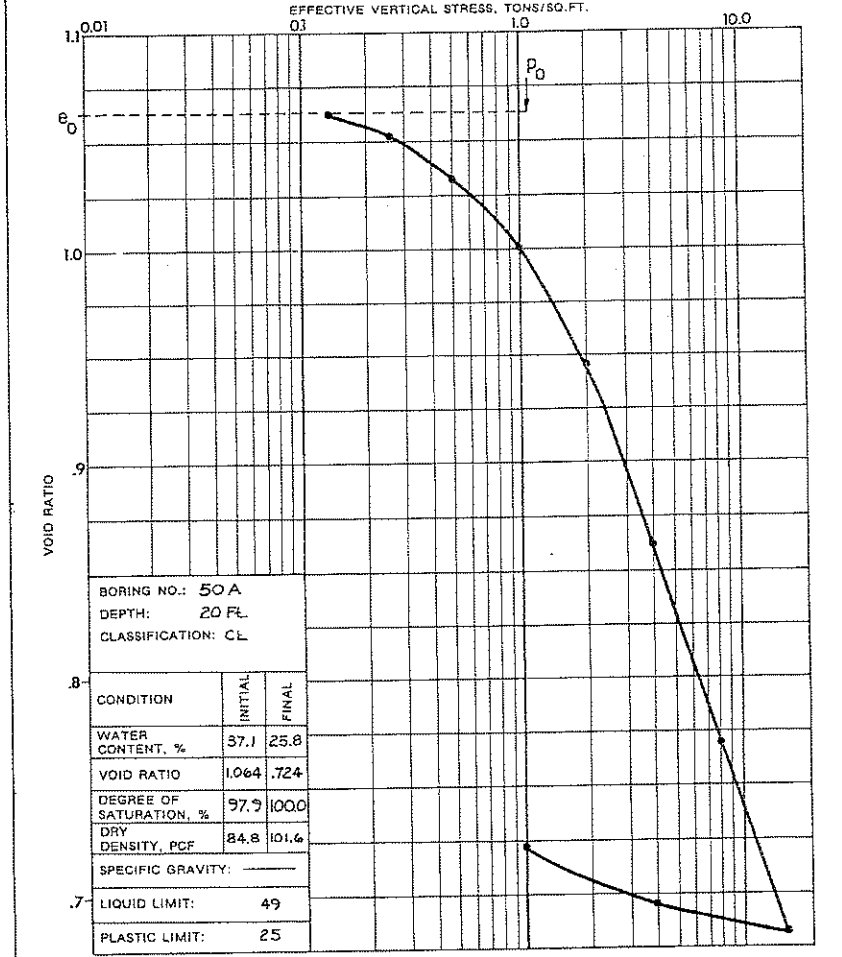


CONDITION	INITIAL	FINAL
WATER CONTENT, %	29.1	22.9
VOID RATIO	.861	.641
DEGREE OF SATURATION, %	94.6	100.0
DRY DENSITY, PCF	94.0	106.5
SPECIFIC GRAVITY:	———	
LIQUID LIMIT:	38	
PLASTIC LIMIT:	18	

CONSOLIDATION TEST RESULTS

ATEC ASSOCIATES

CN-1



CONDITION	INITIAL	FINAL
WATER CONTENT, %	37.1	25.8
VOID RATIO	1.064	.724
DEGREE OF SATURATION, %	97.9	100.0
DRY DENSITY, PCF	84.8	101.6
SPECIFIC GRAVITY:	———	
LIQUID LIMIT:	49	
PLASTIC LIMIT:	25	

CONSOLIDATION TEST RESULTS

ATEC ASSOCIATES

CN-1

APPENDIX E

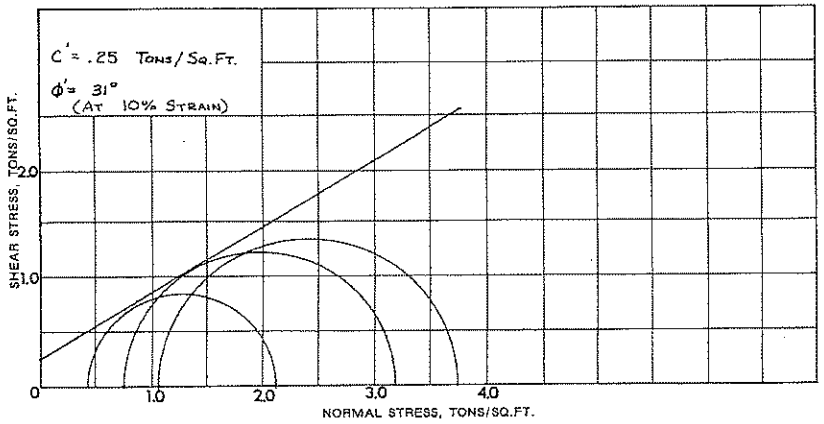
TRIAXIAL TESTS

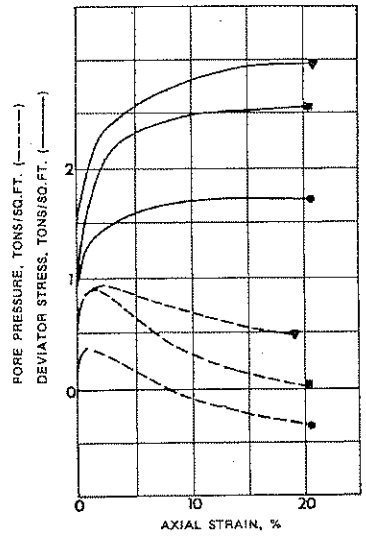
Ottumwa Generating Station-Unit 1
(E-7566)

Table E-1 SUMMARY OF CONSOLIDATED-UNDRAINED TRIAXIAL TEST RESULTS

Boring No.	Depth, ft	c' kg/cm^2	ø' degrees	Effective Confining Pressures tsf	Dry Densities, lbs/cu.ft	% Final Water Contents	Strain Rate %/min
9A	13.0-14.5	0.25	31	.35	101.2	26.2	
				1.06	107.7	20.4	1.0
				1.76	101.1	23.8	
10A	5.0-7.0	0.30	34.5	1.41	94.4	25.8	1.0
				1.82	91.6	27.0	
10A	7.0-9.0	0.30	29	1.06	91.3	27.7	
				2.11	88.1	28.5	1.0
				3.17	96.3	22.8	
18A	19.0-21.0	0.20	34	0.70	107.8	22.2	
				1.41	104.5	19.9	0.5
				2.11	105.7	21.3	
39A	13.0-15.0	0	34	1.06	89.1	30.0	
				2.11	82.9	29.4	.074
				3.17	90.0	27.1	
43A	18.0-20.0	0.3	31	0.35	104.1	23.6	
				1.06	105.3	22.3	0.5
				1.76	105.0	21.6	
48A	16.0-17.9	0	31	1.06	88.3	31.0	
				2.11	88.1	28.9	.071
				3.17	85.2	30.2	
32A *	0.0-7.0	0	40	0.70	109.2	23.1	.071
				1.41	109.6	21.5	
				2.11	109.7	22.0	

* Samples recompacted from disturbed bag sample to approximately 95 percent of modified Proctor maximum dry density.



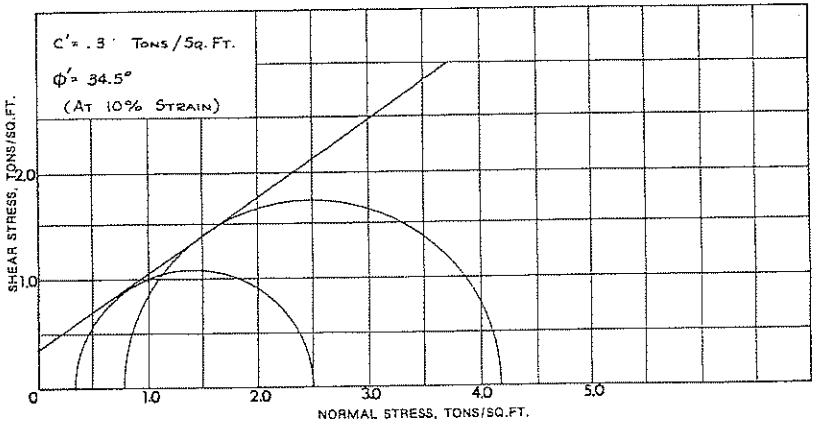


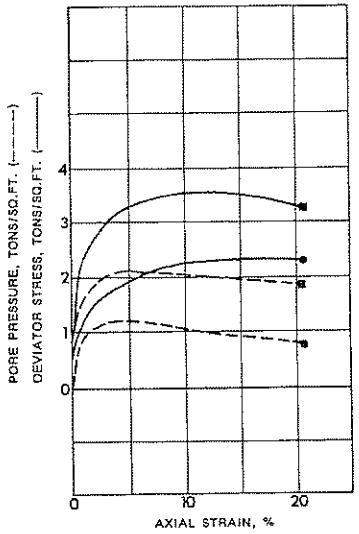
PROJECT NO.: E-7566					
BORING NO.: 9A		DEPTH: 13.0-14.5			
LIQUID LIMIT: ——		PLASTIC LIMIT: ——			
SOIL CLASSIFICATION: CH					
TYPE OF TEST: CONSOLIDATION - UNDRAINED					
RATE OF STRAIN: 1.0 %/MIN.					
TEST DESIGNATION		●	■	▼	○
INITIAL	WATER CONTENT,%	24.9	21.0	24.9	
	DRY DENSITY, PCF	101.2	107.7	101.1	
	SAMPLE HEIGHT, IN.	2.80	2.80	2.80	
	SAMPLE DIAMETER, IN.	1.40	1.40	1.40	
FINAL BACK PRESSURE, TSF		1.97	4.08	1.62	
TOTAL CONSOLIDATION PRESSURE, TSF		2.32	5.14	3.38	
EFFECTIVE CONFINING PRESSURE, TSF		0.35	1.06	1.76	
FINAL WATER CONTENT, %		26.2	20.4	23.8	
REMARKS:					

TRIAXIAL TEST RESULTS

ATEC ASSOCIATES

TX-1



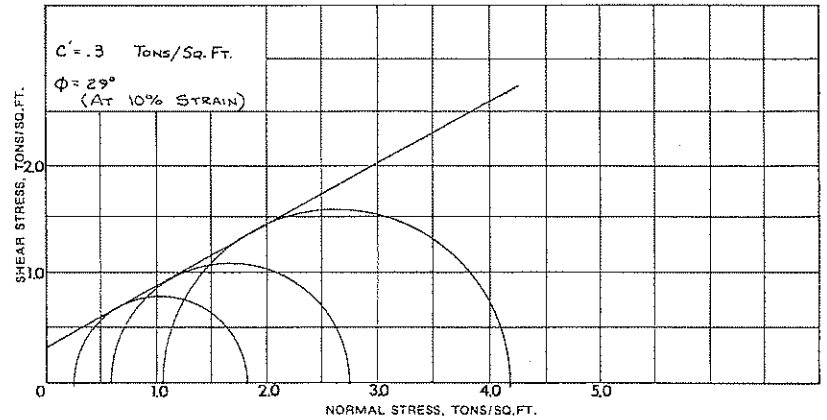


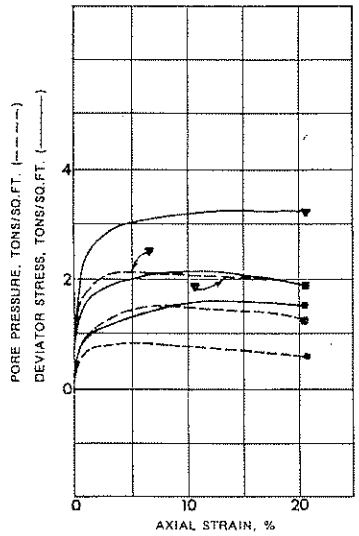
PROJECT NO.: E-7566					
BORING NO.: 10A		DEPTH: 5.0-7.0			
LIQUID LIMIT: 56		PLASTIC LIMIT: 25			
SOIL CLASSIFICATION: CH					
TYPE OF TEST: CONSOLIDATED - UNDRAINED					
RATE OF STRAIN: 1.0 %/MIN.					
TEST DESIGNATION		●	■	▼	○
INITIAL	WATER CONTENT,%	28.5	30.7		
	DRY DENSITY, PCF	94.4	91.6		
	SAMPLE HEIGHT, IN.	2.80	2.80		
	SAMPLE DIAMETER, IN.	1.40	1.40		
FINAL BACK PRESSURE, TSF		1.62	1.97		
TOTAL CONSOLIDATION PRESSURE, TSF		3.03	4.79		
EFFECTIVE CONFINING PRESSURE, TSF		1.41	2.82		
FINAL WATER CONTENT, %		25.8	27.0		
REMARKS:					

TRIAXIAL TEST RESULTS

ATEC ASSOCIATES

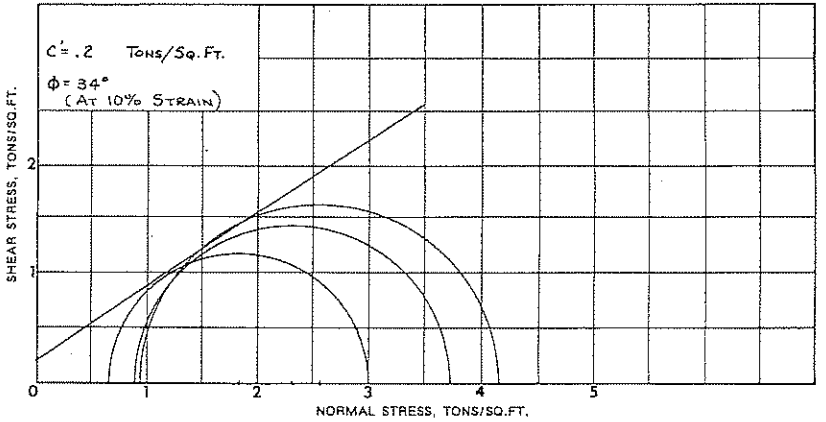
TX-1

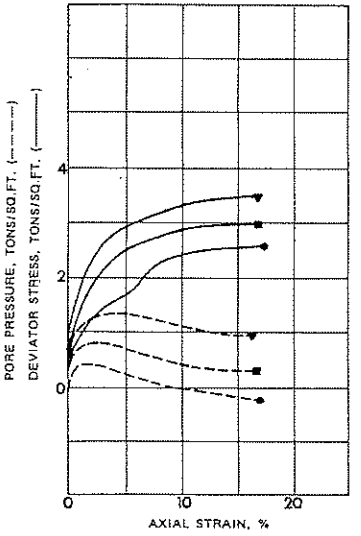




PROJECT NO.: E-7566					
BORING NO.: 10 A		DEPTH: 7.0 - 9.0			
LIQUID LIMIT: 56		PLASTIC LIMIT: 25			
SOIL CLASSIFICATION: CH					
TYPE OF TEST: CONSOLIDATED - UNDRAINED					
RATE OF STRAIN: 1.0 %/MIN.					
TEST DESIGNATION		●	■	▼	○
INITIAL	WATER CONTENT,%	32.1	32.7	27.5	
	DRY DENSITY, PCF	91.3	88.1	96.3	
	SAMPLE HEIGHT, IN.	2.80	2.80	2.80	
	SAMPLE DIAMETER, IN.	1.40	1.40	1.40	
FINAL BACK PRESSURE, TSF		2.32	2.68	1.62	
TOTAL CONSOLIDATION PRESSURE, TSF		3.38	4.79	4.79	
EFFECTIVE CONFINING PRESSURE, TSF		1.06	2.11	3.17	
FINAL WATER CONTENT, %		27.7	28.5	22.8	
REMARKS:					

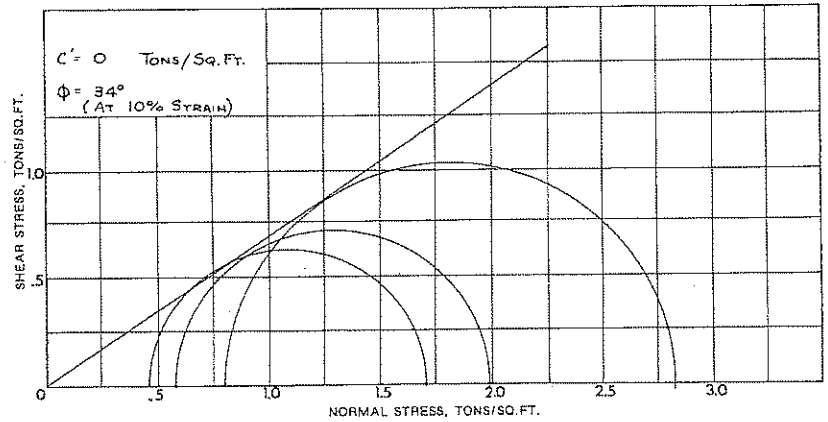
TRIAXIAL TEST RESULTS

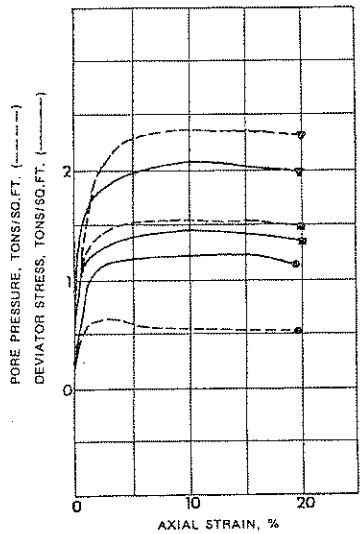




PROJECT NO.: E-7566					
BORING NO.: 18 A		DEPTH: 19.0 - 21.0			
LIQUID LIMIT: 47		PLASTIC LIMIT: 24			
SOIL CLASSIFICATION: CL					
TYPE OF TEST: CONSOLIDATED - UNDRAINED					
RATE OF STRAIN: 0.5 %/MIN.					
TEST DESIGNATION		●	■	▼	○
INITIAL	WATER CONTENT,%	20.6	23.0	20.9	
	DRY DENSITY, PCF	107.8	104.5	105.7	
	SAMPLE HEIGHT, IN.	5.60	5.60	5.60	
	SAMPLE DIAMETER, IN.	2.86	2.87	2.87	
FINAL BACK PRESSURE, TSF		1.62	1.62	2.68	
TOTAL CONSOLIDATION PRESSURE, TSF		2.32	3.03	4.79	
EFFECTIVE CONFINING PRESSURE, TSF		0.70	1.41	2.11	
FINAL WATER CONTENT, %		22.2	19.9	21.3	
REMARKS:					

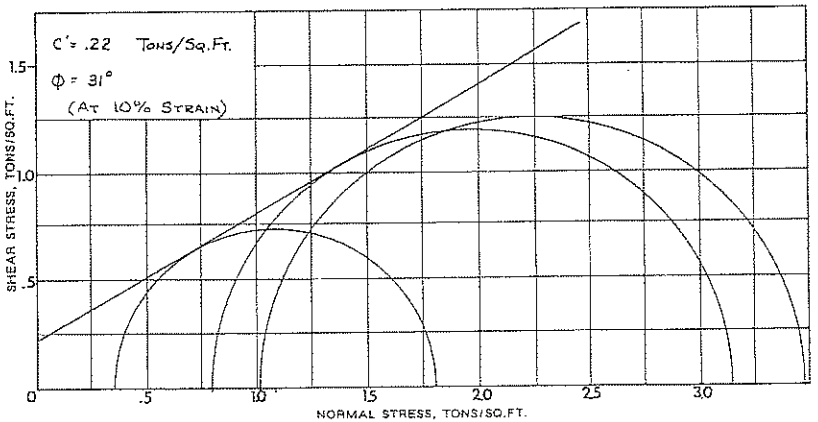
TRIAXIAL TEST RESULTS

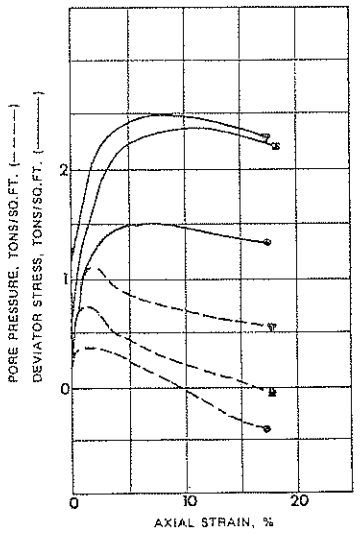




PROJECT NO.: E-7566					
BORING NO.: 39A		DEPTH: 13.0 - 15.0			
LIQUID LIMIT: 42		PLASTIC LIMIT: 25			
SOIL CLASSIFICATION: CL					
TYPE OF TEST: CONSOLIDATED - UNDRAINED					
RATE OF STRAIN: 0.074% / MIN.					
TEST DESIGNATION		●	■	▼	○
INITIAL	WATER CONTENT, %	32.8	38.4	33.9	
	DRY DENSITY, PCF	89.1	82.9	90.0	
	SAMPLE HEIGHT, IN.	2.80	2.80	2.80	
	SAMPLE DIAMETER, IN.	1.40	1.40	1.40	
FINAL BACK PRESSURE, TSF		1.97	1.27	1.62	
TOTAL CONSOLIDATION PRESSURE, TSF		3.03	3.38	4.79	
EFFECTIVE CONFINING PRESSURE, TSF		1.06	2.11	3.17	
FINAL WATER CONTENT, %		30.0	23.4	27.1	
REMARKS:					

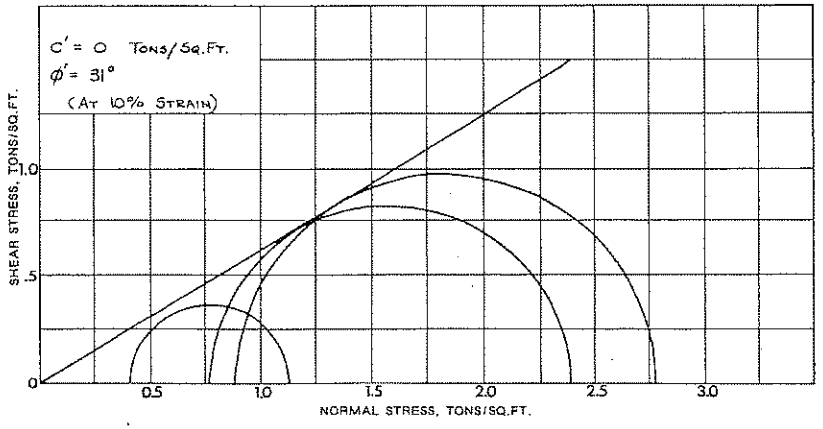
TRIAXIAL TEST RESULTS

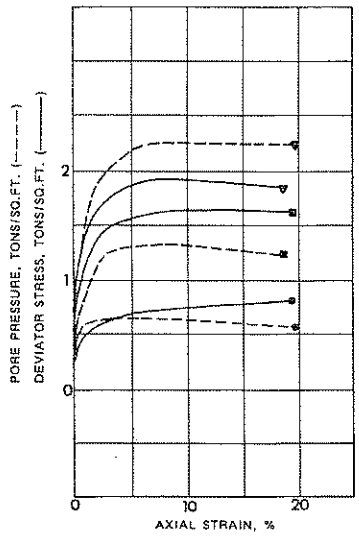




PROJECT NO.: E-7566					
BORING NO.: 43A		DEPTH: 18.0 - 20.0			
LIQUID LIMIT: 32		PLASTIC LIMIT: 15			
SOIL CLASSIFICATION: CL					
TYPE OF TEST: CONSOLIDATED - UNDRAINED					
RATE OF STRAIN: 0.5% / MIN.					
TEST DESIGNATION		●	■	▼	○
INITIAL	WATER CONTENT, %	22.2	22.2	21.1	
	DRY DENSITY, PCF	104.1	105.0	105.3	
	SAMPLE HEIGHT, IN.	5.60	5.37	5.60	
	SAMPLE DIAMETER, IN.	2.87	2.87	2.86	
FINAL BACK PRESSURE, TSF		1.27	1.97	2.32	
TOTAL CONSOLIDATION PRESSURE, TSF		1.62	3.03	4.06	
EFFECTIVE CONFINING PRESSURE, TSF		0.35	1.06	1.76	
FINAL WATER CONTENT, %		23.6	22.3	21.6	
REMARKS:					

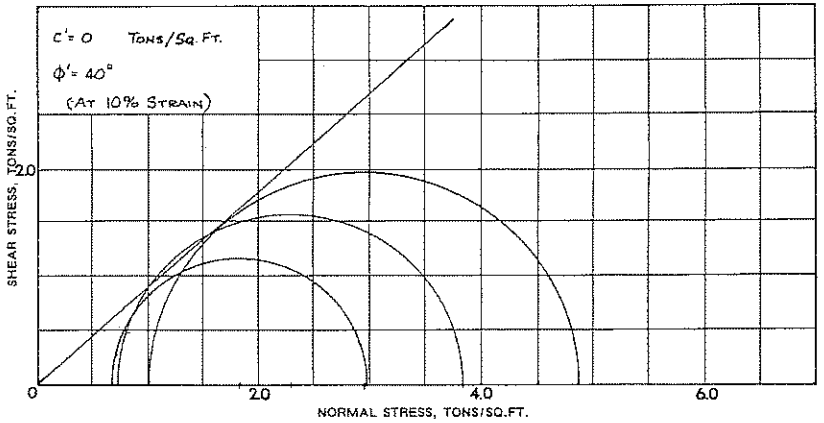
TRIAXIAL TEST RESULTS

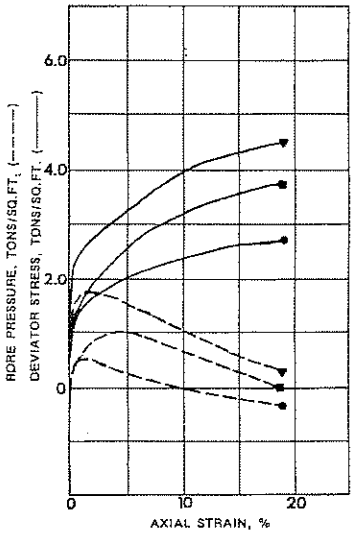




PROJECT NO.: E-7566					
BORING NO.: 48A		DEPTH: 16.0-17.9			
LIQUID LIMIT: 53		PLASTIC LIMIT: 23			
SOIL CLASSIFICATION: CH					
TYPE OF TEST: CONSOLIDATED-UNDRAINED					
RATE OF STRAIN: 0.071%/MIN.					
TEST DESIGNATION		●	■	▼	○
INITIAL	WATER CONTENT,%	33.4	33.4	36.3	
	DRY DENSITY, PCF	88.3	88.1	85.2	
	SAMPLE HEIGHT, IN.	2.80	2.80	2.80	
	SAMPLE DIAMETER, IN.	1.40	1.40	1.40	
FINAL BACK PRESSURE, TSF		1.62	2.32	2.32	
TOTAL CONSOLIDATION PRESSURE, TSF		2.68	4.43	5.49	
EFFECTIVE CONFINING PRESSURE, TSF		1.06	2.11	3.17	
FINAL WATER CONTENT, %		31.0	28.9	30.2	
REMARKS:					

TRIAXIAL TEST RESULTS





PROJECT NO.: E-7566					
BORING NO.: 32		DEPTH: 0-7.0 *			
LIQUID LIMIT: ———		PLASTIC LIMIT: ———			
SOIL CLASSIFICATION: CL					
TYPE OF TEST: CONSOLIDATED - UNDRAINED					
RATE OF STRAIN: 0.07%/MIN.					
TEST DESIGNATION		●	■	▼	○
INITIAL	WATER CONTENT,%	19.5	19.5	19.5	
	DRY DENSITY, PCF	109.2	109.6	109.7	
	SAMPLE HEIGHT, IN.	2.80	2.80	2.80	
	SAMPLE DIAMETER, IN.	1.40	1.40	1.40	
FINAL BACK PRESSURE, TSF		2.32	3.38	4.44	
TOTAL CONSOLIDATION PRESSURE, TSF		3.02	4.79	6.55	
EFFECTIVE CONFINING PRESSURE, TSF		0.70	1.41	2.11	
FINAL WATER CONTENT, %		23.1	21.5	22.0	
REMARKS: * SAMPLE RECOMPACTED FROM DISTURBED BAG SAMPLE TO APPROX. 95% OF MODIFIED PROCTOR MAXIMUM DRY DENSITY.					

TRIAXIAL TEST RESULTS

Ottumwa Generating Station-Unit 1
(E-7566)

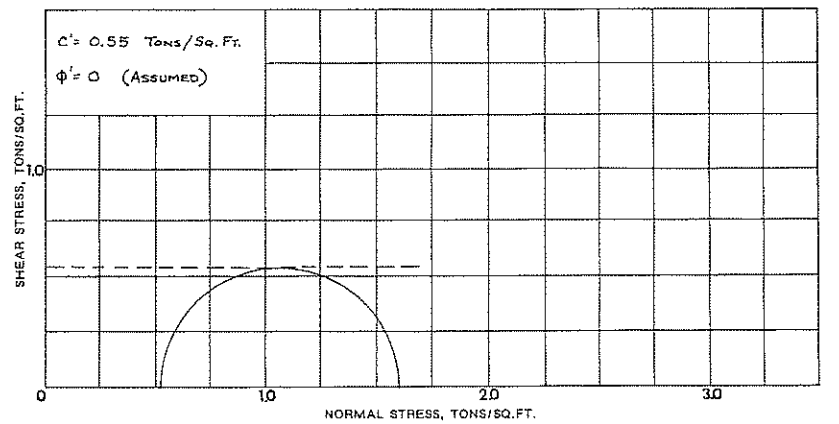
Table E-2 SUMMARY OF UNCONSOLIDATED-UNDRAINED TRIAXIAL TEST RESULTS

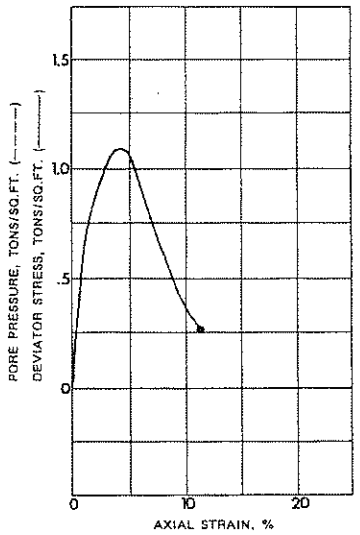
Boring No.	Depth, ft	Total Confining Pressure, tsf	Dry Density, lbs/cu.ft	Moisture Content, %	c (For Ø=0), tons/sq.ft	Remarks
41A	8.0-10.0	0.53	102.6	20.9	0.55	Small hole noted in membrane after test
43A	8.0-10.0	0.53	98.1	25.6	0.54	
45A	9.0-11.0	0.60	113.1	16.9	1.05	
46A	18.0-19.9	0.95	96.8	26.6	0.56	
50A	19.0-21.0	0.90	88.6	34.1	0.37	
32	0.0-7.0	1.41	104.6	19.3	0.85	Sample recompacted from disturbed Bag Sample at approx. 90% of modified Proctor maximum dry density
32	0.0-7.0	1.41	109.5	14.9	8.85 *	Sample recompacted from disturbed Bag Sample at approx. 95% of modified Proctor maximum dry density
32	0.0-7.0	1.41	108.5	20.1	3.38 **	Sample recompacted from disturbed Bag Sample at approx. 95% of modified Proctor maximum dry density

Note: All tests performed at a strain rate of approximately 1.0 percent per minute.

* Unconfined compressive strength for similarly recompacted sample - 10.49 tons/sq.ft

** Unconfined compressive strength for similarly recompacted sample - 5.37 tons/sq.ft



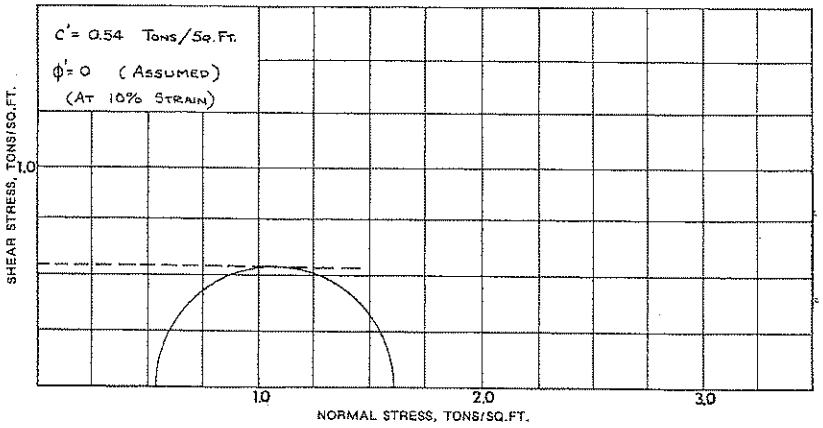


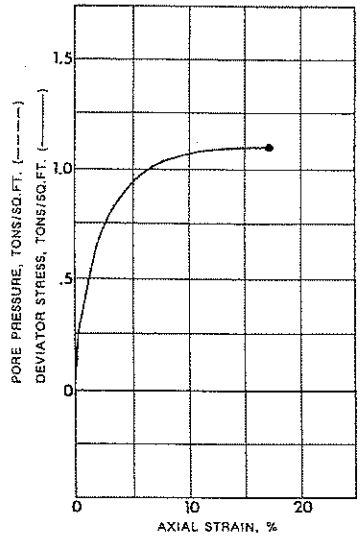
PROJECT NO.: E-7566					
BORING NO.: 41A	DEPTH: 8.0-10.0				
LIQUID LIMIT: 41	PLASTIC LIMIT: 16				
SOIL CLASSIFICATION: CL					
TYPE OF TEST: UNCONSOLIDATED - UNDRAINED					
RATE OF STRAIN: 1.0 % / MIN.					
TEST DESIGNATION		●	■	▼	○
INITIAL	WATER CONTENT, %	20.9			
	DRY DENSITY, PCF	102.6			
	SAMPLE HEIGHT, IN.	5.60			
	SAMPLE DIAMETER, IN.	2.84			
FINAL BACK PRESSURE, TSF		—			
TOTAL CONSOLIDATION PRESSURE, TSF		—			
TOTAL CONFINING PRESSURE, TSF		0.53			
FINAL WATER CONTENT, %		—			
REMARKS: SMALL HOLE NOTED IN MEMBRANE AFTER TEST.					

TRIAXIAL TEST RESULTS

ATEC ASSOCIATES

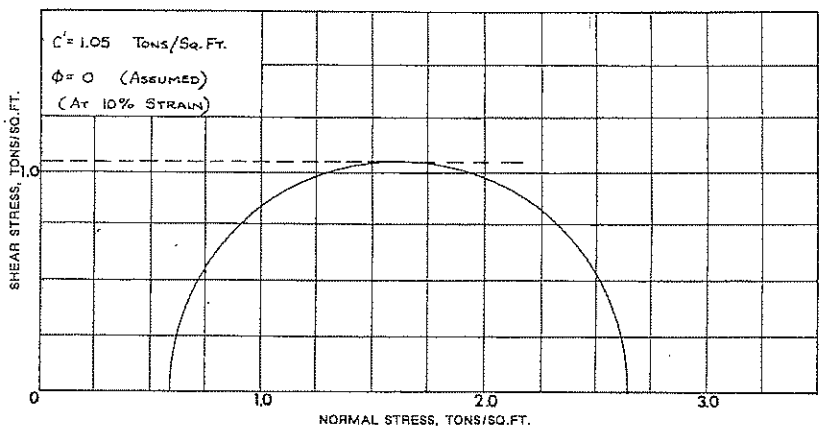
TX-1

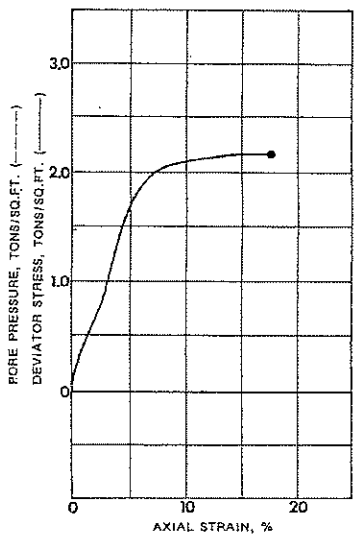




PROJECT NO.: E-7566					
BORING NO.: 43 A	DEPTH: 8.0 - 10.0				
LIQUID LIMIT: ——	PLASTIC LIMIT: ——				
SOIL CLASSIFICATION: CL					
TYPE OF TEST: UNCONSOLIDATED - UNDRAINED					
RATE OF STRAIN: 1.0% / MIN.					
TEST DESIGNATION		●	■	▼	○
INITIAL	WATER CONTENT, %	25.6			
	DRY DENSITY, PCF	98.1			
	SAMPLE HEIGHT, IN.	5.60			
	SAMPLE DIAMETER, IN.	2.87			
FINAL BACK PRESSURE, TSF		——			
TOTAL CONSOLIDATION PRESSURE, TSF		——			
TOTAL CONFINING PRESSURE, TSF		0.53			
FINAL WATER CONTENT, %		——			
REMARKS:					

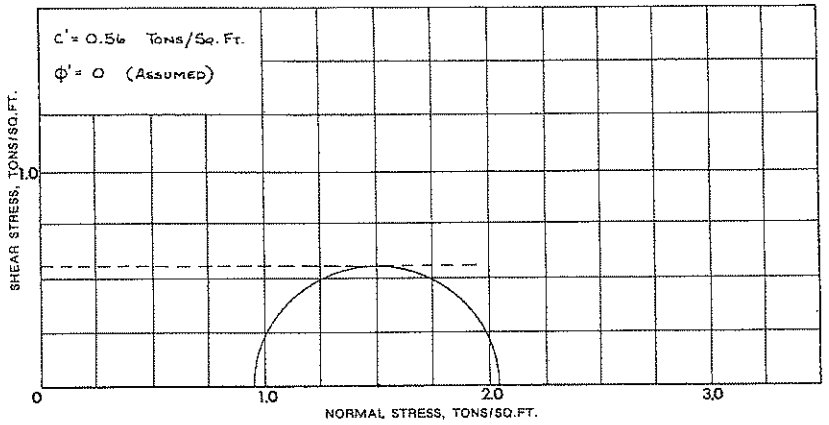
TRIAXIAL TEST RESULTS

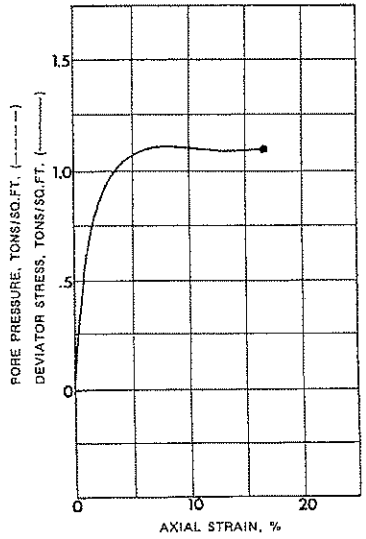




PROJECT NO.: E-7566					
BORING NO.: 45 A	DEPTH: 9.0 - 11.0				
LIQUID LIMIT: 35	PLASTIC LIMIT: 11				
SOIL CLASSIFICATION: CL					
TYPE OF TEST: UNCONSOLIDATED - UNDRAINED					
RATE OF STRAIN: 1.0% / MIN.					
TEST DESIGNATION		●	■	▼	○
INITIAL	WATER CONTENT, %	16.9			
	DRY DENSITY, PCF	113.1			
	SAMPLE HEIGHT, IN.	5.26			
	SAMPLE DIAMETER, IN.	2.82			
FINAL BACK PRESSURE, TSF		——			
TOTAL CONSOLIDATION PRESSURE, TSF		——			
TOTAL CONFINING PRESSURE, TSF		0.60			
FINAL WATER CONTENT, %		——			
REMARKS:					

TRIAXIAL TEST RESULTS



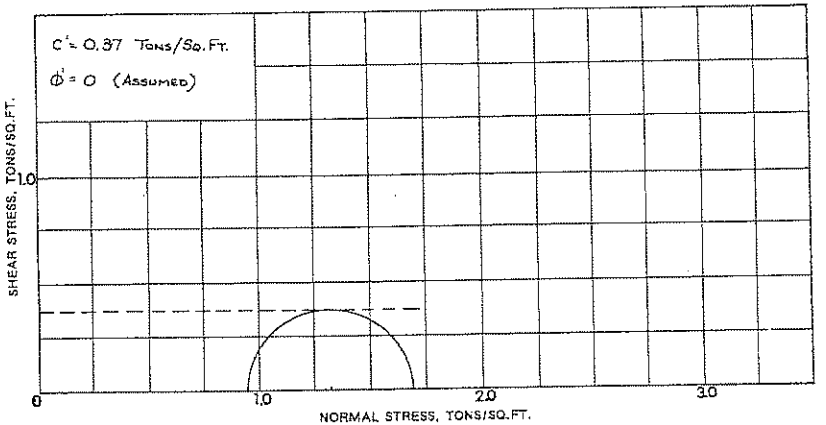


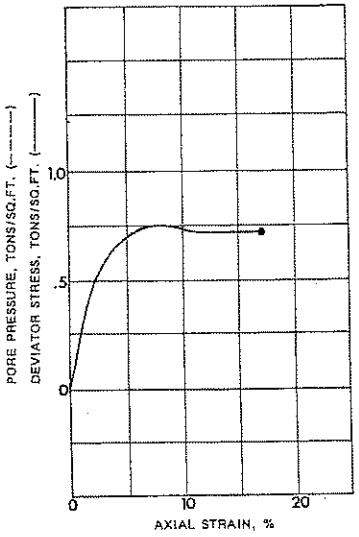
PROJECT NO.: E-7566					
BORING NO.: 46 A	DEPTH: 18.0-19.9				
LIQUID LIMIT: ——	PLASTIC LIMIT: ——				
SOIL CLASSIFICATION: CL					
TYPE OF TEST: Unconsolidated - Undrained					
RATE OF STRAIN: 1.0 % / Min.					
TEST DESIGNATION		●	■	▼	○
INITIAL	WATER CONTENT, %	26.6			
	DRY DENSITY, PCF	96.8			
	SAMPLE HEIGHT, IN.	5.60			
	SAMPLE DIAMETER, IN.	2.87			
FINAL BACK PRESSURE, TSF		——			
TOTAL CONSOLIDATION PRESSURE, TSF		——			
TOTAL CONFINING PRESSURE, TSF		0.95			
FINAL WATER CONTENT, %		——			
REMARKS:					

TRIAXIAL TEST RESULTS

ATEC ASSOCIATES

TX-1



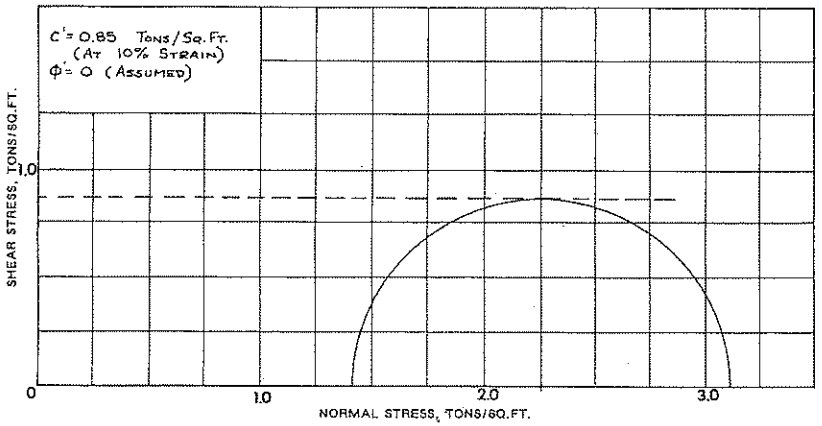


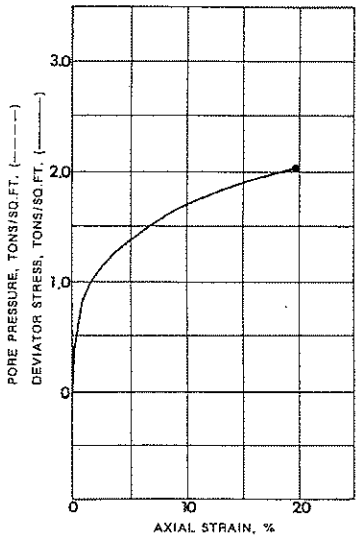
PROJECT NO.: E-7566					
BORING NO.: 50 A	DEPTH: 19.0-21.0				
LIQUID LIMIT: 49	PLASTIC LIMIT: 25				
SOIL CLASSIFICATION: CL					
TYPE OF TEST: Unconsolidated - Undrained					
RATE OF STRAIN: 1.0% / Min.					
TEST DESIGNATION		●	■	▼	○
INITIAL	WATER CONTENT, %	34.1			
	DRY DENSITY, PCF	88.6			
	SAMPLE HEIGHT, IN.	5.60			
	SAMPLE DIAMETER, IN.	2.85			
FINAL BACK PRESSURE, TSF		——			
TOTAL CONSOLIDATION PRESSURE, TSF		——			
TOTAL CONFINING PRESSURE, TSF		0.90			
FINAL WATER CONTENT, %		——			
REMARKS:					

