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November 25, 2020

Andrew Wheeler
Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

Submitted electronically

Subject: **Request for site-specific alternative deadline to initiate closure of CCR surface impoundment pursuant to 40 CFR 257.103(f)(1)**
Ottumwa Generating Station
Interstate Power and Light Company
Ottumwa, Iowa

Mr. Wheeler:

On behalf of Interstate Power and Light Company (IPL), Alliant Energy is submitting the enclosed request for a site-specific alternative deadline to initiate closure of a CCR surface impoundment pursuant to 40 CFR 257.103(f)(1). The enclosed demonstration includes documentation that the criteria in paragraphs §257.103(f)(1)(i) through (iii) have been met.

We appreciate EPA's consideration of this request and the assistance from EPA staff during the development of the enclosed information. Please contact me at (608) 458-3853 or jeffreymaxted@alliantenergy.com if you have any questions or need additional information.

Sincerely,

Jeff Maxted
Manager – Environmental Services
Alliant Energy

Enclosures

Cc: Kirsten Hillyer, Frank Behan, Richard Huggins – U.S. EPA
Nichol Toomire, Jeff Hanson, Marney Hoefer – Alliant Energy

Ottumwa Generating Station Demonstration for a Site-Specific Alternate to Initiation of Closure Deadline

Interstate Power and Light Company

Revision 0
November 25, 2020

Ottumwa Generating Station Demonstration for a Site-Specific Alternate to Initiation of Closure Deadline

Prepared for

Interstate Power and Light Company

Ottumwa, Iowa

Revision 0
November 25, 2020

Prepared by

Burns & McDonnell Engineering Company, Inc.
Kansas City, Missouri

INDEX AND CERTICATION

Interstate Power and Light Company
Ottumwa Generating Station Demonstration for a Site-Specific Alternate to Initiation of Closure Deadline

Report Index and Certification

Certification

I hereby certify, as a Professional Engineer in the State of Iowa, that the information in this document was assembled under my direct personal charge. This report is not intended or represented to be suitable for reuse by Interstate Power and Light Company or others without specific verification or adaptation by the Engineer.

ROBERT N. OWENS
20609

Robert N. Owens

Date: 11/25/20

Robert N. Owens
License Number 20609

My license renewal date is December 31, 2020

Pages or sheets covered by this seal: As noted above.

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LIST OF ABBREVIATIONS

Abbreviation	**Term/Phrase/Name**
BMcD	Burns & McDonnell (IPL's Owner's Engineer)
CCR	Coal Combustion Residual(s)
CCR Rule	Coal Combustion Residuals Rule
CFR	Code of Federal Regulations
IPL	Interstate Power and Light Company (Co-owner and Operator)
ELG	Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category
EPA	Environmental Protection Agency
GCL	Geosynthetic Clay Liner
GPM	Gallons Per Minute
GWPS	Groundwater Protection Standards
IDNR	Iowa Department of Natural Resources
LVWTP	Low Volume Wastewater Treatment Pond
MidAm	MidAmerican Energy Company (Co-owner)
MW	Megawatt
O&M	Operating and Maintenance
RCRA	Resource Conservation and Recovery Act
S&L	Sargent & Lundy
SAP	Sampling and Analysis Plan
SCU	Solids Contact Unit Clarifier
OGS	Ottumwa Generating Station
SSI(s)	Statistically Significant Increase(s)
SSL(s)	Statistically Significant Level(s)

Abbreviation	**Term/Phrase/Name**
Surface Impoundment	OGS Ash Pond
U.S.C.	United States Code
WMB	Water Mass Balance
ZLD	Zero Liquid Discharge

0.0 EXECUTIVE SUMMARY

Interstate Power and Light Company (IPL) is submitting this Demonstration to the U.S. Environmental Protection Agency to obtain approval of an alternate site-specific deadline to initiate closure of the existing CCR Surface Impoundment located at IPL's Ottumwa Generating Station (OGS) near Ottumwa, Iowa. Specifically, **IPL requests EPA to establish the alternate deadline of December 31, 2022 for IPL to cease routing all wastestreams to the OGS Ash Pond** (the "Surface Impoundment") and initiate closure of this CCR unit. The Surface Impoundment has an approximate surface area of 39 acres and receives non-CCR wastestreams from the plant. IPL ceased discharge of CCR wastestreams to the OGS Ash Pond in September 2020 and is currently finalizing the installation of a dry bottom ash handling system.

IPL began identifying compliance options for the OGS Impoundment in December 2015, after the effective date of the CCR Rule (40 CFR Part 257, Subpart D). Identifying options for handling both CCR and non-CCR wastestreams at OGS had to take into account not only the evolving requirements of the CCR Rule, but also the newly revised Effluent Limitations Guidelines and Standards (ELGs), as incorporated into the facility's NPDES wastewater discharge permit. Following a 2016 study, IPL identified several actions to comply with the CCR and ELG rules, including the preferred hybrid closure approach for the Surface Impoundment and closure by removal of the Zero Liquid Discharge (ZLD) Pond. The CCR material in the ZLD Pond will be consolidated into the Surface Impoundment and the pond will receive a new liner system and be repurposed into a Low Volume Wastewater Treatment Pond (LVWTP) to treat non-CCR wastestreams which are currently routed to the Surface Impoundment.

IPL has identified three primary activities that must be completed before IPL can cease all CCR and non-CCR wastestreams to the Surface Impoundment and commence its closure, including:

- Complete installation of dry bottom ash handling system. The plant is currently in outage to install a dry bottom ash handling system and ceased sluicing bottom ash in September 2020.
- Close the inactive ZLD Pond through removal of CCR, construct a low Wastewater Treatment Pond in the original footprint, and reroute non-CCR wastestreams to it.
- Cease non-CCR wastestreams to the Surface Impoundment.

As certified herein, the facility is in compliance with all the requirements of the CCR Rule and will remain in compliance. Regular compliance activities, including required groundwater monitoring and reporting, are ongoing and all required documents have been placed into the facility's Operating Record and posted on the publicly available website. Groundwater monitoring performed under the CCR Rule has identified one constituent listed in Appendix IV to the CCR Rule, cobalt, detected at statistically significant levels exceeding the applicable groundwater protection standards. Subsequent evaluations of the nature and extent of the cobalt impacts found that the concerns are limited to shallow groundwater in the vicinity of the Surface Impoundment. IPL has not identified any offsite impacts or impacts to drinking water sources. IPL has completed the Assessment of Corrective Measures (ACM) and an initial public meeting to discuss the ACM with interested and affected parties was held on June 4, 2020. An addendum to the ACM was completed in November 2020 and IPL will conduct an additional public meeting to discuss the most recent ACM. IPL completed an initial Selection of Remedy Report but remains in the Selection of Remedy phase following the collection of new information that resulted in updates to the ACM.

Alternate offsite disposal capacity is not available and cannot be made available prior to April 11, 2021 for wastestreams currently entering the Surface Impoundment. As acknowledged previously by EPA, it is not feasible to transport wet CCR to an offsite location. Nor is it feasible to transport the facility’s large volume of non-CCR wastestreams offsite for disposal. In addition, as a result of the extensive power production infrastructure on the site, as well as numerous environmental and site-specific physical constraints such as, public roadways, floodplains, streams and wetlands near the plant proper, OGS lacks an alternative suitable location at the plant site for construction of the LVWTP needed to treat the non-CCR wastestreams. OGS estimates that the environmental permitting associated with constructing a new LVWTP in a location outside the ZLD pond footprint (which is being closed by removal) would extend the compliance schedule beyond the timeframe requested in this Demonstration.

As noted above, alternate onsite disposal capacity is not currently available and cannot be made available prior to April 11, 2021. Given the extensive existing power production infrastructure on the site, as well as numerous environmental constraints such as floodplains, streams and wetlands, IPL determined that the best and most feasible location to construct a new LVWTP to treat non-CCR wastestreams currently routed to the Surface Impoundment is within the footprint of the ZLD Pond following the removal of CCR. The ZLD Pond cannot be closed by removal of CCR and repurposed prior to April 11, 2021, thus non-CCR wastestreams must continue to flow to the Surface Impoundment until the LVWTP is in service. Closure of the Surface Impoundment will commence after the LVWTP is in service.

IPL is currently completing installation of the dry bottom ash handling system and no longer discharges CCR wastestreams to the Surface Impoundment. Closure by removal of CCR in the ZLD Pond is scheduled to commence in spring of 2021 with LVWTP construction beginning spring of 2022. Based on the construction schedule set forth in this Demonstration, IPL estimates the LVTWP will be complete and the flow of all CCR and non-CCR wastestreams to the Surface Impoundment will cease by December 31, 2022.

Consequently, because of the demonstrated lack of available alternate disposal capacity before April 11, 2021, as well as the compliance status of the facility and IPL's diligent and good faith efforts since December 2015 to comply with the CCR and ELG Rules, pursuant to 40 C.F.R. § 257.103(f)(1), IPL respectfully requests a site-specific alternate deadline of December 31, 2022, to initiate closure of the Surface Impoundment at OGS.

1.0 INTRODUCTION

On April 17, 2015, the Environmental Protection Agency (EPA) published the final version of the federal Coal Combustion Residuals Rule (CCR Rule), 40 CFR Part 257, Subpart D, to regulate the disposal of coal combustion residual (CCR) materials generated at coal-fired units. The rule is being administered under Subtitle D of the Resource Conservation and Recovery Act (RCRA, 42 United States Code [U.S.C.] §6901 *et seq*.).

On August 28, 2020, the EPA Administrator issued revisions to the CCR Rule that require all unlined surface impoundments to cease receipt of CCR and non-CCR waste and initiate closure by April 11, 2021, unless an alternative deadline is requested and approved. 40 C.F.R. § 257.101(a)(1) (85 Fed. Reg. 53,516, 53,561 (Aug. 28, 2020)). Specifically, owners and operators of a CCR surface impoundment may seek and obtain an alternative closure deadline by demonstrating that there is currently no alternate capacity available on or off-site and that it is not technically feasible to complete the development of alternative capacity prior to April 11, 2021. 40 C.F.R. § 257.103(f)(1)(i) and (ii). To make this demonstration, the facility is required to provide detailed information regarding the process the facility is undertaking to develop the alternative capacity. 40 C.F.R. § 257.103(f)(1).

IPL is subject to the CCR Rule and as such is required to ensure that its CCR units maintain compliance with the requirements of the CCR Rule. Pursuant to the requirements in the CCR Rule, this document serves as IPL's Demonstration for a Site-Specific Alternate to Initiation of Closure Deadline for the existing CCR Surface Impoundment at the Ottumwa Generating Station (OGS), designated as the OGS Ash Pond and hereafter referred to as the Surface Impoundment, located near Ottumwa, Iowa in Wapello County. This document seeks EPA approval under 40 CFR §257.103(f)(1) ("Development of Alternate Capacity Infeasible") for the OGS Surface Impoundment to continue to receive CCR and/or non-CCR wastestreams by demonstrating that the CCR and/or non-CCR wastestreams must continue to be managed in the Surface Impoundment because it is infeasible to complete the measures necessary to provide alternative disposal capacity by April 11, 2021.

To obtain an alternative closure deadline under 40 C.F.R. § 257.103(f)(1), a facility must meet the following three criteria:

1. § 257.103(f)(1)(i) - There is no alternative disposal capacity available on-site or off-site. An increase in costs or the inconvenience of existing capacity is not sufficient to support qualification.

2. § 257.103(f)(1)(ii) - Each CCR and/or non-CCR wastestream must continue to be managed in that CCR surface impoundment because it was technical infeasible to complete the measures necessary to obtain alternative disposal capacity either on or off-site of the facility by April 11, 2021; and
3. § 257.103(f)(1)(iii) - The facility is in compliance with all the requirements of the CCR rule.

To demonstrate that the first two criteria above have been met, 40 C.F.R. § 257.103(f)(1)(iv)(A) requires the owner or operator to submit a work plan that contains the following elements:

- A written narrative discussing the options considered both on and off-site to obtain alternative capacity for each CCR and/or non-CCR wastestreams, the technical infeasibility of obtaining alternative capacity prior to April 11, 2021, and the option selected and justification for the alternative capacity selected. The narrative must also include all of the following:
  - An in-depth analysis of the site and any site-specific conditions that led to the decision to select the alternative capacity being developed;
  - An analysis of the adverse impact to plant operations if the CCR surface impoundment in question were to no longer be available for use; and
  - A detailed explanation and justification for the amount of time being requested and how it is the fastest technically feasible time to complete the development of the alternative capacity.
- A detailed schedule of the fastest technically feasible time to complete the measures necessary for alternate capacity to be available including a visual timeline representation. The visual timeline must clearly show all of the following:
  - How each phase and the steps within that phase interact with or are dependent on each other and the other phases;
  - All of the steps and phases that can be completed concurrently;
  - The total time needed to obtain the alternative capacity and how long each phase and step within each phase will take; and
  - At a minimum, the following phases: engineering and design, contractor selection, equipment fabrication and delivery, construction, and start up and implementation.
- A narrative discussion of the schedule and visual timeline representation, which must discuss the following:
  - Why the length of time for each phase and step is needed and a discussion of the tasks that occur during the specific step;
  - Why each phase and step shown on the chart must happen in the order it is occurring;
  - The tasks that occur during each of the steps within the phase; and

  - Anticipated worker schedules.
- A narrative discussion of the progress the owner or operator has made to obtain alternative capacity for the CCR and/or non-CCR wastestreams. The narrative must discuss all the steps taken, starting from when the owner or operator initiated the design phase up to the steps occurring when the demonstration is being compiled. It must discuss where the facility currently is on the timeline and the efforts that are currently being undertaken to develop alternative capacity.