TRIAXIAL TEST RESULTS

ATEC ASSOCIATES

TX-1



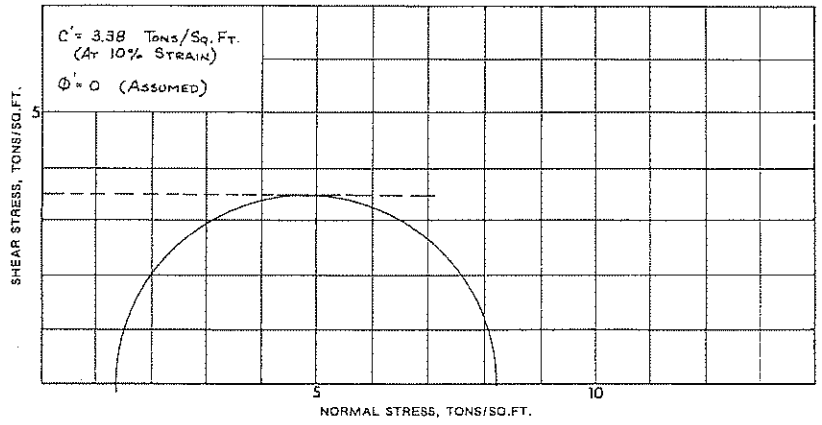


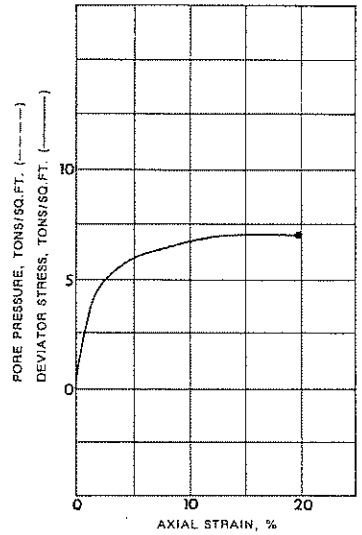
PROJECT NO.: E-7566					
BORING NO.: 32	DEPTH: 0 - 7.0*				
LIQUID LIMIT: ——	PLASTIC LIMIT: ——				
SOIL CLASSIFICATION: CL					
TYPE OF TEST: Unconsolidated - Undrained					
RATE OF STRAIN: 1.0% / Min.					
TEST DESIGNATION		●	■	▼	○
INITIAL	WATER CONTENT,%	19.3			
	DRY DENSITY, PCF	104.6			
	SAMPLE HEIGHT, IN.	2.80			
	SAMPLE DIAMETER, IN.	1.40			
FINAL BACK PRESSURE, TSF		——			
TOTAL CONSOLIDATION PRESSURE, TSF		——			
TOTAL CONFINING PRESSURE, TSF		1.41			
FINAL WATER CONTENT, %		——			

REMARKS: * Sample Recompacted From Disturbed Bag Sample To Approx. 90% Of Modified Proctor Maximum Dry Density

TRIAXIAL TEST RESULTS

ATEC ASSOCIATES TX-1



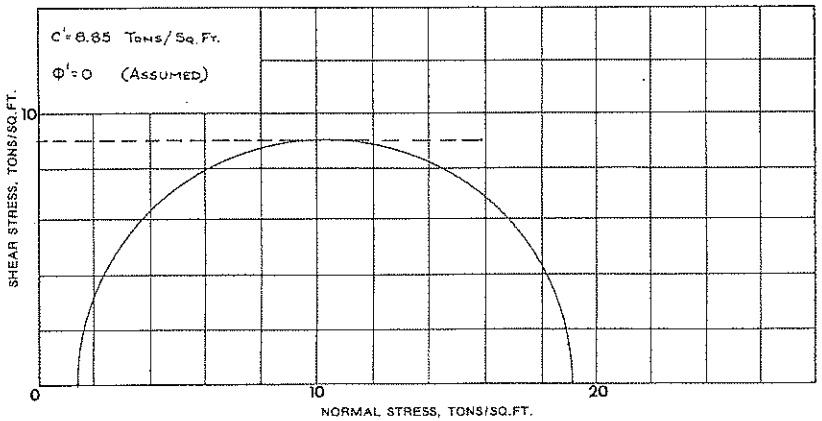


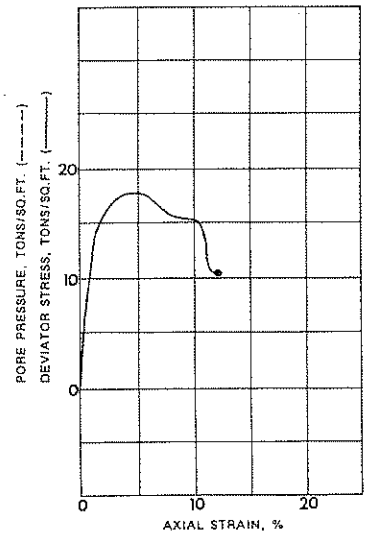
PROJECT NO.: E-7566					
BORING NO.: 32	DEPTH: 0 - 7.0*				
LIQUID LIMIT: ——	PLASTIC LIMIT: ——				
SOIL CLASSIFICATION: CL					
TYPE OF TEST: Unconsolidated - Undrained					
RATE OF STRAIN: 1.0% / Min.					
TEST DESIGNATION		●	■	▼	○
INITIAL	WATER CONTENT,%	20.1			
	DRY DENSITY, PCF	108.5			
	SAMPLE HEIGHT, IN.	2.82			
	SAMPLE DIAMETER, IN.	1.31			
FINAL BACK PRESSURE, TSF		——			
TOTAL CONSOLIDATION PRESSURE, TSF		——			
TOTAL CONFINING PRESSURE, TSF		1.41			
FINAL WATER CONTENT, %		——			

REMARKS: * Sample Recompacted From Disturbed Bag Sample To Appox. 95% Of Modified Proctor Maximum Dry Density

TRIAXIAL TEST RESULTS

ATEC ASSOCIATES TX-1





PROJECT NO.: E-7566					
BORING NO.: 32		DEPTH: 0-7.0+			
LIQUID LIMIT: ——		PLASTIC LIMIT: ——			
SOIL CLASSIFICATION: CL					
TYPE OF TEST: Unconsolidated- Undrained					
RATE OF STRAIN: 1.0% / Min.					
TEST DESIGNATION		●	⊠	▼	○
INITIAL	WATER CONTENT, %	14.9			
	DRY DENSITY, PCF	109.5			
	SAMPLE HEIGHT, IN.	2.82			
	SAMPLE DIAMETER, IN.	1.31			
FINAL BACK PRESSURE, TSF		——			
TOTAL CONSOLIDATION PRESSURE, TSF		——			
TOTAL CONFINING PRESSURE, TSF		1.41			
FINAL WATER CONTENT, %		——			

REMARKS: + Sample Recompacted From Disturbed Bag Sample To Approx. 95% Of Modified Proctor Maximum Dry Density

TRIAXIAL TEST RESULTS

ATEC ASSOCIATES

TX-1

APPENDIX F

GRADATION TESTS

Ottumwa Generating Station-Unit 1
(E-7566)

Table F-1

SUMMARY OF SIEVE ANALYSIS RESULTS

Boring No.	Depth, ft	Percent Gravel	Percent Sand	Percent Silt & Clay	D_{60}, mm	D_{10}, mm	Uniformity Coefficient C_u	Unified Classification Symbol
1	28.5-30.0	0	98	2	0.70	0.22	3.2	SP
2	28.5-30.0	0	97	3	0.30	0.18	1.7	SP
4	8.5-10.0	6	51	43	0.21	-	-	SM
10	13.5-15.0	0	76	24	0.26	-	-	SM
13	28.5-30.0	0	63	37	0.15	-	-	SM
15	16.0-17.5	7	89	4	0.81	0.19	4.2	SP
16	23.5-25.0	18	70	12	0.70	0.06	11.7	SW-SM
17	13.5-15.0	0	98	2	0.72	0.25	2.9	SP
20	8.5-10.0	0	95	5	0.46	0.18	2.6	SP-SM
22	18.5-20.0	1	97	2	0.65	0.20	3.3	SP
23	11.0-12.5	0	69	31	0.16	-	-	SM
27	18.5-20.0	2	74	24	0.42	-	-	SC-SM
28	8.5-9.5	7	56	37	.18	-	-	SC
28	13.5-15.0	13	77	10	.40	.074	5.4	SP-SM
29	24.5-25.0	0	89	11	.19	.07	2.7	SP-SC

Ottumwa Generating Station-Unit 1
(E-7566)

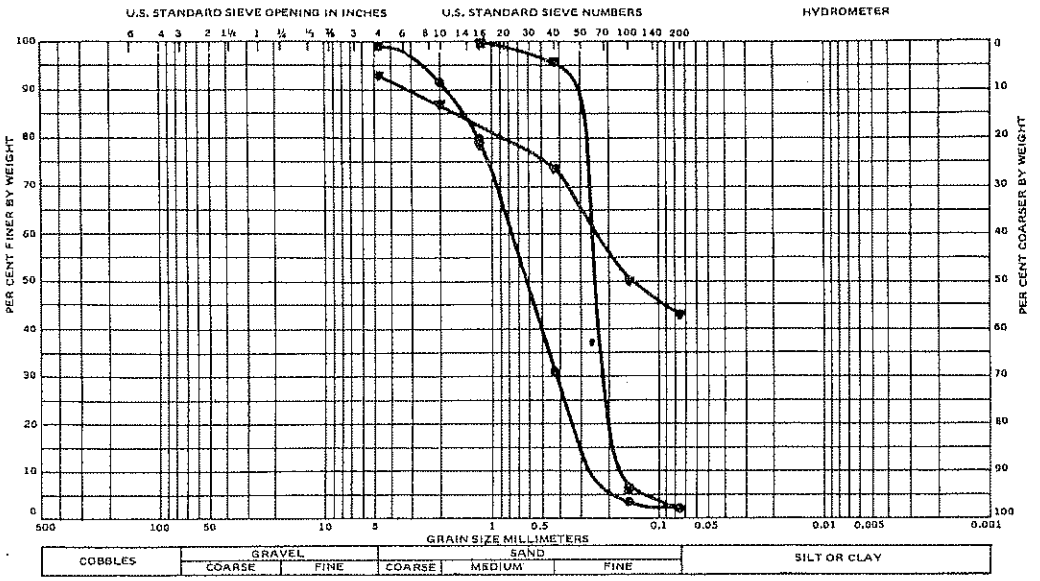
Table F-1

SUMMARY OF SIEVE ANALYSIS RESULTS

Boring No.	Depth, ft	Percent Gravel	Percent Sand	Percent Silt & Clay	D_{60}, mm	D_{10}, mm	Uniformity Coefficient C_u	Unified Classification Symbol
30	23.5-24.0	1	51	48	.19	-	-	SC
32	28.5-30.0	12	70	18	.25	-	-	SM
33	18.5-20.0	0	64	36	.15	-	-	SM
34	13.5-15.0	0	21	79	-	-	-	ML
36	33.5-35.0	14	78	8	.42	.10	4.2	SP-SM
39	16.0-17.0	26	57	17	6.5	-	-	SM
40	13.5-15.0	1	95	4	.28	.11	2.5	SP
41	16.0-17.5	0	99	1	.60	.23	2.6	SP
42	23.5-25.0	26	70	4	2.0	.23	8.7	SW
43	24.0-25.0	0	68	32	.17	-	-	SM
44	8.5-10.0 11.0-12.5	3	93	4	.50	.18	2.8	SP
48	13.5-15.0	0	58	42	.16	-	-	SM
52	8.5-10.0	0	58	42	.42	-	-	SC

ATEC ASSOCIATES

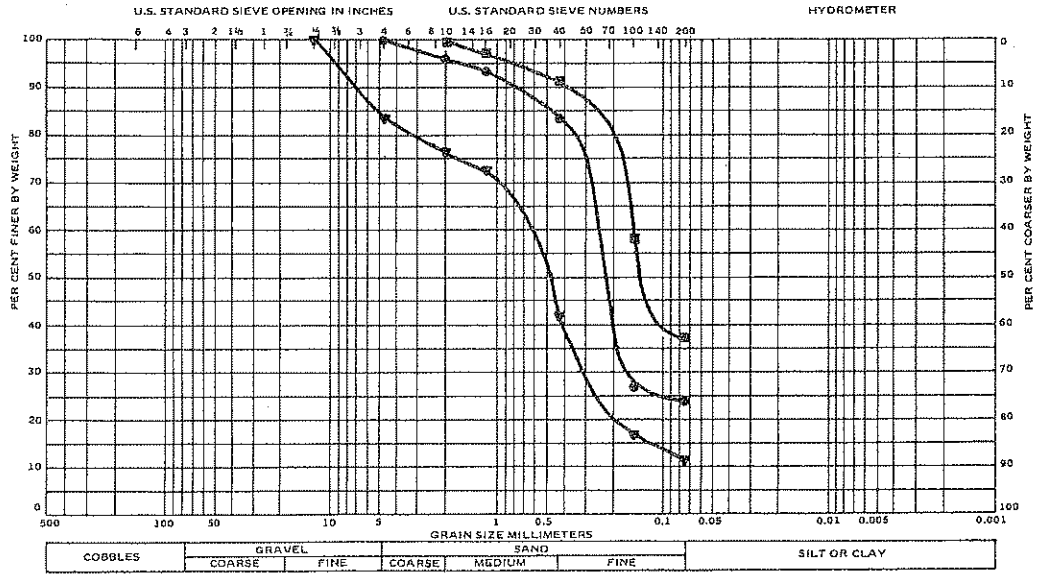
GRADATION CURVES



CURVE	BORING NO.	DEPTH, FT.	DESCRIPTION
●	1	28.5-30.0	Brown fine to medium Sand (SP)
■	2	28.5-30.0	White fine Sand (SP)
▼	4	8.5-10.0	Brown Silty Sand (SM)

ATEC ASSOCIATES

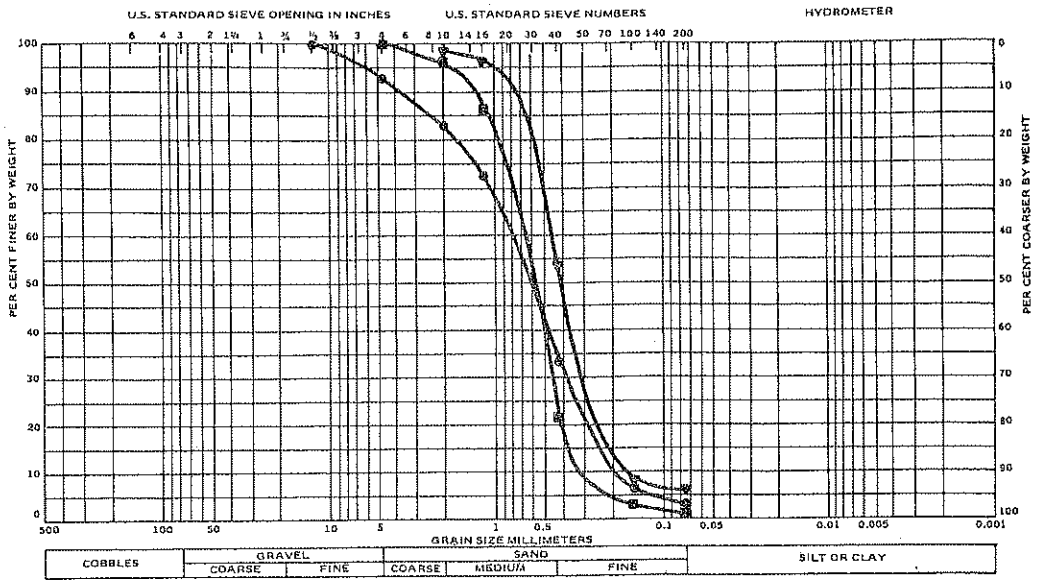
GRADATION CURVES



CURVE	BORING NO.	DEPTH, FT.	DESCRIPTION
●	10	13.5-15.0	Brown to Gray Silty fine Sand (SM)
■	13	28.5-30.0	Brown Silty fine Sand (SM)
▼	16	23.5-25.0	Gray and Brown Silty Sand (SW-SM)

ATEC ASSOCIATES

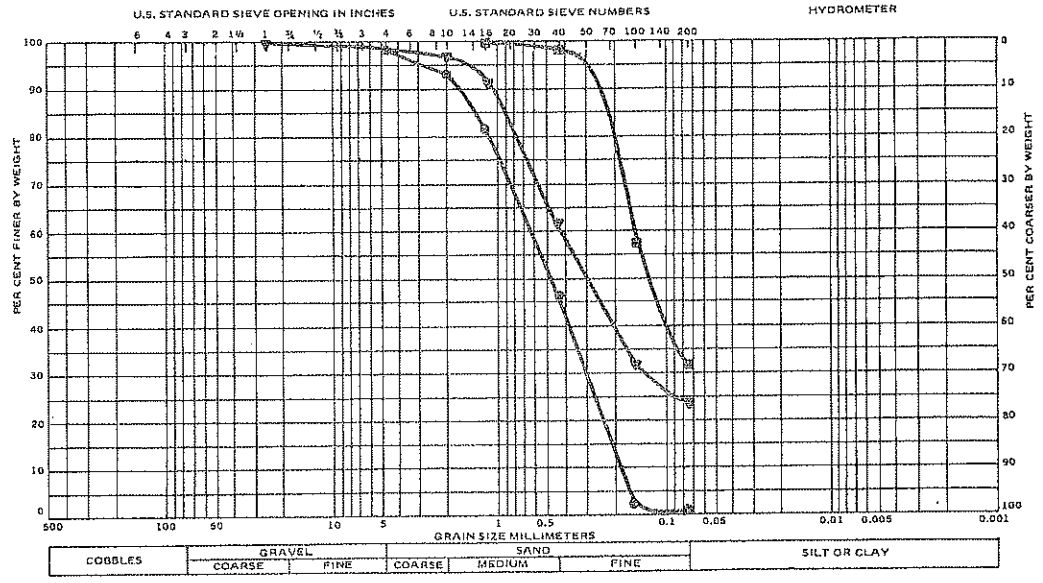
GRADATION CURVES



CURVE	BORING NO.	DEPTH, FT.	DESCRIPTION
●	15	16.0-17.5	Brown fine to medium Sand (SP)
■	17	13.5-15.0	Brown fine to medium Sand (SP)
▼	20	8.5-10.0	Brown Silty fine to medium Sand (SP-SM)

ATEC ASSOCIATES

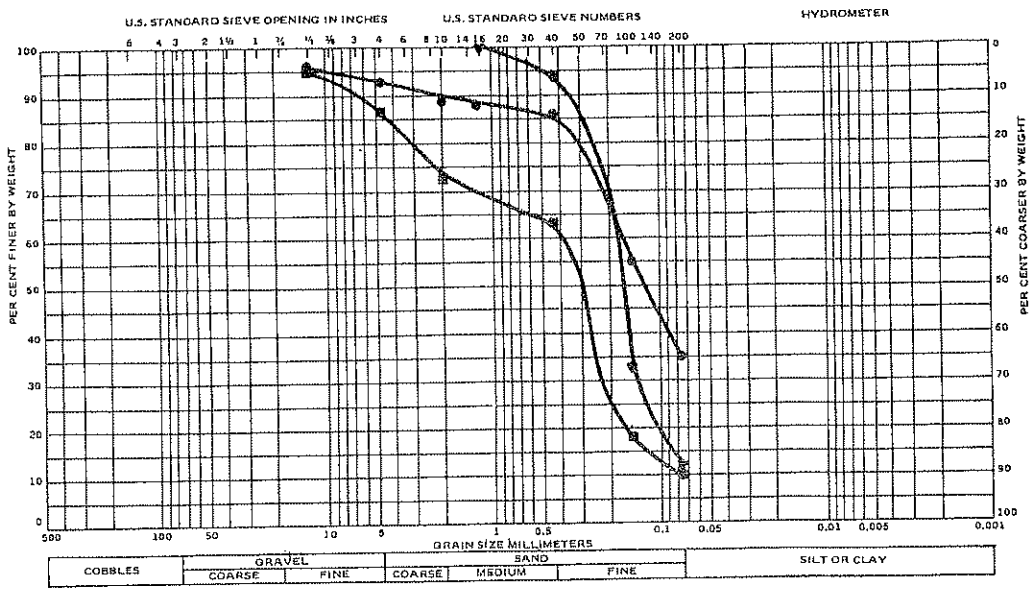
GRADATION CURVES



CURVE	BORING NO.	DEPTH, FT.	DESCRIPTION
●	22	18.5-20.0	Brown fine to medium Sand (SP)
■	23	11.0-12.5	Brown Silty fine Sand (SM)
▼	27	18.5-20.0	Dark Brown Silty Sand (SM)

ATEC ASSOCIATES

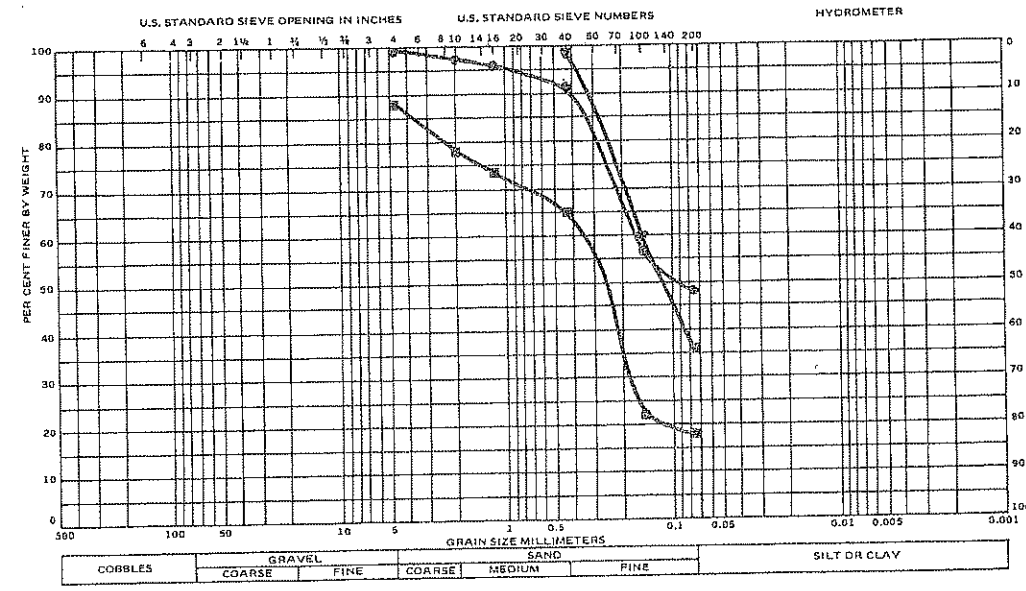
GRADATION CURVES



CURVE	BORING NO.	DEPTH, FT.	DESCRIPTION
●	28	8.5-9.5	Brown Clayey Sand (SC)
■	28	13.5-15.0	Brown Silty Sand (SP-SM)
▼	29	24.5-25.0	Brown Clayey fine Sand (SP-SC)

ATEC ASSOCIATES

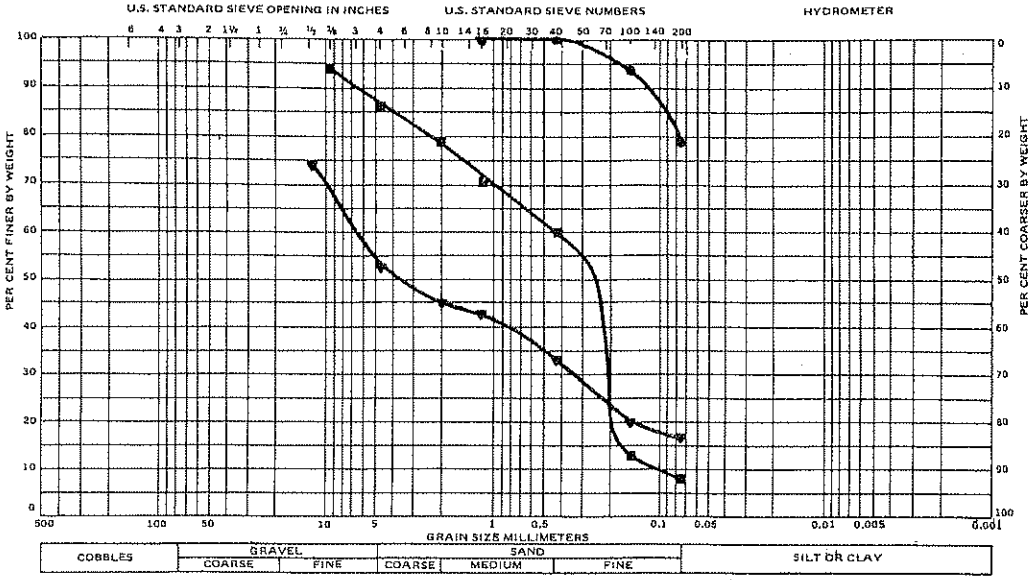
GRADATION CURVES



CURVE	BORING NO.	DEPTH, FT.	DESCRIPTION
●	30	23.5-24.0	Brown Clayey fine Sand (SC)
■	32	28.5-30.0	Gray Silty Sand (SM)
▼	33	18.5-20.0	Gray Silty fine Sand (SM)

ATEC ASSOCIATES

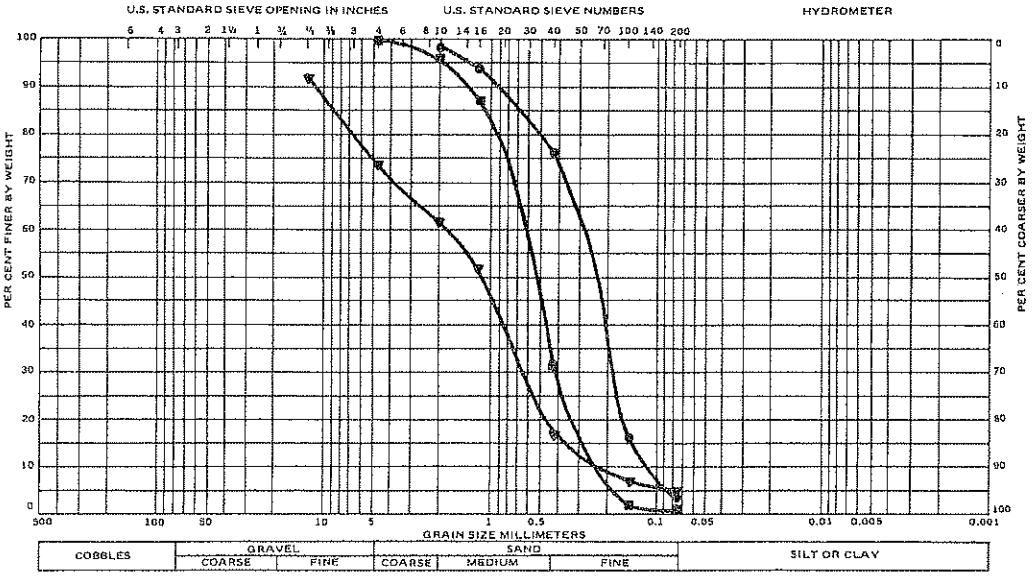
GRADATION CURVES



CURVE	BORING NO.	DEPTH, FT.	DESCRIPTION
●	34	13.5-15.0	Reddish Brown Sandy Silt (ML)
■	36	33.5-35.0	Gray Silty Sand (SP-SM)
▼	39	16.0-17.3	Dark Gray Silty Sand (SM)

ATEC ASSOCIATES

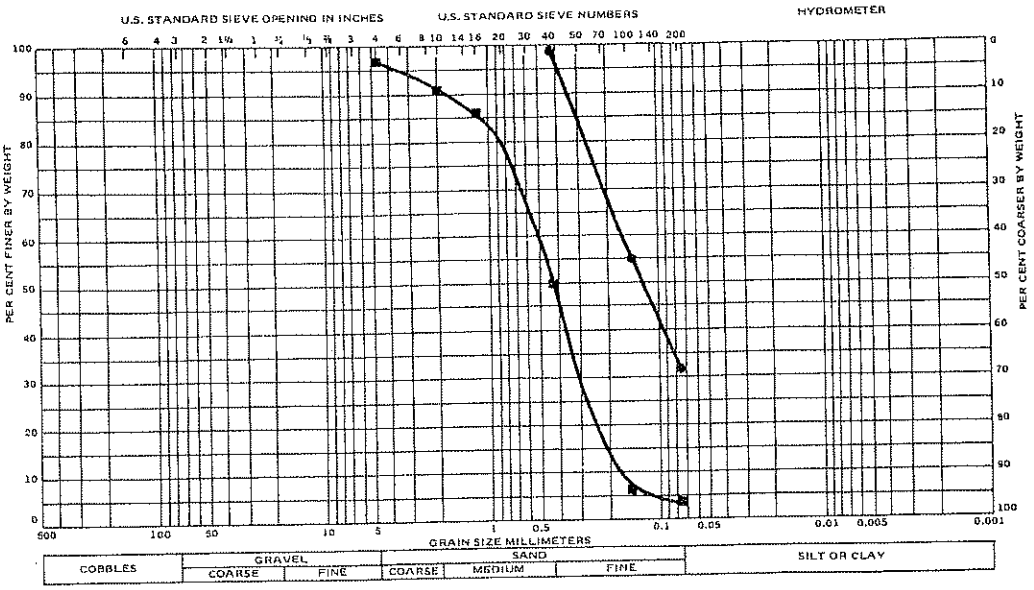
GRADATION CURVES



CURVE	BORING NO.	DEPTH, FT.	DESCRIPTION
●	40	13.5-15.0	Brown fine to medium Sand (SP)
■	41	16.0-17.5	Brown fine to medium Sand (SP)
▼	42	23.5-25.0	Gray fine to coarse Sand (SW)

ATEC ASSOCIATES

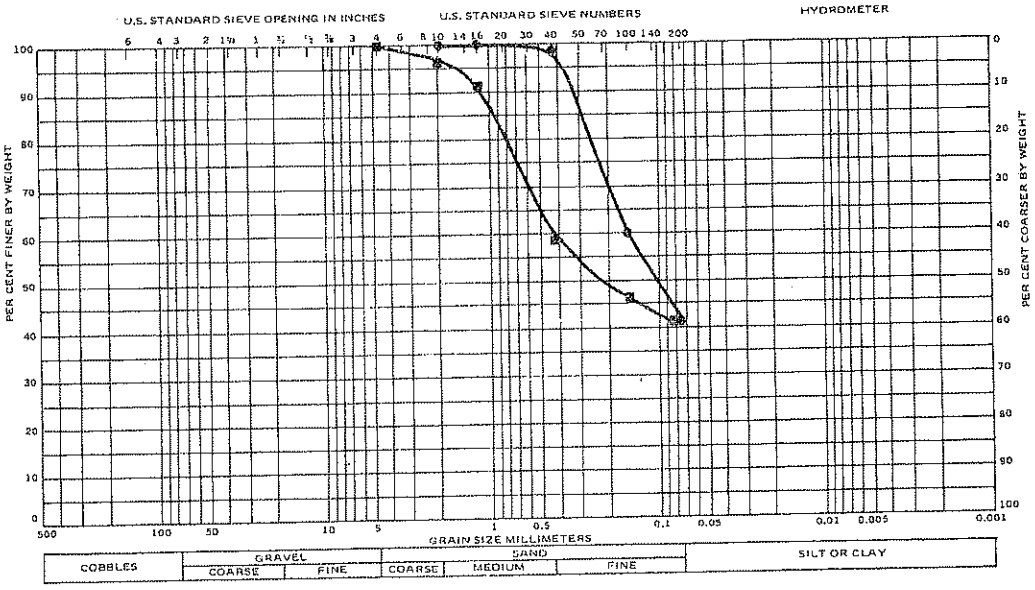
GRADATION CURVES



CURVE	BORING NO.	DEPTH, FT.	DESCRIPTION
●	45	24.0-25.0	Brown Silty fine Sand (SM)
■	44	8.5-12.5	Brown fine to medium Sand (SP)

ATEC ASSOCIATES

GRADATION CURVES



CURVE	BORING NO.	DEPTH, FT.	DESCRIPTION
●	48	14.5-15.0	Brown Silty fine Sand (SM)
■	52	8.5-10.0	Reddish Brown Silty fine to medium Sand (SM)

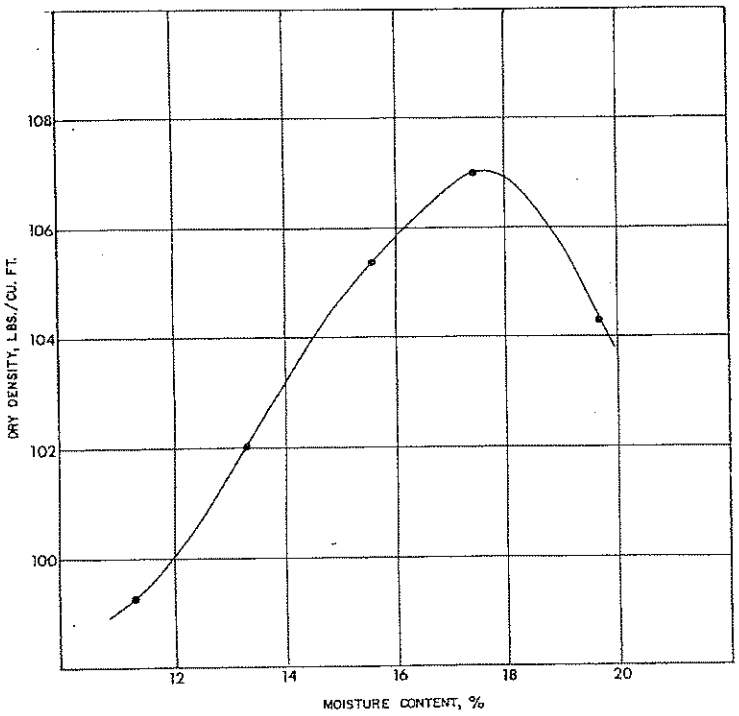
APPENDIX G

COMPACTION TESTS

Ottumwa Generating Station-Unit 1
(E-7566)

Table G-1 SUMMARY OF COMPACTION TEST RESULTS

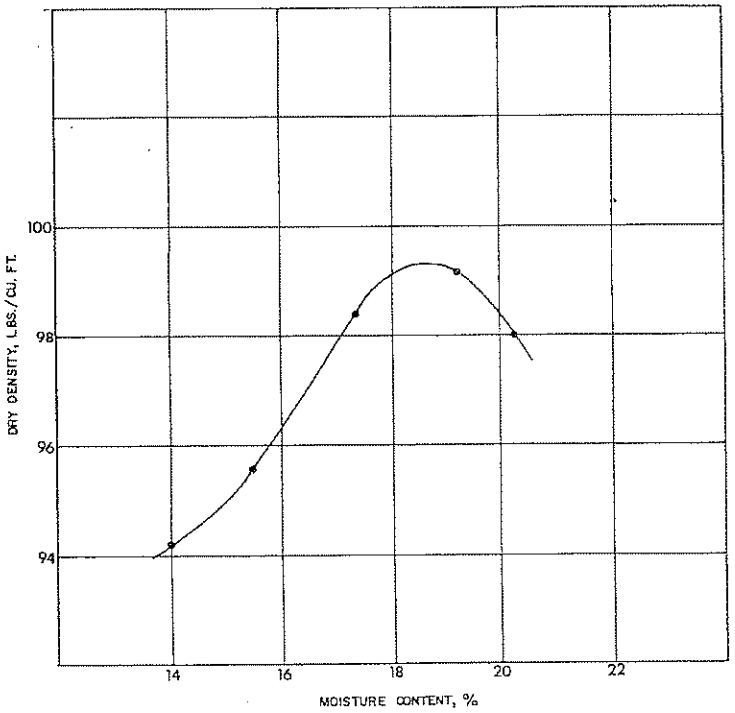
Boring No.	Depth, ft	Standard Proctor (ASTM D-698) Maximum dry density lbs/cu.ft	Standard Proctor (ASTM D-698) Optimum moisture content,%	Modified Proctor (ASTM D-1557) Maximum dry density lbs/cu.ft	Modified Proctor (ASTM D-1557) Optimum Moisture Content,%
30	0-12	107.0	17.7	120.3	13.3
32	0-7	99.3	18.9	115.2	14.7
45	0-8	-	-	117.4	15.3
45	8-20	110.8	16.0	123.0	12.0
46	0-11	107.0	17.9	121.3	13.5
46	13-20	114.1	15.5	125.8	11.0



BORING NO.: 30	DEPTH: 0 - 12.0
SOIL CLASSIFICATION: CL	TEST TYPE: ASTM D 698
MAXIMUM DRY DENSITY: 107.0 lbs/ft³	OPTIMUM MOISTURE CONTENT: 17.7%

MOISTURE - DENSITY RELATIONSHIP

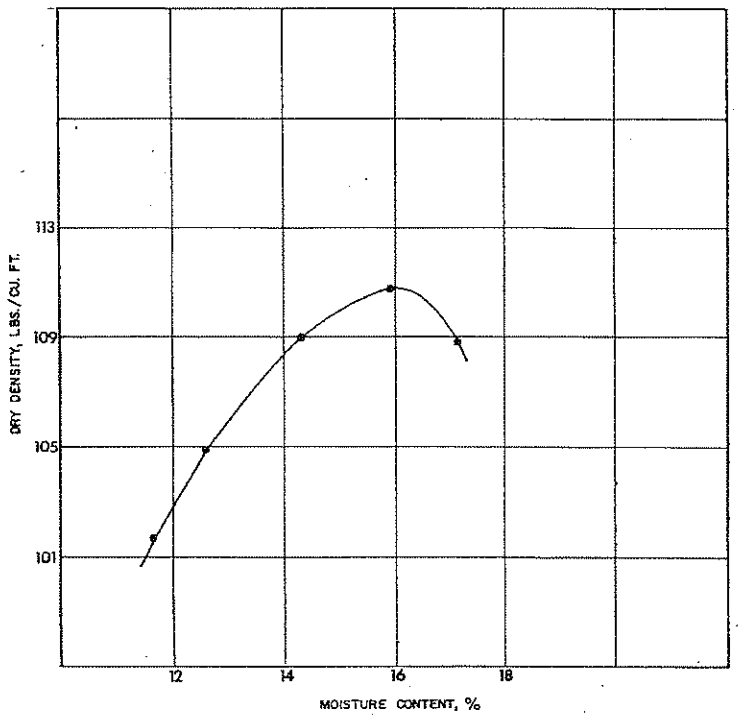
ATEC ASSOCIATES



BORING NO.: 32	DEPTH: 0 - 7.0
SOIL CLASSIFICATION: CL	TEST TYPE: ASTM D 698
MAXIMUM DRY DENSITY: 99.3 lbs./cu. ft.	OPTIMUM MOISTURE CONTENT: 18.9 %

MOISTURE - DENSITY RELATIONSHIP

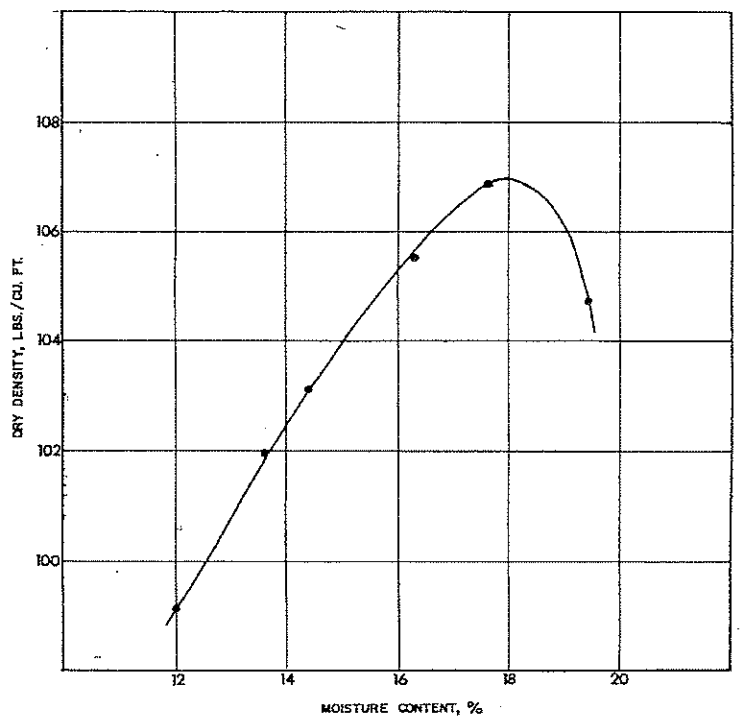
ATEC ASSOCIATES



BORING NO.: 45	DEPTH: 8.0-20.0
SOIL CLASSIFICATION: CL	TEST TYPE: ASTM D 698
MAXIMUM DRY DENSITY: 110.8 lbs/cu.ft.	OPTIMUM MOISTURE CONTENT: 16.0 %

MOISTURE-DENSITY RELATIONSHIP

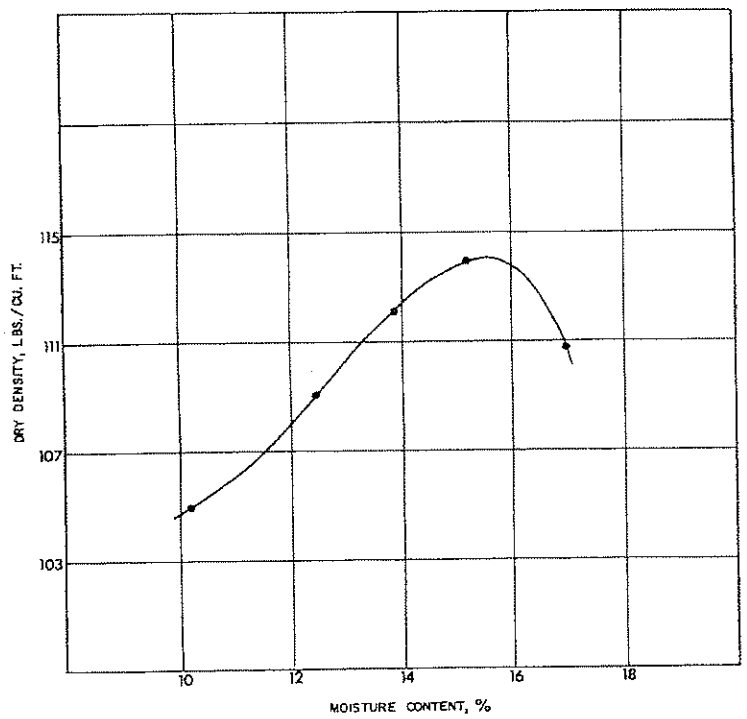
ATEC ASSOCIATES



BORING NO.: 46	DEPTH: 0-11.0
SOIL CLASSIFICATION: CL	TEST TYPE: ASTM D 698
MAXIMUM DRY DENSITY: 107.0 lbs/cu.ft.	OPTIMUM MOISTURE CONTENT: 17.9 %

MOISTURE-DENSITY RELATIONSHIP

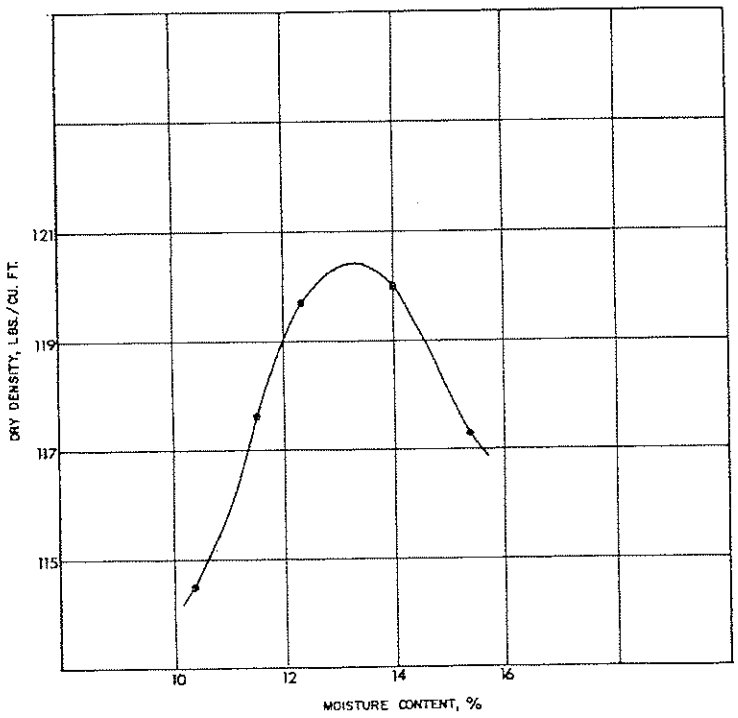
ATEC ASSOCIATES



BORING NO.: 46	DEPTH: 13.0 - 20.0
SOIL CLASSIFICATION: CL & CH	TEST TYPE: ASTM D 698
MAXIMUM DRY DENSITY: 114.1 lbs/cu.ft.	OPTIMUM MOISTURE CONTENT: 15.5 %

MOISTURE - DENSITY RELATIONSHIP

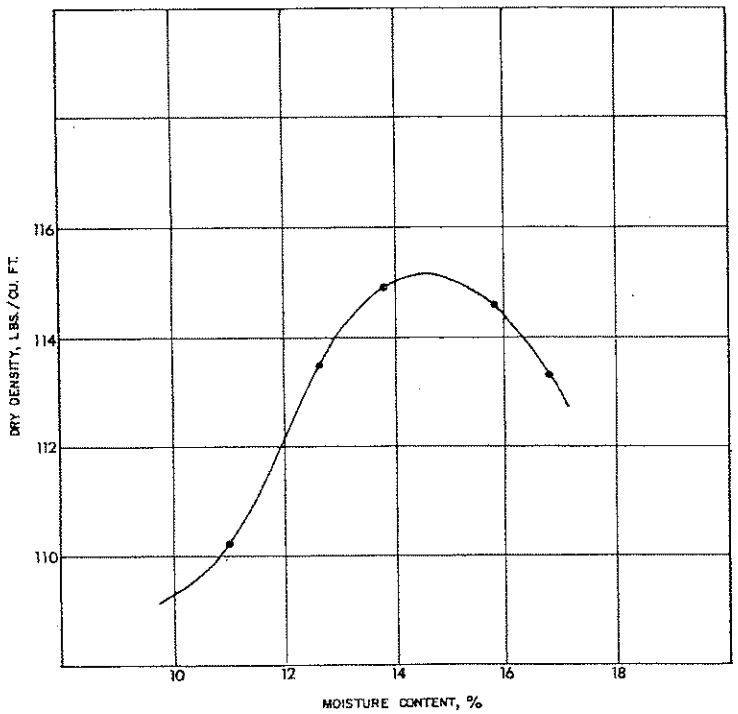
ATEC ASSOCIATES



BORING NO.: 30	DEPTH: 0 - 12.0
SOIL CLASSIFICATION: CL	TEST TYPE: ASTM D 1557
MAXIMUM DRY DENSITY: 120.3 lbs/cu ft.	OPTIMUM MOISTURE CONTENT: 13.3 %

MOISTURE - DENSITY RELATIONSHIP

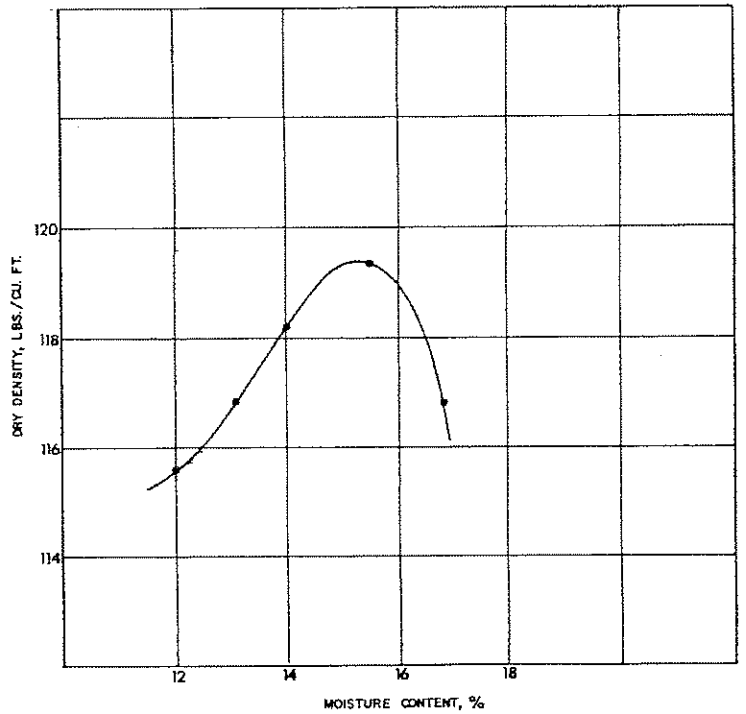
ATEC ASSOCIATES



BORING NO.: 32	DEPTH: 0 - 7.0
SOIL CLASSIFICATION: CL	TEST TYPE: ASTM D 1557
MAXIMUM DRY DENSITY: 115.2 lbs/cu.ft.	OPTIMUM MOISTURE CONTENT: 14.7 %

MOISTURE - DENSITY RELATIONSHIP

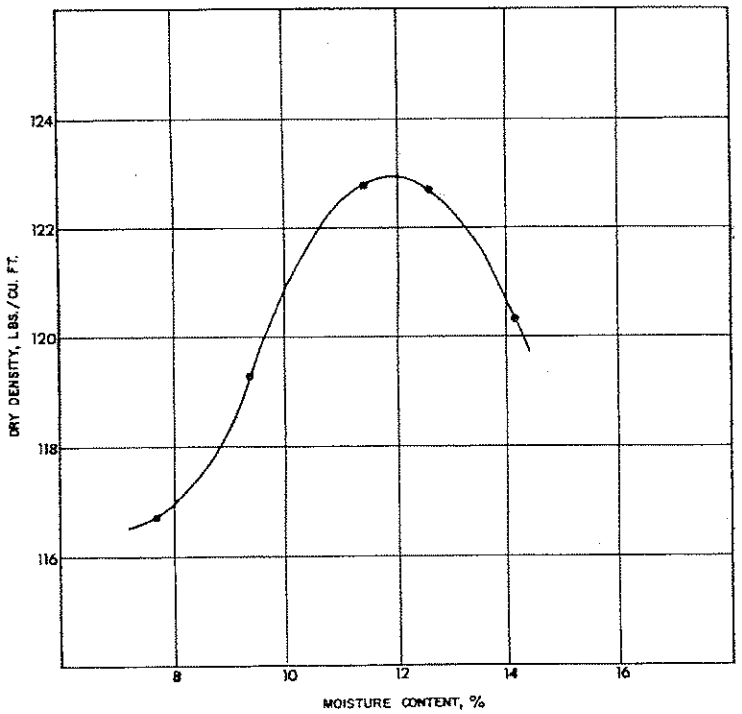
ATEC ASSOCIATES



BORING NO.: 45	DEPTH: 0 - 8.0
SOIL CLASSIFICATION: CL-CH	TEST TYPE: ASTM D 1557
MAXIMUM DRY DENSITY: 117.4 lbs./cu.ft.	OPTIMUM MOISTURE CONTENT: 15.3 %

MOISTURE - DENSITY RELATIONSHIP

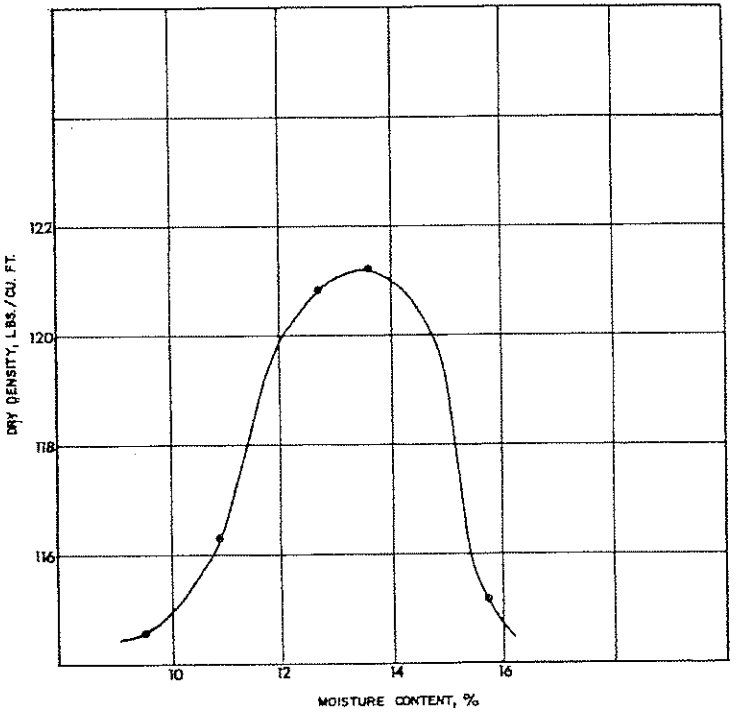
ATEC ASSOCIATES



BORING NO.: 45	DEPTH: 8.0 - 20.0
SOIL CLASSIFICATION: CL	TEST TYPE: ASTM D 1557
MAXIMUM DRY DENSITY: 123.0 lbs./cu Ft	OPTIMUM MOISTURE CONTENT: 12.0 %

MOISTURE - DENSITY RELATIONSHIP

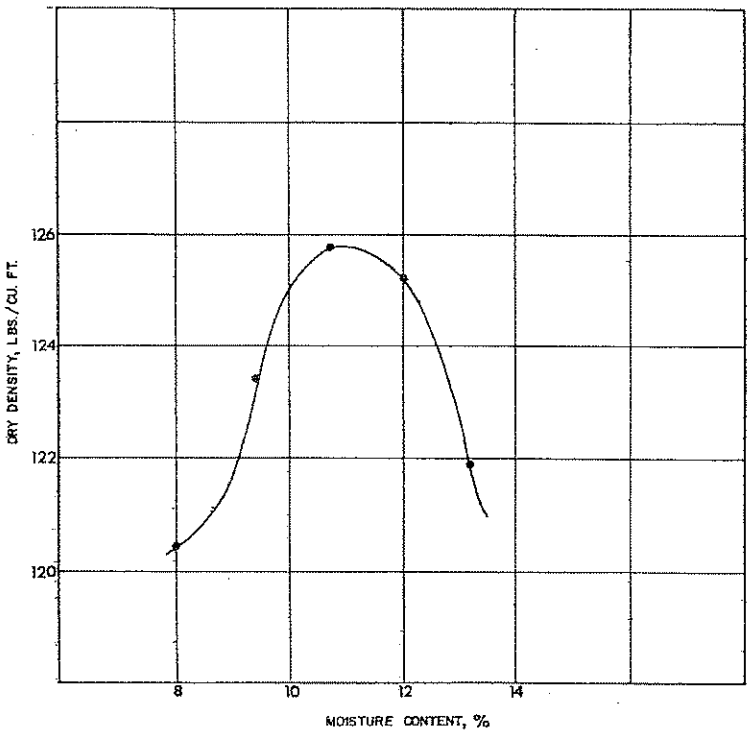
ATEC ASSOCIATES



BORING NO.: 46	DEPTH: 0 - 11.0
SOIL CLASSIFICATION: CL	TEST TYPE: ASTM D 1557
MAXIMUM DRY DENSITY: 121.3 lbs./cu ft	OPTIMUM MOISTURE CONTENT: 13.5 %

MOISTURE - DENSITY RELATIONSHIP

ATEC ASSOCIATES



BORING NO.: 46	DEPTH: 18.0 - 20.0
SOIL CLASSIFICATION: CL & CH	TEST TYPE: ASTM D 1557
MAXIMUM DRY DENSITY: 125.8 lbs/cu.ft.	OPTIMUM MOISTURE CONTENT: 11.0 %

MOISTURE - DENSITY RELATIONSHIP

ATEC ASSOCIATES

APPENDIX H

PERMEABILITY TESTS

Ottumwa Generating Station-Unit 1
(E-7566)

Table H-1 SUMMARY OF PERMEABILITY TEST RESULTS

Boring No.	Depth, ft	Sample Height,in	Sample Diameter,in	Moisture Content,%	Dry Density, lb/cu.ft	Pressure Head, lbs/sq.in	Coefficient of Permeability cm/sec
46	13-20	2.81	1.31	9.6	118.9	10.0	0.7×10^{-8}
46	13-20	2.92	1.44	13.6	118.9	*	**

Note: Samples recompacted from disturbed bag samples to the indicated densities

* Varied from 10 to 40

** No measurable seepage through sample in a seven day period

LOG OF BORING NO. 1

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 5-14-75 LOCATION: N 401,400 E 2,260,828.5

SURFACE ELEVATION– 684

Depth Scale, Ft.	Stratum Depth Ft.	Sample Depth	Standard Penetration Blows/6 in. 3-6 in. Increments	Recovery, %
	Black moist medium stiff SILTY CLAY (CL) with trace organic material		2 2/4	75
		3.5	3 3/6	75
5	Light Brown and Gray medium stiff SILTY CLAY (CL)		2 3/3	60
			2 2/4	100
10	-stiff		4 5/7	100
		14.0	4 5/8	100
15	Gray to Brown moist stiff CLAYEY SILT (ML)		4 5/7	100
			4 5/8	100
20		22.0		
	Brown moist medium stiff SILTY CLAY (CL) with little Sand and trace fine Gravel		3 5/5	100
25	-very moist with limestone fragments	29.0	6 9/23	
30	Brown wet medium dense fine to medium SAND (SP) with trace Silt, coarse Sand	31.0		
	Brown and Gray wet dense SILTY fine to medium SAND (SM-SP) with trace Rock fragments (weathered sandstone)	34.1	100/0.4	
35	Gray loosely cemented Quartz SANDSTONE with Coal partings and thinly laminated Shale	39.1	RC 1 RQD 13	80
40	Gray fine-grained LIMESTONE with Glauconitic CLAY Seams	42.5	RC 2 RQD 16	79
	Gray fine to medium friable Quartz SANDSTONE		RC 3 RQD 71	97
45			RC 4 RQD 26	92
50				

Uncontinued 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 29.0 FT.
AT COMPLETION FT.
AFTER HRS. FT.

Note: Piezometer installed at 35.7'

LOG OF BORING NO. 1 (cont'd)

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 5-14-75 LOCATION: N 401,400 E 2,260,828.5

SURFACE ELEVATION–

Depth Scale, Ft.	Stratum Depth Ft.	Sample Depth	Standard Penetration Blows/6 in. 3-6 in. Increments	Recovery, %
		53.8	RC 5 RQD 56	100
55	White fine-grained LIMESTONE with Calcareous CLAY Seams and Stylolites	59.1	RC 6 RQD 90	97
60	Green SILT and fine-grained SANDSTONE	60.4		
	White fine-grained LIMESTONE -clay seams 60.4-61.3' -chert nodules 63.6-65.0'		RC 7 RQD 85	99
65	-2" shale layers at 66.6, 68.0, and 68.9'			
70	-some stylolites	72.5		
	Gray massive Dolomite		RC 8 RQD 84	
75	-vertical fracture at 76.7'			
80		81.1		
	Gray massive CLAYEY SANDY LIMESTONE	83.8		
85	Gray fine-grained Quartz SANDSTONE	85.7		
	Gray massive CLAYEY LIMESTONE		RC 9 RQD 84	100
	(Badly fractured below 88.5')			
90		92.0		
	Gray fine-grained LIMESTONE	93.1		
95	Gray poorly sorted fine to coarse-grained LIMESTONE	94.5	RC 10 RQD 42	98
	White fine-grained thinly bedded LIMESTONE w/Chert Nodules			
	Gray coarse-grained SANDSTONE w/ Limestone Fragments	98.8 99.4		
	Green soft CLAY SHALE	100.0		

Uncontinued 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: 100.0'
ROCK CORE DIAMETER: 2 1/8"
GROUND WATER: NOTED ON RODS FT.
AT COMPLETION FT.
AFTER HRS. FT.

Discussion of Field Investigation

Test borings were made at a total of 52 locations at the site. These locations are indicated on the Plan of Borings (see Figure 2, Appendix A). The borings were extended to depths of from 13.1 to 100 ft. A Mobile B-50 drill rig mounted on an all-terrain type vehicle was used for the field drilling. Hollow stem augers were used for drilling in soil.

Split spoon samples were obtained by the standard penetration test procedure (ASTM D-1586) at 2.5 to 5.0 ft intervals. Representative portions of all samples were sealed in glass jars and returned to our laboratory for inspection and testing. Relatively undisturbed samples were obtained of certain clayey soils by hydraulically pressing 3-in. O.D. Shelby tubes into the soil at selected locations. These samples were obtained in auxiliary borings drilled within a few feet of the original split spoon borings. The tubes were sealed to prevent moisture loss and returned to our laboratory for testing.

The underlying rock was cored at 44 of the 52 boring locations. The depth of rock cored varied from 5.0 to 65.9 ft. All cores were saved and returned to our laboratory in wooden core boxes.

One inch diameter PVC pipe piezometers were installed at ten locations. The lower 18 inches of each pipe was perforated and the bottom capped. Sand was placed in each hole from a depth of at least 3 to 6 inches below the pipe to at least 6 inches above the perforated section. Cement-sand grout was used to backfill the hole above the sand. Piezometer locations were marked by driving steel angle fence posts in a triangular pattern around the pipe at the ground surface. The depths at which the bottom of the pipes were placed are shown on the boring logs.

Logs of all borings have been included on the following pages. The logs show visual descriptions of all soil and rock strata encountered using the Unified Soil Classification System. Ground water observations, sampling information and other pertinent field data are also included. A sheet defining the terms and symbols used on the logs and explaining the standard penetration test procedure is included at the end of this Appendix.

LOG OF BORING NO. 2

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 5-17-75 LOCATION: N 400,675 E 2,260,828.5

SURFACE ELEVATION- 686

Stratum Depth Ft.	Description	Sample No. / Depth	Blows/6 in. 3-6 in. Increments	Recovery, %
1.0	Brown moist SILTY CLAY(CL) w/trace organic material		5 4/4	75
3.0	Brown moist medium stiff SILTY CLAY(CL) w/trace fine Sand		3 5/5	75
	Brown and Gray moist medium stiff SILTY CLAY (CL)		3 4/5	60
			2 3/3	100
			3 4/5	100
	-little Sand		2 8/7	100
	Brown to Gray moist stiff SILTY CLAY (CL)		4 8/8	100
18.0	-little Sand		4 7/8	100
	Brown to Gray moist stiff CLAY (CL)		3 4/6	100
	-medium stiff			
26.5	White moist medium dense fine SAND (SP) with trace Silt		6 14/12	100
32.0	Dark Gray wet loose SILTY fine to coarse SAND (SM-SW) w/some fine		4/50/0.0	
34.0	to medium Gravel			
	White massive LIMESTONE with Pyrite veins and Calcareous CLAYS		RC 1 RQD 23	100
			RC 2 RQD 29	100
			RC 3 RQD 50	100
43.5	Green soft Glauconitic SHALE		RC 4 RQD 33	100
43.8	LIMESTONE conglomerate with Calcareous CLAY Matrix			
44.4	Note: hole filled in with Sand, offset 3' north-see log of Boring No. 2A			

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: 44.4
ROCK CORE DIAMETER: 2 1/8"
GROUND WATER: NOTED ON RODS 29.5 FT. AT COMPLETION FT. AFTER HRS. FT.

LOG OF BORING NO. 2A

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 5-19-75 LOCATION: N 400,678 E 2,260,828.5

SURFACE ELEVATION- 686

Stratum Depth Ft.	Description	Sample No. / Depth	Blows/6 in. 3-6 in. Increments	Recovery, %
	See Log of Boring No. 2			
34.5	White fine-grained LIMESTONE with Partings filled with Calcareous CLAYS and some Stylolites		RC 1 RQD 46	99
43.2	Interbedded Green SANDY SHALE and LIMESTONE with Stylolites		RC 2 RQD 33	99
49.0			RC 3	81

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.

LOG OF BORING NO. 2 A (cont'd)

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 5-19-75 LOCATION: N 400,678 E 2,260,828.5

DEPTH SCALE, FT.	SURFACE ELEVATION—	STRATUM DEPTH FT.	STANDARD PENETRATION SAMPLE DEPTH	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
55	Gray coarse-grained SANDSTONE interbedded with Limestone and fine grained poorly cemented SANDSTONE			RQD 22			
	(50.6 to 51.6'-limey sandstone (51.6 to 57.0-fine grained sandstone)	57.0		RC 4 RQD 24	99		
60	White fine-grained LIMESTONE with fractures filled with Stylolites and Clay Partings						
65	-chert nodule at 67'			RC 5 RQD 68	99		
70		70.0					

COMPLETION DEPTH: 70.0
ROCK CORE DIAMETER: 2 1/8"
GROUND WATER: NOTED ON RODS FT. AT COMPLETION FT. AFTER HRS. FT.

LOG OF BORING NO. 3

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 5-21-75 LOCATION: N 402,638 E 2,260,828

DEPTH SCALE, FT.	SURFACE ELEVATION— 678	STRATUM DEPTH FT.	STANDARD PENETRATION SAMPLE DEPTH	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
	Dark Gray moist stiff SILTY CLAY (CL) with trace organic material	3.5		6 7/6	10		
5	Brown slightly moist hard SILTY CLAY (CL)			10 26/22	25		
				10 25/21	75		
10		10.5		8 17/17	75		
	Brown and Gray slightly moist very stiff CLAY (CL)			5 10/10	100		
15		15.5		4 7/7	100		
	Brown moist stiff SILTY CLAY (CL) with trace fine Sand	19.5		4 6/6	100		
20	Brown moist medium stiff SILT(ML) w/little fine Sand	22.2		4 5/5	100		
	White fine-grained thinly bedded LIMESTONE with Shale Partings 27.7' to 28.2' -vertical clay filled joint from 22.2 to 22.6' -vertical joint from 24.7 to 26.5'	28.7		RC 1 RQD 14	96		
25	Glauconitic SANDSTONE	29.5		RC 2 RQD 60	100		
30	White fine-grained LIMESTONE interbedded with Gray Quartz SANDSTONE (2" shale seam at 33.1')	37.0		RC 3 RQD 58	100		
	Gray medium friable Quartz SANDSTONE			RC 4 RQD 6	80		
40				RC 5 RQD 38	94		
45	-trace of glauconitic 45.8-51.7' -fine sandstone 48' to 51.5'			RC 6	92		

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.

LOG OF BORING NO. 3 (cont'd)

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 5-21-75 LOCATION: N 402,638 E 2,260,828

SURFACE ELEVATION–

DEPTH SCALE, FT.	STRATUM DEPTH FT.	SAMPLE DEPTH	STANDARD PENETRATION BLOWS/6 in. 3-6 in. INCREMENTS	RECOVERY, %	Uncontined 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
55			RQD 14			
			RC 7			
	57.0		RQD 30	100		
60			RC 8			
			RQD 48	96		
65	67.2					
70						

White grained LIMESTONE with irregular CLAY Filled seams 57 to 58.4'
-chert nodule at 60.0'
-clay partings at 63.6 and 66.5'

Note: Piezometer installed at 55.0'

COMPLETION DEPTH: 67.2'
ROCK CORE DIAMETER: 2 1/8"
GROUND WATER: NOTED ON RODS FT. AT COMPLETION FT. AFTER HRS. FT.

LOG OF BORING NO. 4

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 5-22-75 LOCATION: N 403,500 E 2,260,828.5

SURFACE ELEVATION– 661

DEPTH SCALE, FT.	STRATUM DEPTH FT.	SAMPLE DEPTH	STANDARD PENETRATION BLOWS/6 in. 3-6 in. INCREMENTS	RECOVERY, %	Uncontined 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
	3.0		3 4/4	40		
5	6.0		2 3/3	100		
			3 4/4	80		
10	9.5		2 5/4	50		
	11.0		50/ 50/0.0			
	12.5		RC 1 RQD 13	100		
15			RC 2 RQD 0	100		
	18.8		RC 3 RQD 30	98		
20	21.1					
			RC 4 RQD 30	96		
25	25.2					
	28.3		RC 5 RQD 50	100		
30	29.3					
			RC 6 RQD 32	90		
35	34.8					
			RC 7 RQD 6	82		
40						
			RC 8 RQD 8	84		
45	47.0					
			RC 9 RQD 50	100		

Black moist medium stiff CLAYEY SILT(ML) w/trace Sand and Organic material
Brown and Gray moist medium stiff SANDY SILTY CLAY (CL)
Brown moist medium stiff SILTY CLAY (CL) with trace fine Sand
Brown wet loose SILTY fine to med. SAND(SM-SP)w/tr.c.Sand & fine Gvl
Brown wet dense SANDY CLAYEY SILT (ML) w/limestone fragments
White fine grained LIMESTONE with thin Clay filled partings at intervals of several inches
Glauconitic SANDSTONE and SHALE
Gray massive LIMESTONE
-sandy 23.5 to 24.3'
-shale bed at 24.3'
Gray fine friable QUARTZ SANDSTONE
Interbedded SANDSTONE and LIMESTONE
White fine grained LIMESTONE with Stylolites at 4" intervals
Gray fine to medium friable QUARTZ SANDSTONE with trace of Glauconitic
-sand size limestone fragments 46.3 to 47.0'
White fine grained LIMESTONE with irregular Clay Filled Seams

COMPLETION DEPTH: (cont'd on next page)
ROCK CORE DIAMETER: 2 1/8"
GROUND WATER: NOTED ON RODS 7.1 FT. AT COMPLETION FT. AFTER HRS. FT.

LOG OF BORING NO. 4 (cont'd)

Ottumwa Generating Station-Unit 1

Chillicothe, Iowa

BORING METHOD: HSA DATE: 5-22-75 LOCATION: N 403,500 E 2,260,828.5

SURFACE ELEVATION--

STRATUM DEPTH FT.: 51.3

STANDARD PENETRATION: SAMPLE DEPTH; 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

COMPLETION DEPTH: 51.3'

ROCK CORE DIAMETER: 2 1/8"

GROUND WATER: NOTED ON RODS FT. AT COMPLETION FT. AFTER HRS. FT.

LOG OF BORING NO. 5

Ottumwa Generating Station-Unit 1

Chillicothe, Iowa

BORING METHOD: HSA DATE: 5-28-75 LOCATION: N 400,675 E 2,258,500

SURFACE ELEVATION-- 740

Depth	Description	Stratum Depth Ft.	Sample Depth	Blows/6 in. 3-6 in. Increments	Recovery, %
	Brown moist stiff SILTY CLAY (CL)	3.0		4 6/8	20
5	Lt Brown moist very stiff CLAY (CL)			4 8/10	50
	-stiff	8.0		3 4/7	75
10	Brown moist stiff SILTY CLAY (CL) with trace Sand	11.5		3 5/6	100
	Lt Brown, Gray, and Red very stiff to hard SANDY SILTY CLAY(CL) with soft rock fragments			4 8/11	100
15		16.0		3 10/77	100
	Gray slightly moist hard CLAYEY SILT (ML) with trace fine Sand	19.0		8 42/28	100
20	Lt Brown and Gray slightly moist very stiff CLAY(CL) w/trace fine Sand	21.0		4 8/9	100
	Lt Brown to Red moist very stiff SANDY CLAY (CL)	24.0		12 21/50	100
25	Dk Gray slightly moist SHALY CLAY (CL-CH) with coal seams			29 100/.4	100
30		31.5			
	Dark Gray SANDY SHALE with Black Lamina			RC 1 RQD 9	100
35				RC 2 RQD 52	100
40		43.1			
	Black hard SHALE with Pyrite Vein			RC 3 RQD 35	91
45		47.1			
	Coal w/Pylite flakes and Shale	48.1			

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.

LOG OF BORING NO. 5 (cont'd)

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 5-28-75 LOCATION: N 400,675 E 2,258,500

DEPTH SCALE, FT.	SURFACE ELEVATION–	STRATUM DEPTH FT.	SAMPLE DEPTH	STANDARD PENETRATION BLOWS/6 in. INCREMENTS	RECOVERY, %	SHELBY TUBE
	Gray SILTY SHALE with Clay Seams	54.0				
55	Gray SILTSTONE to fine grained SANDSTONE			RC 4 RQD 10	93	
60	Gray thinly lmainated SHALEY SANDSTONE	60.0				
65	Gray fine grained SANDSTONE (thinly laminated Shale 68.0 to 71.0')	65.8		RC 5 RQD 0	91	
70	Gray fine to medium SANDSTONE	70.0				
75				RC 6 RQD 54	100	
80		80.0				

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

COMPLETION DEPTH: 80.0'
ROCK CORE DIAMETER: 2 1/8"
GROUND WATER: NOTED ON RODS FT. AT COMPLETION FT. AFTER HRS. FT.

LOG OF BORING NO. 6

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 5-29-75 LOCATION: N 400,675 E 2,259,600

DEPTH SCALE, FT.	SURFACE ELEVATION– 711	STRATUM DEPTH FT.	SAMPLE DEPTH	STANDARD PENETRATION BLOWS/6 in. 3–6 in. INCREMENTS	RECOVERY, %	SHELBY TUBE
	Brown moist stiff SILTY CLAY (CL)			5 6/5	50	
	–medium stiff	5.5		4 4/5	50	
5	Brown moist medium stiff CLAY (CL) –trace coarse sand	9.5		3 4/5	90	
				4 7/15	100	
10	Brown slightly moist very stiff SANDY CLAY (CL) w/rock fragments	13.0		6 13/13	40	
	Brown and Black moist stiff CLAY (CH) –trace soft rock fragments	17.0		3 4/7	90	
15				4 5/6	40	
	Brown slightly moist hard SILTY CLAY (CL) w/weathered shale and coal seams			21 23/39	100	
20		24.0		100/.5	60	
25	Dark Gray SHALY SANDSTONE			RC 1 RQD 72	94	
30	–fine gray and black laminations 31.0 to 43.0'			RC 2 RQD 13	99	
35						
40				RC 3 RQD 35	100	
		43.5				
45	Interbedded LIMESTONE & Glauconitic SHALE & SANDSTONE –Pyrite nodule at 45.9' @ –6" vertical clay filled joint	47.7	47.8			

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

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.

LOG OF BORING NO. 6 (cont'd)

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 5-29-75 LOCATION: N 400,675 E 2,259,600

SURFACE ELEVATION—

DEPTH SCALE, FT.		STRATUM DEPTH FT.	SAMPLE DEPTH	STANDARD PENETRATION BLOWS/6 in. 3-6 in. INCREMENTS	RECOVERY, %
55	-clay partings at 49.7', 52.0 and 57.0' -some solution enlarged bedding planes	57.5		RC 4 RQD 43	100
60	Interbedded LIMESTONE & Glauconitic SHALE and SANDSTONE with Green Glauconitic Clay	62.6		RC 5 RQD 26	70
65	Gray fine grained LIMEY SANDSTONE w/traces of Glauconitic	65.2			
	Gray fine to medium grained SANDSTONE, poorly cemented	66.3		RC 6 RQD 30	98
70	Gray f.grained massive LIMESTONE with Stylolites	70.0			
	Note: Piezometer installed at 39.5'				

Uncontined 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: 70.0'
ROCK CORE DIAMETER: 2 1/8"
GROUND WATER: NOTED ON RODS FT. AT COMPLETION FT. AFTER HRS. FT.

LOG OF BORING NO. 7

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.		STRATUM DEPTH FT.	SAMPLE DEPTH	STANDARD PENETRATION 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			6 9/18	100
	-very stiff	18.0		3 2/50	100
	Brown very moist soft SILTY CLAY (CL) w/trace Sand	19.0			
20	Brown wet soft SANDY CLAYEY SILT (ML)	20.3		RC 1 RQD 18	96
	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			

Uncontined 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.

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

SURFACE ELEVATION–

DEPTH SCALE, FT.	STRATUM DEPTH FT.	SAMPLE DEPTH	BLOWS/6 in. 3–6 in. INCREMENTS	RECOVERY, %	STANDARD PENETRATION / Unconfined Compressive Strength, TSF	Natural Dry Density, PCF	Water Content, % / Plast. Lim., % / Liq. Lim., %	Standard Penetration, Blows/Ft.	SHELBY TUBE
55			RC 6 RQD 56	97					
60	60.3								
65									

Gray fine grained LIMESTONE with Stylolites
-irregular clay fillings 48.5 to 49.5'
-chert nodules at 52.0, 52.3 and 59.5'
-lenses of shale at 55.0 and 55.9'

Note: Piezometer installed at 20.0'

COMPLETION DEPTH: 60.3'
ROCK CORE DIAMETER: 2 1/8"
GROUND WATER: NOTED ON RODS FT. / AT COMPLETION FT. / AFTER HRS. FT.

LOG OF BORING NO. 8

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 5-20-75 LOCATION: N 399,625 E 2,260,828.5

SURFACE ELEVATION– 668

DEPTH SCALE, FT.	STRATUM DEPTH FT.	SAMPLE DEPTH	BLOWS/6 in. 3–6 in. INCREMENTS	RECOVERY, %	STANDARD PENETRATION / Unconfined Compressive Strength, TSF	Natural Dry Density, PCF	Water Content, % / Plast. Lim., % / Liq. Lim., %	Standard Penetration, Blows/Ft.	SHELBY TUBE
0			6 5/6 3 5/6	20					
5			3 5/4	100					
	8.5		4 9/11	80					
10	10.5		16 21/12	100					
	14.0		7 100/.3						
15	14.8		RC 1 RQD 23	94					
20	21.6		RC 2 RQD 38	82					
	23.3								
25	25.0		RC 3 RQD 78	92					
30			RC 4 RQD 42	86					
35	35.5								
	36.5		RC 5 RQD 75	100					
40									
	44.0		RC 6 RQD 39	100					
45			RC 7 RQD 41	100					

Brown moist stiff SILTY CLAY (CL)
-medium stiff
Brown moist very stiff SILTY CLAY (CL) with trace Sand
Brown moist dense SILTY SAND (SM) w/trace Clay and fine to medium Gravel
Brown moist stiff SILTY CLAY (CL) w/Limestone Fragments
White fine grained LIMESTONE with Clay Partings
Gray friable Quartz SANDSTONE with Glauconite
White massive LIMESTONE with soft Shale Seams
Gray medium to coarse grained Quartz SANDSTONE
White LIMEY SANDSTONE
White fine grained LIMESTONE w/ irregular Clay Filled Seams 36.5 to 37.5'
-some stylolites
Gray LIMESTONE and SANDSTONE Conglomerate (Possible Paleo Washout)

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.

LOG OF BORING NO. 8 (cont'd)

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

N 399,625

BORING METHOD: HSA DATE: 5-20-75 LOCATION: E 2,260,828.5

SURFACE ELEVATION—

DEPTH SCALE, FT.	STRATUM DEPTH FT.	SAMPLE DEPTH	STANDARD PENETRATION BLOWS/6 in. 3-6 in. INCREMENTS	RECOVERY, %	SHELBY TUBE
55	55.0			100	

Note:

Piezometer installed at 35.0'

COMPLETION DEPTH: 55.0'
ROCK CORE DIAMETER: 2 1/8"

GROUND WATER: NOTED ON RODS FT.
AT COMPLETION FT.
AFTER HRS. FT.

LOG OF BORING NO. 9

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

N 402,638

BORING METHOD: HSA DATE: 6-1-75 LOCATION: E 2,259,600

SURFACE ELEVATION— 704

DEPTH SCALE, FT.	STRATUM DEPTH FT.	SAMPLE DEPTH	STANDARD PENETRATION BLOWS/6 in. 3-6 in. INCREMENTS	RECOVERY, %	SHELBY TUBE
	Dark Brown moist medium stiff SILTY CLAY (CL)		3 3/4	25	
	-very moist, soft	4.0	1 2/3	100	
5	Dark Gray to Black moist medium stiff CLAY (CH)		1 2/4	90	
			3 4/5	100	
10			3 4/6	100	
		14.0	2 4/6	100	
15	Brown moist medium stiff SILTY CLAY (CL) w/trace Sand		3 5/7	90	
	-stiff	18.0	2 2/4	100	
20	Gray moist medium stiff CLAY (CH)				
		22.5			
	Light Brown very moist medium stiff SANDY SILTY CLAY(CL)	24.0	2 4/4	100	
25	Light Brown moist loose CLAYEY SILTY SAND (SC-SM)				
		28.7	14 100/.5	75	
30	Dark Gray SHALY SANDSTONE		RC 1 RQD 22	85	
35			RC 2 RQD 59	100	
	-coal partings at 39.7'				
40		41.4			
	SHALY SANDY LIMESTONE	42.0			
	Gray fine grained massive LIME-STONE	43.0			
45	Gray SHALY LIMESTONE	46.1	RC 3 RQD 75	100	
	Green to Gray Glauconitic LIMEY SANDY SHALE	48.0			

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.

LOG OF BORING NO. 9 (cont'd)

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 6-1-75 LOCATION: N 402,638 E 2,259,600

SURFACE ELEVATION—

DEPTH SCALE, FT.		STRATUM DEPTH FT.	SAMPLE DEPTH	STANDARD PENETRATION BLOWS/6 in. 3-6 in. INCREMENTS	RECOVERY, %	SHELBY TUBE
55	Gray fine grained massive LIMESTONE -shale partings at 51.5 and 54.5' -steeply dipping slickensided joint 50.5 to 51.1'	57.0		RC 4 RQD 69	97	
60	Interbedded LIMESTONE and Glauconitic Sandstones and Shales	59.5				

Note:
Piezometer installed at 30.0'

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

COMPLETION DEPTH: 59.5'
ROCK CORE DIAMETER: 2 1/8"

GROUND WATER: NOTED ON RODS FT. / AT COMPLETION FT. / AFTER HRS. FT.

LOG OF BORING NO. 10

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 6-2-75 LOCATION: N 402,638 E 2,262,500

SURFACE ELEVATION— 650

DEPTH SCALE, FT.		STRATUM DEPTH FT.	SAMPLE DEPTH	STANDARD PENETRATION BLOWS/6 in. 3-6 in. INCREMENTS	RECOVERY, %	SHELBY TUBE
5	Dark Gray moist medium stiff CLAY(CH) with trace organic mat'l			3 4/6	40	
	-soft			2 1/3	60	
	-soft			1 2/2	75	
	-very moist, very soft	9.0		1 1/1	100	
10	Brown to Gray wet very loose SILTY fine to medium SAND(SM-SP) with trace coarse Sand	12.0		2 1/5	100	
	Brown wet medium dense SILTY fine to medium SAND (SM)			3 5/7	25	
15		18.0		2 5/6	75	
20	SAND with LIMESTONE Floaters	21.5		50/0.3	25	
25	Note: Boring was aborted due to auger refusal on limestone floaters-see Boring No. 10B.					

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

COMPLETION DEPTH: 21.5'
ROCK CORE DIAMETER:

GROUND WATER: NOTED ON RODS 7.5 FT. / AT COMPLETION 4.0 FT. / AFTER HRS. FT.

LOG OF BORING NO. 10 B

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

N 402,503

BORING METHOD: HSA DATE: 6-2-75 LOCATION: E 2,262,504

SURFACE ELEVATION– 651

DEPTH SCALE, FT.	STRATUM DEPTH FT.	SAMPLE DEPTH	BLOWS/6 in. 3–6 in. INCREMENTS	RECOVERY, %
See Log of Boring No. 10				
-boulders to 18.0'				
	22.9			
Yellow wet very dense fine SAND (SP) with trace Silt			31 50/.2	50
	27.9			
Gray wet very dense fine SAND (SP)			50/.2	25
	30.0			
Gray fine grained Quartz SAND-STONE, very poorly cemented			RC 1 RQD 0	21
	40.0			

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: 2 1/8"
GROUND WATER: NOTED ON RODS FT. AT COMPLETION FT. AFTER HRS. FT.

LOG OF BORING NO. 11

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

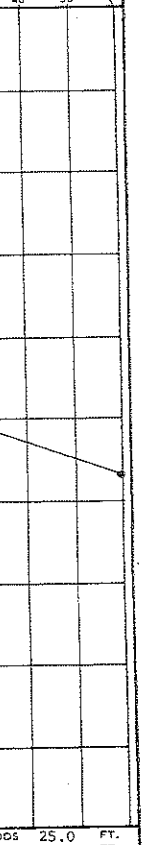
N 400,525

BORING METHOD: HSA DATE: 6-2-75 LOCATION: E 2,261,000

SURFACE ELEVATION– 682

DEPTH SCALE, FT.	STRATUM DEPTH FT.	SAMPLE DEPTH	BLOWS/6 in. 3–6 in. INCREMENTS	RECOVERY, %
Brown and Gray moist stiff SILTY CLAY (CL)			6 6/7	50
-medium stiff	5.5		3 3/5	50
Black and Gray moist medium stiff CLAY (CL)	8.0		2 3/5	100
Brown moist medium stiff SILTY CLAY (CL)	10.5		2 4/5	100
Brown moist very stiff SILTY CLAY (CL)			4 6/11	100
-stiff, trace sand			5 6/10	100
-medium stiff, trace sand			4 6/8	100
	24.0		3 4/6	100
Brown very moist fine to medium SAND (SP)	27.5		3 8/14	100
Brown wet very dense fine to coarse SAND (SW) with some fine to coarse Gravel	28.8		50/.3	25
White fine grained LIMESTONE -vertical iron stained joint 28.8 to 30.8' -clay partings at 32 and 33' -interbedded with glauconitic sandstone and shale 35.4 to 38.3'	38.8		RC 1 RQD 13	83

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: 38.8'
ROCK CORE DIAMETER: 2 1/8"
GROUND WATER: NOTED ON RODS 25.0 FT. AT COMPLETION FT. AFTER HRS. FT.

LOG OF BORING NO. 12

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 6-3-75 & 6-13-75 LOCATION: N 400,000 E 2,261,000

SURFACE ELEVATION– 657

DEPTH SCALE, FT.		STRATUM DEPTH FT.	SAMPLE NO. & DEPTH	STANDARD PENETRATION BLOWS/6 in. 3–6 in. INCREMENTS	RECOVERY, %
0	Dark Brown moist medium stiff SILTY CLAY (CL)			3 3/4	25
	–soft	5.5		2 2/3	25
5	Dark Brown moist soft CLAY (CL)	8.0		2 2/3	100
	Dark Brown very moist soft SILTY CLAY (CL) with trace Sand			2 2/2	100
10		12.0		2 2/3	100
	Brown wet very loose fine SAND (SP)	13.5		2 3/3	100
	Brown very moist medium stiff SANDY CLAYEY SILT (ML)	16.5		4 3/2	100
15	Brown wet very loose fine SAND (SP) w/clay seams and weathered limestone fragments			14 26/31	100
20		22.5			
	Brown wet very dense SILTY fine to coarse SAND (SM-SW) with some fine to medium Gravel	25.5		24 35/34	90
25	White fine grained LIMESTONE with irregular clay filled seams 25.2-26.2'			RC 1 ROD 30	95
	–vertical fractures 26.7-27.7' and 28.2-28.5'	31.4		RC 2 ROD 47	100
30	Gray fine grained SANDSTONE and LIMESTONE Conglomerate (possible Paleo washout)	35.2			
35					
40					

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: 35.2'
ROCK CORE DIAMETER: 1 7/8"
GROUND WATER: NOTED ON RODS 11.5 FT. AT COMPLETION FT. AFTER HRS. FT.

LOG OF BORING NO. 13

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 6-10-75 LOCATION: N 400,000 E 2,258,700

SURFACE ELEVATION– 719

DEPTH SCALE, FT.		STRATUM DEPTH FT.	SAMPLE NO. & DEPTH	STANDARD PENETRATION BLOWS/6 in. 3–6 in. INCREMENTS	RECOVERY, %
0	Brown moist medium stiff to stiff CLAY (CL-CH)			4 4/5	50
		5.5		4 5/6	75
5	Brown moist medium stiff SILTY CLAY (CL) with trace Sand			3 3/5	100
		11.0		3 5/7	100
10	Brown slightly moist very stiff CLAY (CL-CH) w/trace Sand & Gravel	13.5		5 9/10	90
	Brown and Gray mottled moist very stiff CLAY (CH)	15.5		7 10/16	100
15	Brown slightly moist very stiff CLAY (CH)			5 12/16	100
20				6 11/14	100
		26.0		7 9/13	100
25	Brown moist medium stiff SILTY fine SAND (SM) with trace medium to coarse Sand	30.5		6 10/14	100
30	Brown moist medium dense fine to coarse SAND (SW) with little fine to medium Gravel	34.0		9 10/16	
	Gray wet medium dense fine to medium SAND (SP) with trace fine Gravel	36.5			
35	Brown wet loose SILTY fine to coarse SAND (SM-SW) with some fine to medium GRAVEL	41.5		4 4/8	100
40	Gray and Black massive SANDY SHALE with thinly laminated SANDSTONE				
45				RC 1 ROD 81	100

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: 1 7/8"
GROUND WATER: NOTED ON RODS 36.2 FT. AT COMPLETION FT. AFTER HRS. FT.

LOG OF BORING NO. 13 (cont'd)

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 6-10-75 LOCATION: N 400,000 E 2,258,700

SURFACE ELEVATION--

DEPTH SCALE, FT.		STRATUM DEPTH FT.	SAMPLE DEPTH	STANDARD PENETRATION BLOWS/6 in. 3-6 in. INCREMENTS	RECOVERY, %	SHELBY TUBE
55		56.1		RC 2 RQD 73	100	
	Gray fine to medium SANDSTONE with thinly laminated SHALE	58.3				
60	White fine grained LIMESTONE with a few stylolites and solution enlarged bedding planes -0.3' gray shale seam at 65.0'			RC 3 RQD 78	100	
65		69.0				
70	Gray SANDY LIMESTONE	74.0		RC 4 RQD 28	93	
75	Gray fine grained LIMEY friable Quartz SANDSTONE -poorly cemeneted in seams					
80	-irregular clay filled seams in limestone 84.0 to 85.0'	85.0		RC 5 RQD 45	93	
85	White fine grained massive LIME-STONE with Chert nodules and Stylolites					
90		94.0		RC 6 RQD 75	99	
95	Gray fine grained LIMEY SANDSTONE	95.0				
	Gray fine grained SANDY LIMESTONE -shale partings 99 to 100'	100.0				

COMPLETION DEPTH: 100.0'
ROCK CORE DIAMETER: 1 7/8"
GROUND WATER: NOTED ON RODS FT. AT COMPLETION FT. AFTER HRS. FT.

LOG OF BORING NO. 14

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 6-3-75 LOCATION: N 400,000 E 2,263,750

SURFACE ELEVATION-- 686

DEPTH SCALE, FT.		STRATUM DEPTH FT.	SAMPLE DEPTH	STANDARD PENETRATION BLOWS/6 in. 3-6 in. INCREMENTS	RECOVERY, %	SHELBY TUBE
	Brown moist stiff SILTY CLAY(CL)	3.0		5 5/7	40	
	Brown moist medium stiff CLAY (CL)			3 4/6	75	
5		8.0		3 4/4	100	
	Brown moist medium stiff SILTY CLAY (CL)			2 3/3	100	
10				2 4/5	100	
	-stiff	15.5		3 5/7	100	
15	Brown slightly moist very stiff CLAY (CL)			? 11/14	100	
				7 10/14	100	
20	-medium stiff w/limestone frag.	24.7		4/3/ 50/.3	100	
25	White fine grained LIMESTONE w/ Clay filled joints -joints closely spaced 24.7' -shale partings at 28.8'			RC 1 RQD 26	94	
		29.7				
30						
35						

COMPLETION DEPTH: 29.7'
ROCK CORE DIAMETER: 2 1/8"
GROUND WATER: NOTED ON RODS FT. AT COMPLETION FT. AFTER HRS. FT.