To demonstrate that the third criterion above has been met, 40 C.F.R. § 257.103(f)(1)(iv)(B) requires the owner or operator to submit the following information:

- A certification signed by the owner or operator that the facility is in compliance with all of the requirements of 40 C.F.R. Part 257, Subpart D;
- Visual representation of hydrogeologic information at and around the CCR unit(s) that supports the design, construction and installation of the groundwater monitoring system. This includes all of the following:
  - Map(s) of groundwater monitoring well locations in relation to the CCR unit(s);
  - Well construction diagrams and drilling logs for all groundwater monitoring wells; and
  - Maps that characterize the direction of groundwater flow accounting for seasonal variations.
- Constituent concentrations, summarized in table form, at each groundwater monitoring well monitored during each sampling event;
- A description of site hydrogeology including stratigraphic cross-sections;
- Any corrective measures assessment conducted as required at § 257.96;
- Any progress reports on corrective action remedy selection and design and the report of final remedy selection required at § 257.97(a);
- The most recent structural stability assessment required at § 257.73(d); and
- The most recent safety factor assessment required at § 257.73(e).

2.0 WORKPLAN

To demonstrate that the criteria in 40 C.F.R. § 257.103(f)(1)(i) and (ii) have been met, the following is a workplan, consisting of the elements required by § 257.103(f)(1)(iv)(A). IPL is currently completing the installation of a dry bottom ash handling system and no longer discharges bottom ash to the OGS Surface Impoundment. IPL has also elected to install a system of multiple technologies to treat and store the non-CCR wastestreams currently routed to the Surface Impoundment. This workplan documents that there is no alternative capacity available on or off-site for each of the non-CCR wastestreams that IPL plans to continue to manage in the Surface Impoundment throughout the period of this extension and discusses the options considered for alternative disposal capacity. It also provides a detailed schedule for obtaining the selected alternative capacity, including a narrative description of the schedule and an update on the progress already made toward obtaining the alternative capacity.

2.1 § 257.103(f)(1)(iv)(A)(1) - No Alternative Disposal Capacity and Approach to Obtain Alternative Capacity

OGS is co-owned by MidAmerican Energy Company (MidAm) and IPL, operated by IPL, and is comprised of a single operating coal fired unit with a 726 net MW capacity of generation. OGS is located along the Des Moines River in Wapello County, approximately nine miles northwest of Ottumwa, Iowa.

OGS contains two CCR surface impoundments located on the north and east side of the plant site as shown in Appendix A. The OGS Ash Pond is an existing CCR Surface Impoundment that was designed and constructed in the 1970s with an approximate surface area of 39 acres measured within the perimeter dikes. The Surface Impoundment received sluiced bottom ash until September 2020 and continues to receive non-CCR wastestreams generated from inside the plant. The ZLD Pond was designed and constructed in the mid-1970s and has an approximate surface area of 19 acres measured within the perimeter dikes. Although the ZLD Pond received CCR shortly after construction, it has not regularly received wastestreams other than to support contingencies in the plant operations since the early 1980s and is classified as an inactive CCR surface impoundment. This Demonstration has been submitted to request approval of an alternate site-specific deadline of December 31, 2022 to cease all discharges of CCR and non-CCR wastestreams to the OGS Ash Pond.

2.1.1 CCR Wastestreams

IPL is currently completing installation of a dry bottom ash handling system and no longer discharges bottom ash to the Surface Impoundment. There are currently no other CCR wastestreams to the Surface

Impoundment. However, the Surface Impoundment will receive CCR material from the ZLD Pond when it is closed by removal of CCR and repurposed as a new lined wastewater treatment basin.

2.1.2 Non-CCR Wastestreams

Currently, OGS utilizes the Surface Impoundment to manage non-CCR wastestreams from the plant in accordance with the facility's National Pollutant Discharge Elimination System (NPDES) permit. OGS currently recycles wastewater from the Surface Impoundment for reuse throughout the plant for operations or discharges it in accordance with the NPDES permit. The Surface Impoundment receives the non-CCR wastestreams detailed in Table 2-1. For additional details, see the existing water balance included in Appendix A of this demonstration.

IPL intends to install a new 19-acre process water treatment pond, hereafter referred to as the Low Volume Wastewater Treatment Pond (LVWTP), for treatment of the non-CCR wastestreams currently routed to the Surface Impoundment apart from Cooling Tower Blowdown and Air Heater Wash Water. The LVWTP sizing is primarily driven by the need for settling of suspended solid particles to meet NPDES discharge limitations for total suspended solids (TSS), which is dictated by particle size and the peak flow rates experienced. The Surface Impoundment must remain available for treatment of these wastestreams until the LVWTP can be constructed and other non-CCR wastestreams can be re-routed. These projects are described in detail within Section 2.1.6 and 2.3 of this demonstration. Table 2-1 summarizes a description, the status of each of the non-CCR wastestreams throughout the period of the requested extension, and the volume of wastestreams.

Table 2-1: OGS Non-CCR Wastestreams

Non-CCR Wastestream	Average Flow (gpm)	Description	Notes
Clarifier Sludge	65	Sludge from Solids Contact Unit clarifiers used to treat plant makeup water. Collected in clarifiers and blowdown via gravity to Surface Impoundment.	This wastestream includes 9-10% solids and cannot be discharged without treatment due to TSS discharge limits at Outfall 001. This wastestream must be managed in the existing Surface Impoundment until it can be redirected to the new LVWTP.

Non-CCR Wastestream	Average Flow (gpm)	Description	Notes
Cooling Tower Blowdown	445	Blowdown from Cooling Tower is pumped to the existing Ash Water Surge Tank and then overflows to sumps that pump wastewater to the Surface Impoundment	This wastestream will be routed and pumped around the LVWTP to a new Outfall 007 to the Des Moines River. The infrastructure not currently available to discharge this wastestream directly or manage at another location on site and the site discharge permit must be modified before this could occur. This flow will be re-routed from the Surface Impoundment by October of 2022.
Ultrafilter Backwash	18	Filter backwash from the boiler water pre-treatment system wastestreams by gravity to the Surface Impoundment	High TDS stream which cannot be directly discharged. This wastestream must be managed in the Surface Impoundment until it can be redirected to the new LVWTP.
Gravity Filter Backwash	92	Filter backwash from the boiler water pre-treatment system wastestreams by gravity to the Surface Impoundment	This will be redirected to the new LVWTP. There is currently no infrastructure on-site to discharge this wastestream directly or manage at another location on site.
Reverse Osmosis Reject	112	RO reject from the boiler water pre-treatment system wastestreams by gravity to the Surface Impoundment	High TDS stream which cannot be directly discharged. This wastestream must be managed in the Surface Impoundment until it can be redirected to the new LVWTP.
Condensate Polisher Wastewater	4	Polisher wastewater from the boiler water pre-treatment system wastestreams by gravity to the Surface Impoundment	This will be redirected to the new LVWTP. There is currently no infrastructure on-site to discharge this wastestream directly or manage at another location on site.
Boiler Blowdown	127	Boiler blowdown wastewater from the boiler water system wastestream by gravity to the Surface Impoundment	This will be redirected to the new LVWTP. There is currently no infrastructure on-site to discharge this wastestream directly or manage at another location on site.
Misc. Oily Plant Drains	135	Plant drains from various equipment and maintenance sources which are treated by oil water separator prior to flowing by gravity to Surface Impoundment	This will be redirected to the new LVWTP. There is currently no infrastructure on-site to discharge this wastestream directly or manage at another location on site.

Non-CCR Wastestream	Average Flow (gpm)	Description	Notes
Misc. Plant Drains	Intermittent (50 or less)	Plant drains from washdowns, misc. maintenance activities which do not flow through oil water separator and are pumped from boiler area sump to Surface Impoundment	This will be redirected to the new LVWTP. There is currently no infrastructure on-site to discharge this wastestream directly or manage at another location on site.
Stormwater	1,000*	Site stormwater runoff	This will be redirected to the new LVWTP. There is currently no infrastructure on-site to discharge this wastestream directly or manage at another location on site.
Air Heater Wash Water	Intermittent (Outage flow only)	This wastestream is pumped to the Surface Impoundment	Any outages scheduled after April 11, 2021 that include air heater wash events will include provisions to collect this wastestream and use temporary treatment prior to discharge to Outfall 001 until the startup of the LVWTP.
On Site Sewage Treatment Wastestreams	3	Discharge from On Site package sewage treatment system	There is currently no infrastructure on-site to discharge this wastestream directly or manage at another location on site.

*Average Flow rate estimated from volume runoff of total annual rainfall averaged over the year.

These flows need to be treated prior to being discharged to Outfall 001. Due to the solids content in the wastestreams listed in Table 2-1, they cannot be routed to any location on-site other than the existing CCR Surface Impoundment, and the combined volume is too large to be managed on-site in temporary tanks, even when considering reuse of wastewater within the existing plant. Many of these wastestreams are comingled within the plant sumps to be discharged to the current Surface Impoundment and would require additional measures (including sampling, characterization, permit modifications, design, procurement, and installation of new sumps, pumps, piping, and power supplies) to separate these wastestreams. The relatively fine solids in the SCU Blowdown wastewater in particular, would not likely settle sufficiently in a tank system for discharge.

These wastestreams cannot currently be rerouted to other non-CCR impoundments onsite without developing this onsite alternative capacity further. The site discharge permit would need to be modified, and significant plant modifications will be required, including the addition of sumps, pumps, piping, and associated power supply systems.

IPL has evaluated off-site disposal options for the large volume of non-CCR wastestreams and determined that such disposal is not feasible. IPL has not yet identified a publicly owned treatment works (POTW) or alternate wastewater treatment facility that will accept these wastestreams. Off-site disposal also would require on-site temporary storage (such as frac tanks), the installation of sumps/pumps/piping/and power supply to reroute these flows to that temporary storage, permit modifications with external sources (if a POTW can be identified to receive these flows), and significant daily tanker truck traffic driving an unknown distance across Iowa roadways if a POTW could even be identified and contracted to receive it. The numbers of tanks and trucks are summarized as follows for each non-CCR wastestream:

- <u>Clarifier Sludge (65 gpm):</u> This flow would require approximately 5 frac tanks onsite and 13 daily trucks, at 21,000 gallons and 7,500 gallons each. Also, with the fine solids content with this flow additional residence time (more frac tanks) maybe required to meet permit discharge limits.
- <u>Cooling Tower Blowdown (445 gpm):</u> This flow would require approximately 31 frac tanks onsite and 86 daily trucks.
- <u>Ultrafilter Backwash (18 gpm):</u> This flow would require approximately 2 frac tanks onsite and 4 daily trucks.
- <u>Gravity Filter Backwash (92 gpm):</u> This flow would require approximately 7 frac tanks onsite and 18 daily trucks.
- <u>Reverse Osmosis Reject (112 gpm):</u> This flow would require approximately 8 frac tanks onsite and 22 daily trucks.
- <u>Condensate Polisher Wastewater (4 gpm):</u> This flow would require approximately 1 frac tank onsite and 1 daily truck.
- <u>Boiler Blowdown (127 gpm):</u> This flow would require approximately 9 frac tanks onsite and 25 daily trucks.
- <u>Miscellaneous Oily Plant Drains (135 gpm):</u> This flow would require approximately 10 frac tanks onsite and 26 daily trucks.
- <u>Miscellaneous Plant Drains (Intermittent 50 gpm or less):</u> This flow would require approximately 4 frac tanks onsite and 10 daily trucks.
- <u>On Site Sewage Treatment Wastestreams (3 gpm):</u> This flow would require approximately 1 frac tank onsite and 1 daily truck.
- <u>Stormwater (Estimated 1,000 gpm, not accounting for peak flow events):</u> This flow would require approximately 64 frac tanks onsite and 192 daily trucks.

This frac tank traffic as well as the significant daily tanker truck volume for offsite disposal (total of 300 trucks per day during normal operations with increases during rain events) would result in increased potential for safety and noise impacts and further increases in fugitive dust, greenhouse gas emissions and carbon footprint which may require a PSD permit and modification under the Clean Air Act Permit Program if the calculated increase in emissions are over the PSD limits. Consequently, the options considered to install temporary tanks to store and reuse this wastewater onsite or to install pipelines or mobilize trucking for offsite disposal of these wastestreams is not considered a feasible alternative at OGS.

2.1.3 Site-Specific Conditions Supporting Alternative Capacity Approach – § 257.103(f)(1)(iv)(A)(1)(i)

As shown on the site plan in Appendix A, OGS is landlocked between the Des Moines River on the east, Middle Avery Creek on the south, and outside landowners on the north and west. Much of the OGS site that is outside the floodplain (i.e. west of the Des Moines River and North of Middle Avery Creek) is occupied with critical infrastructure including the Surface Impoundment, coal storage pile, cooling towers, switchyard, and transmission lines. There is an existing coal pile runoff pond on site, but it is not large enough to treat the plant non-CCR wastestreams. Based on a review of the available space within the developed portions of the site that support OGS operations, it is not possible to construct a new LVWTP (with associated piping and power supply) that is large enough to receive non-CCR wastestreams and be outside of both the floodplain and the current surface impoundments (see Figure 2 in Appendix A).

IPL owns additional land outside of the developed portions of the site on the other side of Middle Avery Creek. However, construction of an approximately 19-acre LVWTP, pipe racks, power supply, and access roads to connect the pond with the plant would cause additional impacts to waters of the U.S. (excavation, filling, changes in wetland function, and other impacts to surface hydrology), clearing of forested areas, including impacts to protected bat habitat, and probability for impacts to cultural resources in the area.

The Indiana bat (*Myotis sodalis*) is a State- and federally protected species that may occur in the vicinity of OGS, according to the Iowa Department of Natural Resources, Natural Areas Inventory and the U.S. Fish and Wildlife Service’s Information for Planning and Consultation System (IPaC). IPaC also identifies the northern long-eared bat (*Myotis septentrionalis*), a federally protected species, as known or likely to occur in Wapello County. During a habitat assessment of the developed portion of the OGS site in July 2020, conducted by Burns & McDonnell biologists, one potential roost tree for the Indiana bat was identified. Additional roosting habitat may be located within the undeveloped, riparian forested areas along Middle Avery Creek.