LOG OF BORING NO. 15

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 6-4-75 LOCATION: N 400,000 E 2,265,600

SURFACE ELEVATION~ 652

Depth Scale, Ft.	Stratum Depth Ft.	Sample Depth	Standard Penetration: Blows/6 in. Increments	Recovery, %
Dark Brown and Gray moist medium stiff SILTY CLAY (CL)			3 3/4	50
~soft			2 2/3	50
	6.0		2 1/1	100
Dark Gray moist very soft SILT (ML) with trace Clay	8.0		1 1/1	100
Dark Gray moist very soft CLAYEY SILT (ML)	12.0		1 4/8	100
Brown wet fine to coarse SAND (SW) with trace Silt and fine Gravel			4 5/9	25
			4 5/6	40
			4 8/10	25
	22.0			
Gray wet loose SILTY fine to coarse SAND (SM-SW) with trace Clay	24.2		30 50/.2	60
White fine grained LIMESTONE with solution enlarged bedding planes at 2 to 3" intervals	26.4		RC 1 RQD 0	50
Gray fine grained Quartz SANDSTONE, poorly cemented	29.9			
White fine grained LIMESTONE w/ irregular clay filled seams	31.9		RC 2 RQD 50	90
White fine grained LIMESTONE w/ several chert nodules			RC 3 RQD 70	100
	39.6			

Uncontined 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: 39.6'
ROCK CORE DIAMETER: 2 1/8"
GROUND WATER: NOTED ON RODS 7.4 FT. AT COMPLETION FT. AFTER HRS. FT.

LOG OF BORING NO. 16

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 6-13-75 LOCATION: N 400,750 E 2,265,600

SURFACE ELEVATION~ 652.5

Depth Scale, Ft.	Stratum Depth Ft.	Sample Depth	Standard Penetration: Blows/6 in. Increments	Recovery, %
Dark Gray moist medium stiff SILTY CLAY (CL)			3 3/4	40
	5.0		3 4/5	50
Brown very moist loose SANDY SILT (SM)	7.0		2 1/6	50
Brown moist very loose fine SAND (SP)			2 1/1	100
~wet	11.0		1 0/2	100
Dark Brown very moist soft to very soft CLAYEY SILT (ML)			0 1/3	100
	15.0		7 8/12	100
Brown wet medium dense fine to coarse SAND (SW) with trace to little fine to medium Gravel			4 7/13	75
	21.0			
Gray and Brown wet dense SILTY fine to coarse SAND (SW-SM) with little Silt and Gravel (Sandstone and Limestone fragments)			18 16/16	100
~medium dense	31.0		9 9/12	50
White fine grained LIMESTONE w/ irregular Clay filled seams	32.4		RC 1 RQD 38	96
White fine grained massive LIMESTONE with Chert nodules (at 35') and stylolites	36.0			

Uncontined 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: 36.0'
ROCK CORE DIAMETER: 1 7/8"
GROUND WATER: NOTED ON RODS 8.5 FT. AT COMPLETION FT. AFTER HRS. FT.

LOG OF BORING NO. 17

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA | DATE: 6-16-75 | LOCATION: N 400,000 E 2,267,500

SURFACE ELEVATION— 652

Depth Scale, Ft.	Stratum Depth Ft.	Sample Depth	Standard Penetration Blows/6 in. 3–6 in. Increments	Recovery, %
Dark Brown moist medium stiff SILTY CLAY (CL)			2 4/5	25
-very soft	5.5		2 1/1	10
Dark Brown very moist very soft SILT (ML) with trace Clay	9.0		1 1/2	100
Brown wet soft CLAYEY SILT (ML) with sand seams	13.0		1 2/2	100
Brown wet loose fine to medium SAND (SP) with trace Silt and coarse Sand			3 4/4	50
-medium dense	22.5		7 7/8	50
Lt Gray and Brown wet dense fine SAND (SP) w/soft Sandstone frags.	24.4		50/.4	10
Gray to Green fine grained LIME-STONE with interbedded Glauconitic Shale and Sandstone			RC 1 RQD 10	88
-white fine grained limestone w/ shale partings 27.2 to 27.6'	29.3			

Uncontined 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

COMPLETION DEPTH: 29.3'
ROCK CORE DIAMETER: 2 1/8"
GROUND WATER: NOTED ON RODS 10.7 FT. | AT COMPLETION FT. | AFTER HRS. FT.

LOG OF BORING NO. 18

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA | DATE: 6-4-75 | LOCATION: N 401,750 E 2,259,700

SURFACE ELEVATION— 730

Depth Scale, Ft.	Stratum Depth Ft.	Sample Depth	Standard Penetration Blows/6 in. 3–6 in. Increments	Recovery, %
Brown and Gray moist medium stiff CLAY (CH)			3 4/5	25
-stiff	6.5		3 5/6	50
Brown moist medium dense fine SAND (SP) w/little Silt	8.0		4 10/16	100
Brown moist medium dense SILTY fine SAND (SM-SP) with trace Clay	16.0		9 10/14	100
			5 7/10	100
			4 7/7	100
Brown and Gray moist medium stiff CLAYEY SANDY SILT (ML)	18.5		5 5/5	100
Brown and Gray moist stiff CLAY (CL) with trace fine Sand	22.0		3 5/6	100
Brown wet loose SILTY SAND (SM) with trace fine Sand	24.5		3 3/6	100
Gray very moist stiff SILTY CLAY (CL) w/trace Sand	27.5		34 50/.2	75
Black weathered SHALE			70/.5	30
Shaly COAL	35.4		RC 1 RQD 72	100
Gray SANDY FIRE CLAY -clayey sandstone 37.0 to 38.8'	36.1 / 39.5			
Black thinly bedded SHALE	44.3		RC 2 RQD 56	100
Gray SANDY FIRE CLAY and Black SHALE	46.5		RC 3 RQD 75	100
Hard Black SHALE with Pyrite and Clay Seams				

Uncontined 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

COMPLETION DEPTH: (cont'd on next page)
ROCK CORE DIAMETER: 2 1/8"
GROUND WATER: NOTED ON RODS 22.8 FT. | AT COMPLETION FT. | AFTER HRS. FT.

LOG OF BORING NO. 18 (cont'd)

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 6-4-75 LOCATION: N 401,750 E 2,259,700

DEPTH SCALE, FT.	SURFACE ELEVATION–	STRATUM DEPTH FT.	STANDARD PENETRATION SAMPLE DEPTH	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
35				RC 4 RQD 78	98		
				RC 5 RQD 67	100		
	Black SHALE and thinly laminated SANDSTONE	58.1					
60		60.0					

COMPLETION DEPTH: 60.0'
ROCK CORE DIAMETER: 2 1/8"
GROUND WATER: NOTED ON RODS AT COMPLETION FT. / AFTER HRS. FT.

LOG OF BORING NO. 19

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 6-11-75 LOCATION: N 400,000 E 2,259,500

DEPTH SCALE, FT.	SURFACE ELEVATION– 706	STRATUM DEPTH FT.	STANDARD PENETRATION SAMPLE DEPTH	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
	Brown and Gray moist stiff CLAYEY SILT (ML)	2.5		6 6/7	10		
5	Brown and Gray moist stiff SILTY CLAY (CL)	5.5		4 6/9	25		
	Reddish Brown slightly moist very stiff CLAY (CL)	8.5		5 7/12	50		
10	Brown and Gray mottled moist very stiff SILTY CLAY (CL)	10.5		5 9/10	90		
	Brown moist stiff SANDY CLAYEY SILT (ML)	14.0		3 5/6	100		
15	Brown moist medium dense SILTY fine SAND (SM-SP) w/trace Clay & Gray Silty Clay seams	18.5		6 9/12	100		
20	Brown moist medium dense fine to medium SAND (SP) with trace Silt and Clay	22.0		4 4/7	50		
25	Brown moist dense SILTY fine to coarse SAND (SM-SW) with trace Clay	27.5		5 12/13	75		
	Dark Gray weathered SANDY SHALE	29.5		7 12/27	75		
30	Gray fine to medium grained SANDSTONE with thinly laminated Black Shale			33 50/.2	75		
35		36.4		RC 1 RQD 47	100		
40	Gray fine grained massive LIME-STONE with Stylolites, Clay partings and solution enlarged bedding planes			RC 2 RQD 85	100		
				RC 3 RQD 80	96		
45		46.2					

COMPLETION DEPTH: (cont'd on next page)
ROCK CORE DIAMETER: 1 7/8"
GROUND WATER: NOTED ON RODS AT COMPLETION 27.8 FT. / AFTER HRS. FT.

LOG OF BORING NO. 19 (cont'd)

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA | DATE: 6-11-75 | LOCATION: N 400,000 E 2,259,500

SURFACE ELEVATION—

DEPTH SCALE, FT.		STRATUM DEPTH FT.	SAMPLE DEPTH	STANDARD PENETRATION BLOWS/6 in. INCREMENTS	RECOVERY, %	SHELBY TUBE
50	Gray to Green fine grained LIMESTONE with interbedded Glauconitic SHALE and SANDSTONE (stylolites in the limestone)			RC 4 RQD 0	12	
55				RC 5 RQD 45	74	
60		61.4				
65	Gray fine grained friable Quartz SANDSTONE (some seams loosely cemented)	66.6		RC 6 RQD 13	100	
70						

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

COMPLETION DEPTH: 66.6'
ROCK CORE DIAMETER: 1 7/8"
GROUND WATER: NOTED ON RODS FT. | AT COMPLETION FT. | AFTER HRS. FT.

LOG OF BORING NO. 20

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	STANDARD PENETRATION BLOWS/6 in. INCREMENTS	RECOVERY, %	SHELBY TUBE
5	Brown moist very stiff SILTY CLAY (CL) -medium stiff	5.5		6 7/9 5 5/4	50 10	
10	Brown wet loose fine to medium SAND (SP-SM) with trace Silt	10.5		2 2/3 2 1/1	100	
15	Gray dry hard Calcareous CLAY with LIMESTONE fragments (weathered limestone)	14.3		50/.2 50/.3		
20	Gray fine grained LIMESTONE with interbedded Glauconitic SHALE and SANDSTONE	17.2		RC 1 RQD 36	82	
25	Gray fine grained SANDSTONE (loosely cemented) -friable sandstone 29.0 to 31.8' -sand sized limestone frags. 31.2 to 31.8'			RC 2 RQD 17	77	
30	White LIMESTONE with irregular Clay Filled seams	31.8 32.8		RC 3 RQD 95	99	
35	White fine grained massive LIMESTONE with Stylolites	38.5				
40	Gray fine grained massive LIMEY SANDSTONE	40.0		RC 4 RQD	100	

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

COMPLETION DEPTH: 40.0'
ROCK CORE DIAMETER: 1 7/8"
GROUND WATER: NOTED ON RODS 8.0 FT. | AT COMPLETION FT. | AFTER HRS. FT.

LOG OF BORING NO. 21

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 6-15-75 LOCATION: N 400,750 E 2,264,100

SURFACE ELEVATION– 651

DEPTH SCALE, FT.	STRATUM DEPTH FT.	SAMPLE DEPTH	STANDARD PENETRATION BLOWS/6 in. 3-6 in. INCREMENTS	RECOVERY, %
			4 4/6	50
			3 2/4	50
5			3 4/5	75
			3 2/1	100
10	12.0			
			2 2/6	100
15	18.0			
			6 19/27	100
20	21.5			
			19 50/.5	50
25				
	29.7		50/.3	10
30			RC 1 RQD 19	98
35			RC 2 RQD 66	100
40				
45			RC 3 RQD 64	87

Dark Brown moist medium stiff SILTY CLAY (CL)

–very moist, very soft

Dark Brown wet loose SILTY SAND (SM-ML)

Brown wet dense fine to coarse SAND (SW) with some fine to coarse Gravel

Light Gray wet very dense fine SAND (SP)

Gray fine grained Quartz SANDSTONE (non calcareous)

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: 1 7/8"
GROUND WATER: NOTED ON RODS 5.6 FT. AT COMPLETION FT. AFTER HRS. FT.

LOG OF BORING NO. 21 (cont'd)

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 6-15-75 LOCATION: N 400,750 E 2,264,100

SURFACE ELEVATION–

DEPTH SCALE, FT.	STRATUM DEPTH FT.	SAMPLE DEPTH	STANDARD PENETRATION BLOWS/6 in. 3-6 in. INCREMENTS	RECOVERY, %
55	55.5			
			RC 4 RQD 65	95
60	60.0			
	64.4			
65				

Green to Gray Glaconitic SILTY SANDY dense SHALE

Gray fine grained Quartz SAND-STONE (loosely cemented, non calcareous)

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: 64.4'
ROCK CORE DIAMETER: 1 7/8"
GROUND WATER: NOTED ON RODS FT. AT COMPLETION FT. AFTER HRS. FT.

LOG OF BORING NO. 22

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 6-15-75 LOCATION: N 399,000 E 2,267,000

SURFACE ELEVATION— 651.5

DEPTH SCALE, FT.		STRATUM DEPTH FT.	SAMPLE DEPTH	STANDARD PENETRATION BLOWS/6 in. 3-6 in. INCREMENTS	RECOVERY, %
0	Dark Brown moist medium stiff SILTY CLAY (CL)			2 3/3	100
				1 2/2	75
5				1 1/2	100
	-very soft			1 1/1	100
10	-very soft	12.0			
	Brown wet medium dense fine to medium SAND (SP) with trace Silt			6 4/8	100
15		17.5			
	Brown wet medium dense fine to medium SAND (SP) with trace Silt and coarse Sand			4 6/8	50
20					
	-little Gravel	25.6		6 11/17	50
25	White fine grained LIMESTONE -sandy clay Glauconitic bed at 29.5'			RC 1 RQD 10	75
	-irregular clay filled seams in limestone 29.5 to 30.3'	30.3		RC 2 RQD 63	99
30	White fine grained massive LIME-STONE with Chert nodules and Stylolites				
35	-shale partings at 35.0, 39.0 and 39.5'			RC 3 RQD 80	84
		40.0			
40					

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 7.3 FT.
AT COMPLETION FT.
AFTER HRS. FT.

LOG OF BORING NO. 23

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 6-17-75 LOCATION: N 400,000 E 2,260,700

SURFACE ELEVATION— 656

DEPTH SCALE, FT.		STRATUM DEPTH FT.	SAMPLE DEPTH	STANDARD PENETRATION BLOWS/6 in. 3-6 in. INCREMENTS	RECOVERY, %
0	Dark Brown moist medium stiff SILTY CLAY (CL)			3 3/4	50
				3 4/4	100
5				4 4/6	100
		8.0			
	Brown wet very loose to loose SILTY fine SAND (SM)			2 2/2	100
10				2 2/3	100
	-clayey silt seam			3 4/5	100
15	-clayey silt seam			3 2/3	100
				3 3/3	25
20		22.5			
	Brown wet medium dense fine to medium SAND (SP) with rock fragments			10 13/17	
25		27.4			
	White fine grained Limey SAND-STONE	28.3		RC 1 RQD 90	99
30	White fine grained massive LIME-STONE with occasional stylolites and Clay partings				
35	-irregular clay filled seams 28.3 to 29.4'				
		37.4			
40					

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: 37.4'
ROCK CORE DIAMETER: 1 7/8"
GROUND WATER: NOTED ON RODS 8.1 FT.
AT COMPLETION FT.
AFTER HRS. FT.

LOG OF BORING NO. 24

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 6-16-75 LOCATION: N 399,150 E 2,260,000

SURFACE ELEVATION— 671

Depth Scale, Ft.	Stratum Depth Ft.	Sample Depth	Standard Penetration Blows/6 in. (3–6 in. increments)	Recovery, %
Light Brown slightly moist stiff SILTY CLAY (CL)	3.0		5 7/8	50
Light Brown and Gray mottled moist stiff to very stiff CLAY (CL)			5 6/10	100
			4 6/9	100
-very stiff	10.5		5 7/9	100
Brown moist very stiff SILTY CLAY (CL) with little fine Sand	14.0		3 7/9	75
Brown moist medium dense fine SAND (SP)	15.5		5 8/8	100
Gray wet medium dense SILTY fine SAND (SM-SP) with trace Clay	17.0		3 7/20	100
Brown wet medium dense fine to coarse SAND (SW) w/trace Silt and some fine to coarse Gravel	23.0		13 13/15	100
Gray moist very dense SILTY fine SAND (SM-SP)	24.7		54 50/.2	100
Gray fine grained friable Quartz SANDSTONE with Dark Gray Clay laminations	29.7		RC 1 RQD 82	100

Uncontined 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: 29.7'
ROCK CORE DIAMETER: 1 7/8"
GROUND WATER: NOTED ON RODS 15.5 FT. AT COMPLETION FT. AFTER HRS. FT.

LOG OF BORING NO. 25

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 6-17-75 LOCATION: N 401,100 E 2,261,200

SURFACE ELEVATION— 680

Depth Scale, Ft.	Stratum Depth Ft.	Sample Depth	Standard Penetration Blows/6 in. (3–6 in. increments)	Recovery, %
Brown moist medium stiff SILTY CLAY (CL)	2.5		4 5/5	50
Light Brown and Gray moist medium stiff to stiff CLAY (CL-CH)			3 5/7	100
			3 4/4	100
			2 3/4	50
-very stiff, trace sand			4 6/12	100
			4 5/7	100
Brown wet medium dense fine to medium SAND (SP) w/trace Silt, coarse Sand and fine gravel	24.5 27.0		4 8/7	100
White fine grained LIMESTONE			RC 1 RQD 0	94
	31.9		RC 2 RQD 44	100
Note: Boring filled with sand, Redrilled 5' east, See log of Boring No. 25A				

Uncontined 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: 31.9
ROCK CORE DIAMETER: 1 7/8"
GROUND WATER: NOTED ON RODS FT. AT COMPLETION FT. AFTER HRS. FT.

LOG OF BORING NO. 25 A

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 6-18-75 LOCATION: N 401,100 E 2,261,205

SURFACE ELEVATION– 680

DEPTH SCALE, FT.	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
0						
5						
10						
15						
20						
25						
30						
35						
40						

See log of Boring No.25

26.5

White fine grained LIMESTONE with Shale partings 26.5 to 30.5'

RC 1 — RQD 54 — 100

-interbedded units 33.6 to 36.6'

36.5

COMPLETION DEPTH: 36.5'
ROCK CORE DIAMETER: 1 7/8"
GROUND WATER: NOTED ON RODS FT. / AT COMPLETION FT. / AFTER HRS. FT.

LOG OF BORING NO. 26

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 6-16-75 LOCATION: N 403,100 E 2,261,700

SURFACE ELEVATION– 652

DEPTH SCALE, FT.	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
0			3 4/3	30		
5			2 2/2	50		
10			3 4/5	75		
15			2 3/4	100		
20			2 1/2	100		

Dark Brown moist soft to medium stiff CLAY (CH) with trace Organic material

-very soft

16.0

Light Gray wet very dense fine SAND (SP) with trace Silt and Sandstone fragments

16.8

100/.3 — 100

COMPLETION DEPTH: 16.8
ROCK CORE DIAMETER:
GROUND WATER: NOTED ON RODS 6.0 FT. / AT COMPLETION FT. / AFTER HRS. FT.

LOG OF BORING NO. 27

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 6-18-75 LOCATION: N 401,700 E 2,262,900

SURFACE ELEVATION– 652

Depth Scale, Ft.	Stratum Depth Ft.	Sample Depth Ft.	Standard Penetration Blows/6 in. 3-6 in. Increments	Recovery, %
Dark Brown moist medium stiff CLAY (CH) with trace Organic material			2 2/4	50
	5.5		3 3/4	70
Dark Brown moist medium stiff SILTY CLAY (CL)	6.0		2 2/4	70
Dark Brown moist medium stiff CLAY (CH)			4 4/5	75
	17.0		4 3/4	50
Dark Brown wet medium dense fine to medium SAND (SC-SM) w/Silty Clay seams	20.0		4 8/20	85

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: 20.0'
ROCK CORE DIAMETER:
GROUND WATER: NOTED ON RODS 10.5 FT.
AT COMPLETION FT.
AFTER HRS. FT.

LOG OF BORING NO. 28

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 9-30-75 LOCATION: N 400,645 E 2,260,355

SURFACE ELEVATION– 668

Depth Scale, Ft.	Stratum Depth Ft.	Sample Depth Ft.	Standard Penetration Blows/6 in. 3-6 in. Increments	Recovery, %
Brown moist very stiff SILTY CLAY (CL) with trace Sand			4 8/8	100
	5.5			
Brown very moist medium dense CLAYEY SAND (SC) w/little Silt			5 6/6	100
	9.5			
Dark Gray moist stiff SILTY CLAY (CL) with trace Sand				
	13.0		2 5/4	25
Brown wet loose SILTY SAND (SP-SM) w/trace Clay and fine Gravel	15.7		50/0	0
White fine grained LIMESTONE -clay seams at 18.5' and 22.2' -vertical fracture 17.7 to 18.0' -glauconitic sandstone 23.8 to 24.2' -irregularly filled clay seams 24.3 to 25.7'			RC 1 RQD 55	100
	25.7			
* caved to 7.7 ft at completion				

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: 25.7
ROCK CORE DIAMETER: 2 1/8"
GROUND WATER: NOTED ON RODS 13.0 FT.
AT COMPLETION 6.0 FT. *
AFTER 24 HRS. 6.7 FT.

LOG OF BORING NO. 29

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 9-30-75 LOCATION: N 400,925 E 2,260,575

SURFACE ELEVATION– 686

DEPTH SCALE, FT.		STRATUM DEPTH FT.	SAMPLE DEPTH	STANDARD PENETRATION BLOWS/6 in. INCREMENTS	RECOVERY, %
0	Brown and Gray (mottled) moist CLAY (CH)		10	15/14	100
5					
10			9	14/16	100
15			6	12/13	100
20		22.0	2	9/11	100
	Gray moist medium stiff CLAYEY SILT (ML) w/trace fine Sand	24.5	2	4/9	100
25	Brown moist to wet medium dense to dense fine SAND(SP-SC) w/trace Clay & Silt, Sandstone fragments and Gray Clayey Silt partings		12	50/27	100
30		32.0			
	Gray very moist soft to medium stiff CLAY (CH)	34.0	2/15	50/0.1	100
35	White moist calcareous CLAY & LIMESTONE Fragments	34.6			
	White fine grained LIMESTONE -shaly seams 36.0 to 36.5' -1" clay seam at 37.0'	38.7	RC 1	RQD 5	65
40	Green Glauconitic SANDSTONE with interbedded Limestone	42.8			
	White fine grained well-cemented QUARTZ SANDSTONE -limestone layers 46.2-47.0' -poorly cemented 47.0-47.6'	47.6	RC 2	RQD 28	92
45					
	Note: Bag Samples taken 0 to 6 ft *Caved to 24.0 ft at completion				
50					

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: 47.6'
ROCK CORE DIAMETER: 2 1/8"
GROUND WATER: NOTED ON RODS 28.0 FT. AT COMPLETION 23.5 * FT. AFTER HRS. FT.

ATEC ASSOCIATES

LOG OF BORING NO. 30

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 10-1-75 LOCATION: N 401,345 E 2,260,355

SURFACE ELEVATION– 695

DEPTH SCALE, FT.		STRATUM DEPTH FT.	SAMPLE DEPTH	STANDARD PENETRATION BLOWS/6 in. INCREMENTS	RECOVERY, %
0	Brown and Gray slightly moist very stiff CLAY (CL)		8	10/12	100
5		8.0			
10	Brown and Gray moist medium stiff SILTY CLAY (CL)	12.0	6	5/4	100
15	Brown moist stiff SILTY CLAY(CL) w/trace to little Sand	17.0	3	6/7	75
	Brown and Gray moist very stiff SILTY CLAY(CL) w/trace Sand	19.0		12/70/	75
20	Brown moist very dense fine SAND (SP) with trace Silt	21.0		50/.2	
	Brown wet medium dense CLAYEY fine SAND (SC) with some Silt	24.0		7/11	
25	White moist very stiff calcareous CLAY (CL)	24.6		50/.2	
	Gray medium grained CLAYEY LIME-STONE with massive bedding and occasional weathered chert nodules -clay lenses at 25.3, 27.5 and 28.3' -less massive 29.6 to 33.0'			RC 1 RQD 66	100
30		33.0			
	Greenish Gray interbedded LIME-STONE and glauconitic Shale	34.6			
35					
	Note: Bag samples taken 0 to 14 ft				
	* Caved to 10.0 ft at completion				

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: 34.6'
ROCK CORE DIAMETER: 2 1/8"
GROUND WATER: NOTED ON RODS 17.7 FT. AT COMPLETION 8.3 * FT. AFTER HRS. FT.

ATEC ASSOCIATES

LOG OF BORING NO.31

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 10-1-75 LOCATION: N 401,125 E 2,260,475

SURFACE ELEVATION— 689

Stratum Depth Ft.	Description	Sample & Depth	Blows/6 in. 3-6 in. Increments	Recovery, %
7.5	Brown and Gray moist very stiff CLAY (CL-CH)	4	8/10	100
12.5	Brown moist medium stiff SILTY CLAY (CL)	2	5/5	100
16.0	Brown and Gray moist very stiff SILTY CLAY (CL)	4	8/10	100
19.5	Brown very moist very soft SILTY CLAY (CL)	1	2/9	100
21.5	Brown and Gray moist stiff SILTY CLAY (CL) w/weathered Sandstone fragments			
23.8	Gray slightly moist hard calcareous CLAY (CL)		50/.3	100
26.8	White fine grained LIMESTONE with a vertical glauconitic Clay filled joint 24.0 to 26.0'		RC 1 RQD 68	100
33.8	Gray medium grained CLAYEY LIMESTONE -6" long vertical clay filled joints at 26.8, 27.7 and 29.7' -sandy 12.0-13.8'			
	Note: Bag samples taken 0 to 9 ft			

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

COMPLETION DEPTH: 33.8'
ROCK CORE DIAMETER: 2 1/8"
GROUND WATER: NOTED ON RODS none FT. AT COMPLETION FT. AFTER HRS. FT.

ATEC ASSOCIATES

LOG OF BORING NO. 32

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 10-1-75 LOCATION: N 400,645 E 2,260,665

SURFACE ELEVATION— 686

Stratum Depth Ft.	Description	Sample & Depth	Blows/6 in. 3-6 in. Increments	Recovery, %
	Brown and Gray moist hard SILTY CLAY (CL)	12	16/16	100
12.0	-very stiff	3	5/11	100
	Gray and Brown moist very stiff CLAY (CL-CH)	7	9/15	100
		4	9/13	
26.9		4	6/9	100
	Gray very moist dense SILTY SAND (SM) with trace Clay	10	22/10	50
32.5				
34.0	Dark Gray moist very stiff SILTY CLAY (CL)	34	8/16 50/.2	100
34.2	White slightly moist calcareous CLAYEY SILT (ML)			
	White fine grained LIMESTONE -pyrite replaced fossils at 35.8' -thin clay layers 36.5 to 38.3' and 40.3 to 41.5' -interbedded limestone and green glauconitic shale 43.5 to 44.6'		RC 1 RQD 46	100
44.7				
	Note: Bag samples taken 0 to 7 ft *Caved to 27.0 ft at completion			

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

COMPLETION DEPTH: 44.7'
ROCK CORE DIAMETER: 2 1/8"
GROUND WATER: NOTED ON RODS none FT. AT COMPLETION 13.6 * FT. AFTER 24 HRS. 26.4 FT.

ATEC ASSOCIATES

LOG OF BORING NO. 33

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 10-2-75 LOCATION: N 400,805 E 2,260,475

SURFACE ELEVATION= 678

Depth Scale, Ft.	Description	Stratum Depth Ft.	Sample Depth	Standard Penetration: Blows/6 in. 3-6 in. Increments	Recovery, %
5	Brown and Gray moist very stiff SILTY CLAY (CL)			7 9/12	100
10	-slightly moist, hard			12 17/22	100
15		18.0		4 9/10	100
20	Gray moist medium dense SILTY fine SAND (SM)	21.0		4 6/9	75
	Dark Gray moist stiff CLAY (CH)	27.3		4 6/8 50/0	100 0
30	White fine grained LIMESTONE -shaly seams at 1 to 2" intervals from 27.3 to 32.0' -green glauconitic sandy clay 32.1 to 32.5' -shaly seams and stylolites 32.5 to 35.7'			RC 1 RQD 16	87
35		35.7		RC 2 RQD 0	100
	White fine grained Quartz SANDSTONE (well cemented) with Limestone fragments	37.3		RC 3 RQD 83	100
40	Note: Piezometers installed at 24 ft and 37.0 ft * Caved to 26.5 ft at completion				
45					
50					

Standard Penetration, Blows/Ft. (10 20 30 40 50)
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)
Shelby Tube

COMPLETION DEPTH: 37.3'
ROCK CORE DIAMETER: 2 1/8"
GROUND WATER: NOTED ON RODS none FT.
AT COMPLETION 20.0 * FT.
AFTER HRS. FT.

ATEC ASSOCIATES

LOG OF BORING NO. 34

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 10-11-75 LOCATION: N 400,925 E 2,260,355

SURFACE ELEVATION= 687

Depth Scale, Ft.	Description	Stratum Depth Ft.	Sample Depth	Standard Penetration: Blows/6 in. 3-6 in. Increments	Recovery, %
5	Brown and Gray moist very stiff SILTY CLAY (CL)			6 7/10	100
		7.5			
10	Gray moist stiff CLAY (CL-CH)			4 5/8	100
		13.0			
15	Reddish Brown moist very dense SANDY SILT(ML)w/trace Clay & soft Sandstone fragments (weathered sandstone)	15.4		10 26/31	75
20	White Shaly fine grained LIME-STONE -glauconitic shale 22.5 to 25.1'			RC 1 RQD 78	97
25		25.4			
30	*Caved to 14.6 ft at completion				

Standard Penetration, Blows/Ft. (10 20 30 40 50)
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)
Shelby Tube

COMPLETION DEPTH: 25.4'
ROCK CORE DIAMETER: 2 1/8"
GROUND WATER: NOTED ON RODS none FT.
AT COMPLETION 7.2 FT.*
AFTER HRS. FT.

ATEC ASSOCIATES

LOG OF BORING NO. 35

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 10-9-75 LOCATION: N 401,345 E 2,260,575

SURFACE ELEVATION– 687

Depth Scale, Ft.	Stratum Depth Ft.	Sample Depth	Blows/6 in. 3–6 in. Increments	Recovery, %
Brown and Gray moist medium stiff SILTY CLAY (CL)			3 4/6	100
			3 3/5	100
	12.0			
Brown moist very stiff SILTY CLAY (CL) with little Sand			7 9/12	100
			3 5/7	100
	23.0			
Brown wet dense fine SAND(SP) w/ trace Silt	24.5		15 40/23	50
Brown wet weathered SANDSTONE	25.6			
White fine grained LIMESTONE with shaly seams and pyrite veins	27.6		RC 1	
Green to Gray glauconitic SHALE	29.6		RQD 69	99
White fine grained massive LIME-STONE -vertical clay filled joint at 33.5'	35.6			
*Caved to 15.0 ft at completion				

Standard Penetration, Blows/Ft. (10 20 30 40 50)
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)
Shelby Tube

COMPLETION DEPTH: 35.6'
ROCK CORE DIAMETER: 2 1/8"
GROUND WATER: NOTED ON RODS 23.0 FT. AT COMPLETION 8.5 * FT. AFTER HRS. FT.

ATEC ASSOCIATES

LOG OF BORING NO. 36

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 10-2-75 LOCATION: N 401,685 E 2,260,635

SURFACE ELEVATION– 685

Depth Scale, Ft.	Stratum Depth Ft.	Sample Depth	Blows/6 in. 3–6 in. Increments	Recovery, %
Dark Gray slightly moist very stiff SILTY CLAY(CL)w/tr. Org.Matl.	2.5		5 8/10	100
Brown and Gray moist stiff to very stiff CLAY (CL)			5 8/10	100
			4 6/9	100
			5 7/8	100
-medium stiff, trace sand			3 5/5	100
-trace sand			3 6/7	100
			7 11/13	100
			3 7/11	100
			5 5/8	100
	27.5			
Dark Gray moist medium stiff CLAY (CH)			2 3/5	100
	33.0			
Gray wet very dense SILTY fine to coarse SAND(SP-SM)w/little fine to medium Gravel			5/51/ 50/.4	50
	38.5			
Gray fine grained Quartz SANDSTONE with Coal partings -3" fine limestone bed at 39.8' -gray fine grained limestone and quartz sandstone 41.0-41.9'	41.9		RC 1 RQD 46	75
Gray fine grained Quartz SANDSTONE (calcareous matrix , well cemented)	47.5			
Gray fine grained LIMESTONE	48.5			
Note: Bag Samples taken 0 to 5 ft Caved to 22.0 ft at completion				

Standard Penetration, Blows/Ft. (10 20 30 40 50)
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)
Shelby Tube

COMPLETION DEPTH: 48.5 ft
ROCK CORE DIAMETER: 2 1/8"
GROUND WATER: NOTED ON RODS 32.9 FT. AT COMPLETION 15.4 * FT. AFTER HRS. FT.

ATEC ASSOCIATES

LOG OF BORING NO. 37

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 10-3-75 LOCATION: N 402,035 E 2,260,635

SURFACE ELEVATION~ 680

Depth Scale, Ft.	Stratum Depth Ft.	Sample Depth	Blows/6 in. 3-6 in. Increments	Recovery, %
Black moist very stiff SILTY CLAY (CL) with trace organic mat'l	3.0		5 6/12	100
Gray (w/mottled Brown) moist very stiff SILTY CLAY (CL)	8.0		4 7/9 4 9/13	100 100
Brown and Gray moist very stiff CLAY (CL)	13.0		6 13/14 3 8/13	100 100
Brown and Gray moist stiff to very stiff SILTY CLAY (CL) w/trace to little Sand	18.0		5 8/11 4 6/7	100 100
Brown (w/mottled Gray) moist medium stiff CLAY (CL)	23.0		3 6/7	100
Brown wet medium dense SILTY SAND (SM) w/trace Clay and Gravel	27.5		11 10/7	75
Dark Gray very moist soft CLAY(CH)	28.8		60/50/ .2	100
White moist calcareous CLAY & LIMESTONE fragments	29.2		RC1 RQD 0	50
White fine grained LIMESTONE with pyrite veins and calcite crystals at top -thin clay partings at 2" intervals 30.6 to 31.9' and 32.6 to 35.2' -green glauconitic shale 36.7 to 37.8' -stylolites and clay partings 37.8 to 39.3'	39.3		RC 2 RQD 54	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: 39.3'
ROCK CORE DIAMETER: 2 1/8"
GROUND WATER: NOTED ON RODS 23.0 FT. AT COMPLETION FT. AFTER HRS. FT.

ATEC ASSOCIATES

LOG OF BORING NO. 38

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 10-3-75 LOCATION: N 403,000 E 2,260,635

SURFACE ELEVATION~ 682

Depth Scale, Ft.	Stratum Depth Ft.	Sample Depth	Blows/6 in. 3-6 in. Increments	Recovery, %
Gray slightly moist very stiff SILTY CLAY (CL)	3.0		4 6/12	100
Brown and Gray slightly moist hard CLAY (CL)	5.5		8 15/16	100
Brown and Gray moist medium stiff SILTY CLAY (CL) -very soft	12.0		4 4/4 1 1/2	100 100
Brn very moist loose fine SAND(SP)	13.5		1 3/5	75
Dark Brown moist medium stiff SILTY CLAY (CL)	18.0		2 3/6	50
Brown and Gray moist very stiff CLAY (CL)	23.0		4 8/11	100
Gray moist medium stiff CLAY(CH)	27.5		2 3/4	100
SAND	28.8		15 50/.0	0
White fine grained LIMESTONE -vertical fracture 28.8 to 29.8' -clay layers at 30.2 and 31.8' -vertical joint at 32.0'	33.8		RC 1 RQD 44	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: 33.8'
ROCK CORE DIAMETER: 2 1/8"
GROUND WATER: NOTED ON RODS 27.8 FT. AT COMPLETION FT. AFTER HRS. FT.

ATEC ASSOCIATES

LOG OF BORING NO. 39

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	Description	Stratum Depth Ft.	Sample No.	Blows/6 in. 3-6 in. Increments	Recovery, %
0	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

Standard Penetration, Blows/Ft. (10 20 30 40 50)
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)
Shelby Tube

COMPLETION DEPTH: 18.0'
ROCK CORE DIAMETER:
GROUND WATER: NOTED ON RODS 15.0 FT.
AT COMPLETION FT.
AFTER HRS. FT.

ATEC ASSOCIATES

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	Description	Stratum Depth Ft.	Sample No.	Blows/6 in. 3-6 in. Increments	Recovery, %
0	Dark Gray moist stiff CLAY(CH) w/ trace organic material			2 4/7	75
	-medium stiff			3 4/6	75
5		9.0		5 8/11	100
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	-trace coarse sand			4 9/8	100
		18.8		6 6/7	75
20				50/.3	0

Note: Piezometer installed at 18.5 ft

Standard Penetration, Blows/Ft. (10 20 30 40 50)
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)
Shelby Tube

COMPLETION DEPTH: 18.8'
ROCK CORE DIAMETER:
GROUND WATER: NOTED ON RODS 12.0 FT.
AT COMPLETION FT.
AFTER HRS. FT.

ATEC ASSOCIATES

LOG OF BORING NO. 41

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 10-4-75 LOCATION: N 401,880 E 2,263,460

SURFACE ELEVATION– 654

Stratum Depth Ft.	Description	Sample Depth	Blows/6 in. Increments	Recovery, %
2.5	Dark Gray moist stiff SILTY CLAY (CL) w/trace organic material		3 4/7	75
5.5	Dark Gray moist medium stiff CLAYEY SILT (ML)		3 3/3	100
	Dark Gray and Brown moist medium stiff SILTY CLAY (CL)		3 4/6	50
			3 3/4	75
11.8			2 3/4	100
15.6	Brown slightly moist loose to medium dense fine to medium SAND(SP) -trace coarse sand		4 5/6	100
	Brown wet very loose fine to medium SAND (SP)		1 1/3	75
19.5			0 2/4	75
22.5	Gray wet loose fine SAND(SP) w/ trace Silt			
	Dark Brown wet medium dense fine to coarse SAND (SW) w/trace Silt		5 8/9	50
28.0				
30.0	Light Greenish Gray wet very dense fine SAND (SP)		45 50/.3	100
	Greenish Gray loosely cemented fine grained Quartz SANDSTONE -white limestone with irregular clay filled seams from 36.6 to 37.9'		RC 1 RQD 20	55
40.0				

Uncontined 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: 2 1/8"
GROUND WATER: NOTED ON RODS 15.6 FT. AT COMPLETION FT. AFTER HRS. FT.

ATEC ASSOCIATES

LOG OF BORING NO. 42

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 10-7-75 LOCATION: N 402,115 E 2,263,205

SURFACE ELEVATION– 653

Stratum Depth Ft.	Description	Sample Depth	Blows/6 in. Increments	Recovery, %
	Dark Gray moist medium stiff to stiff SILTY CLAY (CL)		5 6/3	100
			4 6/6	100
			5 7/10	100
			2 4/5	100
13.5			2 3/3	100
16.0	Brown moist medium dense fine to medium SAND (SP)		2 7/9	75
	Brown and Gray wet loose to medium dense fine to coarse SAND (SW) with trace Silt and fine Gravel		2 4/5	50
23.0			0 5/7	75
	Gray wet very dense fine to coarse SAND(SW) w/trace Silt and some fine to coarse Gravel		22/37 50/.4	100
29.2			50/.3	100
	Gray loosely cemented medium grained Quartz SANDSTONE		RC 1 RQD 17	61
37.3				
39.2	White fine grained LIMESTONE with irregular Clay-Filled seams (some glauconitic from 32.2–38.3'			

* Caved to 15.8 ft at completion

Boulders 21.0 to 29.2'

Uncontined 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: 39.2'
ROCK CORE DIAMETER: 2 1/8"
GROUND WATER: NOTED ON RODS 13.5 FT. AT COMPLETION 15.1 * FT. AFTER HRS. FT.

ATEC ASSOCIATES

LOG OF BORING NO. 43

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 10-4-75 LOCATION: N 401,875 E 2,261,070

SURFACE ELEVATION– 684

Depth Scale, Ft.	Description	Stratum Depth Ft.	Sample Depth	Standard Penetration Blows/6 in. 3–6 in. Increments	Recovery, %
5	Brown to Gray moist stiff CLAY (CL)			3 4/7	
10	-medium stiff			2 3/5	
15	-very stiff			9 8/11	
20	-medium stiff			3 4/5	
	-trace sand	24.0			
25	Brown wet medium dense SILTY fine SAND (SM)			2 4/7	
		28.0			
30	Brown wet medium dense CLAYEY SAND (SC) w/trace Gravel	29.5		5 8/13	
	Greenish Gray moist very stiff CLAYEY SILT (ML) w/trace Sand	30.3			
		32.1			
35	Gray fine grained CLAYEY LIMESTONE with Glauconitic Clay filled seams			RC 1 RQD 22	54
	Gray loosely cemented fine grained LIMEY QUARTZ SANDSTONE				
40					
45				RC 2 RQD 10	71
50					

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 28.4 FT. AT COMPLETION 20.4 * FT. AFTER HRS. FT.

ATEC ASSOCIATES

LOG OF BORING NO. 43 (cont'd)

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 6-10-75 LOCATION: N 401,875 E 2,261,070

SURFACE ELEVATION– 684

Depth Scale, Ft.	Description	Stratum Depth Ft.	Sample Depth	Standard Penetration Blows/6 in. 3–6 in. Increments	Recovery, %
55	-with sand size pieces of limestone 55.7 to 56.2'			RC 3 RQD 28	96
	White fine grained LIMESTONE w/ irregular Clay Filled seams	56.2 57.6			
60	White fine grained LIMESTONE w/ occasional weathered chert nodules and stylolites			RC 4 RQD 79	100
65					
		69.0			
70	Greenish Gray Glauconitic SHALY QUARTZ SANDSTONE	70.3		RC 5 RQD 53	94
	White fine grained LIMESTONE w/ Black SHALE seams 72.6 to 73.5'	73.5			
75	Brown fine grained massive DOLOMITE	76.5		RC 6 RQD 50	99
	Gray LIMEY SILTY fine grained DOLOMITE				
80		80.3			
85	Note: Piezometers installed at 28.0 ft and 55.0 ft Note: Bag Samples taken 0 to 4 ft *Caved to 23.2 ft at completion				

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: 80.3'
ROCK CORE DIAMETER: 2 1/8"
GROUND WATER: NOTED ON RODS FT. AT COMPLETION FT. AFTER HRS. FT.

ATEC ASSOCIATES

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

Depth	Description	Stratum Depth Ft.	Sample Depth	Blows/6 in. 0–6 in. Increments	Recovery, %
	Dark Gray slightly moist very stiff SILTY CLAY (CL)			10 11/12	
5	Brown moist stiff SANDY CLAY (CL-SC)	5.0		6 8/10	
	Brown moist med.dense fine SAND (SP)	6.3		5 9/6	
10	Brown wet loose fine to medium SAND (SP) w/trace Silt –very loose	8.2		3 3/3	
	Brown wet very loose CLAYEY SAND (SW-SC) w/little fine to med.Gvl	13.0		1 1/2	
15	Brown very moist med.stiff CLAYEY SILT (ML) w/tr.Sand & fine Gvl	15.5		2 2/2	
	Brown wet very loose SANDY SILT (ML)	18.0		2 4/5	
20	Dark Gray very wet soft CLAY (CL-CH) with trace coarse Gravel	20.5		2 2/2	
	Brown wet dense fine to coarse SAND (SW) w/trace Silt & Gravel	24.0		34 25/16	
25	Gray very moist very dense fine SAND (SP) w/trace Silt	26.2		50/.2	
		26.3			
30	Note: SPT from 23.5 to 25.0' driven on a boulder				
	* Caved to 11.8 ft at completion				

Standard Penetration, Blows/Ft. (10 20 30 40 50)
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)
Shelby Tube

COMPLETION DEPTH: 26.3
ROCK CORE DIAMETER:
GROUND WATER: NOTED ON RODS 10.5 FT. AT COMPLETION 8.2 FT. * AFTER HRS. FT.

ATEC ASSOCIATES

LOG OF BORING NO. 45

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 10-5-75 LOCATION: N 400,450 E 2,259,650

SURFACE ELEVATION– 704

Depth	Description	Stratum Depth Ft.	Sample Depth	Blows/6 in. 0–6 in. Increments	Recovery, %
	Light Brown slightly moist very stiff CLAY (CL-CH)			3 9/11	100
5		7.5			
	Brown moist very stiff SILTY CLAY (CL) with trace fine Gravel			5 6/8	100
10		12.5			
	Brown and Gray (mottled) moist very stiff SILTY CLAY (CL) w/trace Sand			5 8/10	100
15		17.5			
	Brown and Gray (mottled) moist medium stiff CLAY (CL-CH)	20.5		3 4/5	100
20	Brown moist medium dense CLAYEY SAND (SC)	22.0		6 10/7	100
	Gray moist very stiff CLAYEY SILT (ML-CH) with Brown fine Sand seams	25.5		7 6/11	100
25	Gray slightly moist hard SANDY SILT (ML)	26.9		23 50/.4	100
	Dark Gray soft SANDY SHALE with Clay seams			RC 1 RQD 65	99
30		34.0			
	Note: Bag Samples taken 0 to 24 ft				

Standard Penetration, Blows/Ft. (10 20 30 40 50)
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)
Shelby Tube

COMPLETION DEPTH: 34.0
ROCK CORE DIAMETER: 2 1/8"
GROUND WATER: NOTED ON RODS none FT. AT COMPLETION FT. AFTER HRS. FT.

ATEC ASSOCIATES

LOG OF BORING NO. 46

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 10-6-75 LOCATION: N 402,370 E 2,259,820

SURFACE ELEVATION– 700

Stratum Depth Ft.	Description	Sample Depth	Standard Penetration Blows/6 in. or 6-in. Increments	Recovery, %
3.0	Black moist medium stiff SILTY CLAY(CL) w/trace organic material		4 4/4	100
6.5	Black moist stiff CLAY(CL) with trace organic material		4 5/6	100
8.5	Dark Brown moist stiff CLAY(CL)		5 6/5	100
11.5	Brown and Gray (mottled) moist medium stiff CLAY(CL)		4 4/5	100
13.5	Brown moist soft CLAYEY SILT(ML) with trace Sand		2 2/2	75
15.5	Gray moist very stiff CLAY (CH)		5 7/10	100
17.5	Brown moist stiff CLAYEY SILT(ML) with trace Sand		4 5/8	100
21.0	Brown moist stiff SILTY CLAY(CL)		4 5/6	100
27.0	Gray and Brown (mottled) moist stiff CLAYEY SILT (ML) with trace Sand		5 6/7	100
31.0	Brown very moist medium stiff CLAY (CL-CH)		3 3/4	100
32.2	Brown slightly moist very dense SILTY SAND (SP-SM)		50/.4	50

Note: Bag Samples taken 0 to 20 ft

*Caved to 32.2 ft at completion

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: 32.2'
ROCK CORE DIAMETER:
GROUND WATER: NOTED ON RODS 12.5 FT. AT COMPLETION 13.6 * FT. AFTER HRS. FT.

ATEC ASSOCIATES

LOG OF BORING NO. 47

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 10-8-75 LOCATION: N 400,985 E 2,263,245

SURFACE ELEVATION– 653

Stratum Depth Ft.	Description	Sample Depth	Standard Penetration Blows/6 in. or 6-in. Increments	Recovery, %
7.0	Dark Brown moist medium stiff SILTY CLAY (CL) with trace organic material		4 4/5	100
10.5	Brown moist very loose fine SAND (SP) w/trace Silt		2 3/2	75
21.0	Dark Brown to Black moist medium stiff SILTY CLAY (CL) w/trace organic material		3 3/6	100
24.0	Gray wet medium dense fine to medium SAND(SP) w/trace Silt, coarse Sand, and fine Gravel		3 7/8	100
28.5	Dark Gray very moist SILTY CLAY(CL) with Sand seams		8 10/24	100
36.8	Gray friable fine grained Quartz SANDSTONE -limestone fragments 33.9-35.3' -white fine grained limestone with irregular clay filled seams 35.3 to 36.1' -white fine grained limestone 36.1 to 36.8'		RC 1 RQD 47	B7

*Caved to 19.4 ft at completion

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: 36.8'
ROCK CORE DIAMETER: 2 1/8"
GROUND WATER: NOTED ON RODS 22.0 FT. AT COMPLETION 11.4 * FT. AFTER HRS. FT.

ATEC ASSOCIATES

LOG OF BORING NO. 48

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 10-7-75 LOCATION: N 401,070 E 2,263,160

SURFACE ELEVATION– 655

Depth	Description	Stratum Depth Ft.	Sample Depth	Blows/6 in. 2nd & 3rd 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				2 4/8	100
	Brown moist loose SILTY fine SAND (SM)	10.5		2 4/6	75
	-wet below 13.0'			0 1/1	50
15	Dark Gray very moist soft CLAY (CH)	15.5		2 1/3	50
	Dark Gray wet very loose SILTY fine SAND (SP-SM)	18.5		1 1/4	50
20	Gray very loosely cemented fine grained LIMEY QUARTZ SANDSTONE	21.0		50/.2	50
	-friable below 27.9'			RC 1	
25	-limestone fragments 30.3 to 31.1'			RQD 33	
	-white fine grained limestone w/ irregular clay filled seams 31.1 to 31.8'			0	
				RC 2	
30				RQD 100	
		31.8		38	
35	*Caved to 12.1 ft at completion				

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: 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. 49

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 10-8-75 LOCATION: N 399,800 E 2,261,075

SURFACE ELEVATION– 656

Depth	Description	Stratum Depth Ft.	Sample Depth	Blows/6 in. 2nd & 3rd Increments	Recovery, %
	Dark Gray to Brown stiff CLAY (CL-CH)			3 5/8	100
5					
	-medium stiff			3 4/4	100
10		12.0			
	Brown and Gray (mottled) moist soft CLAY (CL)			2 2/3	100
15					
	-stiff			4 7/6	100
20		23.5			
	Brown and Gray wet very dense fine SAND (SP)	25.0		9 44/50	100
25					

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: 25.0
ROCK CORE DIAMETER:
GROUND WATER: NOTED ON RODS 12.5 FT.; AT COMPLETION FT.; AFTER HRS. FT.

ATEC ASSOCIATES

LOG OF BORING NO. 50

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	BLOWS/6 in. 3–6 in. INCREMENTS	RECOVERY, %
Dark Gray slightly moist very stiff CLAY (CL-CH)		5	9 10/13	100
	6.0			
Gray and Brown (mottled) moist stiff SILTY CLAY (CL)		10	4 6/7	100
	11.5			
Dark Gray very moist medium stiff CLAY (CL) with trace Sand		15	2 3/3	75
-soft		20	2 2/2	75
	22.5			
Light Gray slightly moist very dense SANDY SILT (ML-SM) (calcareous)	24.5	25	18 50/.5	75
White friable fine grained Quartz SANDSTONE -limestone fragments 24.5 to 25.3		30	RC 1 RQD 36	55
	32.0			
White fine grained LIMESTONE -clay fillings 32.0-33.5'	34.5	35	RC 2 RQD 82	100
*Caved to 18.4 ft at completion				

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: 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

LOG OF BORING NO. 51

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA DATE: 10-9-75 LOCATION: N 400,280 E 2,262,880

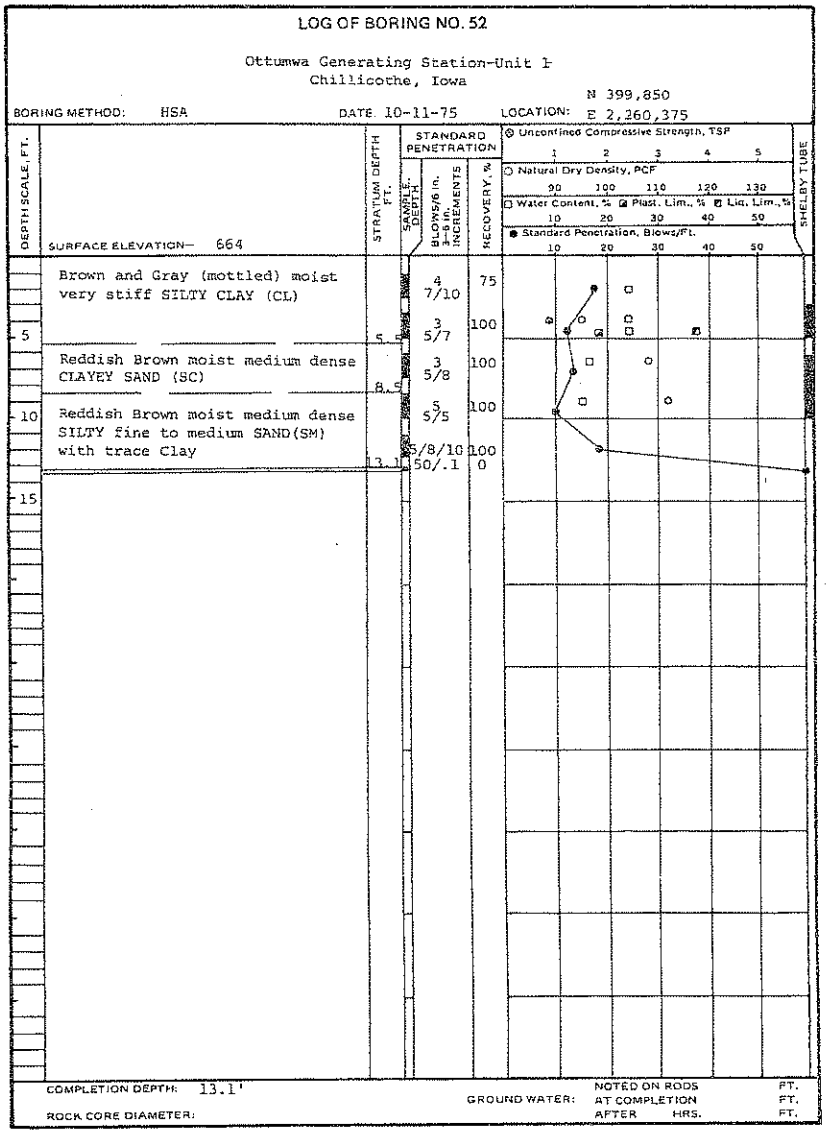
SURFACE ELEVATION– 656

DEPTH SCALE, FT.	STRATUM DEPTH FT.	SAMPLE DEPTH	BLOWS/6 in. 3–6 in. INCREMENTS	RECOVERY, %
Dark Brown slightly moist very stiff SILTY CLAY (CL)		5	10 11/12	100
	8.0			
Brown and Gray mottled moist very stiff SILTY CLAY (CL) w/trace Sand		10	7 11/15	100
	11.0			
Brown moist medium stiff CLAY (CL-CH)		15	3 4/6	100
	18.5			
Brown wet very soft SILTY CLAY (CL) with trace fine Sand	21.0	20	0 1/2	50
Dark Gray moist medium dense SANDY SILT (ML-SM)		25	3 5/6	100
	28.0			
Light Gray wet very dense fine SAND (SP)	29.1	30	23 50/.1	50
Gray friable fine grained Quartz SANDSTONE -Greenish 29.1 to 29.9'	32.6		RC 1 RQD 53	80
White SANDY LIMESTONE	34.5	35		
White fine grained LIMESTONE w/ irregular Clay fillings	35.5			
White Quartz SANDSTONE with irregular Clay Fillings	37.6	40		
*Caved to 15.4 ft at completion				

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: 37.6'
ROCK CORE DIAMETER: 2 1/8"
GROUND WATER: NOTED ON RODS 18.5 FT. AT COMPLETION 14.0 * FT. AFTER HRS. FT.

ATEC ASSOCIATES



Ottumwa Generating Station-Unit 1
(E-7566)

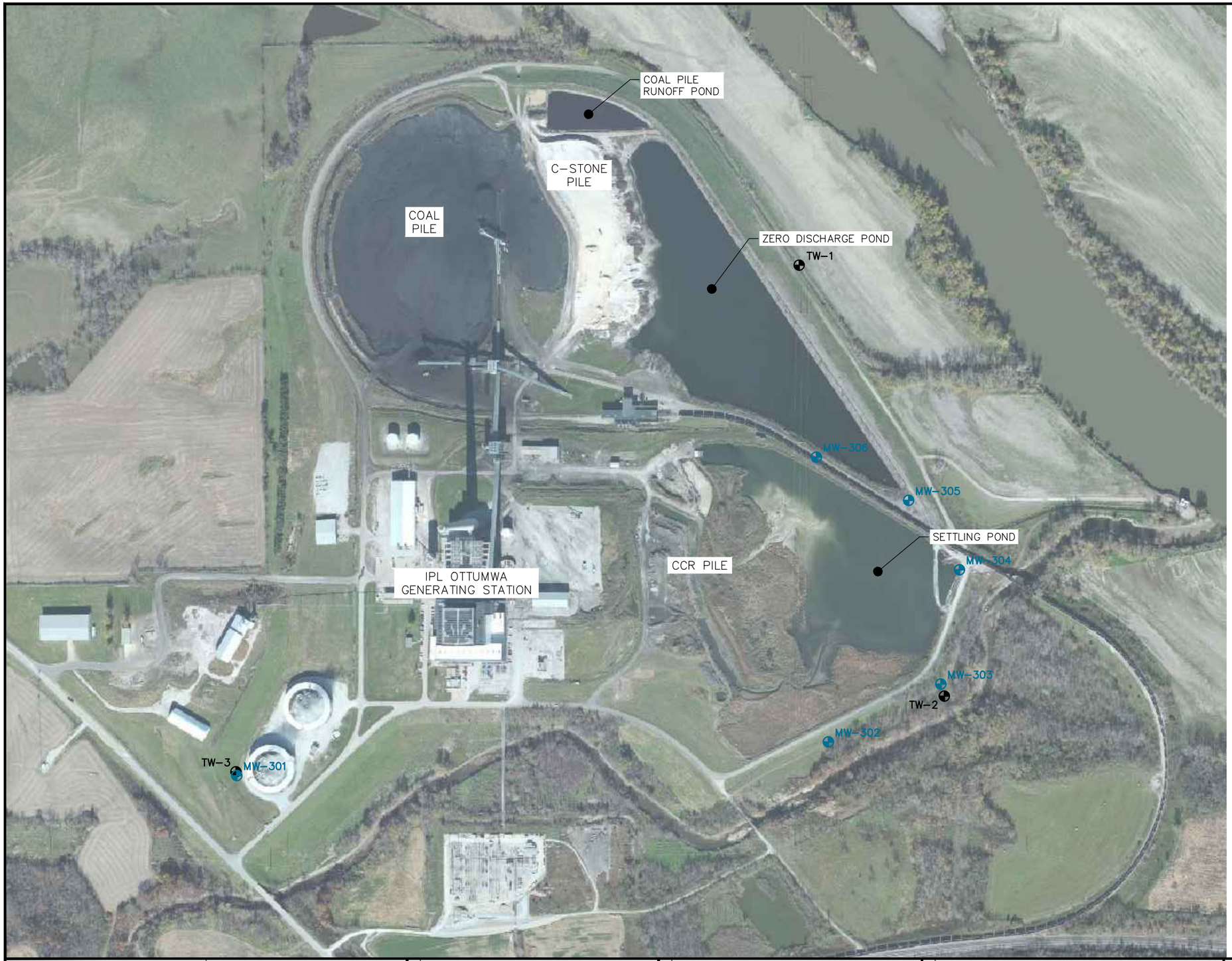
Table I-1 Summary of Piezometer Locations and Water Level Measurements June 19 and October 11, 1975

Boring No.	Ground Surface Elevation	Depth, ft (Elev) of Bottom of Piezometer	Aquifer Material	Depth(El) of Water June 19,'75	Depth(El) of Water Oct. 11,'75
1	684	35.7 (648.3)	Gray Quartz Sandstone	23.8(660.2)	25.8(658.2)
3	678	55.0 (623.0)	Gray Quartz Sandstone	20.0(658.0)	22.7(655.2)
6	711	39.5 (671.5)	Dk Gray Shaly Sandstone	Dry	Dry
7	676	20.0 (656.0)	Brn Sandy Clayey Silt	19.1(656.9)	19.1(656.9)
8	668	35.0 (633.0)	Gray Quartz Sandstone	15.4(652.6)	15.6(652.4)
9	704	30.0 (674.0)	Dk Gray Shaly Sandstone	3.9(700.1)	4.6(699.4)
33	678	37.0 (641.0)	Gray fine grained Sand-stone	-	24.1(653.9)
33	678	24.0 (654.0)	Gray Silty fine Sand	-	21.6(656.4)
40	652	18.5 (633.5)	Brown fine to medium Sand	-	12.6(639.4)
43	684	55.0 (629.0)	Gray fine grained Limey Sandstone	-	22.1(661.9)
43	684	28.0 (656.0)	Brn Silty fine Sand	-	23.0(661.0)

APPENDIX E – Geoprobe Soil Borings - 2016

Alliant Energy
Interstate Power and Light Company
Ottumwa Generating Station
Ottumwa, Iowa

History of Construction



LEGEND

TW-1	EXISTING MONITORING WELL LOCATION (APPROXIMATE)
MW-301	NEW MONITORING WELL

NOTES:

1. MONITORING WELLS MW-301, MW-302, MW-304, WERE INSTALLED BY CASCADE DRILLING, LLP. UNDER THE SUPERVISION OF SCS ENGINEERS FROM NOVEMBER 11-12, 2015.
2. MONITORING WELLS MW-303 AND MW-305 WERE INSTALLED BY CASCADE DRILLING LLP. UNDER THE SUPERVISION OF SCS ENGINEERS ON DECEMBER 7-8, 2015.
3. MONITORING WELLS MW-301, MW-302, MW-304 AND MW-306 WERE SURVEYED BY FRENCH RENEKER ASSOCIATES, INC. ON DECEMBER 3, 2015.
4. MONITORING WELLS MW-303 AND MW-305 WERE SURVEYED BY FRENCH-RENEKER ASSOCIATES, INC. ON FEBRUARY 11, 2016.

N

500 0 500

SCALE: 1" = 500'

PROJECT NO.	25215135.00	DRAWN BY:	AHB
DRAWN:	05/29/15	CHECKED BY:	KAK
REVISED:	04/15/16	APPROVED BY:	

ENGINEER: SCS ENGINEERS
2830 DAIRY DRIVE MADISON, WI 53718-6751
PHONE: (608) 224-2830

CLIENT: INTERSTATE POWER AND LIGHT CO.
20775 POWER PLANT ROAD
OTTUMWA, IA 52501

SITE: OTTUMWA GENERATING STATION
OTTUMWA, IOWA

MONITORING WELL LOCATION MAP

FIGURE 2

I:\25215135\Drawings\OGS Upgradient Locations\Site Plan.dwg, 4/15/2016 1:31:21 PM

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
IPL- Ottumwa Generating Station SCS#: 25215135.40		MW-301

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Todd Schmalfeld Cascade Drilling	11/10/2015	11/10/2015	4-1/4 hollow stem auger

Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		MW-301	Feet	684.3 Feet	8.5 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 400,077 N, 1,899,709 E S/C/N
NW 1/4 of SW 1/4 of Section 26, T 73 N, R 15 W
Lat ° ' "
Long ° ' "
Local Grid Location ☐ N Feet ☐ S ☐ E Feet ☐ W

Facility ID	County	Civil Town/City/ or Village
	Wapello	Ottumwa

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			1	TOPSOIL.	TOPSOIL									
			2	SANDY SILT WITH GRAVEL, gray (7.5YR 6/1), gravel is fine.										
			3											
			4		ML									
S1	10	woh I 3 9	5							W				
			6											
			7	WEATHERED SANDSTONE, very weak, light gray matrix (10YR 7/1), scondary color very dark gray 910YR 3/1), massive.										
S2	13	24 50	8							W				
			9											
			10											
S3	5	50	11		SANDSTONE					W				
			12											
S4	6	50	13							W				
			14											
S5	4	50	15							W				
				Endo of Boring at 15 feet bgs.										

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature for Kyle Kramer

Firm SCS Engineers
2830 Dairy Drive Madison, WI 53718

Tel: (608) 224-2830
Fax:

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
IPL- Ottumwa Generating Station SCS#: 25215135.40		MW-302

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Todd Schmalfeld Cascade Drilling	11/10/2015	11/10/2015	4-1/4 hollow stem auger

Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		MW-302	Feet	671.6 Feet	8.5 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 400,267 N, 1,902,625 E S/C/N
NE 1/4 of SE 1/4 of Section 26, T 73 N, R 15 W
Lat ° ' "
Long ° ' "
Local Grid Location ☐ N ☐ E Feet ☐ S Feet ☐ W

Facility ID	County	Civil Town/City/ or Village
	Wapello	Ottumwa

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			1	TOPSOIL.	TOPSOIL									
			1	LEAN CLAY WITH SAND, dark gray (10YR 4/1).										
			2											
			3											
			4											
			5											
			6											
			7		CL									
			8											
			9											
			10											
S1	19	14 57	11							M				
			12											
			13											
S2	19	24 711	14							M				
			14	LEAN CLAY WITH SAND, very dark gray (5Y 3/1).										
			15		CL									
			16											

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature for Kyle Kamm

Firm SCS Engineers
2830 Dairy Drive Madison, WI 53718

Tel: (608) 224-2830
Fax:

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number MW-302

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
S3	24	2 3 9 9	17	POORLY GRADED SAND, olive yellow (2.5Y 6/6).	SP					M				
S4	24	4 4 4 4	18 19	LEAN CLAY, dark grayish brown (10YR 4/2). POORLY GRADED GRAVEL, fine.	CL GP					W				saturation @ 18 ft bgs.
S5	15	2 3 3 6	20 21 22	LEAN CLAY, brownish yellow (10YR 6/8). POORLY GRADED GRAVEL WITH CLAY, gray (10YR 5/1), fine.	CL GP-GC					W				
S6	24	3 4 8 9	23 24							W				
S7	24	4 3 6 8	25 26 27	POORLY GRADED SAND, gray (10YR 5/1), medium grained.	SP					W				
S8	24	7 8 11 9	28 29	Same as above, but brown (10YR 5/3). POORLY GRADED SAND, gray (10YR 5/1), fine grained, (weathered bedrock?).						W				
S9	23	5 14 33 50/.4	30 31 32	Medium grained.	SP					W				
S10	12	12 50/.3	33 34	POORLY GRADED SAND, olive yellow (2.5Y 7/1), fine grained, (weathered bedrock?).						W				
S11	3	50/.3	35 36 37	End of Boring at 37 feet bgs.	SP					W				

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SOIL BORING LOG INFORMATION

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
IPL- Ottumwa Generating Station SCS#: 25215135.40		MW-303

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Todd Schmalfeld Cascade Drilling	12/8/2015	12/8/2015	4-1/4 hollow stem auger

Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		MW-303	Feet	659.0 Feet	8.5 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 400,583 N, 1,903,215 E S/C/N
NE 1/4 of SE 1/4 of Section 26, T 73 N, R 15 W

Lat ° ' "
Long ° ' "

Local Grid Location ☐ N ☐ E Feet ☐ S Feet ☐ W

Facility ID	County	Civil Town/City/ or Village
	Wapello	Ottumwa

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			1–14	FILL, boring location was cleared to 9' bgs by hydrovac, then back filled.	FILL									
			9–14	WEATHERED SANDSTONE, medium grained, brown (10YR 5/4).	SANDSTONE									
S1	1	50	11							W				
S2	NR		13											
			14	End of Boring at 14.5 ft bgs.										

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature for Kyle Kramer

Firm SCS Engineers
2830 Dairy Drive Madison, WI 53718

Tel: (608) 224-2830
Fax:

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
IPL- Ottumwa Generating Station SCS#: 25215135.40		MW-304

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Todd Schmalfeld Cascade Drilling	11/11/2015	11/11/2015	4-1/4 hollow stem auger

Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		MW-304	Feet	680.1 Feet	8.5 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 401,152 N, 1,903,287 E S/C/N
SE 1/4 of NE 1/4 of Section 26, T 73 N, R 15 W
Lat ° ' "
Long ° ' "
Local Grid Location ☐ N ☐ E Feet ☐ S Feet ☐ W

Facility ID	County	Civil Town/City/ or Village
	Wapello	Ottumwa

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			1	TOPSOIL.	TOPSOIL									
			1	FAT CLAY, black (10YR 2/1).										
			2											
			3											
			4											
			5											
			6											
			7		CH									
			8											
			9											
			10											
S1	23	4 5 4 5	11							M				
			12											
			13	FAT CLAY, yellowish brown (10YR 5/4).										
S2	19.5	4 4 5 5	14		CH					M				
			15	FAT CLAY, yellowish brown (10YR 3/4).	CH									
			16											

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature for Kyle Kramer

Firm SCS Engineers
2830 Dairy Drive Madison, WI 53718

Tel: (608) 224-2830
Fax:

Boring Number MW-304

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
S3	12	3 3 4 5	17	FAT CLAY, yellowish brown (10YR 3/4). *(continued)*						M				
S4	22	4 3 7 12	18 19							M				
S5	23	2 7 8 9	20 21							M				
S6	23	3 4 8 6	22 23 24							M				
S7	23	5 11 15 11	25 26		CH					M				
S8	15	4 4 5 6	27 28 29							M				
S9	18	4 6 9 9	30 31							M				
S10	24	4 6 7 6	32 33 34							M				
S11	16	2 2 4 6	35 36	FAT CLAY, DARK OLIVE BROWN (2.5Y 3/3).						M				
S12	24	4 3 5 5	37 38 39		CH					M				
S13	18	2 3 3 3	40 41							M				
			42											

Boring Number MW-304

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Sample: Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
			43	FAT CLAY, DARK OLIVE BROWN (2.5Y 3/3). *(continued)*	CH									
S14	24	3 4 9 14	44	SANDY SILT, very dark gray.	ML					W				
			45	POORLY GRADED SAND, medium grained, gray (5Y 6/1), (weathered bedrock).										
S16	15	30 50/.4	46							W				
			47											
S17	5	33 50/.2	48		SP					W				
			49											
			50											
S18		50/.4	51							W				
			52	End of Boring at 52 feet bgs.										

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
IPL- Ottumwa Generating Station SCS#: 25215135.40		MW-305

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Todd Schmalfeld Cascade Drilling	12/7/2015	12/8/2015	4-1/4 hollow stem auger

Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		MW-305	Feet	681.5 Feet	8.5 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 401,473 N, 1,903,023 E S/C/N
SE 1/4 of NE 1/4 of Section 26, T 73 N, R 15 W
Lat ° ' "
Long ° ' "
Local Grid Location ☐ N ☐ E Feet ☐ S Feet ☐ W

Facility ID	County	Civil Town/City/ or Village
	Wapello	Ottumwa

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			1	TOPSOIL	TOPSOIL									
				GRAVEL	GP									
			2	FAT CLAY										
			3											
			4											
			5											
			6											
			7											
			8											
			9		CH									
			10	FAT CLAY, very dark grayish brown (10YR 3/2).										
S1	18	3 6 9 11	11							W				
			12											
			13	same as above except, brown (10YR 4/3).										
S2	22	3 7 14 22	14							W				
			15											
			16											

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: for Kyle Kramer
Firm: SCS Engineers, 2830 Dairy Drive Madison, WI 53718
Tel: (608) 224-2830
Fax:

Boring Number MW-305

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
S3	22	5 15 14 15	17	FAT CLAY *(continued)*										
S4	20	3 5 13 15	18 19 20		CH									
S5	24	4 5 7 11	21 22	FAT CLAY WITH SILT, dark gray (10YR 4/1).						M				
S6	20	7 11 15 20	23 24	same as above except, very dark brown (10YR 2/2).						M				
S7	24	4 8 11 12	25 26 27	same as above except, very dark gray (10YR 3/1).	CH					M				
S8	24	8 12 16 21	28 29							M				
S9	13	4 4 7 12	30 31 32							M				
S10	24	5 6 9	33 34	LEAN CLAY, very dark brown (10YR 2/2).						W				
S11	24	4 4 5 7	35 36 37		CL					W				
S12	22	2 2 3 5	38 39 40	same as above except, very dark grayish brown (10YR 3/2).						W				
S13	6	3 9 11	41 42	POORLY GRADED SANDY GRAVEL, fine, brown (10YR 4/3).	GPS					W				water @ 41.0 ft bgs.

Boring Number MW-305 Page 3 of 3

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
S14	22	23 50	43	POORLY GRADED SAND, medium grained, yellowish brown (10YR 5/4), (weathered bedrock). *(continued)*	SP					S				
			44											
			45											
S15	6	5 10 50	46		SP					S				
			47											
			48											
S16	6	50	49							S				
			50	End of Boring at 50 ft bgs.										

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
IPL- Ottumwa Generating Station SCS#: 25215135.40		MW-306

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Todd Schmalfeld Cascade Drilling	11/12/2015	11/12/2015	4-1/4 hollow stem auger

Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		MW-306	Feet	681.1 Feet	8.5 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 401,666 N, 1,902,629 E S/C/N
SE 1/4 of NE 1/4 of Section 26, T 73 N, R 15 W
Lat ° ' "
Long ° ' "
Local Grid Location ☐ N Feet ☐ S ☐ E Feet ☐ W

Facility ID	County	Civil Town/City/ or Village
	Wapello	Ottumwa

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			1	TOPSOIL.	TOPSOIL									
			2	FAT CLAY, dark olive brown (2.5Y 3/3).										
			3											
			4											
			5											
			6											
			7		CH									
			8											
			9											
			10											
S1	18	3 6 9 11	11							M				
			12											
			13	FAT CLAY, gray (10YR 5/1).										
S2	22	5 6 7 9	14							M				
			15		CH									
			16											

I hereby certify that the information on this form is true and correct to the best of my knowledge.

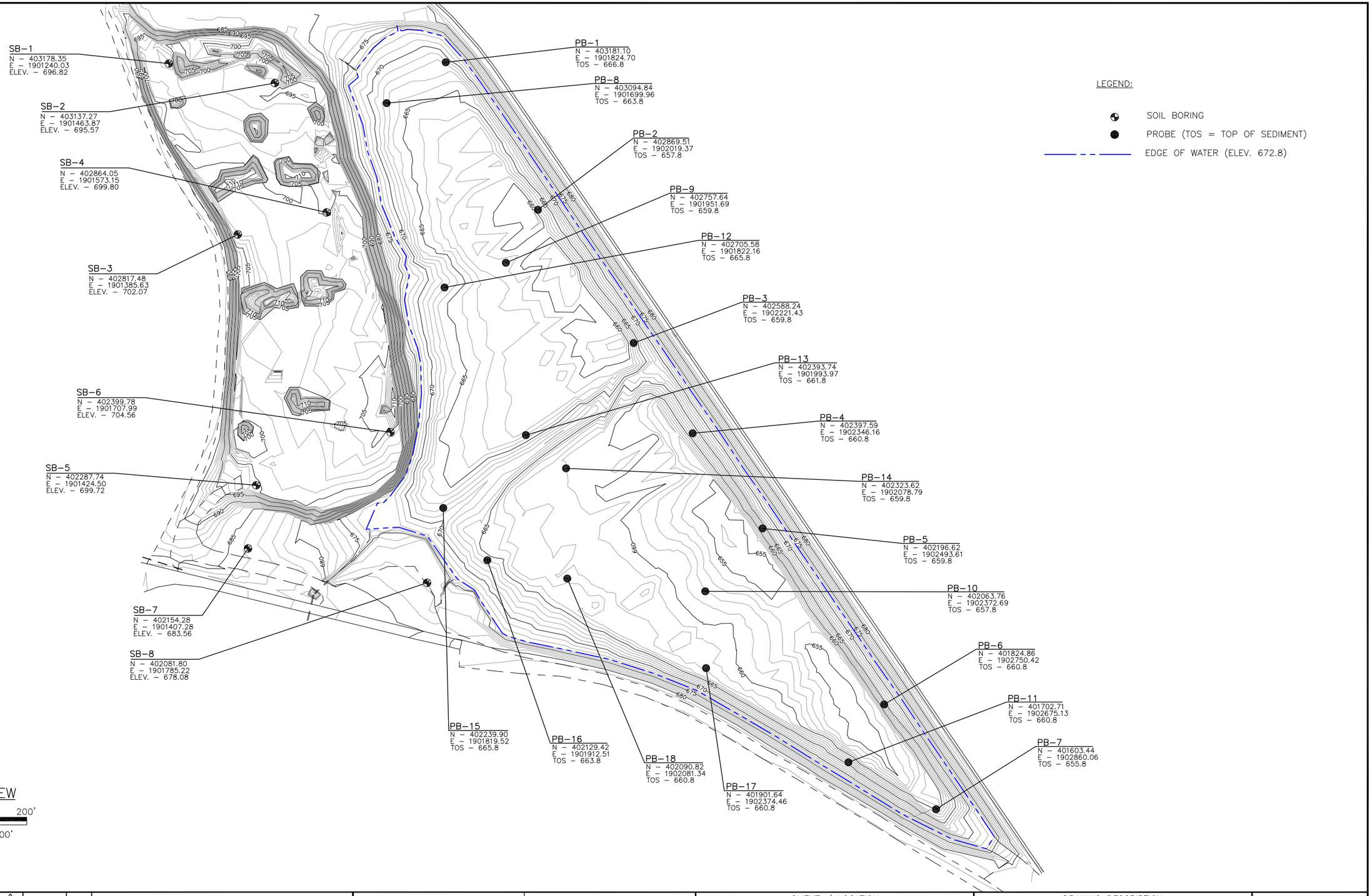
Signature for Kyle Kramer

Firm SCS Engineers
2830 Dairy Drive Madison, WI 53718

Tel: (608) 224-2830
Fax:

Boring Number MW-306 Page 2 of 2

Sample Number and Type	Sample Length Att. & Recovered (in)	Sample Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
S3	22	5 10 10 14	17	FAT CLAY, gray (10YR 5/1). *(continued)* FAT CLAY, gray (10YR 5/1).	CH					M				
			18	FAT CLAY, dark olive brown (2.5Y 3/3).										
S4	13	5 8 14 17	19							M				
			20											
S5	15	5 6 13 16	21							W				
			22		CH									
			23											
S6	15	3 5 7 9	24							W				
			25											
S7	22	2 5 7 11	26	POORLY GRADED SAND, very dark grayish brown (10YR 3/2), medium to coarse grained, (weathered bedrock?).						W				
			27											
			28											
S8	NR	7 3 4 3	29							W				
			30		SP									
S9	18	1 1 2 2	31							W				
			32											
			33											
S10	13	WOR	34							W				
				End of Boring at 34.5 feet bgs.										



PLAN VIEW

0 100' 200'

SCALE: 1"=200'

REV	DATE	BY	DESCRIPTION
5			
4			
3			
2			
1			

SCALE: AS SHOWN | DATE: 6-14-16
DRAWN BY: JFD | CHECKED BY: --- | APPROVED BY: ---

HARD HAT SERVICES™
Engineering, Construction and Management Solutions

CLIENT / LOCATION
INTERSTATE POWER AND LIGHT (IPL)
OTTUMWA GENERATING STATION
OTTUMWA, IA

DRAWING DESCRIPTION
C-STONE PILE AND
ZERO LIQUID DISCHARGE POND

JOB ----------
SHT. FIGURE
DWG. ----------

BORING LOG

CABENO Environmental Field Services, LLC
More than just A Probing Company

CLIENT: Hard Hat Inc.

COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

PROJECT: Alliant Energy Ottumwa, IA **BORING NO.:** ***PB-15***

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Bob Solak*
DATE BEGAN: *06/22/16*
DATE FINISHED: *06/22/13*
GROUND SURFACE ELEVATION: *NOT MEASURED*

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS	PID GRAPH	DEPTH IN FEET	PROFILE	DESCRIPTION
						0		SURFACE WATER
						-2		
						-4		
						-6		
						-8		
						-10		@10' compentent sediment
	SP1	4'/5'				-12		CLAY; dark gray grading to olive; low to high plasticity; moist; trace sand & gravel.
						-14		
						-16		
	SP2	3'/5'				-18		@18' grades tan
						-20		
						-22		Bottom of borings @ 20'
						-24		Boring advanced from atop a barge using a Geoprobe 6610DT and discrete macro-core tooling.
						-26		
						-28		
						-30		

BORING LOG

CABENO Environmental Field Services, LLC
More Than Just A Probing Company

CLIENT: Hard Hat Inc.

COORDINATES: *N NOT SURVEYED* *E NOT SURVEYED*

PROJECT: Alliant Energy Ottumwa, IA **BORING NO.:** *PB-16*

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Bob Solak*
DATE BEGAN: *06/21/16*
DATE FINISHED: *06/21/16*
GROUND SURFACE ELEVATION: *NOT MEASURED*

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS	PID GRAPH	DEPTH IN FEET	PROFILE	DESCRIPTION
						0		SURFACE WATER
						-2		
						-4		
						-6		
						-8		
						-10		@12' soft sediemnt @13' competent sediment
						-12		
	SP1	2'/2'				-14		ASH; black to dark gray; fine grained; poorly graded; wet.
						-16		
	SP2	5'/5'				-18		CLAY; tan; low to high plasticity; moist; trace sand & gravel.
						-20		Bottom of borings @ 20' Boring advanced from atop a barge using a Geoprobe 6610DT and discrete macro-core tooling.
						-22		
						-24		
						-26		
						-28		
						-30		

BORING LOG

CABENO Environmental Field Services, LLC
More Than Just A Probing Company

CLIENT: Hard Hat Inc.

COORDINATES: *N NOT SURVEYED* *E NOT SURVEYED*

PROJECT: Alliant Energy Ottumwa, IA **BORING NO.:** ***PB-18***

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Bob Solak*
DATE BEGAN: *06/22/16*
DATE FINISHED: *06/22/13*
GROUND SURFACE ELEVATION: *NOT MEASURED*

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS	PID GRAPH	DEPTH IN FEET	PROFILE	DESCRIPTION
						0		SURFACE WATER
						-2		
						-4		
						-6		
						-8		
						-10		
						-12		
						-14		@15' compentent sediment
						-16		SILT; black; non-plastic; wet; some organics.
	SP1	5'/5'				-18		Sandy CLAY; dark gray grading to black; low plasticity; wet; trace organic matter.
						-20		
	SP2	1'/5'				-22		SAND; brown; fine to medium grained; well graded; wet; trace silt.
						-24		
						-26		Bottom of borings @ 25'
						-28		Boring advanced from atop a barge using a Geoprobe 6610DT and discrete macro-core tooling.
						-30		

BORING LOG

CABENO Environmental Field Services, LLC
More Than Just A Probing Company

CLIENT: Hard Hat Inc.

COORDINATES: *N NOT SURVEYED* *E NOT SURVEYED*

PROJECT: Alliant Energy Ottumwa, IA **BORING NO.:** ***PB-10***

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Bob Solak*
DATE BEGAN: *06/22/16*
DATE FINISHED: *06/22/13*
GROUND SURFACE ELEVATION: *NOT MEASURED*

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS	PID GRAPH	DEPTH IN FEET	PROFILE	DESCRIPTION
						0		SURFACE WATER
						-2		
						-4		
						-6		
						-8		
						-10		
						-12		
						-14		
						-16		@18' compentent sediment
	SP1	2'/2'				-18		SILT; black; non-plastic; wet; some organics.
						-20		Silty CLAY; dark gray grading olive; low to high plasticity; moist; trace organics.
	SP2	5'/5'				-22		
						-24		Sandy CLAY; tan; low plasticity; moist; trace silt.
						-26		SAND; brown; fine to medium grained; well graded; wet; trace silt.
	SP3	2'/5'				-28		
						-30		Bottom of borings @ 30'
						-32		Boring advanced from atop a barge using a Geoprobe 6610DT and discrete macro-core tooling.
						-34		

BORING LOG

CABENO Environmental Field Services, LLC
More Than Just A Probing Company

CLIENT: Hard Hat Inc.

COORDINATES: N NOT SURVEYED
E NOT SURVEYED

PROJECT: Alliant Energy Ottumwa, IA **BORING NO.:** *PB-17*

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Bob Solak*
DATE BEGAN: *06/22/16*
DATE FINISHED: *06/22/13*
GROUND SURFACE ELEVATION: *NOT MEASURED*

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS	PID GRAPH	DEPTH IN FEET	PROFILE	DESCRIPTION
						0		SURFACE WATER
						-2		
						-4		
						-6		
						-8		
						-10		
						-12		
						-14		@15' compentent sediment
								ASH & SILT; black; non-plastic; wet; some organics.
	SP1	1'/5'				-16		Sandy CLAY; gray; low to high plasticity; moist; trace silt.
						-18		
						-20		
	SP2	1'/5'				-22		
						-24		SAND; brown; fine to medium grained; well graded; wet; trace silt.
						-26		Bottom of borings @ 25'
						-28		Boring advanced from atop a barge using a Geoprobe 6610DT and discrete macro-core tooling.
						-30		

BORING LOG

CABENO Environmental Field Services, LLC
More Than Just A Probing Company

CLIENT: Hard Hat Inc.

COORDINATES: *N NOT SURVEYED* *E NOT SURVEYED*

PROJECT: Alliant Energy Ottumwa, IA **BORING NO.:** *PB-11*

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Bob Solak*
DATE BEGAN: *06/22/16*
DATE FINISHED: *06/22/13*
GROUND SURFACE ELEVATION: *NOT MEASURED*

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS	PID GRAPH	DEPTH IN FEET	PROFILE	DESCRIPTION
						0		SURFACE WATER
						-2		
						-4		
						-6		
						-8		
						-10		
						-12		
						-14		@15' compentent sediment
								SILT; black; non-plastic; wet; some organics.
	SP1	3'/5'				-16		CLAY; gray grading to olive; low to high plasticity; moist; trace sand and organics.
						-18		
						-20		
						-22		@22' grades Sandy
	SP2	2.5'/5'				-24		SAND; brown; fine to coarse grained; well graded; wet; trace gravels.
						-26		Bottom of borings @ 25'
						-28		Boring advanced from atop a barge using a Geoprobe 6610DT and discrete macro-core tooling.
						-30		

BORING LOG

CABENO Environmental Field Services, LLC
More Than Just A Probing Company

CLIENT: Hard Hat Inc.

COORDINATES: *N NOT SURVEYED* *E NOT SURVEYED*

PROJECT: Alliant Energy Ottumwa, IA **BORING NO.:** ***PB-7***

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Bob Solak*
DATE BEGAN: *06/22/16*
DATE FINISHED: *06/22/13*
GROUND SURFACE ELEVATION: *NOT MEASURED*

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS	PID GRAPH	DEPTH IN FEET	PROFILE	DESCRIPTION
						0		SURFACE WATER
						-2		
						-4		
						-6		
						-8		
						-10		
						-12		
						-14		
						-16		
						-18		@20' compentent sediment
						-20		ASH & SILT; black; non-plastic; wet; some organics.
	SP1	5'/5'				-22		CLAY; brown grading dark gray; low to high plasticity; moist; trace gravel.
						-24		
						-26		Bottom of borings @ 25'
						-28		Boring advanced from atop a barge using a Geoprobe 6610DT and discrete macro-core tooling.
						-30		

BORING LOG

CABENO Environmental Field Services, LLC
More Than Just A Probing Company

CLIENT: Hard Hat Inc.

COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

PROJECT: Alliant Energy Ottumwa, IA **BORING NO.:** ***PB-6***

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Bob Solak*
DATE BEGAN: *06/22/16*
DATE FINISHED: *06/22/13*
GROUND SURFACE ELEVATION: *NOT MEASURED*

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS	PID GRAPH	DEPTH IN FEET	PROFILE	DESCRIPTION
						0		SURFACE WATER
						-2		
						-4		
						-6		
						-8		
						-10		
						-12		
						-14		@15' compentent sediment
						-16		ASH & SILT; black; non-plastic; wet; some organics.
	SP1	2.5'/5'				-18		CLAY; gray grading to olive; low to high plasticity; moist.
						-20		
	SP2	4'/5'				-22		
						-24		
						-26		Bottom of borings @ 25'
						-28		Boring advanced from atop a barge using a Geoprobe 6610DT and discrete macro-core tooling.
						-30		

BORING LOG

CABENO Environmental Field Services, LLC
More Than Just A Probing Company

CLIENT: Hard Hat Inc.

COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

PROJECT: Alliant Energy Ottumwa, IA **BORING NO.:** ***PB-14***

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Bob Solak*
DATE BEGAN: *06/21/16*
DATE FINISHED: *06/21/16*
GROUND SURFACE ELEVATION: *NOT MEASURED*

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS	PID GRAPH	DEPTH IN FEET	PROFILE	DESCRIPTION
						0		SURFACE WATER
						-2		
						-4		
						-6		
						-8		
						-10		
						-12		
						-14		@16' competent sediment
						-16		SILT; black; non-plastic; wet; some organics.
	SP1	4'/5'				-18		ASH; dark gray; fine grained; poorly graded; wet.
						-20		CLAY; gray; low to high plasticity; moist; trace sand and gravel.
	SP2	5'/5'				-22		
						-24		
						-26		Bottom of borings @ 25'
						-28		Boring advanced from atop a barge using a Geoprobe 6610DT and discrete macro-core tooling.
						-30		

BORING LOG

CABENO Environmental Field Services, LLC
More Than Just A Probing Company

CLIENT: Hard Hat Inc.

COORDINATES: *N NOT SURVEYED* *E NOT SURVEYED*

PROJECT: Alliant Energy Ottumwa, IA **BORING NO.:** ***PB-4***

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Bob Solak*
DATE BEGAN: *06/21/16*
DATE FINISHED: *06/21/16*
GROUND SURFACE ELEVATION: *NOT MEASURED*

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS	PID GRAPH	DEPTH IN FEET	PROFILE	DESCRIPTION
						0		SURFACE WATER
						-2		
						-4		
						-6		
						-8		
						-10		
						-12		
						-14		@15' competent sediment
	SP1	3'/5'				-16		CLAY; olive to reddish orange; low to high plasticity; moist; trace to some coal bits & ash.
						-18		
						-20		ASH; light gray; fine grained; poorly graded; wet.
	SP2	4'/5'				-22		
						-24		CLAY; tan; low to high plasticity; moist; trace sand.
						-26		Bottom of borings @ 25'
						-28		Boring advanced from atop a barge using a Geoprobe 6610DT and discrete macro-core tooling.
						-30		

BORING LOG

CABENO Environmental Field Services, LLC
More Than Just A Probing Company

CLIENT: Hard Hat Inc.