A cultural resources desktop review of the OGS area, performed by Burns & McDonnell in June 2020, found 16 archaeological sites within the study area, as documented by I-Sites, the online Iowa database for archaeological sites. These archaeological sites, which included open habitations, artifact scatters, mounds, a cabin, and a prehistoric camp, were identified during four surveys performed between 1975 and 2006 for the Ottumwa Generating Station. Based on the established use of this area along the Des Moines River and Middle Avery Creek by prehistoric and historic groups, additional cultural resources would likely be identified in the undeveloped areas adjacent to the plant site and impacted by construction.

A field delineation of the OGS site was performed in July 2020, which identified significant wetland areas onsite, including areas presumed to be jurisdictional wetlands and streams (located outside of existing wastewater treatment systems), as well as wetland characteristics within the existing Surface Impoundment area. Based on the extent of wetlands within the developed portion of the OGS, construction of a new LVWTP and associated infrastructure on adjacent, undeveloped land could require significant wetland impacts (i.e., 0.5 acre or more) and a Section 404 Individual Permit from the U.S. Army Corps of Engineers.

The permitting timeline for impacts of this scale, outside the developed portions of the site, could be in excess of 12 to 18 months beyond what is currently planned for the LVWTP and would require compensatory mitigation for losses to waters of the U.S. (under Section 404 of the Clean Water Act) and protected species habitat (under the Endangered Species Act, Migratory Bird Treaty Act, and/or the Bald and Golden Eagle Protection Act).

Constructing the new LVWTP within the existing footprint of the ZLD Pond is currently the fastest feasible alternative for managing non-CCR wastestreams and would avoid additional impacts to waters of the U.S. and other natural and cultural resources in the Des Moines River and Avery Creek watershed.

2.1.4 Impact to Plant Operations if Alternative Capacity Not Obtained – § 257.103(f)(1)(iv)(A)(1)(ii)

As described in Sections 2.1.1, 2.1.2, and 2.1.6 of this demonstration, in order to continue to operate, generate electricity, and comply with both the CCR Rule and the IDNR permit conditions, OGS must continue to use the Surface Impoundment for treatment of non-CCR wastestreams until alternate disposal capacity can be developed. This development includes three primary activities that still must be completed in order to cease routing wastestreams to the Surface Impoundment:

- Complete installation of dry bottom ash handling system. The plant is in outage to install a dry bottom ash handling system and no longer discharges bottom ash to the Surface Impoundment.
- Close the inactive ZLD pond through removal of CCR, construct a Low Volume Wastewater Treatment Pond in the original footprint, and reroute non-CCR wastestreams to it.
- Cease non-CCR wastestreams to the Surface Impoundment.

These activities cannot be completed concurrently. Each activity must be completed prior to the next activity beginning. The Surface Impoundment must be allowed to continue to receive these wastestreams until construction of the new LVWTP is completed or the facility would not be able to discharge wastewaters in accordance with the NPDES permit and would therefore be unable to operate.

2.1.5 Options Considered Both On and Off-Site to Obtain Alternative Capacity

As EPA explained in the preamble of the 2015 rule, it is not possible for sites that sluice CCR material to an impoundment to eliminate the impoundment and dispose of the material offsite. See 80 Fed. Reg. 21,301, 21,423 (Apr. 17, 2015) (“[W]hile it is possible to transport dry ash off-site to [an] alternate disposal facility that is simply not feasible for wet-generated CCR. Nor can facilities immediately convert to dry handling systems.”). IPL recognizes this fact and agrees with EPA that offsite disposal of wet-generated material is not an option for OGS. Nor is it feasible to provide offsite treatment of the large volume of non-CCR wastewaters currently routed to the Surface Impoundment. As explained above it is not practical to install an extensive temporary treatment system due to the amount of frac tanks and interconnecting piping that would be necessary for treatment of the wastestreams prior to discharging to Outfall 001. There also is not infrastructure in place to send flows to a local treatment facility and the time to develop and permit this infrastructure would be longer than the proposed plan to develop the LVWTP (which has already been designed and is currently being permitted and for which IPL is currently procuring construction services).

The facility is currently in outage to complete installation a dry bottom ash handling system, consisting of bottom ash extraction conveyors and a storage silo. Installation was originally planned to be completed by the summer of 2020 but impacts of the COVID-19 pandemic pushed outage work to the fall of 2020. Once the conversion is complete, dry bottom ash will be sent to an off-site landfill for disposal.

OGS evaluated the construction of new impoundments as a solution for CCR compliance. As shown on Figure 2 in Appendix A, OGS is landlocked with the Des Moines river located on the east, and Middle Avery Creek along the south side of the plant. The western and northern boundary is formed by residential properties as shown in Figure 2. Much of the site that is outside the floodplain is occupied with critical infrastructure including coal storage pile, the switchyard, transmission lines, railroad lines and the existing site impoundments. The limited space and congestion in and around the plant does not provide sufficient space for the construction of a new pond(s) or temporary tanks to manage and store non-CCR wastestreams. The other areas adjacent to OGS within the plant boundary are not considered technically feasible to support the construction of new impoundments due to potential wetlands impacts, acquisition of water rights, and permitting concerns as noted on Figure 2 in Appendix A.

The other options considered for alternative disposal capacity of the non-CCR wastestreams currently routed to the Surface Impoundment are summarized in Table 2-2.

Table 2-2: OGS Alternatives for Disposal Capacity

Alternative Capacity Technology	Average Time (Months)[1]	Feasible at OGS?	Selected?	IPL Notes
Conversion to dry handling	33.8	Yes	Yes	The facility is in outage to complete installation of a dry bottom ash handling system and ceased sluicing bottom ash in September 2020.
Non-CCR wastewater basin	23.5	Yes	Yes	A new LVWTP is being constructed as one part of the solution to comply with EPA and IDNR requirements. The volume of non-CCR wastestreams cannot be contained within existing non-CCR basins with adequate residence time to meet discharge limits. There is not adequate space onsite to construct additional non-CCR basins outside the footprint of the Surface Impoundment and ZLD Pond. The ZLD Pond will need to be closed by removal prior to the LVTWP construction.
Wastewater treatment facility	22.3	Yes	No	Closing the ZLD Pond and constructing the LVWTP within the footprint of the ZLD Pond was selected for wastewater treatment. Designing and permitting a new facility will add a minimum to six months to the remaining project schedule.

Alternative Capacity Technology	Average Time (Months)[1]	Feasible at OGS?	Selected?	IPL Notes
New CCR surface impoundment	31	No	No	There is not adequate space within the developed areas of the site to construct a new CCR surface impoundment, and a new impoundment alone would not allow for ELG compliance (a high recycle system would be required). Construction of a new surface impoundment in peripheral areas that complies with the Location Restrictions would result in substantial impacts to jurisdictional waters that would extend this average timeframe further to allow for permitting.
Retrofit of a CCR surface impoundment	29.8	Yes	No	The construction of the LVWTP is essentially a retrofit of the ZLD Pond Surface Impoundment for the continued use of non-CCR wastestreams; however, the LVWTP will not be considered a CCR surface impoundment moving forward.
Multiple technology system	39.1	Yes	Yes	This is being implemented as described above to include dry ash conversions, a new LVWTP (non-CCR impoundment), additional treatment in the solids contact unit clarifier, and redirection of various non-CCR wastestreams.
Temporary treatment system	Not defined	No	No	These systems would not realistically provide the required non-CCR wastewater storage capacity to replace the Surface Impoundment. The wastestreams are comingled within the plant boundary and the time required to separate the streams and place a tank-based storage system into service would be greater than the proposed plan of development of the LVWTP.

[1]From Table 3. See 85 Fed. Reg. at 53534.

2.1.6 Approach to Obtain Alternate Disposal Capacity

Due to the overall water management needs of the facility, including ELG compliance requirements to eliminate the discharge of ash transport water and provide the necessary storage and treatment of the non-CCR wastestreams generated at the site, the only viable solution for alternative disposal capacity involves a combination of technologies.

As shown on the schedule in Appendix B, IPL has been in the process of developing alternate disposal capacity since the final CCR Rule was published in April 2015. Shortly after the rule was released and prior to the effective date of the rule, IPL hired Sargent & Lundy (S&L) to evaluate the impacts from the rule and begin compiling the required compliance documentation. S&L completed a technology evaluation that investigated multiple technology options for compliance with the CCR and ELG rules.

Following the 2016 study, IPL selected a dry bottom ash system to replace the bottom ash sluicing system. This selection was based on comparison of capital cost, O&M cost, several business factors, and future regulatory risk associated with each of the alternatives that were deemed to be technically feasible at OGS. S&L and IPL jointly developed the design basis, as well as the preliminary design and project budget, for the selected system.

In late 2018, IPL hired Burns & McDonnell to develop a design basis for the treatment of non-CCR wastestreams. The design basis for the treatment system included a new lined Low Volume Wastewater Treatment Pond, constructed within the footprint of the existing ZLD Pond, to treat non-CCR wastestreams generated at OGS, additional chemical feed/treatment system for the existing SCU clarifiers, LVWTP wastewater recycle pumps, a wastewater re-direct lift station, and various non-CCR wastestream reroutes.

Each of the noted scope items is required to provide alternate treatment for the CCR and non-CCR wastestreams that currently are routed to the Surface Impoundment. Once installed, the scope items will enable IPL to initiate closure of the Surface Impoundment. This closure is intended to minimize risk to groundwater associated with the Surface Impoundment. Despite the large degree of regulatory uncertainty and ongoing updates to the ELG and CCR Rule during project development and implementation, as a prudent utility, IPL forged ahead with the project in order to meet the scheduled 2020 major outage for installation of the dry bottom ash handling system, produce construction plans for the new LVWTP, and design the closure of the Surface Impoundment. OGS's current NPDES Permit requires the facility to cease of discharge pollutants in ash transport water by June 1, 2022. This environmentally responsible and aggressive effort by IPL allows for the project to beat the ELG compliance dates by approximately 20 months for zero discharge of ash transport water.

The new ash handling equipment specifications were developed as part of the project scoping effort and were issued for bid in December 2017. An Engineering, Procurement, Construction (EPC) contract was awarded in the spring of 2018. Engineering and procurement efforts commenced shortly thereafter. Construction began in the fall of 2018, with the intent of completing the bottom ash conversion during an outage in the spring of 2020. Due to the COVID-19 pandemic, the tie in outage was ultimately postponed to the fall of 2020. The plant ceased sluicing bottom ash in September 2020.

The Surface Impoundment will continue receiving non-CCR wastestreams until the new LVWTP construction is completed in December 2022, at which point non-CCR wastestreams will be redirected to the LVWTP. The Surface Impoundment will also receive the excavated material from the ZLD Pond in 2021, including residual CCR from early operations of the plant.

The LVWTP was sized to provide residence time for the SCU blowdown sludge and the surges of stormwater runoff that occur during heavy rain events. Based on the estimated residence time required, the LVWTP will have a total storage volume of 18 million gallons (occupying 19 acres) to treat the non-CCR wastestreams. The LVWTP plan and cross sections are included in Appendix A.

The LVWTP construction will require close coordination between plant operations and the construction Contractor and cannot begin until the ZLD Pond closure by removal of CCR has been completed. This work will proceed in the following order once the pond construction contract is awarded:

- Contractor will begin lowering the pond level (removing free water) in the ZLD Pond. The water will be sent to the Surface Impoundment to be treated and discharged through Outfall 001.
- Residual material from ZLD Pond, including CCR and an estimated one-foot thick layer of underlying soils will be removed from the ZLD Pond and placed into the Surface Impoundment.
- A new LVWTP outlet structure and recycle pump structure (to recycle wastewater back to plant) will be constructed.
- The LVWTP subgrade, diversion berms, GCL liner, geomembrane liner, and protective cover (including channel lining or grout mat systems) will be installed.
- The LVWTP recycle pumps, diversion structure, inflow/outflow piping will be installed and all non-CCR wastestreams will be redirected to the new LVWTP.

Closure of the Surface Impoundment will officially commence no later than 30 days after the date on which the Surface Impoundment receives the known final receipt of waste, including both CCR and non-CCR waste streams. The LVWTP construction is expected to be finalized no later than December 2022, allowing for final receipt of non-CCR wastestreams in the Surface Impoundment and initiation of closure no later than December 31, 2022; however, this date may be delayed by a number of factors, including delays in dewatering and removal efforts caused by adverse weather, contractor efficiency, changes to the actual quantities required for CCR removal and over-excavation, and potential COVID-19 pandemic impacts to the LVWTP construction schedule. If such a delay were to occur, IPL would detail the delay in the semi-annual progress reports and if needed submit a request a revision to the final receipt date as allowed under the rule.

The construction contract for the new LVWTP and closure of the Surface Impoundment has been released for bid in late October 2020 and is expected to be awarded in March 2021. IPL is currently in the process of permitting the construction of the new LVWTP and the closure of the ZLD Pond and the Surface Impoundment. The Contractor will be able to begin dewatering the ZLD Pond to support removal of material second quarter of 2021 as there are currently no wastestreams going to the ZLD Pond. The remainder of the work required to develop the new LVWTP is described further in Section 2.3 of this demonstration.