COORDINATES: *N NOT SURVEYED* *E NOT SURVEYED*

PROJECT: Alliant Energy Ottumwa, IA BORING NO.: ***PB-5***

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Bob Solak*
DATE BEGAN: *06/21/16*
DATE FINISHED: *06/21/16*
GROUND SURFACE ELEVATION: *NOT MEASURED*

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS	PID GRAPH	DEPTH IN FEET	PROFILE	DESCRIPTION
						0		SURFACE WATER
						-2		
						-4		
						-6		
						-8		
						-10		
						-12		
						-14		@16' competent sediment
						-16		SILT; black; non-plastic; wet; some organic matter.
	SP1	0.5'/5'				-18		ASH; tan to gray; fine grained; poorly graded; wet.
						-20		CLAY; olive to dark gray; low to high plasticity; moist; trace sand and plant matter.
	SP2	3.8'/5'				-22		
						-24		
						-26		
	SP3	2.5'/5'				-28		
						-30		Bottom of borings @ 30'
						-32		Boring advanced from atop a barge using a Geoprobe 6610DT and discrete macro-core tooling.
						-34		

BORING LOG

CABENO Environmental Field Services, LLC
More Than Just A Probing Company

CLIENT: Hard Hat Inc.

COORDINATES: *N NOT SURVEYED* *E NOT SURVEYED*

PROJECT: Alliant Energy Ottumwa, IA **BORING NO.:** ***PB-1***

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Bob Solak*
DATE BEGAN: *06/21/16*
DATE FINISHED: *06/21/16*
GROUND SURFACE ELEVATION: *NOT MEASURED*

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS	PID GRAPH	DEPTH IN FEET	PROFILE	DESCRIPTION
						0		SURFACE WATER
						-2		
						-4		
						-6		
						-8		@9' competent sediment
						-10		SILT; black; non-plastic; wet; some organic matter.
	SP1	3'/5'				-12		
						-14		
						-16		ASH; gray; fine grained; poorly graded; wet.
	SP2	3'/5'				-18		
						-20		CLAY; gray; low to high plasticity; moist; trace sand and plant matter.
	SP3	4'/5'				-22		
						-24		
						-26		Bottom of borings @ 25'
						-28		Boring advanced from atop a barge using a Geoprobe 6610DT and discrete macro-core tooling.
						-30		

BORING LOG

CABENO Environmental Field Services, LLC
More Than Just A Probing Company

CLIENT: Hard Hat Inc.

COORDINATES: *N NOT SURVEYED* *E NOT SURVEYED*

PROJECT: Alliant Energy Ottumwa, IA **BORING NO.:** ***PB-8***

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Bob Solak*
DATE BEGAN: *06/21/16*
DATE FINISHED: *06/21/16*
GROUND SURFACE ELEVATION: *NOT MEASURED*

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS	PID GRAPH	DEPTH IN FEET	PROFILE	DESCRIPTION
						0		SURFACE WATER
						-2		
						-4		
						-6		
						-8		
						-10		@ 12' competent sediment
	SP1	2.5'/5'				-12		SILT; black; non-plastic; wet; some organic matter.
						-14		ASH; black to gray; fine grained; poorly graded; wet.
	SP2	4'/5'				-16		
						-18		
						-20		CLAY; black to gray; low to high plasticity; moist; trace sand and plant matter.
	SP3	2'/5'				-22		
						-24		
						-26		Bottom of borings @ 25'
						-28		Boring advanced from atop a barge using a Geoprobe 6610DT and discrete macro-core tooling.
						-30		

BORING LOG

CABENO Environmental Field Services, LLC
More Than Just A Probing Company

CLIENT: Hard Hat Inc.

COORDINATES: N NOT SURVEYED
E NOT SURVEYED

PROJECT: Alliant Energy Ottumwa, IA **BORING NO.:** *PB-12*

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Bob Solak*
DATE BEGAN: *06/21/16*
DATE FINISHED: *06/21/16*
GROUND SURFACE ELEVATION: *NOT MEASURED*

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS	PID GRAPH	DEPTH IN FEET	PROFILE	DESCRIPTION
						0		SURFACE WATER
						-2		
						-4		
						-6		
						-8		
						-10		@ 10' competent sediment
						-12		SILT; black; non-plastic; wet; some organic matter.
	SP1	2.5'/5'				-14		ASH; black to gray; fine grained; poorly graded; wet.
						-16		CLAY; black to gray; low to high plasticity; moist; trace sand and plant matter.
	SP2	4'/5'				-18		
						-20		@21' grades Sandy CLAY
	SP3	4'/5'				-22		
						-24		
						-26		Bottom of borings @ 25'
						-28		Boring advanced from atop a barge using a Geoprobe 6610DT and discrete macro-core tooling.
						-30		

BORING LOG

CABENO Environmental Field Services, LLC
More Than Just A Probing Company

CLIENT: Hard Hat Inc.

COORDINATES: *N NOT SURVEYED* *E NOT SURVEYED*

PROJECT: Alliant Energy Ottumwa, IA **BORING NO.:** ***PB-9***

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Bob Solak*
DATE BEGAN: *06/21/16*
DATE FINISHED: *06/21/16*
GROUND SURFACE ELEVATION: *NOT MEASURED*

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS	PID GRAPH	DEPTH IN FEET	PROFILE	DESCRIPTION
						0		SURFACE WATER
						-2		
						-4		
						-6		
						-8		
						-10		
						-12		
						-14		@ 16' competent sediment
						-16		SILT; black; non-plastic; wet; some organic matter.
	SP1	1'/5'				-18		CLAY; gray to olive; low to high plasticity; moist; trace sand.
						-20		@ 20.5' is a 4" piece of wood, no soil recovery after wood to 25'.
	SP2	0'/5'				-22		
						-24		
						-26		SAND; brown; fine grained; poorly graded; wet; trace stil.
	SP3	1'/5'				-28		
						-30		Bottom of borings @ 30'
						-32		Boring advanced from atop a barge using a Geoprobe 6610DT and discrete macro-core tooling.
						-34		

BORING LOG

CABENO Environmental Field Services, LLC
More Than Just A Probing Company

CLIENT: Hard Hat Inc.

COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

PROJECT: Alliant Energy Ottumwa, IA **BORING NO.:** ***PB-2***

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Bob Solak*
DATE BEGAN: *06/21/16*
DATE FINISHED: *06/21/16*
GROUND SURFACE ELEVATION: *NOT MEASURED*

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS	PID GRAPH	DEPTH IN FEET	PROFILE	DESCRIPTION
						0		SURFACE WATER
						-2		
						-4		
						-6		
						-8		
						-10		
						-12		
						-14		
						-16		
	SP1	0.5'/5'				-18		@ 18' competent sediment
						-20		SILT; black; non-plastic; wet; some organic matter.
						-22		CLAY; gray to olive; low to high plasticity; moist; trace sand.
	SP2	4'/5'				-24		
						-26		Bottom of borings @ 25'
						-28		Boring advanced from atop a barge using a Geoprobe 6610DT and discrete macro-core tooling.
						-30		

BORING LOG

CABENO Environmental Field Services, LLC
More Than Just A Probing Company

CLIENT: Hard Hat Inc.

COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

PROJECT: Alliant Energy Ottumwa, IA **BORING NO.:** ***PB-3***

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Bob Solak*
DATE BEGAN: *06/21/16*
DATE FINISHED: *06/21/16*
GROUND SURFACE ELEVATION: *NOT MEASURED*

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS	PID GRAPH	DEPTH IN FEET	PROFILE	DESCRIPTION
						0		SURFACE WATER
						-2		
						-4		
						-6		
						-8		
						-10		
						-12		
						-14		@ 16' competent sediment
						-16		SILT; black; non-plastic; wet; some organic matter.
	SP1	2.5'/5'				-18		CLAY; light brown to olive; low to high plasticity; moist.
	SP2	3'/5'				-20		
						-22		
						-24		
						-26		Bottom of borings @ 25'
						-28		Boring advanced from atop a barge using a Geoprobe 6610DT and discrete macro-core tooling.
						-30		

BORING LOG

CABENO Environmental Field Services, LLC
More Than Just A Probing Company

CLIENT: Hard Hat Inc.

COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

PROJECT: Alliant Energy Ottumwa, IA **BORING NO.:** ***PB-13***

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Bob Solak*
DATE BEGAN: *06/21/16*
DATE FINISHED: *06/21/16*
GROUND SURFACE ELEVATION: *NOT MEASURED*

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS	PID GRAPH	DEPTH IN FEET	PROFILE	DESCRIPTION
						0		SURFACE WATER
						-2		
						-4		
						-6		
						-8		
						-10		
						-12		
						-14		@ 14' competent sediment
	SP1	3'/5'				-16		CLAY; brown to olive; low to high plasticity; moist; trace sand and silt.
						-18		
						-20		
	SP2	3.5'/5'				-22		
						-24		@ 24' grades Sandy CLAY
						-26		Bottom of borings @ 25'
						-28		Boring advanced from atop a barge using a Geoprobe 6610DT and discrete macro-core tooling.
						-30		

BORING LOG

CABENO Environmental Field Services, LLC
More Than Just A Probing Company

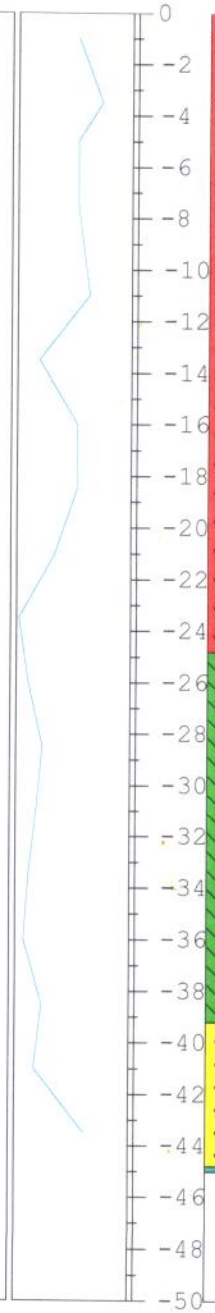
CLIENT: Hard Hat Inc.

COORDINATES: *N NOT SURVEYED* *E NOT SURVEYED*

PROJECT: Alliant Energy Ottumwa, IA **BORING NO.:** *SB1*

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Bob Solak*
DATE BEGAN: *04/27/16*
DATE FINISHED: *04/27/16*
GROUND SURFACE ELEVATION: *NOT MEASURED*

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS
	SS1	3"/18"	20/>50	>50
	SS2	5"/18"	10/20/>50	>70
	SS3	3"/18"	15/>50	>50
	SS4	4"/18"	17/>50	>50
	SS5	6"/18"	10/10/>50	>60
	SS6	6"/18"	7/4/14	18
	SS7	3"/18"	20/>50	>50
	SS8	3"/18"	20/>50	>50
	SS9	18"/18"	8/17/15	32
	SS10	3"/18"	6/1/1	2
	SS11	10"/18"	2/4/6	10
	SS12	10"/18"	6/8/14	22
	SS13	12"/18"	6/7/10	17
	SS14	16"/18"	3/3/8	11
	SS15	14"/18"	2/3/4	7
⊠	SS16	14"/18"	3/7/15	22
	SS17	18"/18"	7/7/7	16
	SS18	12"/18"	4/8/>50	>58



PID GRAPH	DEPTH IN FEET	PROFILE	DESCRIPTION
	0		
	-2		ASH; yellowish brown; fine grained; poorly graded; dry to moist.
	-4		
	-6		
	-8		
	-10		
	-12		
	-14		@14' is an 8" coal seam, fine to coarse grained.
	-16		
	-18		
	-20		
	-22		
	-24		
	-26		CLAY; dark gray; low plasticity; moist; some coal.
	-28		
	-30		@29.5' coal grades out
	-32		@31' grades trace organic plant matter
	-34		@33.5' grades bright green
	-36		@36' grades light gray
	-38		
	-40		SAND; brown; fine to coarse grained; well graded; wet; trace to some silt and clay.
	-42		
	-44		LIMESTONE; light gray; weathered; fine grained to finely crystalline.
	-46		Bottom of boring at 45'. Boring backfilled w/ soil cuttings to ground surface on 4/27/16.
	-48		
	-50		

BORING LOG

CABENO Environmental Field Services, LLC
More Than Just A Probing Company

CLIENT: Hard Hat Inc.

COORDINATES: *N NOT SURVEYED* *E NOT SURVEYED*

PROJECT: Alliant Energy Ottumwa, IA **BORING NO.:** *SB2*

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Bob Solak*
DATE BEGAN: *04/26/16*
DATE FINISHED: *04/27/16*
GROUND SURFACE ELEVATION: *NOT MEASURED*

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS	PID GRAPH	DEPTH IN FEET	PROFILE	DESCRIPTION
∇	SS1	4"/18"	9/8/>50	>58		0		ASH; yellowish brown; fine grained; poorly graded; dry to moist.
	SS2	4"/18"	8/20/>50	>70		-2		
	SS3	12"/18'	8/10/9	19		-4		
	SS4	14"/18'	8/11/12	23		-6		
	SS5	14"/18'	2/2/3	5		-8		
	SS6	12"/18'	2/3/8	11		-10		
	SS7	16"/18'	4/5/8	13		-12		
	SS8	12"/18'	4/2/1	3		-14		
	SS9	18"/18'	1/1/1	2		-16		
	SS10	18"/18'	11/4/2	6		-18		
	SS11	18"/18'	1/1/0	1		-20		COAL; black; fine to coarse grained; well graded; moist; trace clay.
	SS12	18"/18'	1/1/1	2		-22		ASH; yellow brown; fine grained; poorly graded; wet.
	SS13	18"/18'	8/7/4	11		-24		
	SS14	14"/18'	2/2/3	5		-26		
	SS15	12"/18'	2/3/4	7		-28		
	SS16	14"/18'	2/2/3	5		-30		
	SS17	12"/18'	2/3/3	6		-32		@32' grades light gray
	SS18	6"/18"	5/3/>50	>53		-34		CLAY; dark gray; low plasticity; moist; trace organic plant matter.
						-36		
						-38		
						-40		
						-42		
						-44		LIMESTONE; light gray; weathered; fine grained to finely crystalline.
						-46		Bottom of boring at 45'. Boring backfilled w/ soil cuttings to ground surface on 4/27/16.
						-48		
						-50		

BORING LOG

CABENO Environmental Field Services, LLC
More Than Just A Probing Company

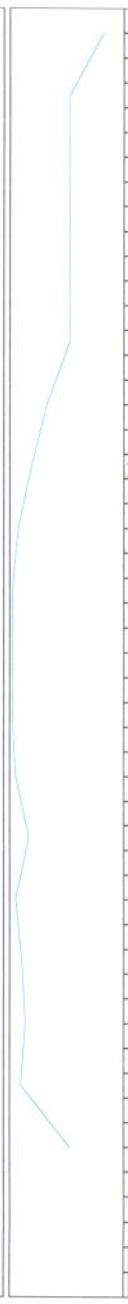
CLIENT: Hard Hat Inc.

COORDINATES: *N NOT SURVEYED* *E NOT SURVEYED*

PROJECT: Alliant Energy Ottumwa, IA **BORING NO.:** *SB3*

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Bob Solak*
DATE BEGAN: *04/26/16*
DATE FINISHED: *04/26/16*
GROUND SURFACE ELEVATION: *NOT MEASURED*

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS
N	SS1	10"/18"	27/28/>50	>78
	SS2	4"/18"	9/>50	>50
	SS3	3"/18"	15/>50	>50
	SS4	3"/18"	15/>50	>50
	SS5	2"/18"	30/>50	>50
	SS6	4"/18"	17/>50	>50
	SS7	10"/18"	9/16/15	31
	SS8	8"/18"	8/8/10	18
	SS9	8"/18"	2/3/4	7
	SS10	10"/18"	2/1/1	2
	SS11	12"/18"	1/1/1	2
	SS12	12"/18"	1/1/1	2
	SS13	18"/18"	1/2/3	5
	SS14	18"/18"	7/8/8	16
	SS15	16"/18"	1/2/3	5
	SS16	16"/18"	2/4/6	10
	SS18	16"/18"	3/4/9	13
	SS19	18"/18"	4/6/3	9
	SS20	16"/18"	2/5/>50	>50



DEPTH IN FEET	PROFILE	DESCRIPTION
0		
-2		
-4		
-6		ASH; yellowish brown; fine grained; dry. @6' lost shoe on split sppon
-8		
-10		
-12		
-14		
-16		
-18		COAL; black; fine to coarse; well graded; dry.
-20		ASH; yellowish brown; fine grained; dry. @21' is a 3" coal seam
-22		
-24		
-26		CLAY; olive gray to brown; low to high plsaticity; moist; some coal & bottom ash.
-28		@28.5' grades trace coal & bottom ash
-30		@30' coal & bottom ash grade out
-32		
-34		SAND;olive to brown; fine grained; poorly graded; wet; trace to some clay.
-36		
-38		CLAY; gray mottled w/ brown; low to high plasticity; moist.
-40		
-42		SAND; brown; fine grained; poorly graded; wet; trace silt & clay.
-44		
-46		LIMESTONE; light gray; weathered; fine grained to finely crystalline.
-48		
-50		Bottom of boring at 47.5'. Boring backfilled w/ soil cuttings to ground surface on 4/26/16.
-52		

BORING LOG

CABENO Environmental Field Services, LLC
More Than Just A Probing Company

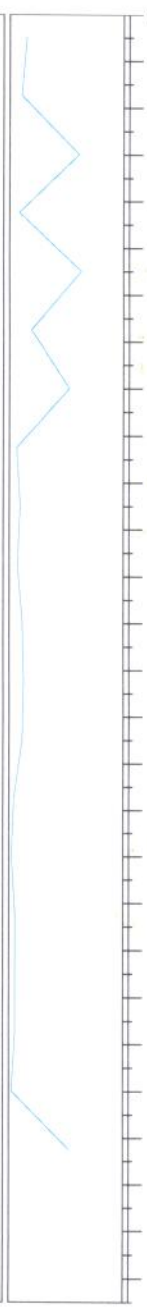
CLIENT: Hard Hat Inc.

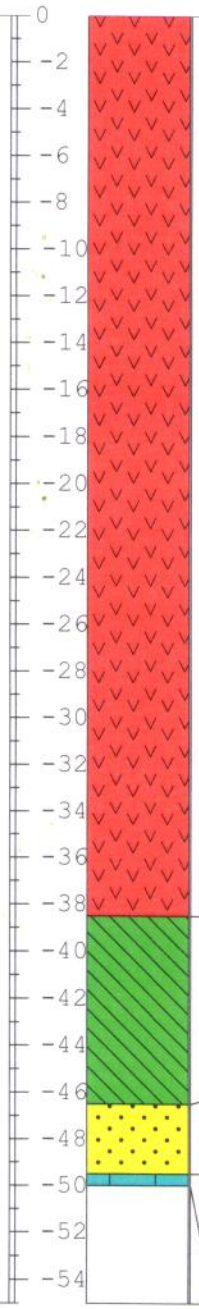
COORDINATES: *N NOT SURVEYED* *E NOT SURVEYED*

PROJECT: Alliant Energy Ottumwa, IA **BORING NO.:** ***SB4***

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Bob Solak*
DATE BEGAN: *04/26/16*
DATE FINISHED: *04/26/16*
GROUND SURFACE ELEVATION: *NOT MEASURED*

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS
	SS1	14"/18"	8/10/4	14
	SS2	8"/18"	5/3/7	10
	SS3	4"/18"	8/8/>50	>58
	SS4	4"/18"	5/6/2	8
	SS5	10"/18"	8/10/>50	>60
	SS6	10"/18"	6/10/8	18
	SS7	3"/18"	13/>50	>50
	SS8	10"/18"	7/4/2	6
	SS9	14"/18"	13/4/5	9
	SS10	18"/18"	2/3/4	7
	SS11	18"/18"	2/7/4	11
	SS12	12"/18"	7/5/7	12
	SS13	12"/18"	2/4/7	11
	SS14	18"/18"	4/2/2	4
	SS15	14"/18"	2/1/1	2
	SS16	16"/18"	2/2/3	5
	SS18	16"/18"	2/2/3	5
	SS19	18"/18"	2/2/3	5
∇	SS20	16"/18"	2/1/1	2
	SS21	18"/18"	2/>50	>50





DESCRIPTION
ASH; yellowish brown; fine grained; dry.
@31 grading light gray to white.
CLAY; gray; low to high plasticity; moist.
SAND; brown: fine grained; poorly graded; wet; trace silt.
LIMESTONE; light gray; weathered; fine grained Bottom of boring at 48.5'. Boring backfilled w/ soil cuttings to ground surface on 4/26/16.

BORING LOG

CABENO Environmental Field Services, LLC
More Than Just A Probing Company

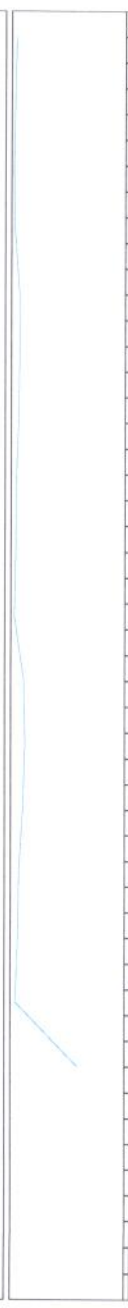
CLIENT: Hard Hat Inc.

COORDINATES: *N NOT SURVEYED* *E NOT SURVEYED*

PROJECT: Alliant Energy Ottumwa, IA **BORING NO.:** ***SB5***

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Bob Solak*
DATE BEGAN: *04/25/16*
DATE FINISHED: *04/25/16*
GROUND SURFACE ELEVATION: *NOT MEASURED*

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS
	SS1	14"/18"	4/3/1	4
	SS2	6"/18"	3/2/1	3
	SS3	12"/18"	3/1/1	2
	SS4	10"/18"	2/2/1	3
	SS5	14"/18"	2/4/3	7
	SS6	10"/18"	2/3/4	7
	SS7	12"/18"	4/3/3	6
	SS8	10"/18"	1/2/2	4
	SS9	16"/18"	2/2/2	4
	SS10	16"/18"	1/1/2	3
	SS11	16"/18"	1/5/6	11
	SS12	16"/18"	2/5/7	12
	SS13	16"/18"	2/4/6	10
	SS14	16"/18"	1/3/4	7
	SS15	16"/18"	2/3/3	6
	SS16	16"/18"	2/2/2	4
∇	SS18	6"/18"	3/6/>50	>56



DEPTH IN FEET	PROFILE	DESCRIPTION
0 to -12		ASH; yellowish brown; fine grained; moist.
-12 to -14		COAL; black; fine to coarse grained; well graded; dry.
-14 to -42		CLAY; gray; low plasticity; moist; trace sand.
-20		@19'grades brown
-26		@26' grades SiltyCLAY
-42 to -44		LIMESTONE; light gray; weathered; fine grained to finely crystalline.
-44 to -50		Bottom of boring at 44.5'. Boring backfilled w/ soil cuttings to ground surface on 4/25/16.

BORING LOG

CABENO Environmental Field Services, LLC
More Than Just A Probing Company

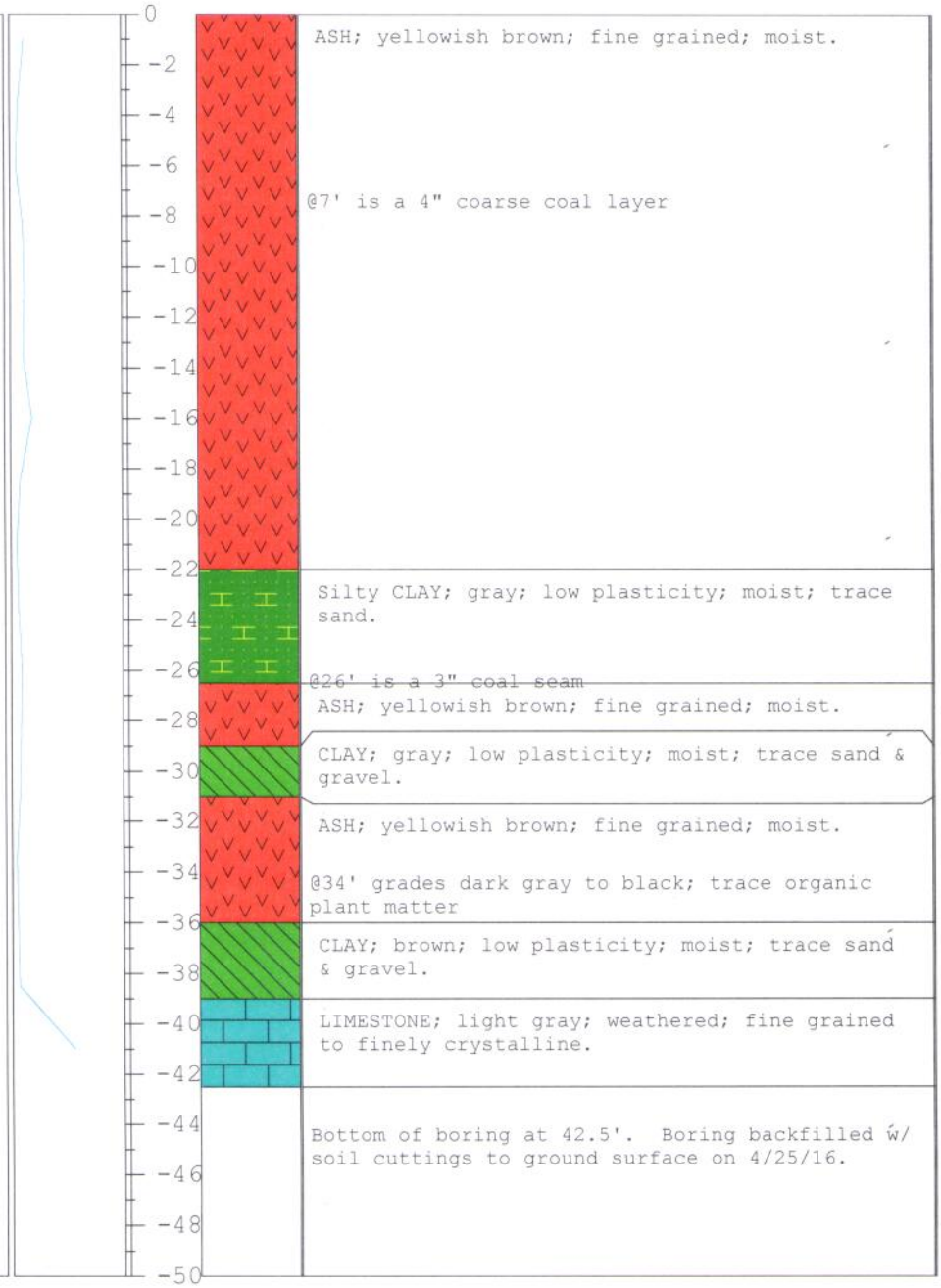
CLIENT: Hard Hat Inc.

COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

PROJECT: Alliant Energy Ottumwa, IA **BORING NO.:** *SB6*

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Bob Solak*
DATE BEGAN: *04/25/16*
DATE FINISHED: *04/25/16*
GROUND SURFACE ELEVATION: *NOT MEASURED*

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS
∇	SS1	9"/18"	5/5/7	12
	SS2	4"/18"	3/3/4	7
	SS3	8"/18"	2/2/3	5
	SS4	8"/18"	3/4/7	11
	SS5	6"/18"	3/5/7	12
	SS6	6"/18"	3/5/6	11
	SS7	6"/18"	5/10/8	18
	SS8	6"/18"	7/3/5	8
	SS9	12"/18"	4/2/3	5
	SS10	4"/18"	5/3/3	6
	SS11	12"/18"	5/4/5	9
	SS12	12"/18"	6/6/2	8
	SS13	12"/18"	3/3/4	7
	SS14	14"/18"	2/2/2	4
	SS15	12"/18"	2/2/3	5
	SS16	14"/18"	2/3/3	6
	SS18	6"/18"	3/3/>50	>53



DEPTH IN FEET	PROFILE	DESCRIPTION
0 to -22		ASH; yellowish brown; fine grained; moist. @7' is a 4" coarse coal layer
-22 to -26		Silty CLAY; gray; low plasticity; moist; trace sand. @26' is a 3" coal seam
-26 to -30		ASH; yellowish brown; fine grained; moist.
-30 to -32		CLAY; gray; low plasticity; moist; trace sand & gravel.
-32 to -36		ASH; yellowish brown; fine grained; moist. @34' grades dark gray to black; trace organic plant matter
-36 to -40		CLAY; brown; low plasticity; moist; trace sand & gravel.
-40 to -42		LIMESTONE; light gray; weathered; fine grained to finely crystalline.
-42 to -50		Bottom of boring at 42.5'. Boring backfilled w/ soil cuttings to ground surface on 4/25/16.

BORING LOG

CABENO Environmental Field Services, LLC
More Than Just A Probing Company

CLIENT: Hard Hat Inc.

COORDINATES: *N NOT SURVEYED* *E NOT SURVEYED*

PROJECT: Alliant Energy Ottumwa, IA **BORING NO.:** *SB7*

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Bob Solak*
DATE BEGAN: *04/27/16*
DATE FINISHED: *04/27/16*
GROUND SURFACE ELEVATION: *NOT MEASURED*

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS	PID GRAPH	DEPTH IN FEET	PROFILE	DESCRIPTION
	SS1	10"/18"	3/4/5	9		0		CLAY; brown; low plasticity; moist; trace silt; plant matter & coal pieces.
	SS2	10"/18"	3/3/3	6		-2		
	SS3	14"/18"	1/2/2	4		-4		
	SS4	10"/18"	1/1/3	4		-6		@6' plant material and coal grade out
	SS5	12"/18"	2/2/4	6		-8		
	SS6	12"/18"	2/4/5	9		-10		
	SS7	12"/18"	2/3/4	6		-12		
	SS8	12"/18"	2/3/3	6		-14		@13.5' grades trace sand & gravel
	SS9	10"/18"	1/4/3	7		-16		@16' grades reddish brown
⊠	SS10	18"/18"	1/1/2	3		-18		
	SS11	4"/12"	20/>50	>70		-20		
						-22		SAND; orange; fine grained; poorly graded; moist; trace silt.
						-24		@23.5' grades wet
						-26		LIMESTONE; light gray; weathered; fine grained to finely crystalline.
						-28		Bottom of boring at 26.5'. Boring backfilled w/ soil cuttings to ground surface on 4/27/16.
						-30		

BORING LOG

CABENO Environmental Field Services, LLC
More Than Just A Probing Company

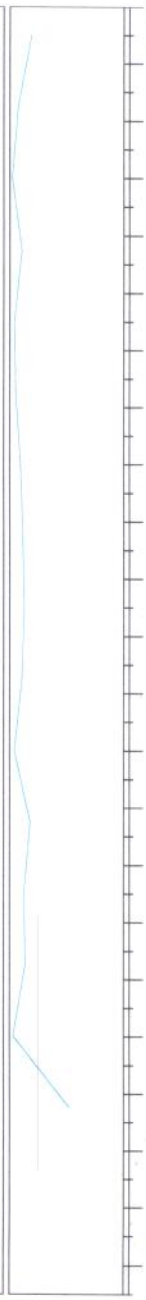
CLIENT: Hard Hat Inc.

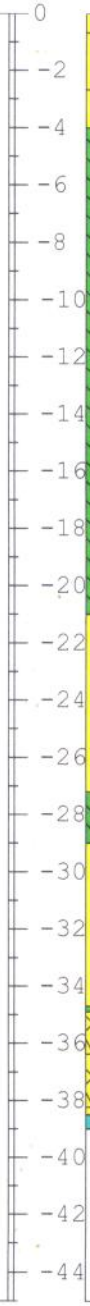
COORDINATES: *N NOT SURVEYED* *E NOT SURVEYED*

PROJECT: Alliant Energy Ottumwa, IA **BORING NO.:** ***SB8***

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Bob Solak*
DATE BEGAN: *04/27/16*
DATE FINISHED: *04/27/16*
GROUND SURFACE ELEVATION: *NOT MEASURED*

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS
N	SS1	6"/18"	5/9/9	18
	SS2	10"/18"	3/4/3	7
	SS3	10"/18"	1/1/1	2
	SS4	10"/18"	3/4/6	10
	SS5	12"/18"	2/2/2	4
	SS6	10"/18"	2/2/3	5
	SS7	16"/18"	2/3/6	9
	SS8	12"/18"	2/4/7	11
	SS9	18"/18"	2/4/8	12
	SS10	18"/18"	2/4/6	10
	SS11	12"/18"	2/1/3	4
	SS12	12"/18"	5/7/10	17
	SS13	18"/18"	3/6/6	12
	SS14	18"/18"	5/7/6	13
	SS15	3"/18"	1/1/2	3
	SS16	6"/18"	20/>50	>50





DEPTH IN FEET	PROFILE	DESCRIPTION
0 – -4		SandySILT; brown; non-plastic; moist; trace to some gravel & coalbits.
-4 – -20		CLAY; brown; low plasticity; moist; trace sand & gravel. @6' grades gray @18.5' grades SiltyCLAY.
-20 – -28		SAND; brown; fine grained; poorly graded; wet; trace silt.
-28 – -30		CLAY; gray; high plasticity; moist.
-30 – -34		SAND; brown; medium grained; poorly graded; wet; trace silt.
-34 – -36		CLAY; gray; high plasticity; moist.
-36 – -38		GRAVEL; brown; rounded to sub-rounded; wet; trace to some silt & sand.
-38 – -40		LIMESTONE; light gray; weathered; fine grained to finely crystalline.
-40 – -44		Bottom of boring at 40'. Boring backfilled w/ soil cuttings to ground surface on 4/27/16.

BORING LOG

CABENO Environmental Field Services, LLC
More Than Just A Probing Company

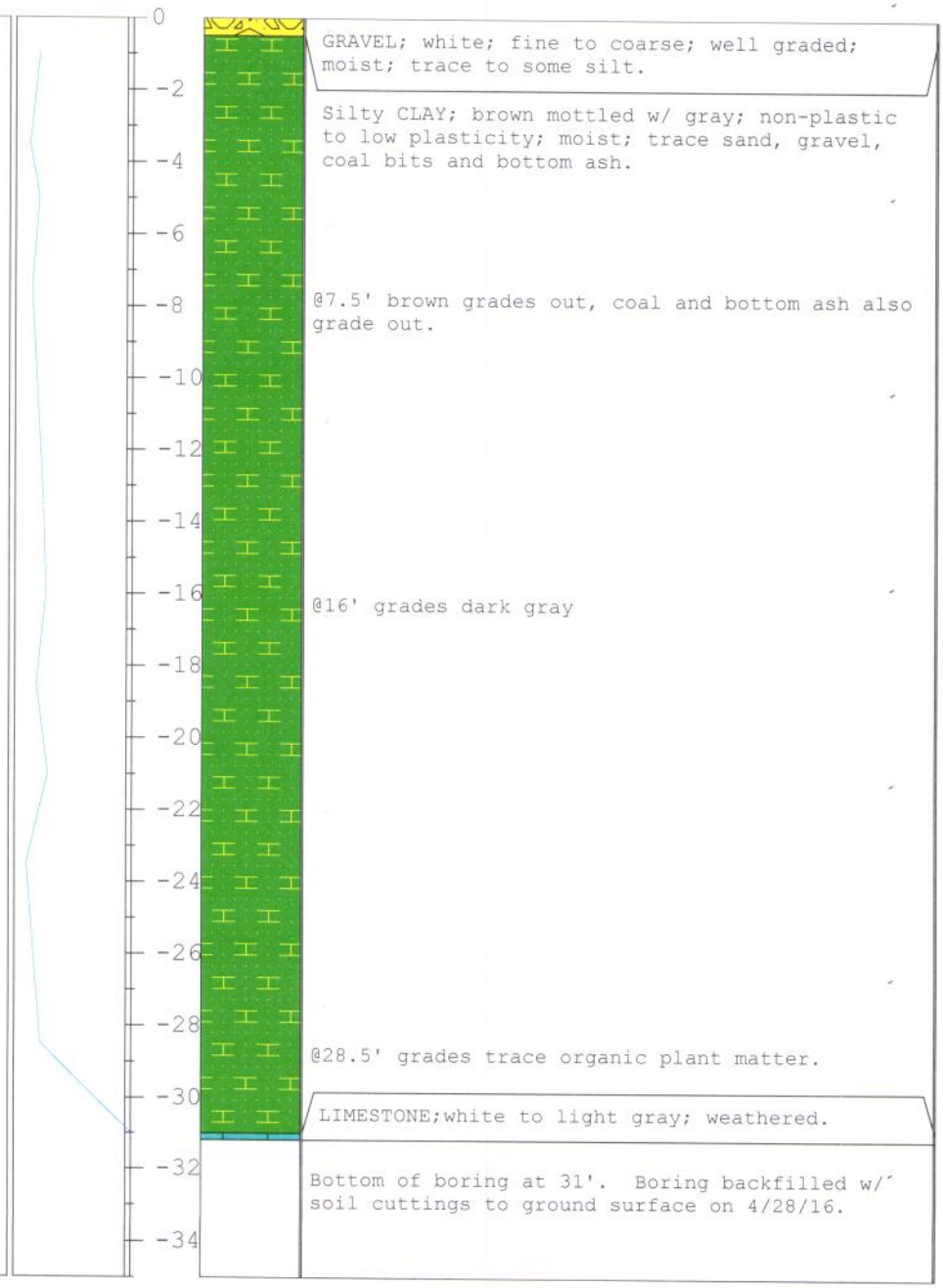
CLIENT: Hard Hat Inc.

COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

PROJECT: Alliant Energy Ottumwa, IA BORING NO.: *SB9*

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Bob Solak*
DATE BEGAN: *04/28/16*
DATE FINISHED: *04/28/16*
GROUND SURFACE ELEVATION: *NOT MEASURED*

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS
	SS1	6"/18"	5/4/6	10
	SS2	8"/18"	3/3/3	6
	SS3	8"/18"	3/4/6	10
	SS4	6"/18"	2/3/4	7
	SS5	10"/18"	3/3/7	10
	SS6	10"/10"	3/4/8	12
	SS7	12"/12"	3/5/8	13
	SS8	12"/12"	3/4/5	9
	SS9	12"/12"	3/4/10	14
	SS10	12"/12"	3/2/3	5
	SS11	12"/12"	2/2/6	8
	SS12	12"/12"	3/5/6	11
	SS13	2"/18"	>50	50



DESCRIPTION

GRAVEL; white; fine to coarse; well graded; moist; trace to some silt.

Silty CLAY; brown mottled w/ gray; non-plastic to low plasticity; moist; trace sand, gravel, coal bits and bottom ash.

@7.5' brown grades out, coal and bottom ash also grade out.

@16' grades dark gray

@28.5' grades trace organic plant matter.

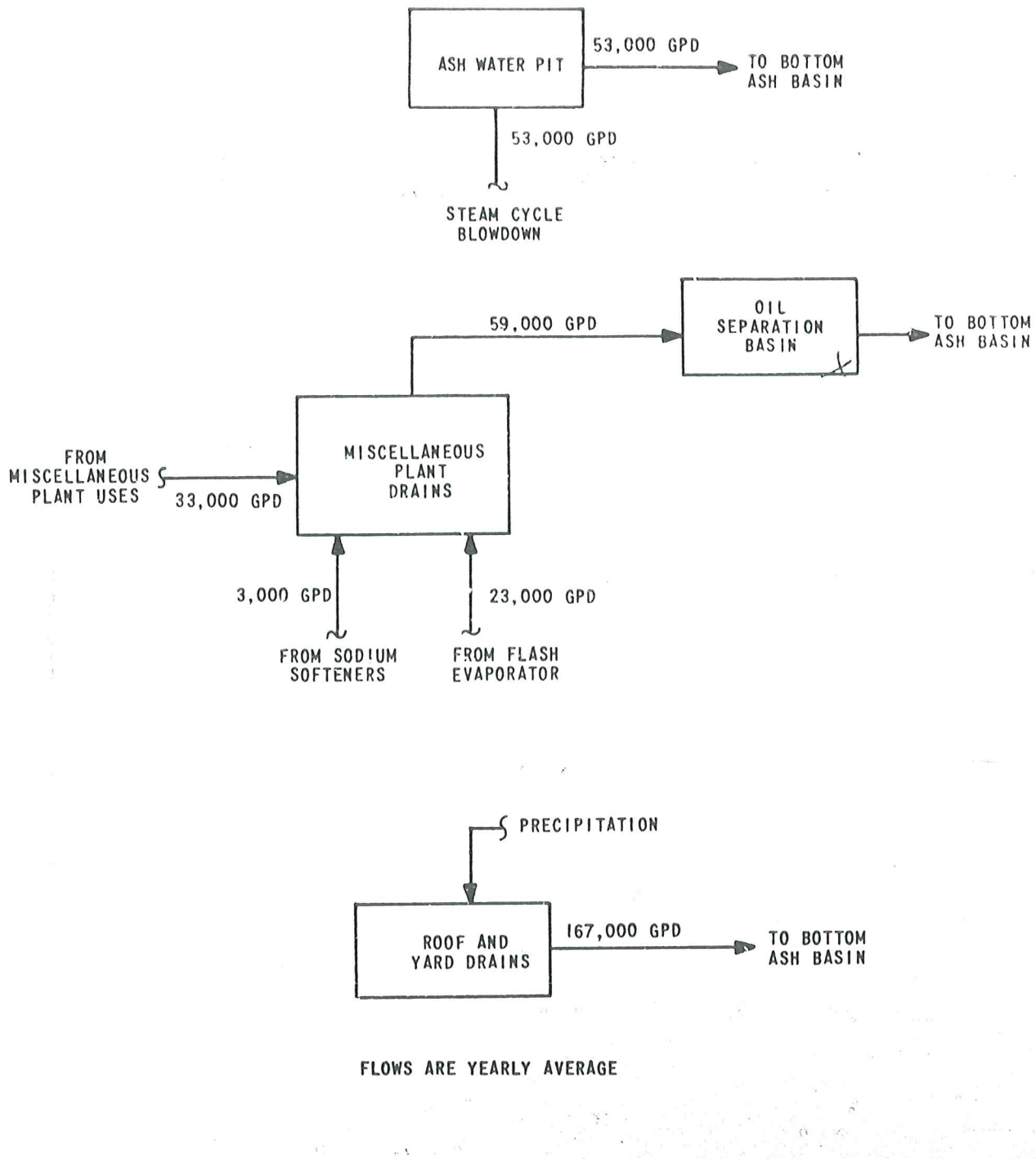
LIMESTONE;white to light gray; weathered.

Bottom of boring at 31'. Boring backfilled w/ soil cuttings to ground surface on 4/28/16.