2.1.7 Technical Infeasibility of Obtaining Alternative Capacity prior to April 11, 2021

Based on the foregoing facts, IPL cannot cease non-CCR wastestreams and initiate closure of the Surface Impoundment until the new LVWTP is constructed within the footprint of the ZLD Pond (in order to receive and treat the non-CCR wastestreams). And despite IPL’s early, proactive approach to these requirements, those actions cannot be completed prior to April 11, 2021. Thus, the conditions at OGS demonstrate that no alternative disposal capacity is available on-site or off-site, satisfying the requirement of 40 CFR 257.103(f)(1)(i), and IPL respectfully requests a site-specific extension of the deadline to initiate closure of the Surface Impoundment until December 31, 2022 – the date on which those actions are expected to be completed.

IPL began its selected compliance project execution for OGS with scoping studies in 2015, submitted an application for approval for the dry bottom ash conversion in 2017, and awarded contracts to procure the necessary long-lead equipment items early in 2018 prior to the remand of closure requirements by the U.S. Court of Appeals for the D.C. Circuit in *USWAG*, which caused EPA to revise § 257.101(a)(1) to require owners and operators to cease placement of both CCR and non-CCR wastestreams into all unlined CCR surface impoundments no later than April 11, 2021. This work has been executed proactively and aggressively but has not yet been completed and will not be complete by this deadline.

2.1.8 Justification for Time Needed to Complete Development of Alternative Capacity Approach – § 257.103(f)(1)(iv)(A)(1)(iii)

The schedule for developing alternative disposal capacity is described in more detail in Sections 2.2 and 2.3. The milestones for progress are summarized in Table 2-3 below. IPL believes this represents the fastest technically feasible timeframe for compliance at OGS, and these durations are consistent with EPA’s assessment that 34 months accurately reflects the amount of time needed to retrofit a single generating unit with dry ash conversions, followed by an additional 24 months to construct a non-CCR basin. Due to construction in the existing ZLD Pond footprint, the CCR material in the ZLD Pond must be removed prior to building the new LVWTP; however, IPL is still forecasting completion of the pond construction in a 26 month period from the date of this submittal, while also accelerating the removal of material from the unlined ZLD Pond.

Table 2-3: Compliance Project Progress Milestones

Year or Progress Reporting Period	Status	Milestone Description	IPL Notes
2020	Completed	Bottom ash sluice flows ceased at beginning of Fall outage.	The bottom ash CCR wastestream has been eliminated prior to the April 11, 2021 deadline.
2020	Completed	Issue bid packages to contractors for closure of ZLD Pond, LVWTP construction and closure of the Surface Impoundment.	
April 30, 2021		ZLD Pond closure, LVWTP construction and Surface Impoundment closure contract awarded and preparing to mobilize to install pond dewatering water treatment system and begin removing CCR material from ZLD Pond.	Non-CCR wastestreams will continue to be routed to Surface Impoundment during this time as described in Table 2-1.
October 31, 2021		ZLD Pond lowering complete and CCR/subgrade removal underway.	
April 30, 2022		Complete removal of all CCR material and one foot of over excavation from ZLD Pond (projected to be a week after this progress reporting date).	The inactive ZLD Pond will be closed through removal of CCR and accumulated sediment prior to installation of the LVWTP liner. The Surface Impoundment is projected to stop receiving CCR material (from the ZLD Pond) by this date.
October 31, 2022		Geosynthetic component of LVWTP liner installation complete and installation of protective cover and riprap underway.	
December 30, 2022		Complete construction of LVWTP liner system, pumps, piping, and outlet structure.	The pond startup should be completed unless there are delays to the projected schedule. The Surface Impoundment closure will start within 30 days of redirecting the remaining non-CCR wastestreams to the LVWTP.

Year or Progress Reporting Period	Status	Milestone Description	IPL Notes
December 31, 2022		Proposed site-specific deadline for ceasing receipt of CCR and non-CCR wastestreams and initiating closure of the Surface Impoundment	The remaining closure activities for the Surface Impoundment will occur after this date and consequently are not included in this Demonstration.

2.2 Detailed Schedule to Obtain Alternative Disposal Capacity - § 257.103(f)(1)(iv)(A)(2)

The required visual timeline representation of the schedule for the activities outlined in Sections 2.1.6 and 2.3 is included in Appendix B of this demonstration.

2.3 Narrative of Schedule and Visual Timeline - § 257.103(f)(1)(iv)(A)(3)

As shown in Appendix B and described in Sections 2.1.6 and 2.4, IPL has already undertaken significant planning and implementation steps towards initiating closure of the Surface Impoundment. In fact, the work to obtain alternate disposal capacity for the CCR wastestreams at OGS has already been completed. This section of the demonstration is focused on the remaining work necessary to obtain alternate disposal capacity for the CCR and non-CCR wastestreams and to initiate Surface Impoundment closure at OGS.

Unit 1 Outage - (Tie in Outage): The outage to tie in the new dry ash handling equipment for Unit 1 is underway and planned to be operational by December 2020. Bottom Ash sluice to the Surface Impoundment ceased in September of 2020. There is a significant amount of work that is scheduled to take place during the unit outage, including removing the existing boiler hoppers, removing the existing ash sluicing equipment, installing the new dry bottom ash handling equipment, completing piping tie-ins, completing electrical tie-ins, and performing startup of the new equipment and tuning of the ash handling system. This outage had been planned for the spring of 2020, but it was pushed to the fall due to COVID-19 and associated health and safety protocols. The outage requires significant coordination with plant operation and Midcontinent Independent System Operator (MISO), the grid operator. During the outage, critical path construction will occur twenty-four hours per day, seven days per week, as required to get the unit back online as soon as possible.

ZLD Pond Closure/New LVWTP Construction: The contract to remove material, including CCR, from the ZLD Pond to construct the new LVWTP within the footprint of the ZLD Pond is planned to be awarded around March 2021. The durations shown in the schedule in Appendix B are based on a number of factors, including a 50-hour per week construction schedule (with weekend work allowed as required to make up for weather delays), the estimated volumes of CCR material and over-excavated soil to be removed from the ZLD Pond, and the estimated earthwork, liners, protective cover, structures, and piping quantities for the new LVWTP.

Season 1 (2021): The sequence of activities for this LVWTP construction is described in Section 2.1.6, outlined within Appendix B, and summarized in the paragraphs below. Contractor mobilization will not take place until May 2021. Once the Contractor mobilizes to close the ZLD Pond and construct the LVWTP within the ZLD Pond footprint, the Contractor will work to complete early construction activities including installing erosion control, lowering the pond water level (remove the free water from the impoundment), and preparing laydown and construction office areas. Lowering of the pond water level will begin during the spring of 2021. There are no influent streams into the ZLD Pond other than precipitation that falls on the pond. Installation of dewatering equipment to lower the pond level and dewater the CCR material in the ZLD Pond is scheduled to begin in June 2021. Water from the ZLD Pond will be routed to the Surface Impoundment for treatment where it will be discharged via the existing IDNR outfall in accordance with the limits defined in the existing NPDES permit. Throughout the 2021 season, material will be removed from the ZLD Pond and consolidated into the Surface Impoundment. Construction activity will likely cease in the winter months of each season. Heavy civil construction and earthwork is difficult to perform in the winter months due to freezing and thawing cycles that occur in the Upper Midwest region.

In Season 2 (2022), the Contractor will return to complete closure of the ZLD Pond. Grading of diversion berms, the outlet control structures and recycle pump structure will begin in May 2022. While the structures are being completed and installed, the Contractor will begin fine grading of the LVWTP bottom to prepare the surface for GCL and geomembrane liners. The liners will be installed over the 19-acre LVWTP. Once the liners are installed, a granular material layer will be placed for liner protection followed by riprap lining on the sides of the LVWTP. The piping installation (to reroute the non-CCR wastestreams to the LVWTP) will be performed concurrently with the LVWTP construction and is not on the critical path of the project. The LVWTP is planned to be completed in December 2022. The new LVWTP will discharge through a new Outfall 007 that will be permitted through the IDNR and the U.S. Army Corps of Engineers. Approval of the new Outfall 007 is expected to occur no later than the spring of 2022. At the completion of the LVWTP, the non-CCR wastestreams will be routed to the LVWTP and Surface Impoundment closure capping in place can commence as required by 40 CFR 257.101(a). The expected plant water balance after these modifications is included in Appendix A.

There are several variables that could impact the construction of the LVWTP and the initiation of closure of the Surface Impoundment including delays in dewatering and removal efforts associated with weather, contractor efficiency, actual total volume of material to be removed and hauled to the Surface Impoundment, and the COVID-19 pandemic. IPL has developed this plan for the LVWTP construction with the assumption that minimal activities will occur during the winter months when dewatering efficiency and contractor safety might be impacted in addition to technical concerns with placing and compacting frozen material; however, IPL does plan to allow the Contractor to work later into the winter and to start earlier if the weather allows.

While IPL and BMcD have developed, planned, scheduled, and worked to gain State Agency approvals for this complex project according to the proposed timeline, force majeure events, the effects COVID-19, dewatering challenges, unforeseen additional quantities of ash and soil within the ZLD Pond impoundment, and/or over-excavation required for visual inspections and removal could necessitate more time for completion of the project, including completion of the phases needed to bring the LVWTP online and allow closure of the Surface Impoundment to commence. The project schedule is based on a typical construction timeline for working conditions in central Iowa. Winter construction will typically cease in December and restart in March in a typical construction season. Addition time has not been included in the current schedule to address the items stated above. IPL recognizes there is process in place to request an extension if the progress of the project is not progressing as outlined in this Demonstration. It is estimated that approximately 97,000 cubic yards of CCR material will be removed from the ZLD pond and consolidated into the Surface Impoundment. An additional 50,000 cubic yards is estimated for the one foot of over excavation. These estimates are based on aerial and bathymetric surveys completed in the summer of 2019 and comparing the surveys to original pond construction drawings to develop these quantities. IPL recognizes these are estimates and the actual amount of material to be moved will differ from these estimated quantities. The contract for LVWTP construction will be awarded based on quantities stated above, with provisions in place for unit price adjustments if required during execution. This recognizes the possibility that additional material may be discovered, or additional subgrade soils may need to be removed, thus requiring additional time for this removal effort. Such a discovery could cause the date for completion of the LVWTP to be postponed beyond the anticipated completion date in December 2022, into 2023 given the limitations on wintertime construction. The current schedule does not assume that atypical adverse events will occur and IPL would advise EPA as soon as it is aware of the possibility of the need for an extension and work to obtain any necessary approvals in a timely manner.

2.4 Progress Narrative Toward Obtaining Alternative Capacity - § 257.103(f)(1)(iv)(A)(4)

As described in Section 2.1.6 and as shown in Appendix B, IPL has made considerable progress toward creating alternative disposal capacity for the CCR and non-CCR wastestreams at OGS that are currently disposed of in the Surface Impoundment. At the time of this request, the Unit 1 bottom ash conversion is underway and is in the tie-in outage to complete the conversion. The design of the new LVWTP is complete and permitting through the IDNR has begun. The construction contract has been issued for bid and is anticipated to be awarded in March of 2021. Construction of that work is scheduled to begin in the spring of 2021. IPL has spent significant resources and effort implementing this solution to date, despite the ongoing rule changes and uncertainty around the final CCR and ELG regulations.

3.0 DOCUMENTATION AND CERTIFICATION OF COMPLIANCE

To demonstrate that the criteria in 40 C.F.R. § 257.103(f)(1)(iii) has been met, the following information and submissions are submitted pursuant to 40 C.F.R. § 257.103(f)(1)(iv)(B) to demonstrate that the facility is in compliance with the CCR rule. The OGS facility has two CCR units including:

- The Ash Pond (which is the subject of this demonstration)
- The Zero Liquid Discharge (ZLD) Pond (which has ceased receiving wastestreams and will begin construction for closure by removal in the spring of 2021)

The Ottumwa-Midland Landfill and the Ottumwa-Midland Phase 1 Expansion referenced on the OGS CCR compliance website are located approximately 12 miles from OGS and on the other side of the Des Moines River. As these CCR units are not located on contiguous land, these units are part of a separate facility. Consequently, IPL has not included compliance documents for these units as part of this submittal for the OGS facility.

3.1 Owner's Certification of Compliance - § 257.103(f)(1)(iv)(B)(1)

In accordance with 40 C.F.R. § 257.103(f)(1)(iv)(B)(1), I hereby certify, based on information provided to me by, and my inquiry of, persons immediately responsible for compliance with the CCR rule at the Ottumwa Generating Station, that the Ottumwa Generating Station, including the OGS Ash Pond, is in compliance with 40 C.F.R. Part 257, Subpart D -- Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments. All the required CCR compliance information for the Ottumwa Generating Station is up-to-date and posted on the Alliant Energy CCR Rule Data and Compliance website.

Interstate Power and Light Company

Nichol D. Toomire

Nichol Toomire
(Printed Name)

Director of Operations
(Title)

November 25, 2020

(Date)

3.2 Visual Representation of Hydrogeologic Information - § 257.103(f)(1)(iv)(B)(2)

Consistent with the requirements of § 257.103(f)(1)(iv)(B)(2)(i) – (iii), IPL has attached the following items to this demonstration:

- Map(s) of groundwater monitoring well locations in relation to the CCR unit (Appendix C1)
- Well construction diagrams and drilling logs for all groundwater monitoring wells (Appendix C2)
- Maps that characterize the direction of groundwater flow accounting for seasonal variations (Appendix C3)

3.3 Groundwater Monitoring Results - § 257.103(f)(1)(iv)(B)(3)

Under the CCR Groundwater Monitoring Program at OGS, all groundwater samples are collected and analyzed in accordance with the Sampling and Analysis Plan (SAP), included in Appendix C4. All monitoring data is evaluated in accordance with the certified statistical method(s) to determine if any statistically significant increases (SSIs) of Appendix III parameters or SSLs of Appendix IV parameters over GWPS exist. There was one background well, MW-301 and five down gradient wells, MW-302, MW-303, MW-304, MW-305 and MW-306 installed in November and December of 2015 for the Ash Pond. Background sampling began in late 2016 and a total of eight rounds of background samples were collected. The first semiannual detection monitoring samples were collected in November 2017.