APPENDIX F – OGS CCR Surface Impoundment Drawings

Alliant Energy
Interstate Power and Light Company
Ottumwa Generating Station
Ottumwa, Iowa

History of Construction

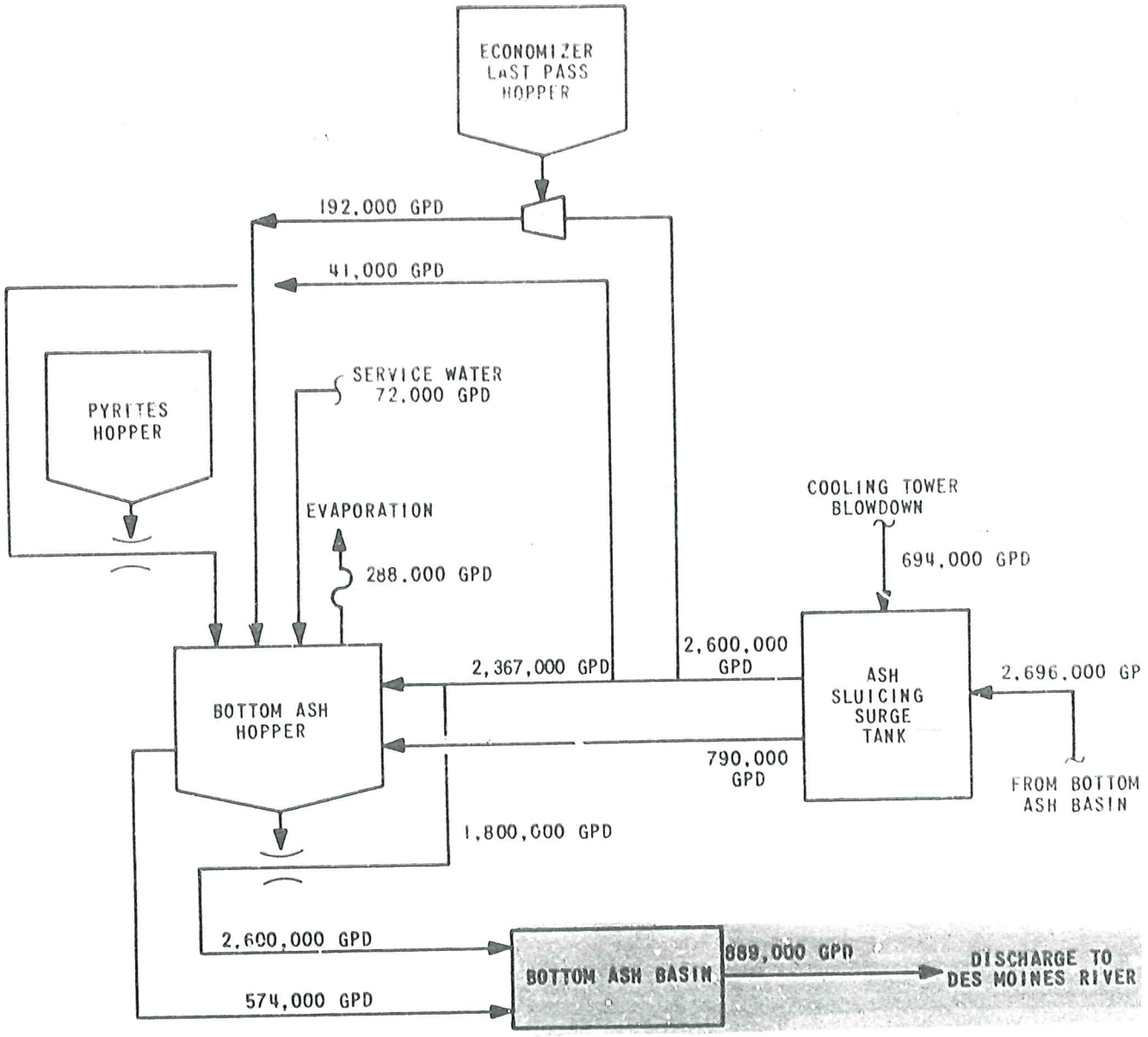


FLOWS ARE YEARLY AVERAGE

FLANT DRAIN SYSTEM

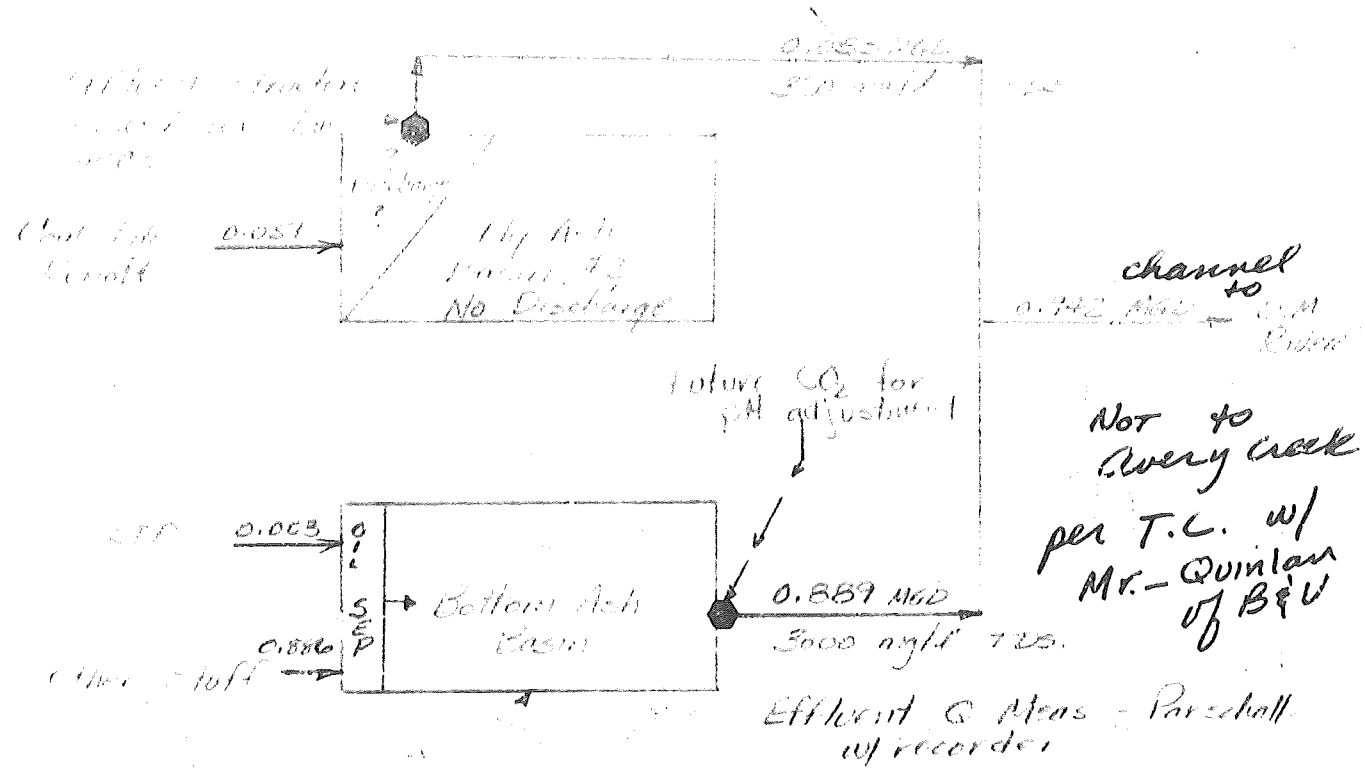
OGS-1-7/28/76

FIGURE 7.02E-1



ALL FLOWS ARE ANNUAL AVERAGES BASED ON UNIT AT 100 PER CENT LOAD FACTOR.

BOTTOM ASH SYSTEM



KR tracks act as embankment for ponds.

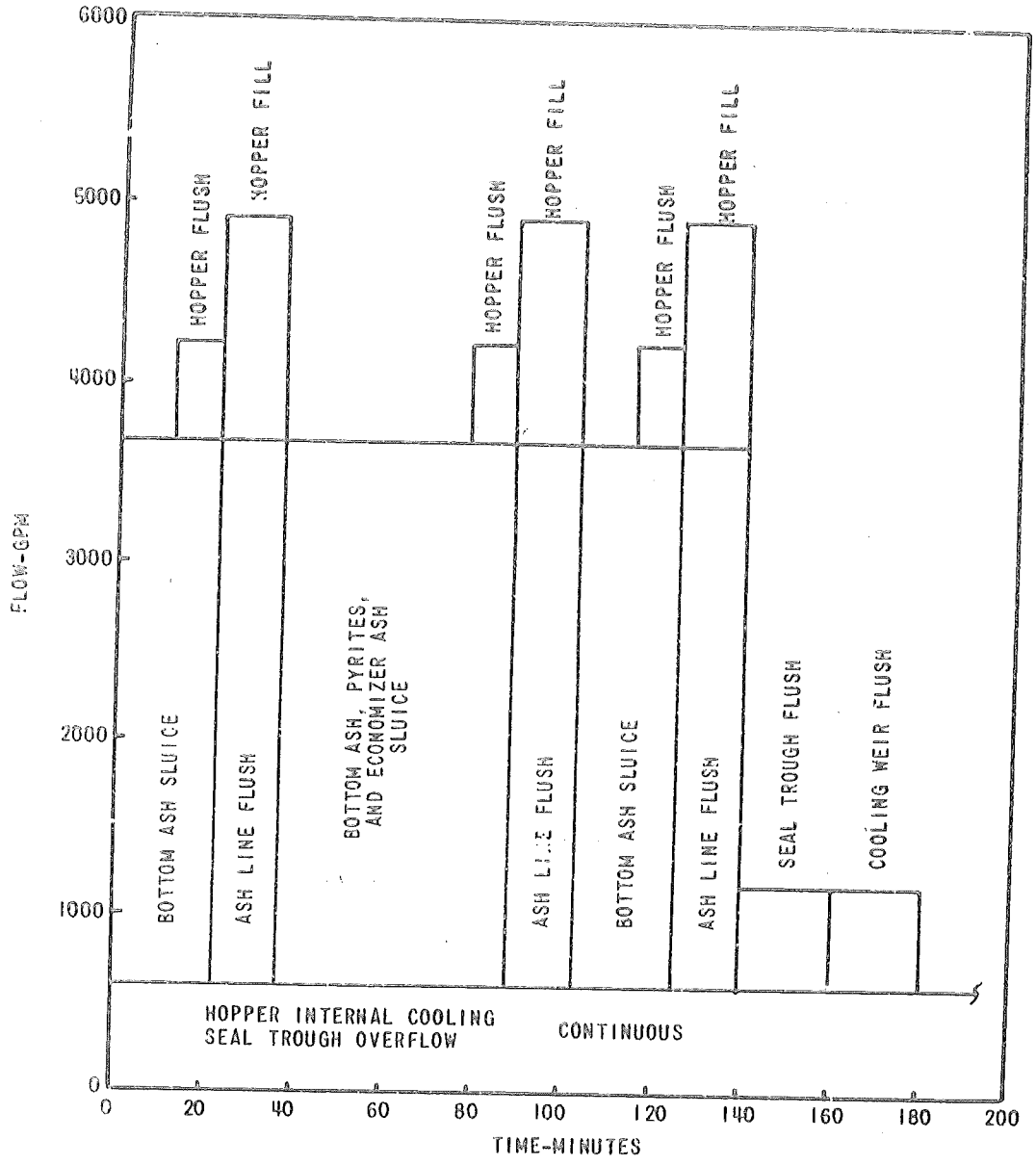
Refer to 9/17/76 submittal in PER notes for process descriptions.

CONSTRUCTION PERMIT EFFLUENT LIMITATIONS:

		AVG	1-day MAX
**	TSS	30 mg/l	100 mg/l
**	Oil & Grease	15 mg/l	20 mg/l
**	pH	6.0 - 9.0	
	TEMP	(not to violate stds of Des Moines River)	

** Taken from 40CFR423.15 (pp473-476)
Steam Electric Power Generating Po-nt Sources -
Standards of Performance for New Point Sources

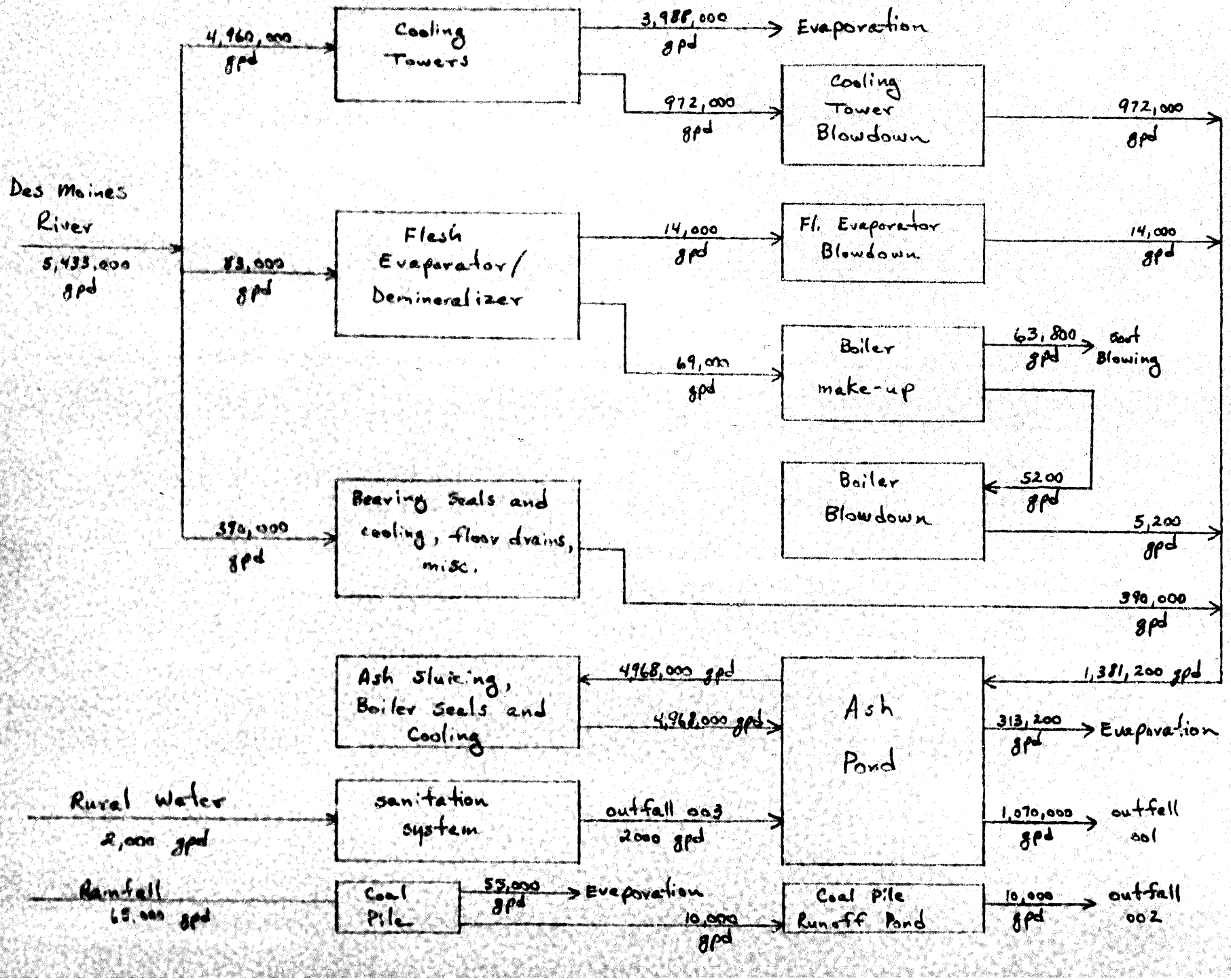
1984

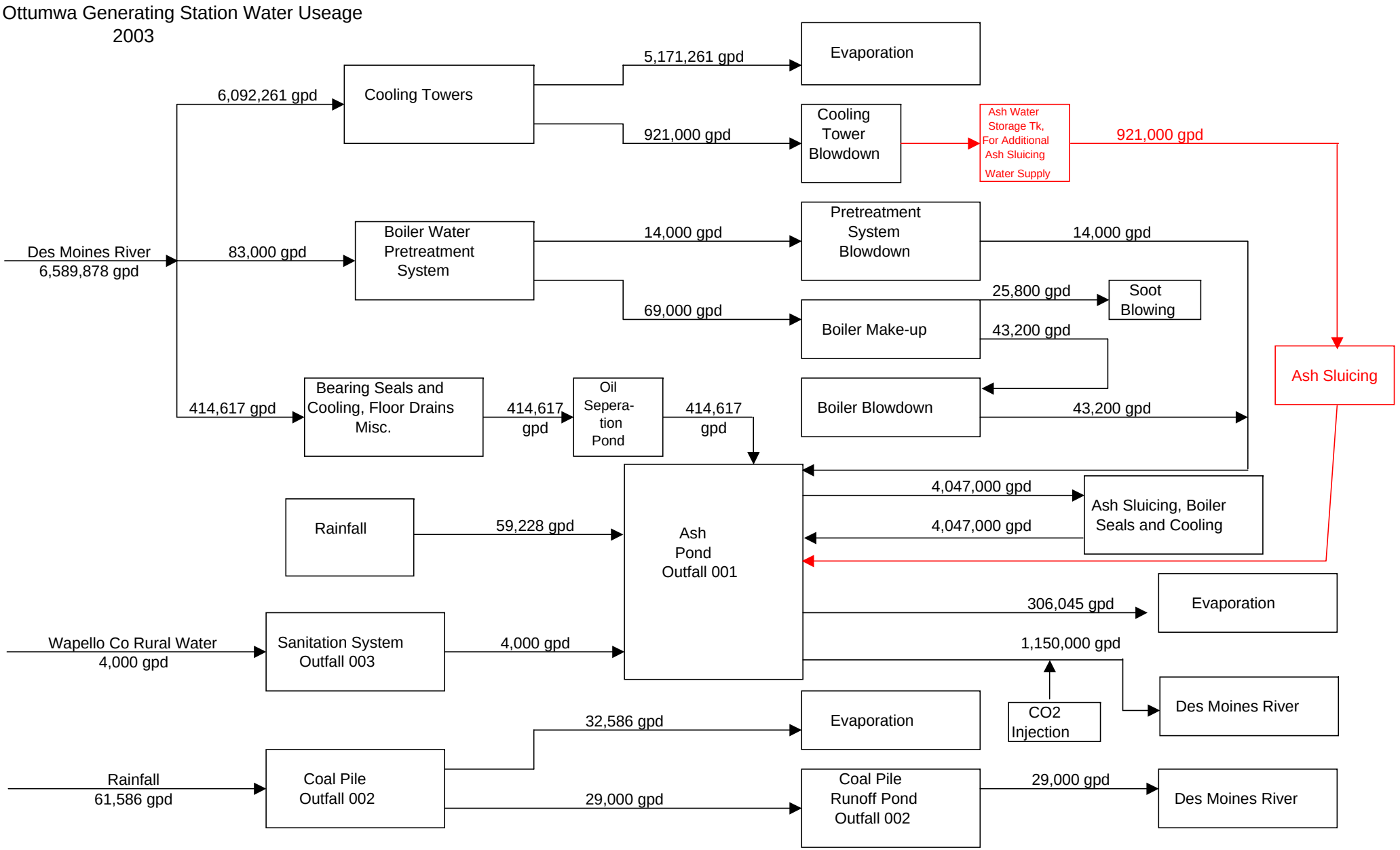


ASH HANDLING SYSTEM WATER REQUIREMENTS
100 PERCENT LOAD

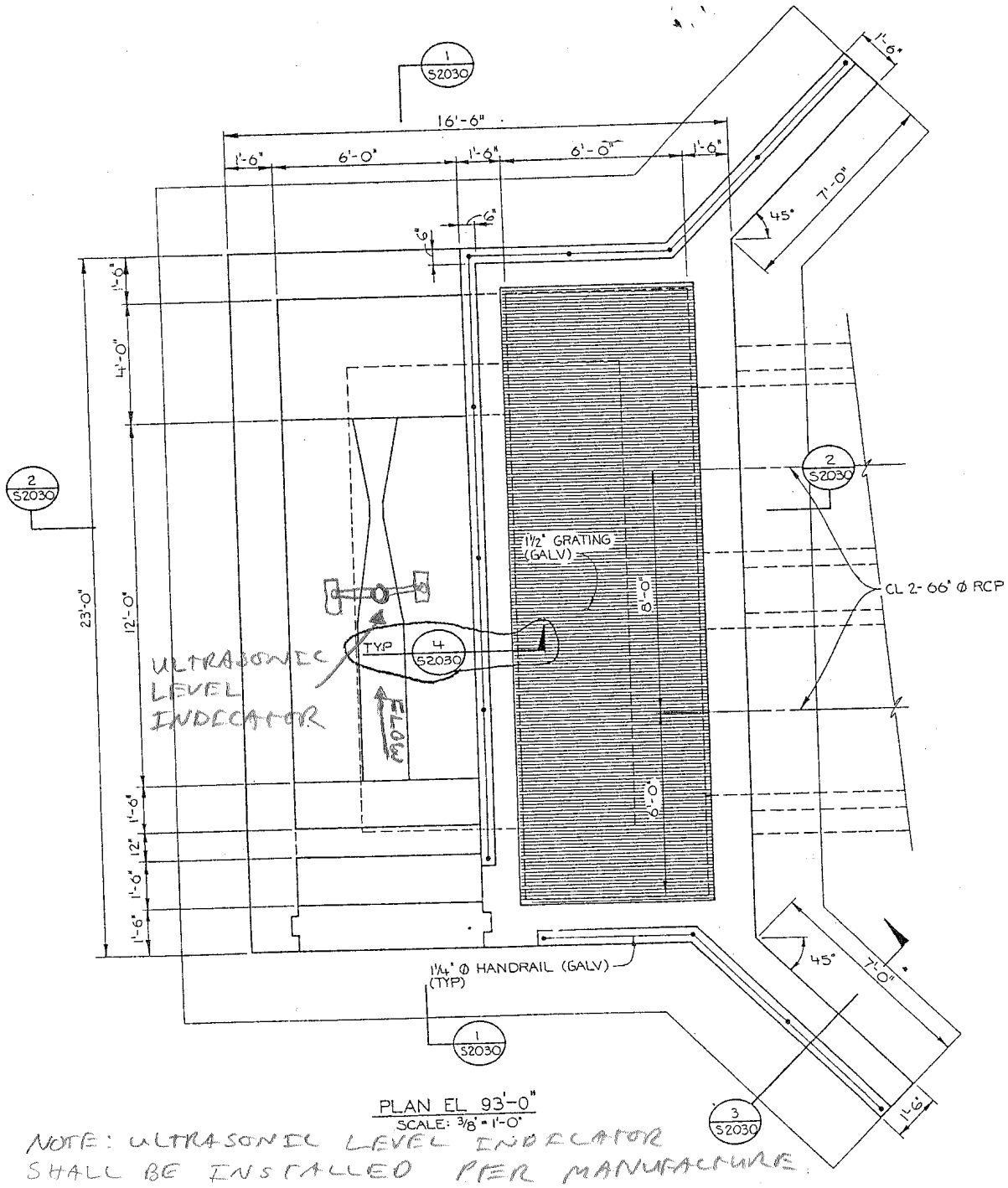
FIGURE 2

Ottumwa Generating Station Water Useage — 1995

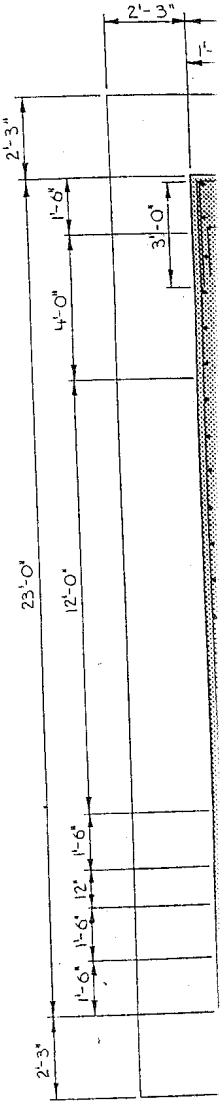



Ottumwa Generating Station Water Useage
2003
Des Moines River
6,589,878 gpd
6,092,261 gpd
Cooling Towers
5,171,261 gpd
Evaporation
921,000 gpd
Cooling Tower Blowdown
Ash Water Storage Tk, For Additional Ash Sluicing Water Supply
921,000 gpd
83,000 gpd
Boiler Water Pretreatment System
14,000 gpd
Pretreatment System Blowdown
14,000 gpd
69,000 gpd
25,800 gpd
Soot Blowing
Boiler Make-up
43,200 gpd
414,617 gpd
Bearing Seals and Cooling, Floor Drains Misc.
414,617 gpd
Oil Seperation Pond
414,617 gpd
Boiler Blowdown
43,200 gpd
Ash Sluicing
Rainfall
59,228 gpd
Ash Pond Outfall 001
4,047,000 gpd
4,047,000 gpd
Ash Sluicing, Boiler Seals and Cooling
306,045 gpd
Evaporation
Wapello Co Rural Water
4,000 gpd
Sanitation System Outfall 003
4,000 gpd
1,150,000 gpd
Des Moines River
CO2 Injection
32,586 gpd
Evaporation
Rainfall
61,586 gpd
Coal Pile Outfall 002
29,000 gpd
Coal Pile Runoff Pond Outfall 002
29,000 gpd
Des Moines River

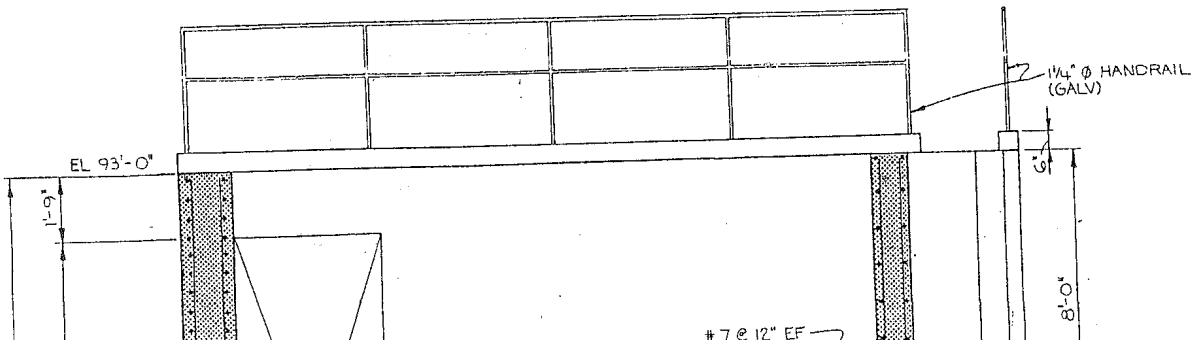
DRAWING 7 OF 3

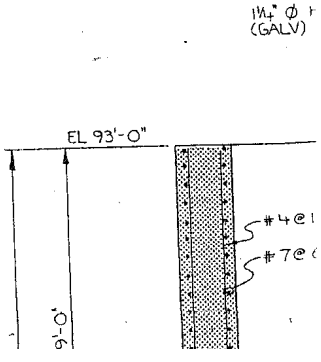


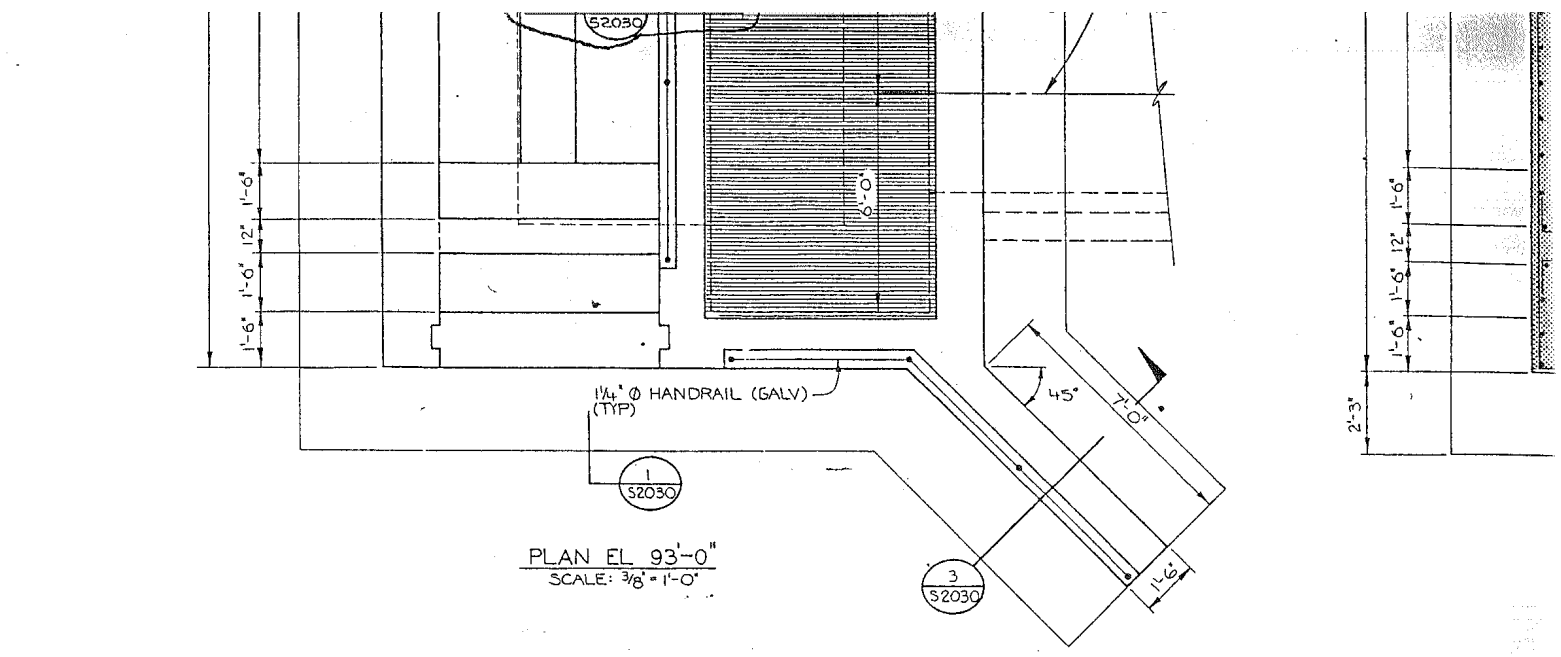
PLAN EL 93'-0"
SCALE: 3/8" = 1'-0"

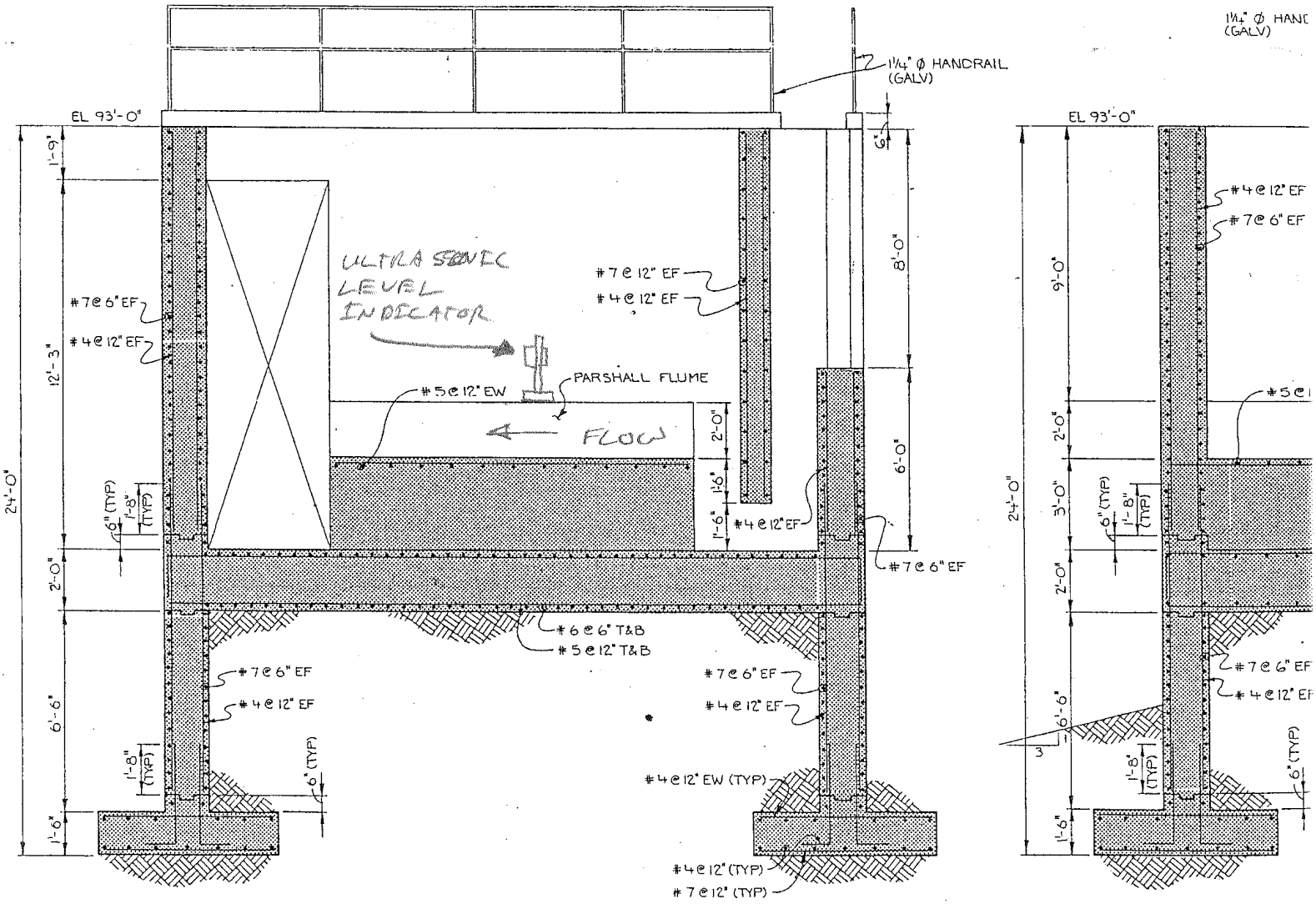


NOTE: ULTRASONIC LEVEL INDICATOR SHALL BE INSTALLED PER MANUFACTURE INSTALLATION INSTRUCTIONS.









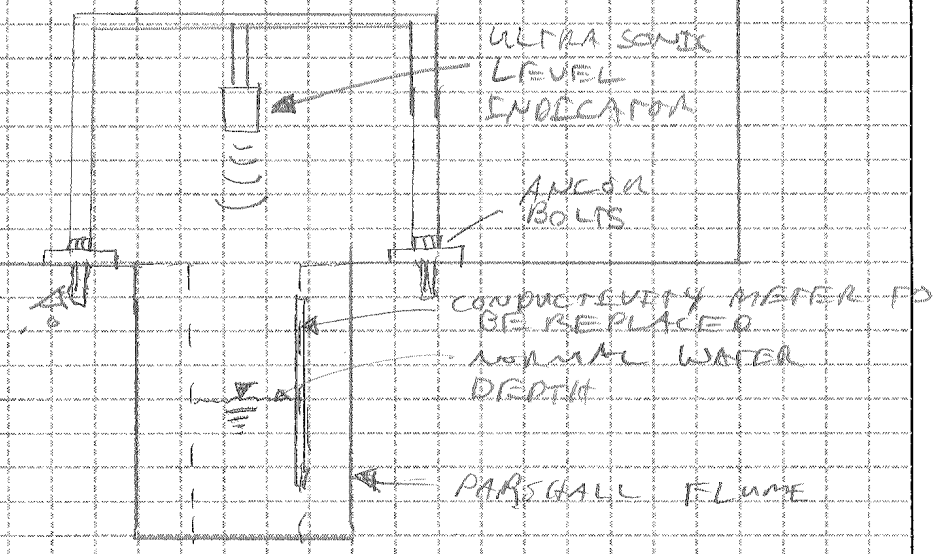
SECTION 1
SCALE: 3/8" = 1'-0"
SEE THIS DWG

DRAWING 2 of 3

HARD HAT SERVICES, INC.
Engineering, Construction and Management Solutions

SHEET NO. 3 OF 3
PROJECT 154.005.002
DATE 12/14/05
BY MHL CKD —

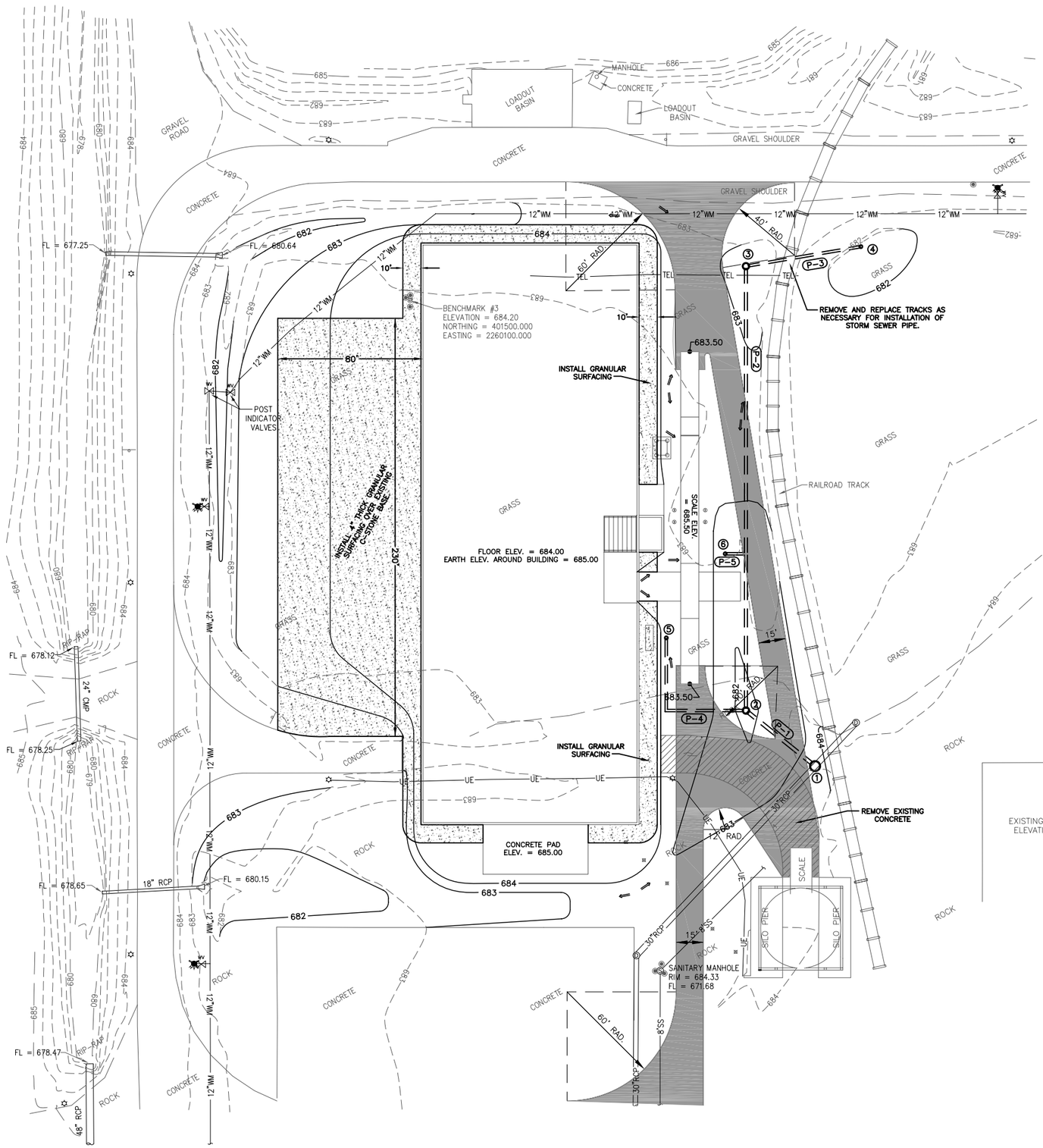
ALLIANT ENERGY
OTTUMWA GENERATING STATION
OUTFALL 001 UPGRADES

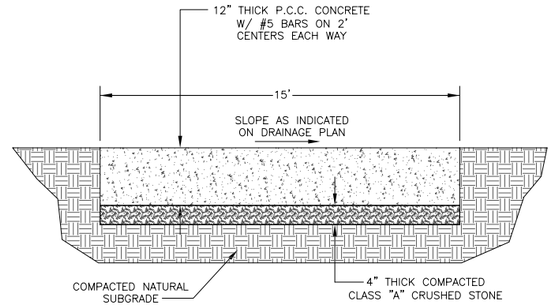


ULTRASONIC LEVEL INDICATOR
INSTALLATION

NTS

NOTE: ULTRASONIC LEVEL INDICATOR WILL BE INSTALLED PER MANUFACTURER INSTALLATION INSTRUCTIONS





TYPICAL PAVEMENT SECTION
(NO SCALE)

LIST OF STORM SEWER PIPE

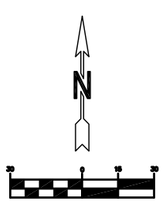
LINE NUMBER	LOCATION From	LOCATION To	PIPE DIA. Inches	LENGTH OF LINE Feet	SLOPE %	FLOW LINES INLET Elevation	FLOW LINES OUTLET Elevation
P-1	1	2	18	48	0.40	677.55	677.37
P-2	2	3	15	242	0.40	678.62	677.65
P-3	3	4	12	63	0.40	678.97	678.72
P-4	2	5	12	84	1.00	678.49	677.65
P-5	TEE	6	12	10	2.00	678.20	678.00

LIST OF STORM SEWER STRUCTURES

NUMBER	LOCATION NORTHING	LOCATION EASTING	TYPE	GRATE (RIM) Elev.	BOTTOM WELL Elev.
1	401243.80	2260322.87	"M-A" MANHOLE	684.00	676.87
2	401274.37	2260284.84	AREA DRAIN	681.50	677.15
3	401518.77	2260284.84	AREA DRAIN	682.00	678.00
4	401529.55	2260348.09	AREA DRAIN	681.50	677.50
5	401314.33	2260241.01	AREA DRAIN	683.25	678.00
6	401360.58	2260273.43	AREA DRAIN	682.25	677.70

LEGEND

- 12"WM — 12"WM = WATER MAIN
- 8"SS — 8"SS = SANITARY SEWER
- UE — UE = UNDERGROUND ELECTRIC
- TEL — TEL = UNDERGROUND TELEPHONE
- = HYDRANT
- = WATER VALVE
- = SANITARY SEWER MANHOLE
- = STORM SEWER MANHOLE
- = LIGHT POLE
- = BOLLARD
- = SIGN
- RCP = REINFORCED CONCRETE PIPE
- CMP = CORREGATED METAL PIPE
- = DRAINAGE ARROW
- 870 = EXISTING CONTOURS
- 870 = PROPOSED CONTOURS



REVISIONS			FLD. BK.: 218	SCALE: 1" = 30'		GARDEN & ASSOCIATES	FLY ASH STORAGE BUILDING SITE	PROJECT NO.: 9005234
REVISION NO.	DATE	DESCRIPTION	DATE: 6/06	DRN.: BJU	APP.:	OSKALOOSA , IOWA	OTTUMWA GENERATING STATION	DRAWING NO.: PAVING PLAN
						641 – 672 – 2526		SHEET 1 OF 1

N

C P-103 SH1

A P-103 SH2

1 2 3 4 5 6 7 8 9 10

11'-5" 11'-7" 320'-0"

7" 35'-2" 35'-6" 35'-6" 35'-6" 35'-6" 35'-6" 35'-6" 35'-6" 35'-2" 7"

A B C

7" 60'-0" 60'-0" 7"

120'-0"

15'-9½" 7'-6½" 18'-0" 18'-0" 7'-6½" 15'-9½"

15'-5" 25'-0" 88'-11⅞" 12'-8½" 35'-10½"

D S-101

PS-10 PS-101

PS-09 PS-101

PS-08 PS-101

PS-11 PS-102

PS-07 PS-101

PS-05 PS-101

PS-12 PS-101

PS-03 PS-101

EXPANSION JOINT (TYP. AS SHOWN)

5'-2" 18'-0" 18'-0" 35'-4" 13'-1⅜" 18'-0" 18'-10⅝"

1

EXISTING ASH SILO

18'-0" 9'-0" 9'-0"

℄ BAGHOUSE AND BUCKET ELEVATOR

℄ BUCKET ELEVATOR DISCHARGE

℄ SPOUT/TRUCK SCALES

8'-0" 5'-9" 19'-11" 27'-11"

℄ DOOR

℄ ELEVATOR BE-114

℄ SPOUT

℄ BAGHOUSE

℄ FAN

131'-0"

160'-0"

9'-9" 13'-0" 9'-7¼"

56'-10½" 113'-5" 30'-4" 70'-1½" TRUCK SCALE 10'-4"