Monitoring wells MW-307, MW-308, and MW-309 were installed as downgradient wells in October 2016 for the ZLD Pond. Background sampling for the ZLD Pond began in January 2017 and continued through October 2018. The first semiannual detection monitoring samples were collected in April 2019.

Monitoring wells MW-310, MW-311, MW-310A, MW-311A, and MW-305A were installed as part of the Corrective Action program for the OGS Ash Pond between August 2019 and March 2020 to assess the nature and extent of cobalt concentrations downgradient of the Main Ash Pond following observation of a statistically significant level exceeding the groundwater protection standard for cobalt in monitoring well MW-305.

Tables summarizing constituent concentrations at each groundwater monitoring well from MW 301 to MW-311A are included in Appendix C4. The most recent annual groundwater monitoring reports for the OGS Ash Pond and OGS ZLD Pond are also included in Appendix C4.

3.4 Description of Site Hydrogeology - § 257.103(f)(1)(iv)(B)(4)

The following description was provided in the Corrective Measures Assessment and is included as stated below in Appendix C5. Monitoring wells MW-301 through MW-306 (for the OGS Ash Pond) and MW-307 through MW-309 (for the ZLD Pond) were installed to intersect the uppermost aquifer at the site. Due to variations in the unconsolidated material thickness and the bedrock surface, some wells are screened in unconsolidated material and some are in bedrock. The unconsolidated material at these well locations generally consists of a clay layer overlying clay and sand. The total monitoring well boring depths are between 14 and 50 feet. The depth to bedrock at the site is variable, and the bedrock surface is highly weathered in some areas. Bedrock was encountered as shallow as 7 feet and as deep as 44 feet below ground surface in the monitoring well borings. Shallow groundwater at the site generally flows toward the Des Moines River. The groundwater flow patterns from October 2018, April and October 2019, and April of 2020 are provided in Appendix C3. Geologic cross sections have been prepared for OGS. One cross-section line runs through upgradient well MW-301 and downgradient monitoring wells MW-306 and MW-307 and crosses the OGS Ash Pond and the OGS ZLD Pond. The second cross-section runs through upgradient well MW-301 and downgradient wells MW-305/305A and MW-310/310A and includes downgradient areas to the Des Moines River. Both cross-sections and their locations are included in Appendix C5. Geologic material and estimated water table levels are identified on the cross section.

3.5 Corrective Measures Assessment - § 257.103(f)(1)(iv)(B)(5)

Based on the results of the groundwater monitoring efforts completed to date (see Section 3.3) a Assessment of Corrective Measures (ACM) has been completed and is included as Appendix C6.

A statistically significant level exceeding the groundwater protection standard for cobalt was observed in MW-307, which is part of the monitoring well network for the OGS ZLD Pond. An alternative source demonstration was successfully completed for this observation and is included in Appendix C4. The ZLD Pond remains in assessment monitoring and therefore a corrective measures assessment is not required at this time.

3.6 Remedy Selection Progress Report - § 257.103(f)(1)(iv)(B)(6)

IPL completed an initial Selection of Remedy Report in September 2020, but remains in the Selection of Remedy phase following the collection of new information that resulted in updates to the ACM. The semi-annual progress report from March, 2020, is also included in Appendix C7.

3.7 Structural Stability Assessment - § 257.103(f)(1)(iv)(B)(7)

Pursuant to § 257.73(d), the initial structural stability assessment report for the Ash Pond and the ZLD Pond was prepared in September 2016 and an update was completed in October 2020. The most recent version is included as Appendix C8.

3.8 Structural Safety Factor Assessment - § 257.103(f)(1)(iv)(B)(8)

Pursuant to § 257.73(e), the initial safety factor assessment report for the Ash Pond and the ZLD Pond was prepared in September 2016 and an update was completed in October 2020. The most recent version is included as Appendix C9.

4.0 CONCLUSION

Based upon the information submitted in this demonstration, it has been shown that the Surface Impoundment at Ottumwa Generating Station qualifies for a site-specific alternate deadline for the initiation of closure as allowed by 40 C.F.R. §257.103 – Alternate Closure Requirements and specifically 40 C.F.R. 257.103(f)(1) – Site Specific Alternate to Initiation of Closure Deadline.

Therefore, IPL requests that EPA approve this demonstration, thereby granting the alternate deadline of December 31, 2022 to cease routing all CCR and non-CCR wastestreams to the Surface Impoundment and initiate closure of the CCR unit. IPL has ceased discharge of sluiced bottom ash to the Surface Impoundment and, throughout the period of this extension, will reduce wastestreams to the Surface Impoundment as described in Table 2-1 for CCR and/or non-CCR wastestreams as soon as feasible. There are several variables that could impact the construction of the LVWTP and the initiation of closure of the Surface Impoundment, including delays in dewatering and removal efforts associated with weather, contractor efficiency, and actual total volume of material to be excavated and disposed on site, as well as potential COVID-19 impacts. IPL will communicate with EPA if there are any delays in project completion as a result of the COVID-19 pandemic, discovery of additional quantities of CCR and soil, potential weather-related delays to excavation, or other unforeseen challenges, so that IPL can meet its obligations under the CCR Rule while safely accommodating the large numbers of contractors and employees that will need to work onsite through project completion. IPL will update EPA on the project and any potential schedule impacts with semi-annual progress reports required at 40 CFR § 257.103(f)(1)(x), and if a need for a later compliance deadline is determined, IPL will seek additional time as described in 40 CFR § 257.103(f)(1)(vii).

APPENDIX A – SITE PLAN, LVWTP DRAWINGS, AND WATER BALANCES

PRELIMINARY - NOT FOR CONSTRUCTION

no.	date	by	ckd	description
A	10/26/20	RNO	PTB	ISSUED WITH DEMONSTRATION LETTER

no.	date	by	ckd	description

BURNS McDONNELL
9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
Burns & McDonnell Engineering Co, Inc.

designed: A. MUCKENTHALER
detailed: J. RIDDER

INTERSTATE POWER & LIGHT
OTTUMWA GENERATING STATION
POND CLOSURE AND
WASTEWATER TREATMENT PROJECT

OTTUMWA, IA

SITE PLAN

project: 110321
contract:

drawing: **FIGURE 1**
rev. — A

sheet of sheets

file 110321FIGURE_1.DGN

10/23/2020

LEGEND

— · — · —	PROPERTY BOUNDARY
— — —	FLOODPLAIN BOUNDARY
▨	FLOODPLAIN AREA
▩	OCCUPIED AREA

PRELIMINARY - NOT FOR CONSTRUCTION

no.	date	by	ckd	description	no.	date	by	ckd	description
A									

BURNS McDONNELL
9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
Burns & McDonnell Engineering Co, Inc.

designed: R. OWENS
detailed: J. RIDDER

INTERSTATE POWER & LIGHT
OTTUMWA GENERATING STATION
POND CLOSURE AND
WASTEWATER TREATMENT PROJECT

OTTUMWA, IA

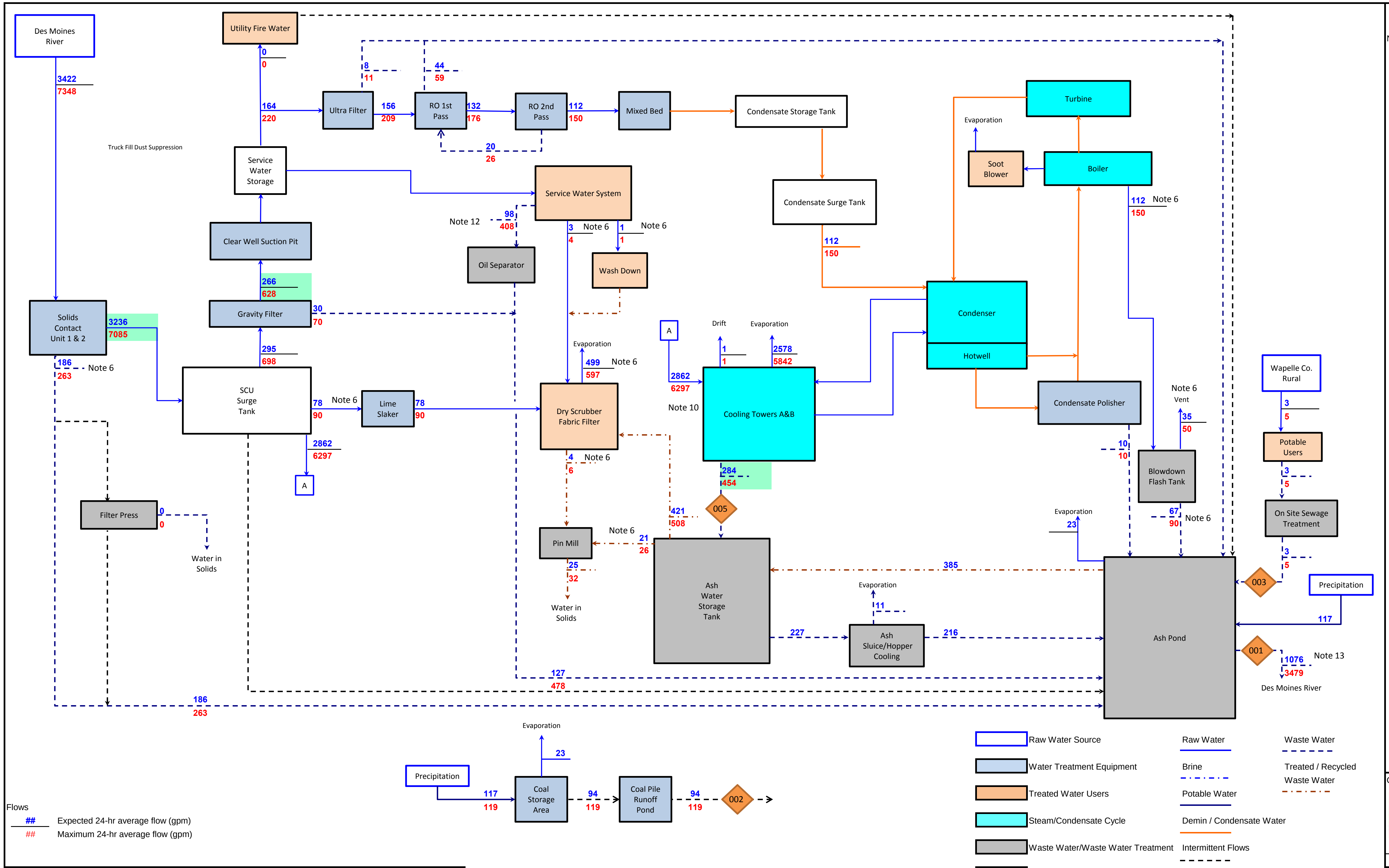
SITE PLAN

project: 110321
contract:
drawing: **FIGURE 2**
rev. — **A**
sheet of sheets
file 110321-FIGURE_2.DGN

Z:\Clients\ENR\IPL\110321 [illegible] -FIGURE_2.dgn

10/21/2020

APPENDIX E – OGS EXISTING WATER BALANCE



Notes:

1 Flows are in gallons per minute, rounded to the nearest gallon.

2 Sewage Treatment Outfall [003], and Coal Pile Runoff Outfall [002] are taken from DMR data.

3 Precipitation is based off of DMR outfall data; precipitation and evaporation assumed to be equal for the ash and coal pile ponds, as they are approximately the same size.

4 Fire water and water treament recovery/reject values are based off of the Review of the OGS Water Treament system report.

5 Condensate polisher reject is assumed 100,000gal/regneration; one regeneration per week - Engineering judgement.

6 Average and maximum values are based off of maximum load and low load operation water balances respectively.

7 Bottom ash evaporation based on bottom ash vendor data.

8 Assume filter press is not operational.

9 Cooling Tower cycles of concentration assumed 10 based on Review of the OGS Water Treatment System report.

10 CT Blowdown, SCU Effluent and GF Effluent data from (actual) Flow Integrator Data.

11 Soot blowing steam losses assume minimal water loss.

12 Wash water flow assumed to balance Gravity Filter Effluent Average flow.

13 Ash Pond Outfall [001] DMR data indicates 1076 gpm average outflow to the Des Moines River.

Drawing Release Record

Rev	Date	Prepared	Reviewed	Approved	Purpose
A0	20-Nov-15	D.B.Pierik	M.Heermann	D. Buchel	Intial Issue