DRAWING NO. 04153-P-101	REVISION NO. 1	SHEET NO. 1 OF 5

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

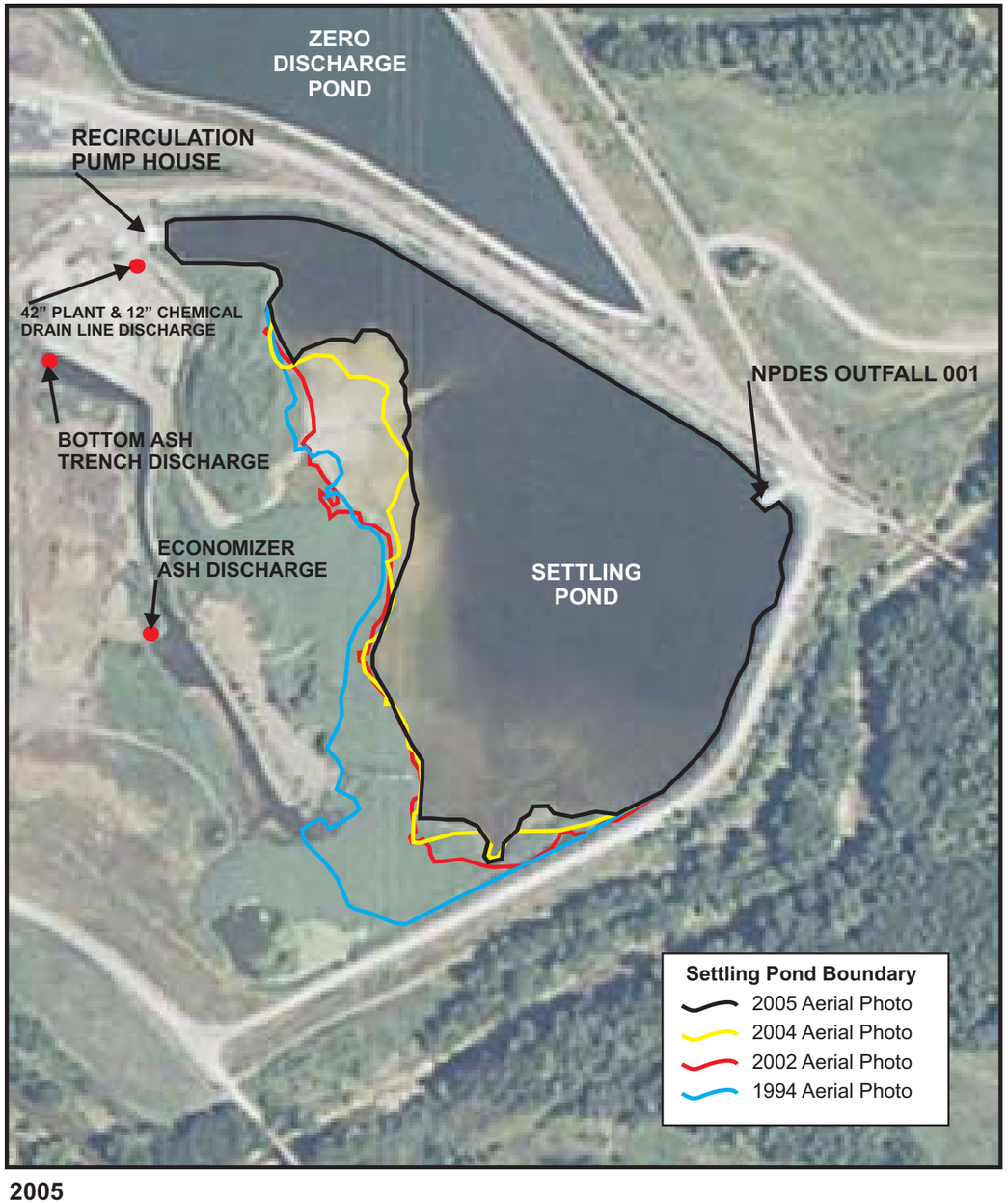
FIGURE 1

FACILITY LAYOUT

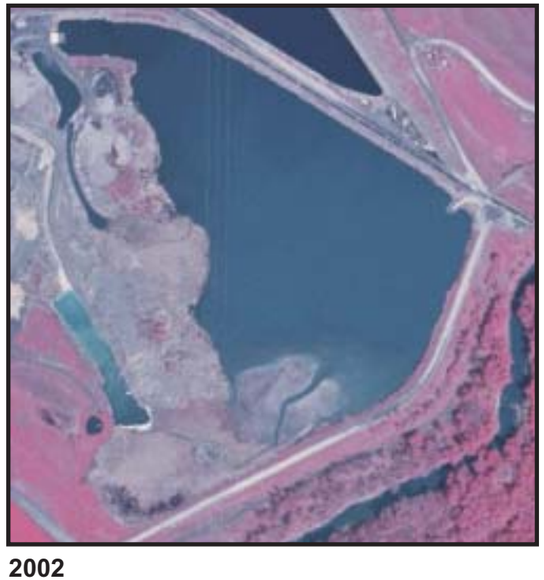
DATE:
OCT 2006

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

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

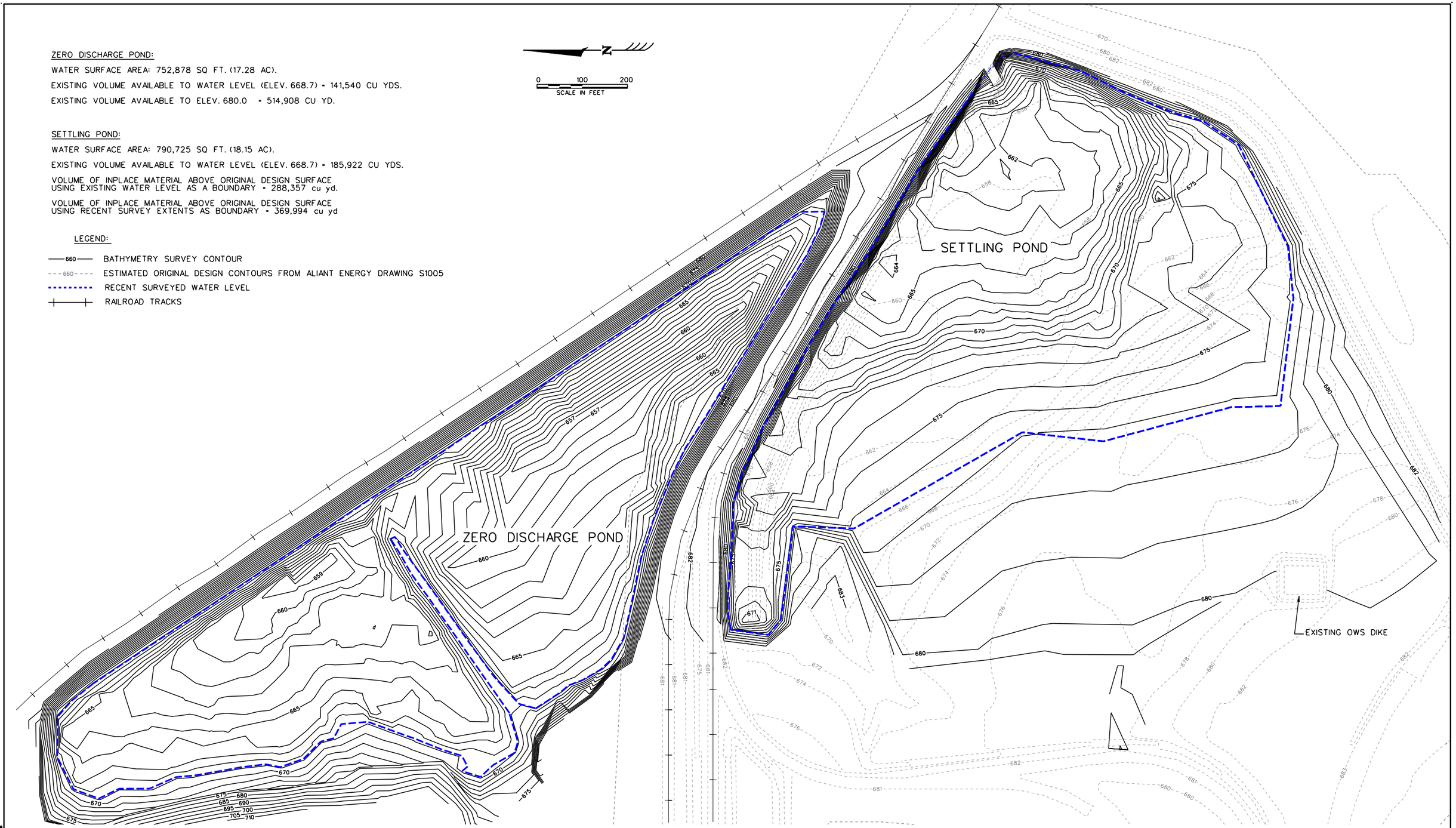
660 ESTIMATED ORIGINAL DESIGN CONTOURS FROM ALIANT ENERGY DRAWING S1005

RECENT SURVEYED WATER LEVEL

RAILROAD TRACKS

N

0 100 200
SCALE IN FEET



$FILE.ABBREV$

940 E. Diehl Rd, Suite 150
Naperville, IL 60563
(630) 637-9470

HARD HAT SERVICES ™
Engineering, Construction and Management Solutions

ALLIANT ENERGY
OTTUMWA, IOWA

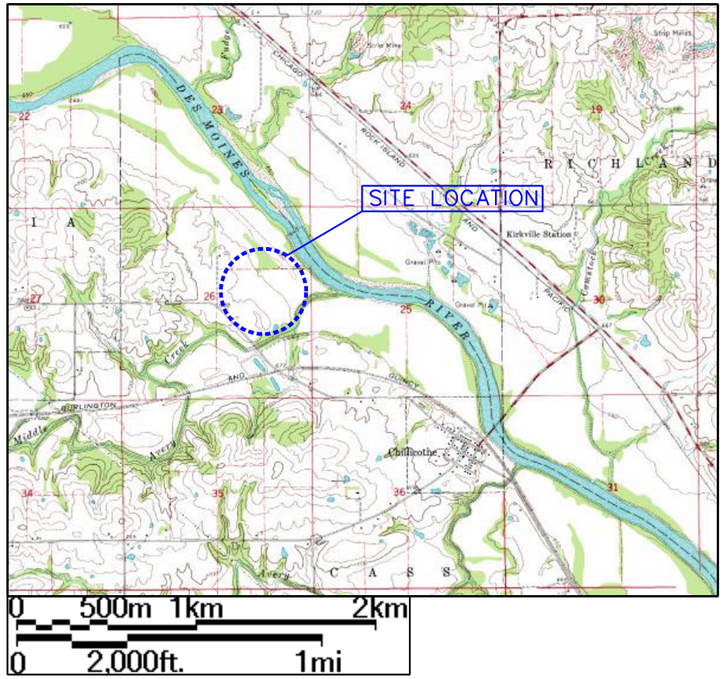
CURRENT POND VOLUMES

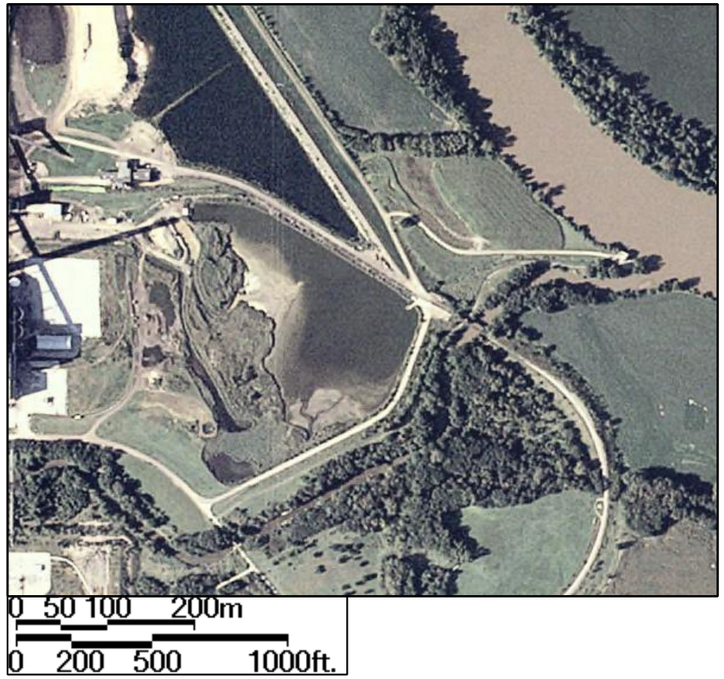
FIGURE:
3

INTERSTATE POWER & LIGHT
OTTUMWA GENERATING STATION
20775 POWER PLANT ROAD, OTTUMWA IOWA

SETTLING POND RECONFIGURATION

(DECEMBER, 2007)





SHEET INDEX

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the state of Iowa.

(signature) (date)

Printed or typed name: _____

License number: _____

My license renewal date is December 31, _____

Pages or sheets covered by this seal: _____

REV	DATE	BY	DESCRIPTION

SCALE: NONE

DESIGNED: _____
DRAWN: _____
CHECKED: _____

CLIENT: INTERSTATE POWER & LIGHT
OTTUMWA GENERATING STATION

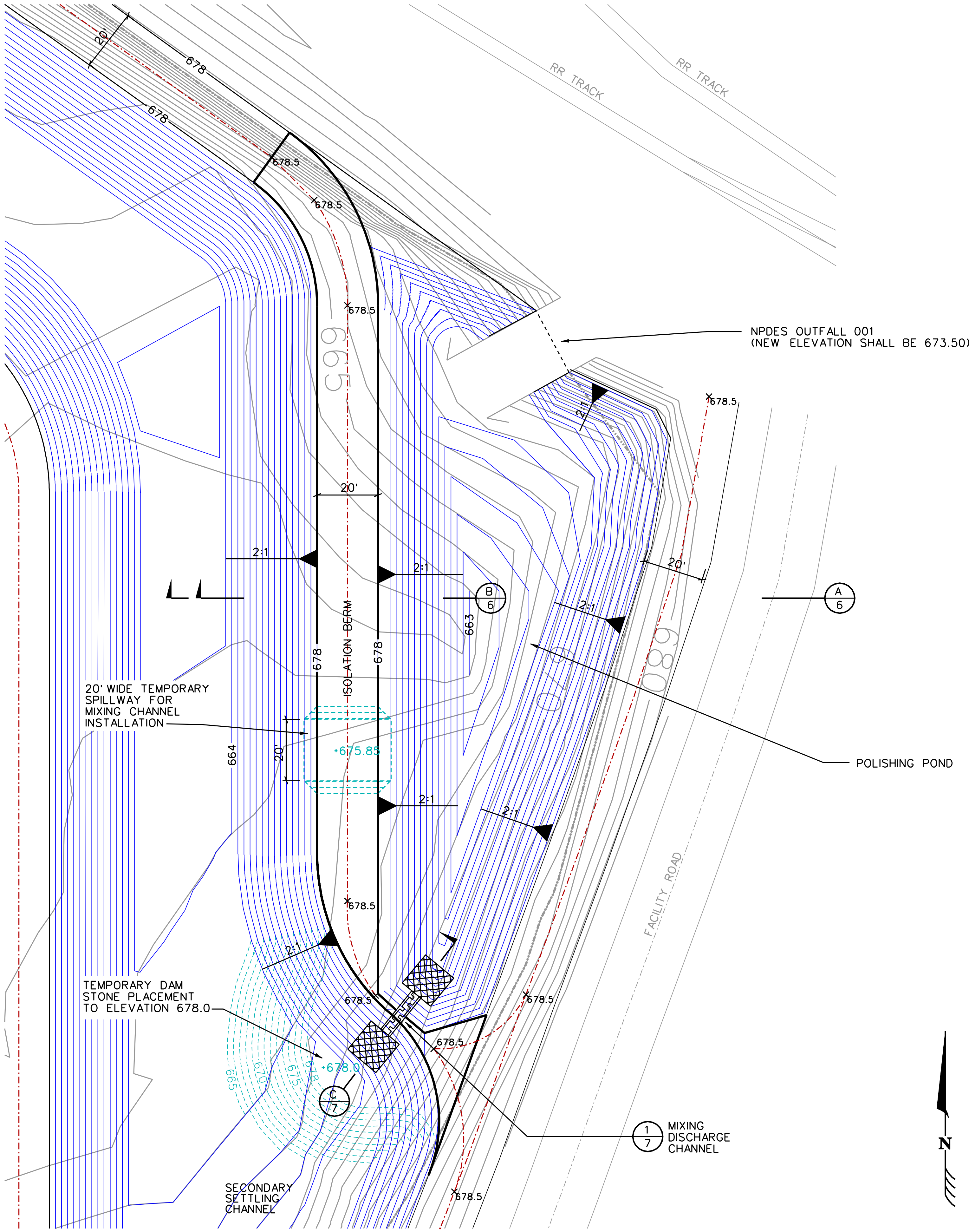
TITLE: COVER SHEET

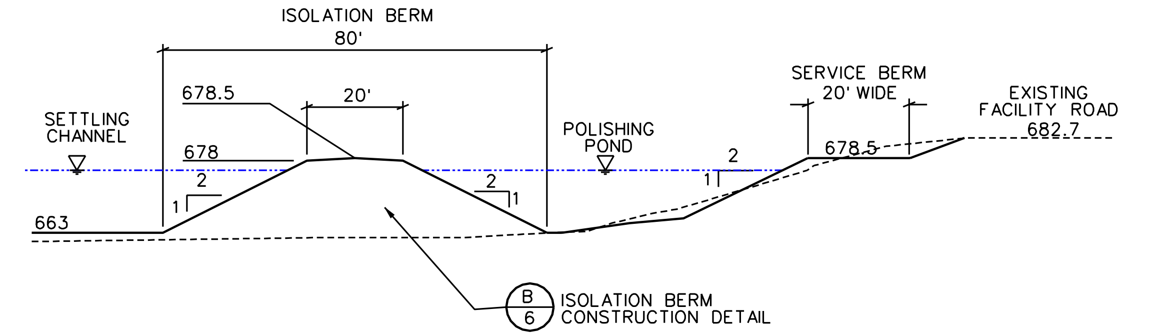
HARD HAT SERVICES TM
Engineering, Construction and Management Solutions
940 E. Diehl Rd, Suite 150
Naperville, IL 60563
(630) 637-9470

SHEET: 1 OF 8 SHEETS

DRAWING NUMBER: 1-2035-0-D-C1100-001

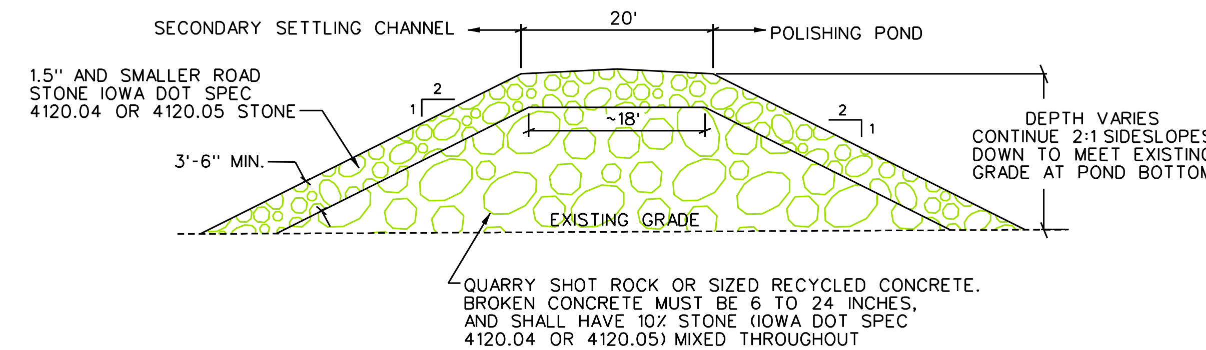
12/28/2007 ...\OGS-Cover.dgn





SECTION (A/6)

0 20 40
SCALE IN FEET



ISOLATION BERM CONSTRUCTION (B/6)

0 10 20
SCALE IN FEET

NOTES:

1. CONTRACTOR SHALL NOT DISTURB ANY OPERATIONS AT THE FACILITY DURING THE CONSTRUCTION OF THE ISOLATION BERM

2. ISOLATION BERM CONSTRUCTION SEQUENCE:
   1) CONTRACTOR SHALL CONSTRUCT ISOLATION BERM AS SHOWN AND CONSTRUCT A 20 FOOT LONG TEMPORARY SPILLWAY TO ELEVATION 675.85(JOEL SHOW ALIGNMENT AND COORDINATES FOR THE TEMPORARY SPILLWAY AND THE MIXING CHANNEL).
   2) CONTRACTOR SHALL CONSTRUCT THE TEMPORARY DAM TO ELEVATION 678.50 WITH IOWA DOT SPEC. 4120.04 OR 4120.05 STONE.
   3) CONTRACTOR SHALL LOWER THE OUTFALL DISCHARGE TO ELEVATION 673.50
   4) CONTRACTOR SHALL REMOVE STONE AND COMPACT THE SUBGRADE AND INSTALL THE MIXING CHANNEL TO THE DESIGN ELEVATIONS.
   5) AFTER THE CONCRETE MIXING CHANNEL IS SET IN PLACE, THE CONTRACTOR SHALL REMOVE EXCESS STONE MATERIAL FROM THE TEMPORARY DAM TO ESTABLISH THE FINAL GRADES.
   6) CONTRACTOR SHALL REMOVE THE TEMPORARY SPILLWAY BY COMPLETING THE ISOLATION BERM AS SHOWN ON DETAIL XXX.

REV	DATE	BY	DESCRIPTION

SCALE: 0 20 40 SCALE IN FEET

DESIGNED:______
DRAWN:______
CHECKED:______

CLIENT: INTERSTATE POWER & LIGHT
OTTUMWA GENERATING STATION

TITLE: POLISHING POND

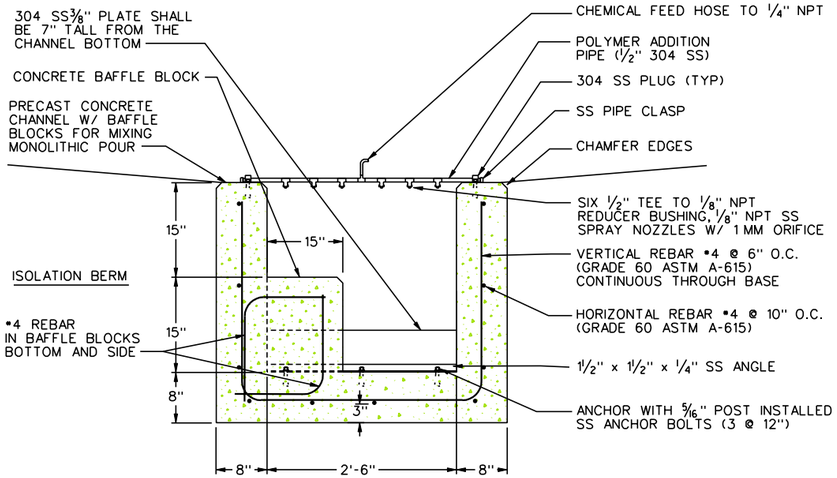
HARD HAT SERVICES ™
Engineering, Construction and Management Solutions
940 E. Diehl Rd, Suite 150
Naperville, IL 60563
(630) 637-9470

SHEET: 6 OF 8 SHEETS

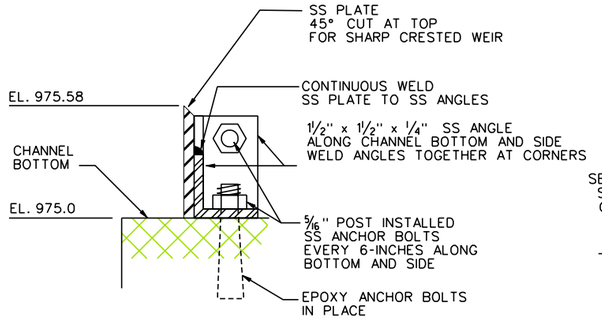
DRAWING NUMBER: 1-2035-0-D-C1100-006

...\OGS-Polishing Pond.dgn

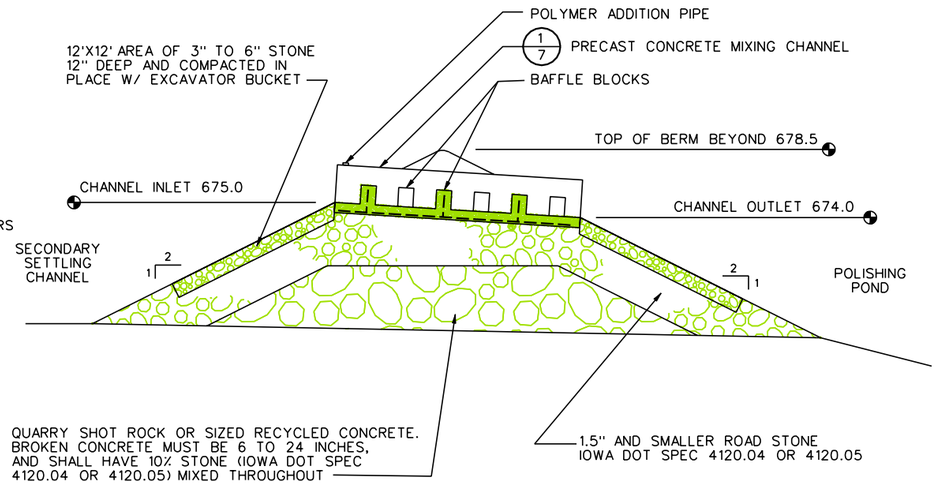
12/28/2007



SECTION A/7
1" = 2'-0"
0 1 2
SCALE IN FEET



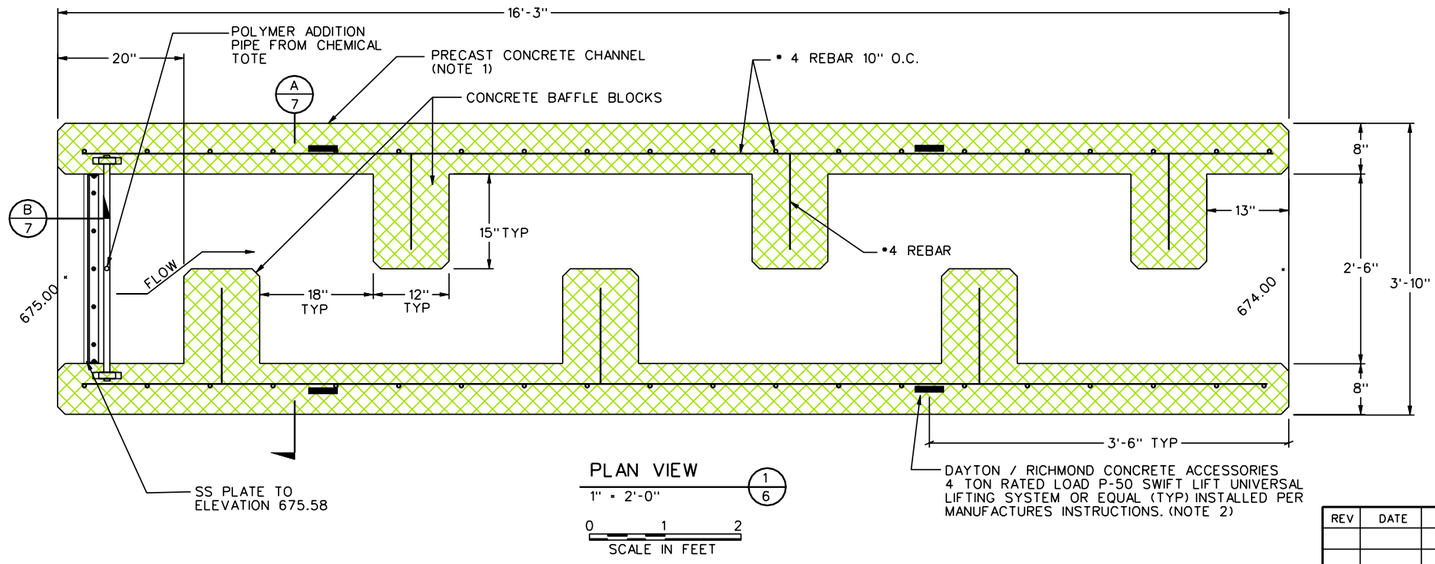
SECTION B/7
NTS



MIXING CHANNEL SECTION C/6
0 5 10
SCALE IN FEET

NOTE:

1. PRECAST CONCRETE COMPRESSIVE STRENGTH SHALL BE MONOLITHIC POUR. TYPE III HIGH-EARLY CONCRETE (4,000 PSI AT 7 DAYS: 6,000 PSI AT 28 DAYS). WITH 5% AIR ENTRAINMENT AND BRUSHED FINISH. CONCRETE CONSTRUCTION SHALL BE IN ACCORDANCE WITH ACI 301-99 AND ACI 318-02. CHANNEL WALLS AND BAFFLE BLOCKS SHALL HAVE CHAMFERED EDGES.
2. THE LIFTING ANGLE FOR THE STRAPS SHALL BE GREATER THAN 45 DEGREES FROM HORIZONTAL.



PLAN VIEW 1/6
1" = 2'-0"
0 1 2
SCALE IN FEET

REV	DATE	BY	DESCRIPTION

SCALE: AS SHOWN
DESIGNED:
DRAWN:
CHECKED:

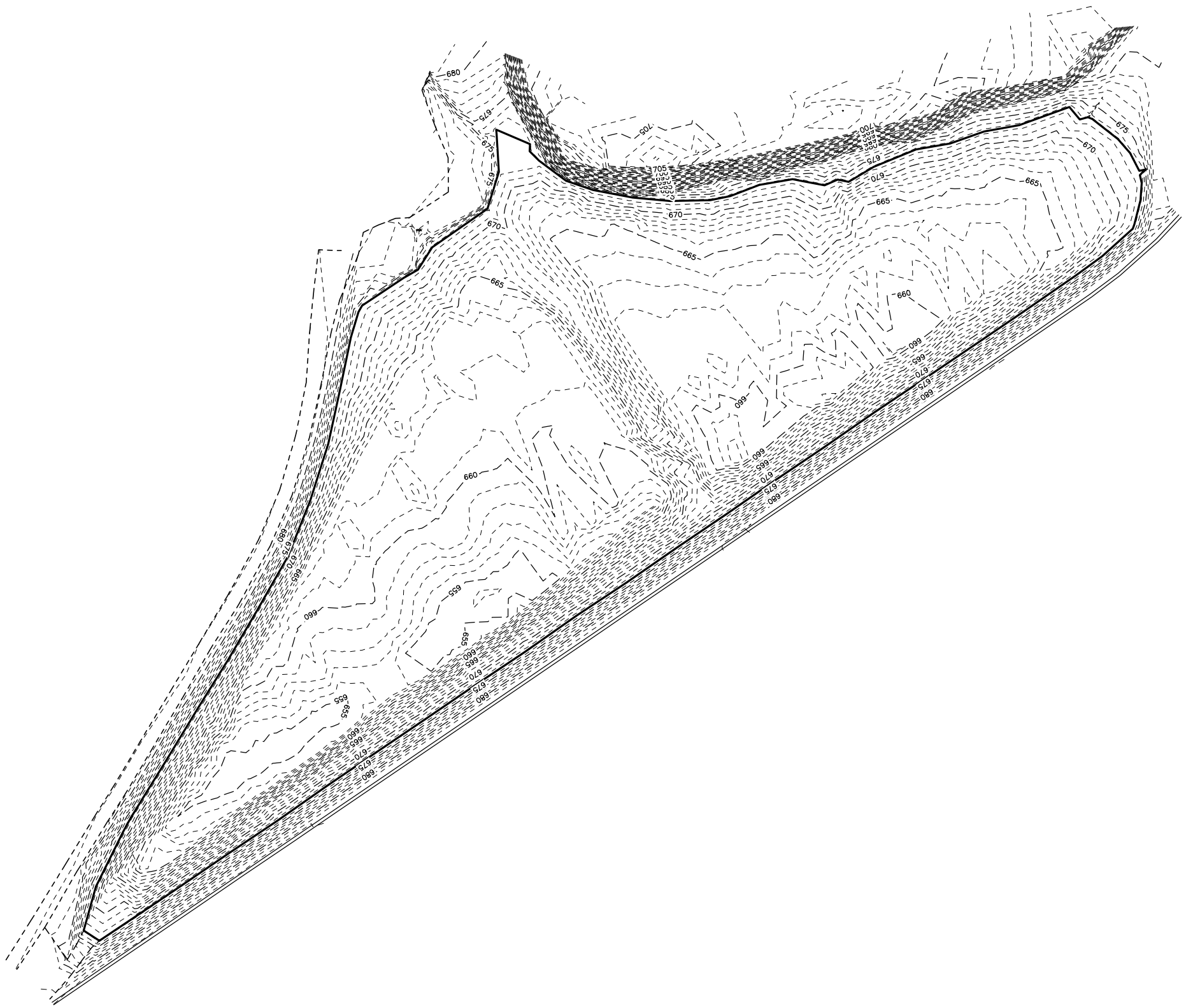
CLIENT: INTERSTATE POWER & LIGHT
OTTUMWA GENERATING STATION

TITLE: MIXING CHANNEL

HARD HAT SERVICES TM
Engineering, Construction and Management Solutions
940 E. Diehl Rd, Suite 150
Naperville, IL 60563
(630) 637-9470

SHEET: 7 OF 8 SHEETS
DRAWING NUMBER: 1-2035-0-D-C1100-007

12/28/2007 ...\OGS-Mixing Channel.dgn


680
675
670
665
660
655
705
700

APPENDIX G – Dike and Grading Work Specifications

Alliant Energy
Interstate Power and Light Company
Ottumwa Generating Station
Ottumwa, Iowa

History of Construction

ALLIANT ENERGY
INTERSTATE POWER AND LIGHT CO.

OTTUMWA GENERATION STATION

GENERAL CONSTRUCTION (1 OF 2)

SPECIFICATION: 6713 C6C
WORK ORDER NO: 81-61-0588-09

BLACK & VEATCH

Section 2A - EARTHWORK

2A.1 GENERAL. This section covers general earthwork and shall include the necessary preparation of the construction areas; removal and disposal of all debris; excavation and trenching as required; the handling, storage, transportation, and disposal of all excavated material; all necessary sheeting, shoring, and protection work; preparation of subgrades; pumping and dewatering as necessary or required; protection of adjacent construction; backfilling; pipe embedment; construction of fills and embankments; surfacing and grading; and other appurtenant work.

2A.2 SHEETING AND SHORING. The stability of previously constructed structures and facilities shall not be impaired or endangered by excavation work. Previously constructed structures and facilities include both structures and facilities existing when this construction began and structures and facilities already provided under these specifications.

Hazardous and dangerous conditions shall be prevented and the safety of personnel shall be maintained. Adequate sheeting and shoring shall be provided as required to protect and maintain the stability of previously constructed structures and facilities and the sides of excavations and trenches until they are backfilled. Sheeting, bracing, and shoring shall be designed and built to withstand all loads that might be caused by earth movement or pressure, and shall be rigid, maintaining shape and position under all circumstances.

2A.3 REMOVAL OF WATER. The Contractor shall provide and maintain adequate dewatering equipment to remove and dispose of all surface and ground water entering excavations and other parts of the work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the construction to be provided therein is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result. Ground water level shall be maintained at least 12 inches below the bottom of each excavation.

2A.4 BLASTING. No blasting or other use of explosives for excavation will be permitted, unless authorized in writing by the Engineer or the Company.

In the event blasting is authorized, the Contractor shall comply with all laws, ordinances, applicable safety code requirements, and regulations relative to the handling, storage, and use of explosives and the protection of life and property. The Contractor shall be responsible for all damage caused by his blasting operations. Suitable methods shall be employed to confine all materials lifted by blasting within the limits of the excavation or trench.

2A.5 CLASSIFICATION OF EARTH MATERIALS. No classification of excavated materials will be made except for identification purposes. Excavation work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the contract work, re gardless of the type, character, composition, or condition thereof.

All rock which cannot be handled and compacted as earth shall be kept separate from other excavated materials and shall not be mixed with backfill, fill, or embankment materials except as specified or directed.

Soil identification shall be in accordance with Table 1 of the Unified Soil Classification System which is bound herewith at the end of this section. Identification and classification shall be based upon visual examination and simple manual tests performed by qualified personnel furnished by the Contractor.

2A.6 FREEZING WEATHER RESTRICTIONS. Backfilling and construction of fills and embankments during freezing weather shall not be done except by permission of the Field Project Manager. No earth material shall be placed on frozen surfaces, nor shall frozen materials, snow, or ice be placed in any backfill, fill, or embankment.

2A.7 MAINTENANCE OF TRAFFIC. The Contractor shall conduct his work so as to interfere as little as possible with the Company's operations and the work of other contractors. Whenever it is necessary to cross, obstruct, or close roads, driveways, parking areas, and walks, the Contractor shall provide and maintain suitable and safe bridges, detours, or other temporary expedients at his own expense. In making open cut road crossings, the Contractor shall not block more than one-half of the road at any time.

Where required, the Contractor shall widen the shoulder on the opposite side of the road to facilitate traffic flow while blocking half of a road with an open cut. Temporary crushed rock surfacing shall be provided as necessary on the widened shoulders.

2A.8 PROTECTION OF UNDERGROUND CONSTRUCTION. The Contractor shall locate, protect, shore, brace, support, and maintain all existing underground pipes, conduits, drains, and other underground construction which may be uncovered or otherwise be affected by the work.

2A.9 PRESERVATION OF TREES. Trees shall be preserved and protected as much as possible. Unless specifically authorized by the Company, trees shall be removed from only those areas which will be excavated, filled, or built upon. Consideration will be given to the removal of additional trees only where essential, in the opinion of the Field Project Manager, for the safe, effective execution of the work.

Trees left standing shall be adequately protected from permanent damage by construction operations. Trimming of standing trees, where required, shall be as directed by the Field Project Manager.

2A.10 UNAUTHORIZED EXCAVATION. Except where otherwise authorized, indicated, or specified, all material excavated below the bottom of concrete structures which will be supported by the subgrade shall be replaced with concrete placed monolithic with the concrete above. Material excavated below structures supported on piers shall be replaced with crushed rock or gravel. The crushed rock or gravel shall be compacted to a density equal to or greater than the density of the adjacent undisturbed soil.

2A.11 STABILIZATION. Subgrades for structures and the bottom of trenches shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud and muck; and shall be sufficiently stable to remain firm and intact under the feet of the workmen.

Subgrades for structures and trench bottoms which are otherwise solid but which become mucky on top due to construction operations, shall be reinforced with one or more layers of crushed rock or gravel.

The finished elevation of stabilized structure subgrades shall not be above the subgrade elevations indicated on the drawings.

Not more than 1/2 inch depth of mud or muck shall be allowed to remain on stabilized trench bottoms when the pipe embedment material is placed thereon.

All stabilization work shall be performed by and at the expense of the Contractor.

2A.12 TESTING. All field and laboratory testing required to determine compliance with the compaction requirements of this section will be provided by the Company. The Contractor shall provide the services of one or more employees as necessary to assist the Company's field testing representative. The Contractor will be furnished one copy of the test results.

Maximum density for cohesive compacted materials placed under this section will be determined in accordance with ASTM D698. The terms "maximum density" and "optimum moisture content" shall be as defined in ASTM D698.

Relative density for noncohesive compacted materials placed under this section will be determined in accordance with ASTM D2049. The term "relative density" shall be as defined in ASTM D2049.

2A.13 SITE PREPARATION. Ground surfaces within the construction areas will be cleared of all trees and brush under Specification 6713-C-6A, Sitework Construction, and will be essentially free of debris and surface vegetation.

Any remaining brush, trash, and surface vegetation shall be removed in preparing the work site under these specifications and shall be transported to the Company's disposal facility. Waste shall be unloaded and disposed of as directed by the Field Project Manager.

Day-to-day construction waste shall be disposed of as specified in the Special Conditions.

2A.14 ROADWAY ROADBEDS. Roadway roadbed construction shall include excavation and subgrade preparation, and fills and embankments where required. Fills and embankments shall be constructed as specified hereinafter. In excavated roadbed areas, overburden shall be removed and the subgrade shall be shaped to line, grade and cross section, and compacted to a depth of at least 6 inches to 95 per cent of maximum density at optimum moisture content as determined by ASTM D698 when that test is appropriate, or to 70 per cent relative density as determined by ASTM D2049 when that test is appropriate. This operation shall include any scarifying, reshaping, and wetting required to obtain proper compaction. Soft, organic, and otherwise unsuitable material shall be removed from the subgrade and replaced with suitable material.

All material in the upper 18 inches of the subgrade in both cut and fill sections, shall be material with compaction characteristics equal to or better than inorganic clays of low to medium plasticity. This material shall be classified as Group CL or ML as indicated on the Unified Soil Classification chart bound herein at the end of this section.

The subgrade shall be compacted and finished to a true surface and no depression shall be left that will hold water or prevent proper drainage. The subgrade shall be finished to within 0.1 of a foot of the elevation indicated on the drawings. Any deviation of the subgrade surface in excess of one inch as indicated by a 16 foot straightedge, or template cut to typical section, shall be corrected by loosening, adding or removing material, reshaping, and recompacting.

Ditches and drains along the subgrade shall be maintained as required for effective drainage. Whenever ruts of 2 inches or more in depth are formed, the subgrade shall be brought to grade, reshaped, and recompacted. Storage or stockpiling of materials on the subgrade will not be permitted.

Roadway subgrades shall be maintained throughout the work under these specifications.

Roadway surfacing is covered in Sections 2F and 2G of these specifications.

2A.15 FILLS AND EMBANKMENTS. To the maximum extent available, suitable earth materials obtained from excavation shall be used for the construction of fills and embankments. Additional material shall be obtained from borrow pits as necessary. After preparation of the fill or embankment site, the subgrade shall be scarified, leveled, and rolled so that surface materials of the subgrade will be compact and well bonded with the first layer of the fill or embankment. All material deposited in fills and embankments shall be free from rocks or stones, brush, stumps, logs, roots, debris and organic or other objectionable materials. Fills and embankments shall be constructed in horizontal layers not exceeding 8 inches in uncompacted thickness. Material deposited in piles or windrows by excavating and hauling equipment shall be spread and leveled prior to compaction.

Each layer shall be thoroughly compacted by rolling or other methods acceptable to the Engineer. The compacted density of each layer shall be at least 95 per cent of the maximum density at optimum moisture content as determined by ASTM D698 when that test is appropriate or 70 per cent of relative density as determined by ASTM D2049 when that test is appropriate. If the material fails to meet the density specified, compaction methods shall be modified as required to attain the specified density.

2A.15.1 Subgrade Preparation. After preparation of the fill or embankment site, the subgrade shall be leveled and rolled so surface materials of the subgrade will be as compact and well bonded with the first layer of the fill or embankment as specified for subsequent layers.

2A.15.2 Placement and Compaction. All fill and embankment materials shall be placed in approximately horizontal layers not to exceed 8 inches in uncompacted thickness. Material deposited in piles or windrows by excavating and hauling equipment shall be spread and leveled before compaction.

Each layer of material being compacted shall have the best practicable uniform moisture content to insure satisfactory compaction. The Contractor shall add water and harrow, disc, blade, or otherwise work the material in each layer as required to insure uniform moisture content and adequate compaction.

2A.15.3 Borrow Areas. Material necessary to complete fills and embankments shall be excavated from borrow areas and hauled to the fill or embankment site. Borrow material will be available on the Company's property.

The location, size, shape, depth, drainage, and surfacing of all borrow areas shall be acceptable to the Field Project Manager. Borrow areas

shall be regular in shape, with finish graded surfaces when completed. Side slopes shall not be steeper than three horizontal to one vertical, and shall be uniform for the entire length of any one side.

2A.16 STRUCTURE EXCAVATION. Excavation for structures shall be done to lines and elevations indicated on the drawings and to the limits required to perform the construction work. Machine excavation shall be controlled to prevent undercutting the proper subgrade elevations and shall not be used within 10 feet of permanent structures and facilities. Only hand tools shall be used for excavation around permanent structures and facilities.

Work shall be done so that the construction areas will be as free as possible from obstructions and from interference with the transportation, storage, or handling of materials. Excavated materials free of trash, rocks, roots, and other foreign materials, and which meet the specified requirements, may be used as required for the fills, embankments, and backfills constructed under these specifications.

Vertical faces of excavations shall not be undercut to provide for extended footings.

2A.17 STRUCTURE BACKFILL. Backfill around and outside of structures shall be deposited in layers not to exceed 6 inches in uncompacted thickness and mechanically compacted, using platform type tampers, to at least 95 per cent of maximum density at optimum moisture content as determined by ASTM D698 when that test is appropriate, or to 70 per cent relative density as determined by ASTM D2049 when that test is appropriate. at least the density of adjacent undisturbed earth. Compaction of structure backfill by rolling will be permitted provided the desired compaction is obtained and damage to the structure is prevented. Compaction of structure backfill by inundation with water will not be permitted.

Material for structure backfill shall be composed of earth only and shall contain no wood, grass, roots, broken concrete, stones, trash, or debris of any kind.

No tamped, rolled, or otherwise mechanically compacted backfill shall be deposited or compacted in water.

All backfill material shall consist of loose earth having a moisture content such that the required density of the compacted soil will be obtained with the compaction method used. Moisture content shall be distributed uniformly and water for correction of moisture content shall be added sufficiently in advance so that proper moisture distribution and compaction will be obtained. Granular material shall be wet, not just damp, when compacted.

Particular care shall be taken to compact structure backfill which will be beneath pipes, drives, roads, or other surface construction or structures. In addition, wherever a trench will pass through structure backfill, the structure backfill shall be placed and compacted to an elevation at least 12 inches above the top of the pipe before the trench is excavated.

2A.18 COMPACTED ROCK FILL. Compacted rock fill shall consist of crushed rock conforming to ASTM C33, gradation 1-1/2 inch to crusher fines. The rock fill shall be placed on undisturbed subgrade and compacted to maximum density. Compaction shall be performed with vibrating mechanical compactors unless otherwise acceptable to the Engineer.

Compacted rock fill shall be placed under all slabs 24 inches or less in thickness. The thickness of the compacted rock fill shall be a minimum of 6 inches.

Crushed rock for compacted fill shall be handled and placed in a manner that will prevent segregation of sizes. The fill material shall have the best practicable moisture content to achieve maximum density with the compaction methods used. The material shall be placed in horizontal layers not more than 6 inches in uncompacted thickness.

If concrete is to be placed on the compacted rock fill, the fill shall be finished with a thin layer of clean concrete sand to fill all voids and interstices and to obtain the required subgrade elevation. A polyethylene film moisture barrier shall be placed over the sand as specified in the cast-in-place concrete section.

2A.19 MAINTENANCE AND RESTORATION OF FILLS, EMBANKMENTS, AND BACKFILLS. Fills, embankments and backfills that settle or erode before final acceptance of the work under these specifications, and pavement, structures, and other facilities damaged by such settlement or erosion, shall be repaired. The settled or eroded areas shall be refilled, compacted, and graded to conform to the elevation indicated on the drawings or to the elevation of the adjacent ground surface. Damaged facilities shall be repaired in a manner acceptable to the Field Project Manager.

Earth slopes of the roads constructed under these specifications shall be maintained to the lines and grades indicated on the drawings until the final acceptance of the road slopes by the Field Project Manager.

2A.20 FINAL GRADING. After all construction work under these specifications has been completed, all ground surface areas disturbed by this construction or construction plant and operations shall be graded. The grading shall be finished to the contours and elevations indicated on the drawings or, if not indicated, to the matching contours and elevations of the original, undisturbed ground surface. In any event, the final grading shall provide smooth uniform surfacing and effective drainage of the ground areas.

2A.21 DISPOSITION OF MATERIALS. Excavated earth material shall be used to construct fills, embankments and backfills to the extent required. Surplus earth, if any, and materials which are not suitable for fills, embankments, and backfills shall be spoiled on the site in a manner and location as directed by the Field Project Manager.

Materials shall be deposited in the disposal areas and leveled and compacted in 12 inch maximum layers. Compaction shall be by not less than three passes of a bulldozer.