Project No: 13391-014

Owner: ALLIANT ENERGY

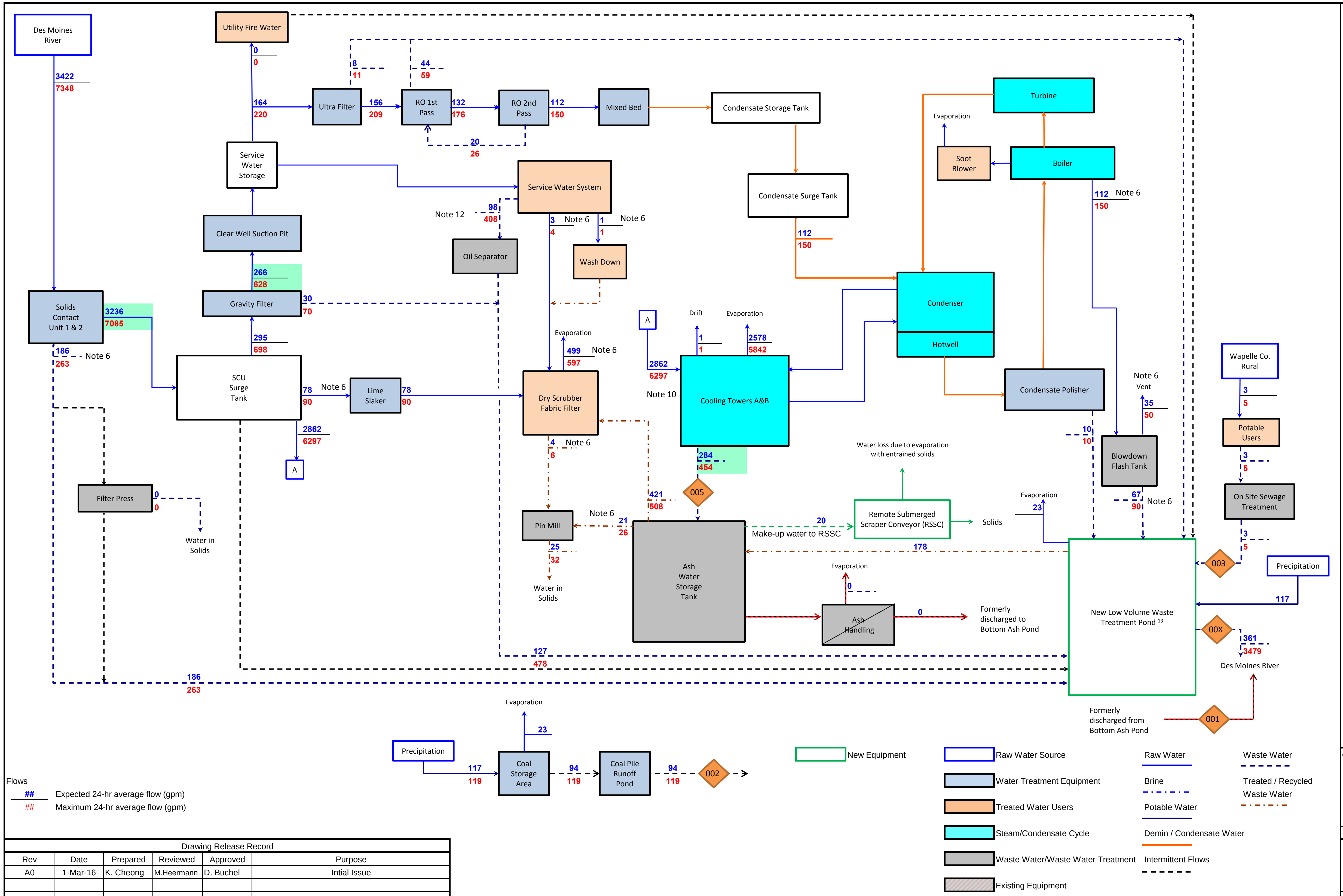
Engineer: Sargent & Lundy LLC

Alliant - Edgewater Generating Station

Water and Ash Planning Project
Preliminary Water Balance

MSK-OGS-WB-001

APPENDIX F – OGS WATER BALANCE - PROPOSED MODIFICATIONS



Notes:

1 Flows are in gallons per minute, rounded to the nearest gallon.

2 Sewage Treatment Outfall [003], and Coal Pile Runoff Outfall [002] are taken from DMR data.

3 Precipitation is based off of DMR outfall data; precipitation and evaporation assumed to be equal for the ash and coal pile ponds, as they are approximately the same size.

4 Fire water and water treament recovery/reject values are based off of the Review of the OGS Water Treament system report.

5 Condensate polisher reject is assumed 100,000gal/regneration; one regeneration per week - Engineering judgement.

6 Average and maximum values are based off of maximum load and low load operation water balances respectively.

7 Assume filter press is not operational.

8 Cooling Tower cycles of concentration assumed 10 based on Review of the OGS Water Treatment System report.

9 CT Blowdown, SCU Effluent and GF Effluent data from (actual) Flow Integrator Data.

10 Soot blowing steam losses assume minimal water loss.

11 Wash water flow assumed to balance Gravity Filter Effluent Average flow.

12 Water balance calculated the discharge flow at new permitted Outfall 00X, based on cooling tower blowdown flowmeter data, SCU and gravity filter flow integrator data, and annual recorded water usage.

13 Bottom ash pond is consolidated with C-Stone stockpile, closed and then capped. The existing ZLD Pond will be repurposed as the New Low Volume Waste Treatment (LVWT) Pond by clean closure and then fully lined. All low volume waste streams shall be redirected to the LVWT pond and discharged through a new permitted outfall.

14 Make-up water flow rate to RSSC is required based on a 7 hr basis.

Drawing Release Record

Rev	Date	Prepared	Reviewed	Approved	Purpose
A0	1-Mar-16	K. Cheong	M.Heermann	D. Buchel	Intial Issue

Project No: 13391-014

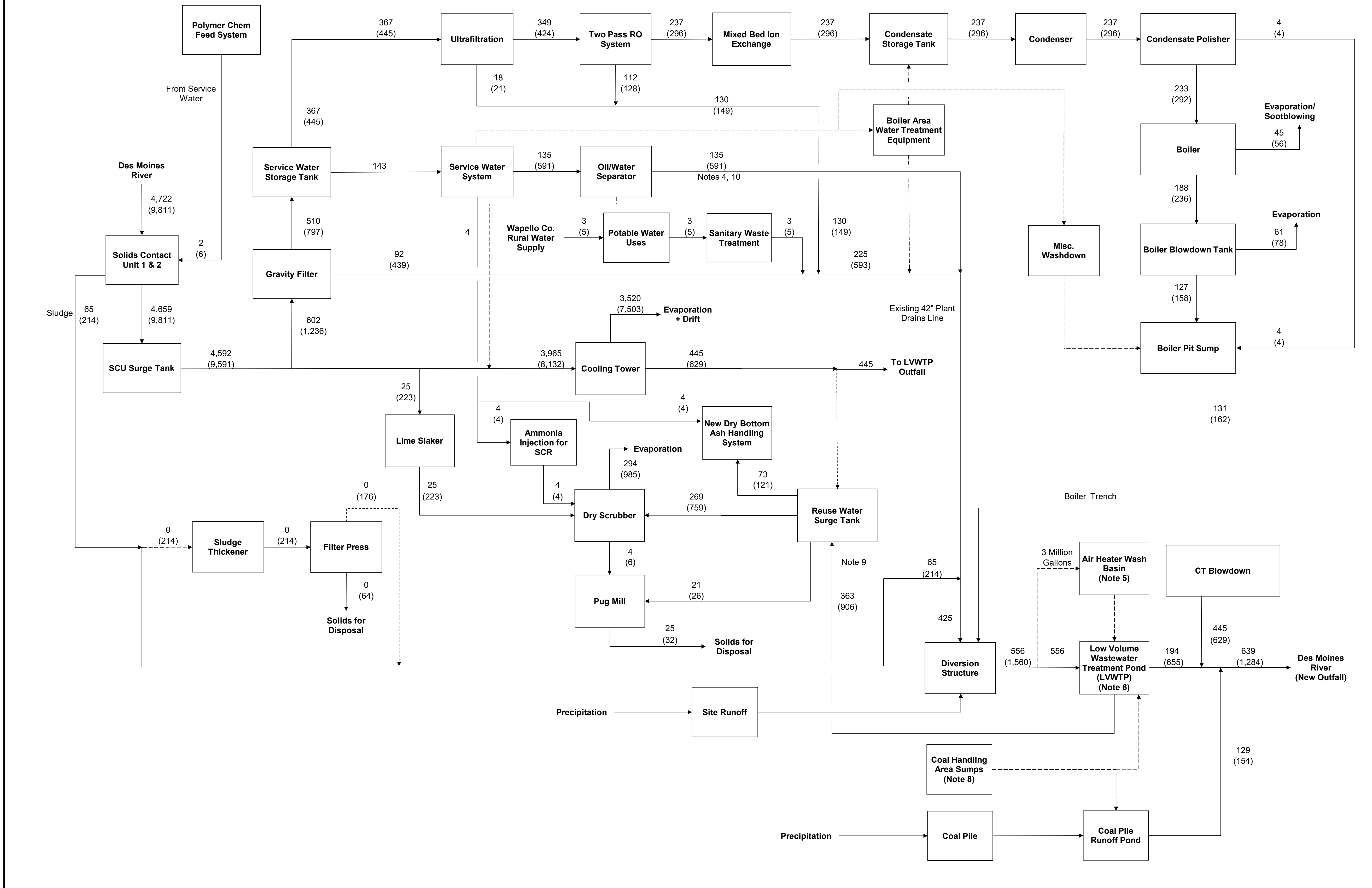
Owner: ALLIANT ENERGY

Engineer: Sargent & Lundy

Alliant - Ottumwa Generating Station

Water and Ash Planning Project
Proposed Modification Water Balance

MSK-OGS-WB-002



no.	date	by	ckd	description
A	11/15/18	DKE	KLG	Issue with PDR
B	12/7/18	DKE	KLG	Final PDR Issue
C	4/15/19	DKE	PTB	Updated Final PDR Issue
D	6/12/20	PTB	BDH	Final Design for Permitting
E	10/1/2020	PTB	RNO	Labeling Updated Permitting

NOTES:

1. Flows are shown in gallons per minute (gpm) and rounded to the nearest gpm. Max flows shown in ().
2. Flows are based on average daily conditions.
3. Majority of process flows based on existing WMB produced by Sargent & Lundy. Drawing No. MSK-OGS-WB-002.
4. Shaded flow for OWS based on BMcD flow measurements taken in 2018.
5. Air heater wash volume based on BMcD flow measurements during October 2018 outage.
6. Low volume wastewater treatment pond equipped with 2x100% pumps rated at 1,500 gpm each.
7. Precipitation flows not included in flow balance.
8. Coal handling sumps assumed to discharge to existing surface ditches that discharge into coal pile runoff pond or will be redirected to the low volume wastewater treatment pond. Sump flows not included in balance.
9. Intermittent design flow from LVWTP is 290 gpm average or 785 gpm max for dry scrubber. Bottom ash handling makeup flows are approximate.
10. Actual design maximum flow is less than 591 GPM. This was a 2018 instantaneous value measured by BMcD and is included for conservatism on permitting flows.

FINAL

BURNS McDONNELL

date
10/1/2020

detailed
D. Elliott

designed
P. Brandt

checked
B. Hansen

Alliant Energy

Ottumwa Generating Station
Water Mass Balance

Future Conditions - Low Volume Wastewater Treatment Pond

project
110321

contract

drawing
110321MM1WMB-001 ---

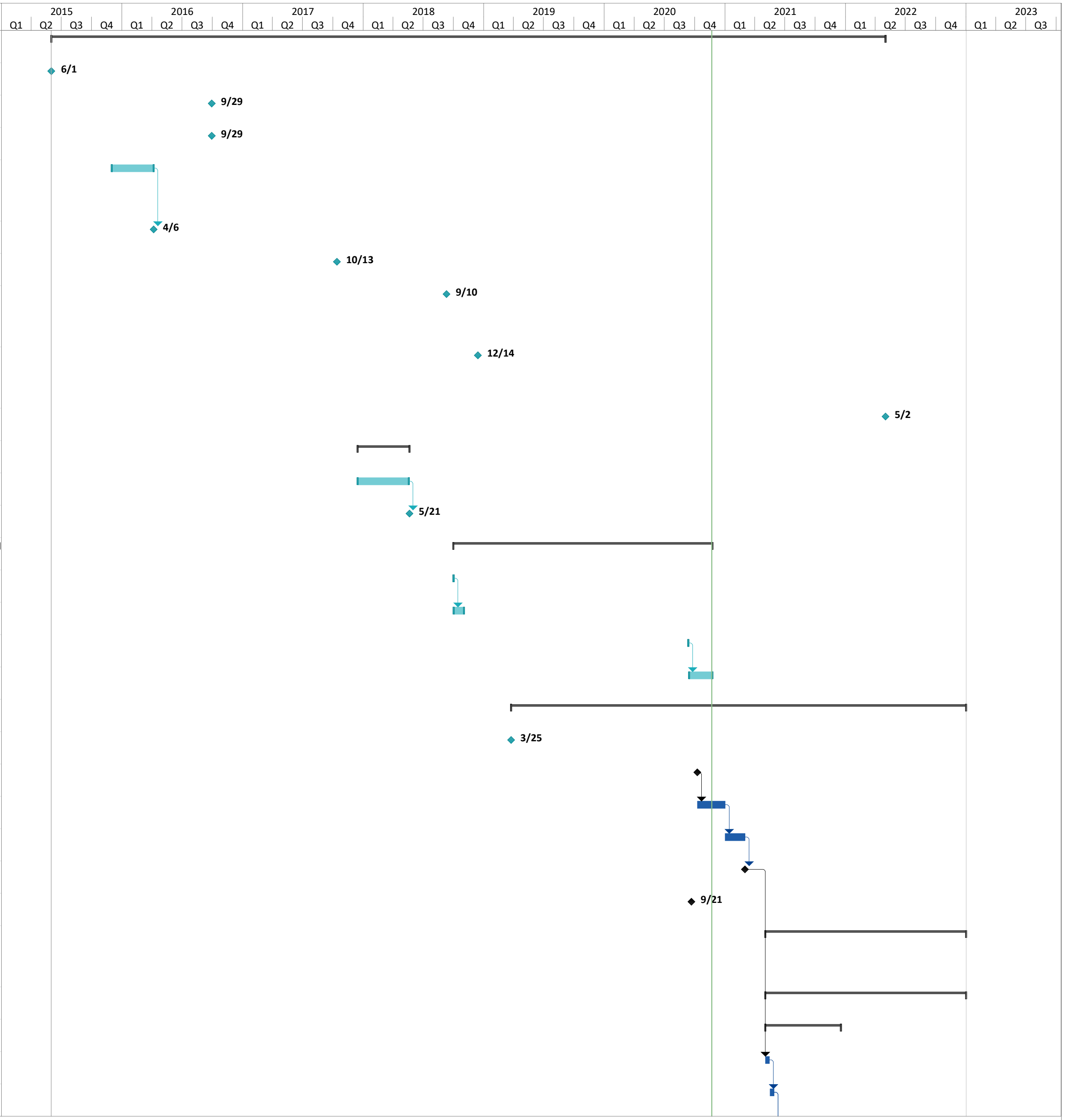
rev.
E

sheet 1 of 1 sheets

file

APPENDIX B – SCHEDULE

ID	Task Name	Duration	Start	Finish
1	**Technology Project Selection**	**1805 days**	**Mon 6/1/15**	**Mon 5/2/22**
2	IPL Began Preparing CCR Compliance Documents	0 days	Mon 6/1/15	Mon 6/1/15
3	IPL Completed Liner Documentation	0 days	Thu 9/29/16	Thu 9/29/16
4	IPL Prepared Surface Impoundment History of Construction	0 days	Thu 9/29/16	Thu 9/29/16
5	IPL to Evaluate Ash Pond Closure Options and Prepared Bottom Ash and Low Volume Wastewater Treatment Technology Evaluation	91 days	Tue 12/1/15	Tue 4/5/16
6	S&L Issued Ash Water Upgrade Summary Report for IPL Revie	0 days	Wed 4/6/16	Wed 4/6/16
7	IPL Selected Bottom Ash System Technology	0 days	Fri 10/13/17	Fri 10/13/17
8	IPL Retained BMcD to Further Evaluate Ash Pond Closure Options and Low Volume Wastewater Treatment Technology Evaluation	0 days	Mon 9/10/18	Mon 9/10/18
9	IPL Selected Ash Pond Closure Method and Low Volume Wastewater Treatment Technologies	0 days	Fri 12/14/18	Fri 12/14/18
10	Receive new NPDES permit from IDNR	0 days	Mon 5/2/22	Mon 5/2/22
11	**Engineering and Procurement**	**111 days**	**Fri 12/15/17**	**Mon 5/21/18**
12	IPL Bid Specification for Bottom Ash Handling System	111 days	Fri 12/15/17	Fri 5/18/18
13	IPL Awarded Bottom Ash Handling System Contract	0 days	Mon 5/21/18	Mon 5/21/18
14	**Equipment Construction**	**561 days**	**Mon 10/1/18**	**Mon 11/23/20**
15	EPC Contractor Mobilize	1 day	Mon 10/1/18	Mon 10/1/18
16	Pre-Outage Construction	23 days	Tue 10/2/18	Thu 11/1/18
17	Tie In Outage	1 day	Fri 9/11/20	Fri 9/11/20
18	Bottom Ash Handling System Operational	51 days	Mon 9/14/20	Mon 11/23/20
19	**Preparation for Closure**	**986 days**	**Mon 3/25/19**	**Sat 12/31/22**
20	IPL Released Design of Pond Closure and LVWTP	0 days	Mon 3/25/19	Mon 3/25/19
21	OGS Ash Pond Closure and LVWTP Design Documents Issued	0 days	Fri 10/9/20	Fri 10/9/20
22	OGS Ash Pond Closure and LVWTP Bid period	60 days	Fri 10/9/20	Thu 12/31/20
23	OGS Ash Pond Closure and LVWTP Bid Evaluation	42 days	Fri 1/1/21	Mon 3/1/21
24	OGS Ash Pond Closure and LVWTP Contract Award	0 days	Mon 3/1/21	Mon 3/1/21
25	Cease Continuous CCR sluice flows to Ash Pond	0 days	Mon 9/21/20	Mon 9/21/20
26	Final receipt of non-CCR waste streams in ash pond/begin routing to new LVWTP	436 days	Mon 5/3/21	Sat 12/31/22
27	**OGS Ash Pond Closure and LVWTP Construction**	**436 days**	**Mon 5/3/21**	**Sat 12/31/22**
28	**Season 1**	**165 days**	**Mon 5/3/21**	**Fri 12/17/21**
29	Mobilization	10 days	Mon 5/3/21	Fri 5/14/21
30	Develop Laydown and Install Erosion Control Measure	10 days	Mon 5/17/21	Fri 5/28/21

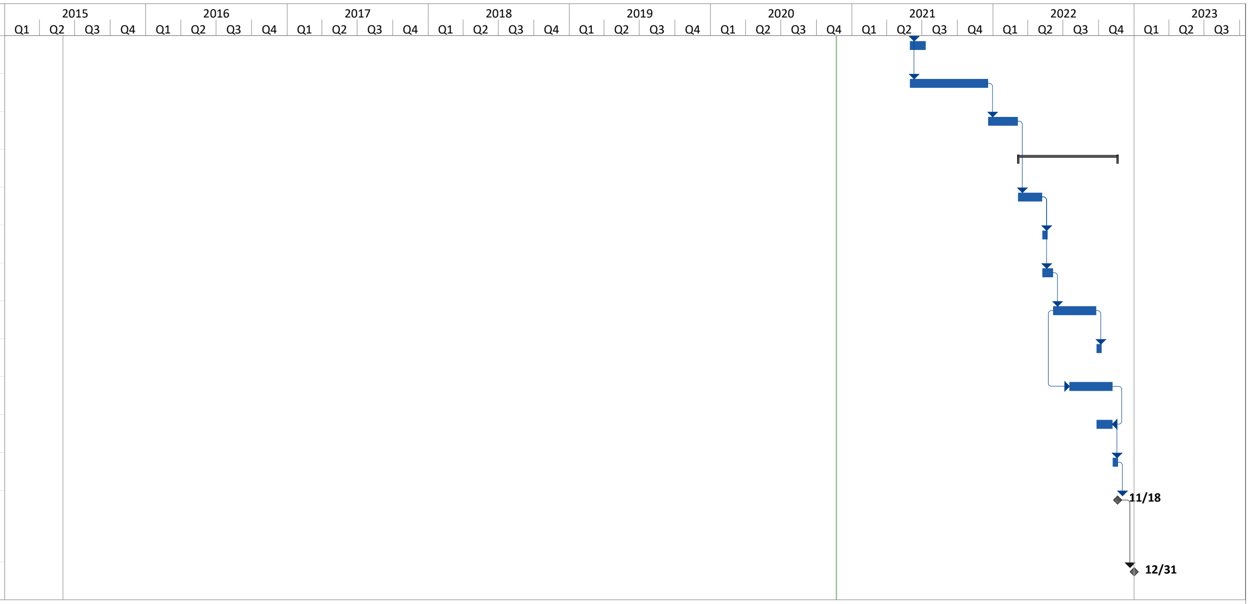


Project: Surface Impoundment Extension Demonstration
Date: Sun 11/22/20

Task	▬	Project Summary	⌐¬	Inactive Milestone	◇	Manual Summary Rollup	▬	Deadline	⇩
Split	┈	External Tasks	▬	Inactive Summary	⌐¬	Manual Summary	⌐¬	Progress	─
Milestone	◆	External Milestone	◇	Manual Task	▬	Start-only	[	Manual Progress	─
Summary	⌐¬	Inactive Task	▭	Duration-only	▬	Finish-only	]		

**Gaps between seasons indicate winter months.

ID	Task Name	Duration	Start	Finish
31	ZLD Pond Lowering (remove free water)	30 days	Mon 5/31/21	Fri 7/9/21
32	CCR/subgrade removal from ZLD Pond to OGS Ash Po	145 days	Mon 5/31/21	Fri 12/17/21
33	Winter Shutdown	55 days	Mon 12/20/21	Fri 3/4/22
34	**Season 2**	**185 days**	**Mon 3/7/22**	**Fri 11/18/22**
35	CCR/subgrade removal from ZLD Pond to OGS Ash Po	45 days	Mon 3/7/22	Fri 5/6/22
36	Prep subgrade for liner construction	10 days	Mon 5/9/22	Fri 5/20/22
37	LVWTP Earthwork and Structure Construction	20 days	Mon 5/9/22	Fri 6/3/22
38	LVWTP Liner Installation (GCL, geomembrane, geotext	80 days	Mon 6/6/22	Fri 9/23/22
39	IDNR inspect liner installation	10 days	Mon 9/26/22	Fri 10/7/22
40	Protective Cover/Riprap Installation LVWTP	80 days	Mon 7/18/22	Fri 11/4/22
41	Piping Reroutes to LVWTP	30 days	Mon 9/26/22	Fri 11/4/22
42	Startup, Punchlist, and Contract Closeout	10 days	Mon 11/7/22	Fri 11/18/22
43	LVWTP Construction Complete and receiving Non-CCR Wastestreams	0 days	Fri 11/18/22	Fri 11/18/22
44	Initiate Closure of OGS Ash Pond	0 days	Sat 12/31/22	Sat 12/31/22



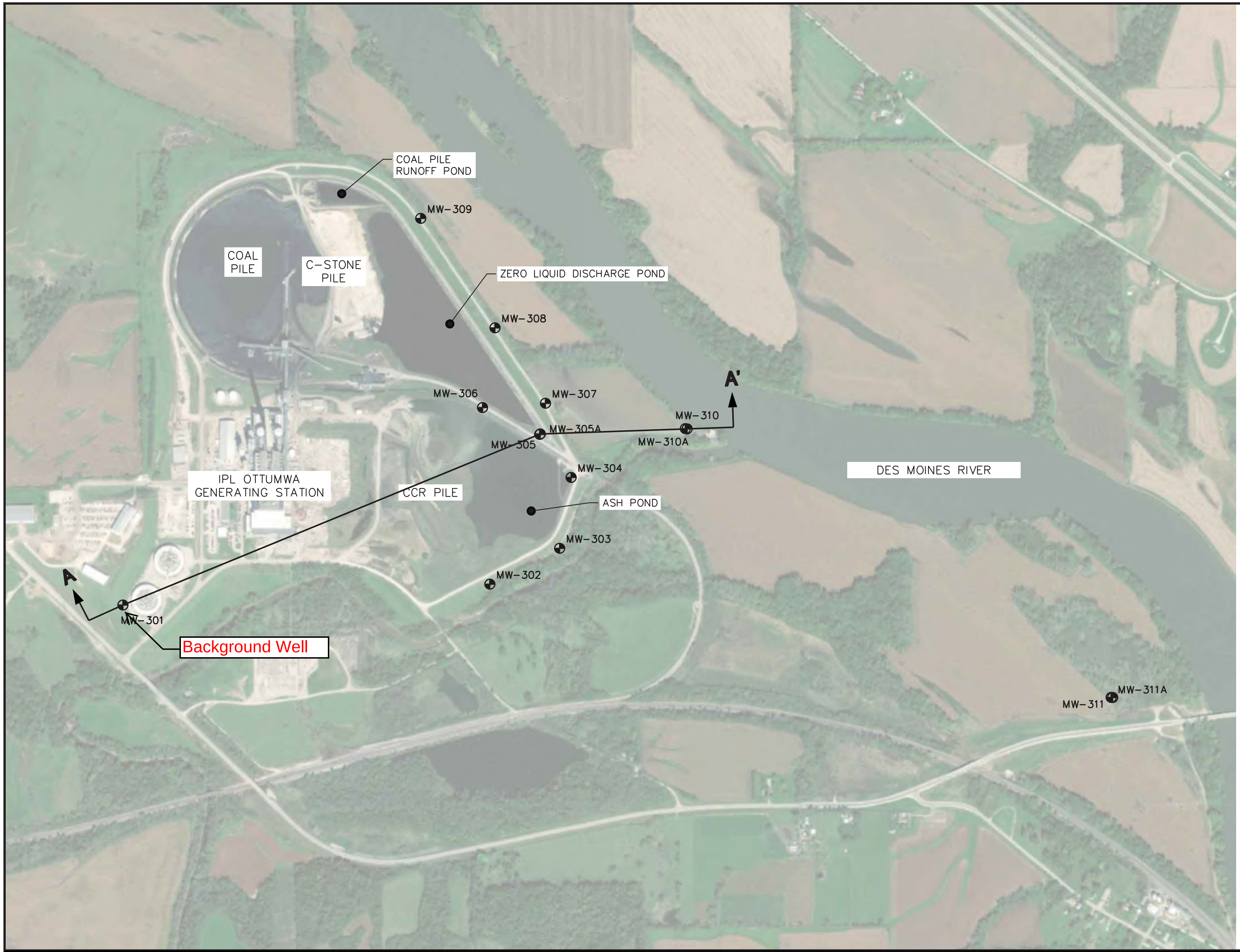
Project: Surface Impoundment Extension Demonstration
Date: Sun 11/22/20

Task	▬	Project Summary	⊓	Inactive Milestone	◇	Manual Summary Rollup	▬	Deadline	⇩
Split	┈	External Tasks	▬	Inactive Summary	⊓	Manual Summary	⊓	Progress	─
Milestone	◆	External Milestone	◆	Manual Task	▬	Start-only	[	Manual Progress	─
Summary	⊓	Inactive Task	▭	Duration-only	▬	Finish-only	]		

**Gaps between seasons indicate winter months.

APPENDIX C – COMPLIANCE DOCUMENTS

APPENDIX C1– MONITORING WELL LOCATION MAP



LEGEND

● MONITORING WELL

GEOLOGIC CROSS SECTION

NOTES:

1. 2014 AERIAL PHOTOGRAPH SOURCES: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA FSA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY.
2. MONITORING WELLS MW-301, MW-302, AND MW-304, WERE INSTALLED BY CASCADE DRILLING, LLP. UNDER THE SUPERVISION OF SCS ENGINEERS FROM NOVEMBER 11-12, 2015.
3. MONITORING WELLS MW-303 AND MW-305 WERE INSTALLED BY CASCADE DRILLING LLP. UNDER THE SUPERVISION OF SCS ENGINEERS ON DECEMBER 7-8, 2015.
4. MONITORING WELLS MW-307, MW-308, AND MW-309 WERE INSTALLED BY CASCADE DRILLING, LLP. UNDER THE SUPERVISION OF SCS ENGINEERS FROM OCTOBER 25-27, 2016.
5. MONITORING WELLS MW-310 AND MW-311 WERE INSTALLED BY ROBERTS ENVIRONMENTAL DRILLING ON AUGUST 27, 2019.
6. MONITORING WELLS MW-305A, MW-310A, AND MW-311A WERE INSTALLED BY ROBERTS ENVIRONMENTAL DRILLING BETWEEN FEBRUARY 27, 2020 AND MARCH 3, 2020.

N

800 0 800

SCALE: 1" = 800'

PROJECT NO.	25220083.00	DRAWN BY:	BSS
DRAWN:	11/15/2019	CHECKED BY:	MDB
REVISED:	05/11/2020	APPROVED BY:	EJN 9/11/2020

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

ALLIANT ENERGY
OTTUMWA GENERATING STATION
OTTUMWA, IOWA

SITE PLAN
AND MONITORING WELL LOCATIONS

FIGURE
2

I:\25220083.00\Drawings\Site Plan and Monitoring Well Locations.dwg, 5/11/2020 7:55:48 AM

APPENDIX C2– WELL CONSTRUCTION DIAGRAMS AND DRILLING LOGS

Environmental Consultants
and Contractors

2830 Dairy Drive
Madison, WI 53718-6751

608 224-2830
FAX 608 224-2839
www.scsengineers.com

SCS ENGINEERS

October 10, 2017
File No. 25216072.17

Mr. Rob Saunders
Ottumwa Generating Station
20775 Power Plant Road
Ottumwa, IA 52501

Subject: Ottumwa Generating Station – Monitoring Well Construction Documentation

Dear Mr. Saunders:

SCS Engineers has completed the installation of six groundwater monitoring wells (MW-301 through MW-306) at the Ottumwa Generating Station in Ottumwa, Iowa (**Figure 1**). These wells were installed to support compliance with the final Coal Combustion Residuals Rule (40 CFR 257.50-107). The monitoring well locations are shown on **Figure 2**. **Attachments A** through **C** include documentation of well design, installation, and development as required by 40 CFR 257.91(e)(1).

This monitoring well construction documentation report is ready to be entered into the operating record as required by 40 CFR 257.105(h)(2).

Please contact us at (608) 224-2830 if you have any questions about the well documentation.

Sincerely,

Meghan Blodgett
Hydrogeologist
SCS ENGINEERS

Thomas J. Karwoski
Project Manager
SCS ENGINEERS

TK/AV_lmh/MDB

cc: Jeff Maxted, Alliant Energy
Matt Hanson, Ottumwa Generating Station

Enclosures:
Figure 1 – Site Location Map
Figure 2 – Monitoring Well Location Map
Attachment A – Boring Logs
Attachment B – Well Construction and Development Forms
Attachment C – Hydraulic Conductivity Testing Results

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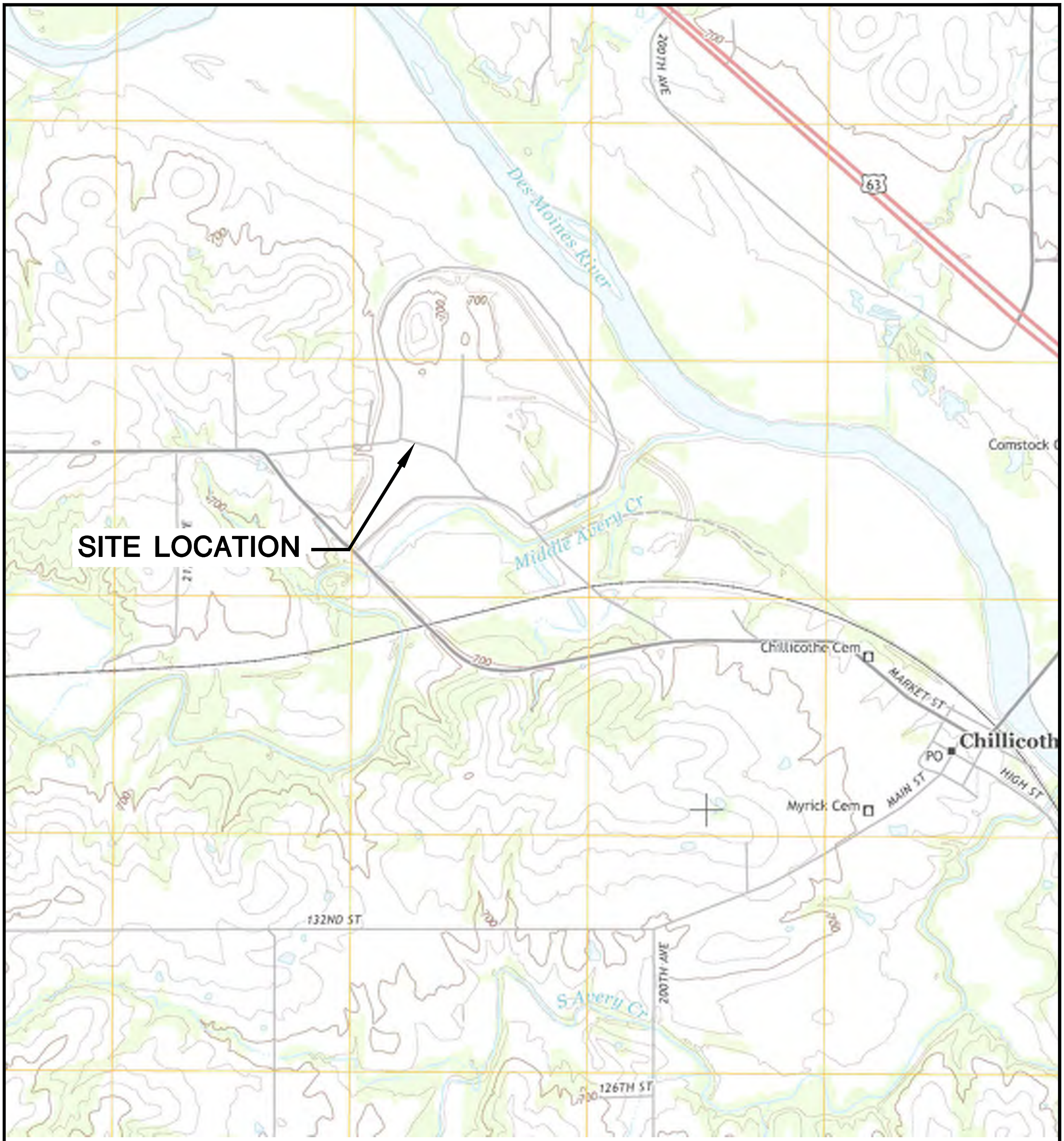
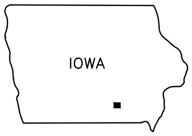


CHILLICOTHE QUADRANGLE
IOWA–WAPELLO CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
2013
SCALE: 1" = 2,000'



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

SITE
OTTUMWA GENERATING STATION
OTTUMWA, IOWA

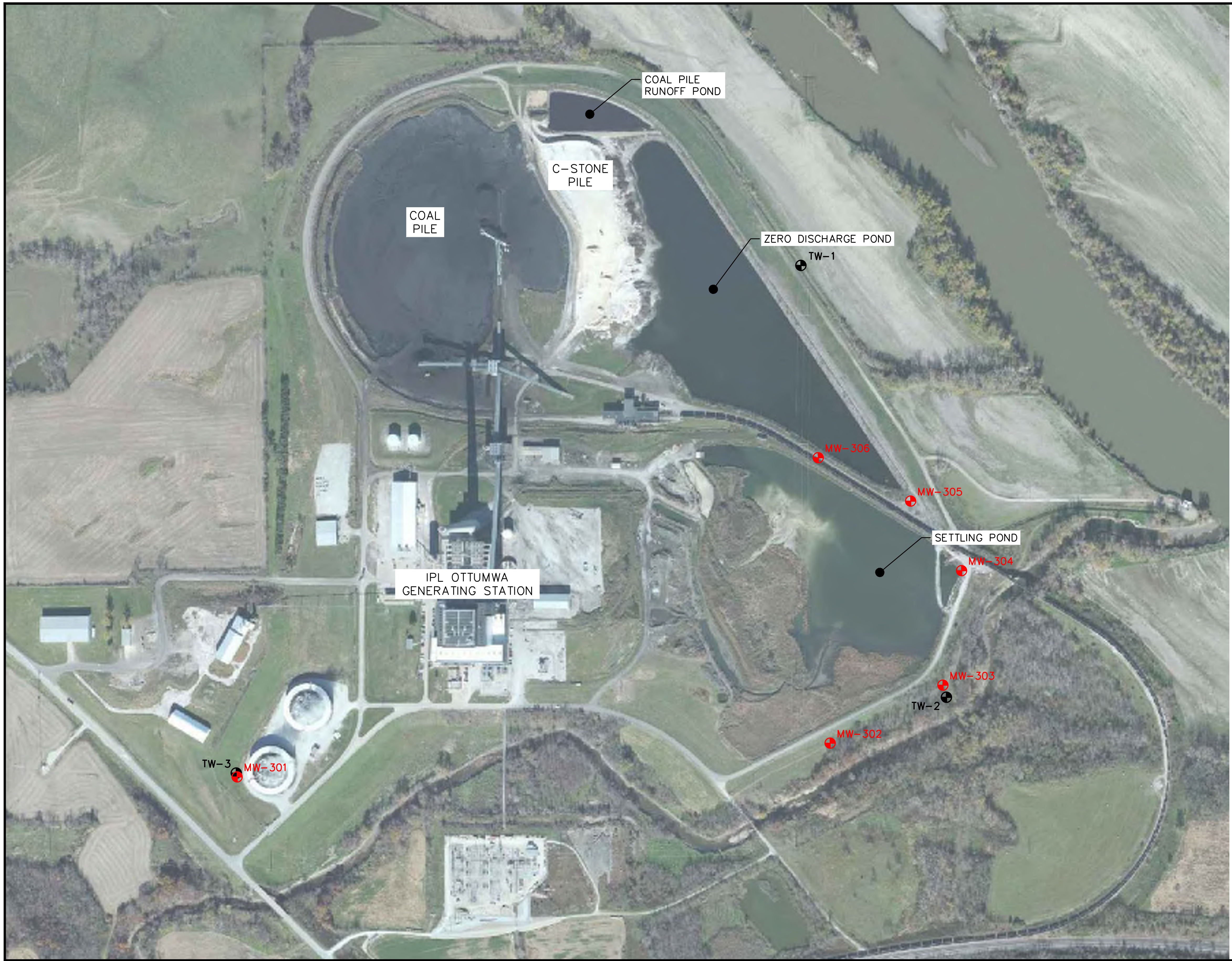
SITE LOCATION MAP

PROJECT NO.	25215135.00	DRAWN BY:	AHB
DRAWN:	05/29/15	CHECKED BY:	KAK
REVISED:	03/08/16	APPROVED BY:	

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

FIGURE
1

I:\252151□5\Drawings\O□S □□gradient Locations\Site Loc.dwg, □/10/2016 9:25:□7 AM

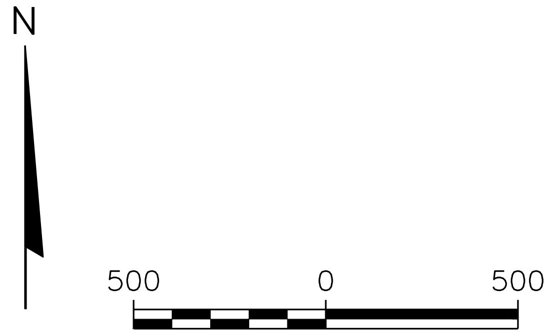


LEGEND

● 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.



SCALE: 1" = 500'

PROJECT NO.	25216072	DRAWN BY:	AHB/JMO
DRAWN:	05/29/15	CHECKED BY:	KAK
REVISED:	09/22/17	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:\25216072.00\Drawings\Site Plan.dwg, 9/22/2017 11:15:27 AM

ATTACHMENT A

Boring Logs

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

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

Page 1 of 1

Facility/Project Name IPL- Ottumwa Generating Station SCS#: 25215135.40		License/Permit/Monitoring Number	Boring Number MW-301	
Boring Drilled By: Name of crew chief (first, last) and Firm Todd Schmalfeld Cascade Drilling		Date Drilling Started 11/10/2015	Date Drilling Completed 11/10/2015	Drilling Method 4-1/4 hollow stem auger
Unique Well No.	DNR Well ID No.	Common Well Name MW-301	Final Static Water Level Feet	Surface Elevation 684.3 Feet
				Borehole Diameter 8.5 in

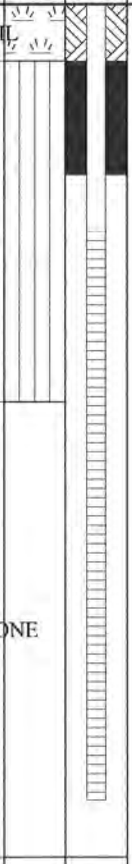
Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 400,077 N, 1,899,709 E S/C/N
NW 1/4 of SW 1/4 of Section 26, T 73 N, R 15 W

Lat ___ ° ___ ' ___ "
Long ___ ° ___ ' ___ "

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

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

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			0–1	TOPSOIL.	TOPSOIL									
			1–7	SANDY SILT WITH GRAVEL, gray (7.5YR 6/1), gravel is fine.	ML									
S1	10	woh 1 3 9								W				
			7–15	WEATHERED SANDSTONE, very weak, light gray matrix (10YR 7/1), scondary color very dark gray 910YR 3/1), massive.	SANDSTONE									
S2	13	24 50								W				
S3	5	50								W				
S4	6	50								W				
S5	4	50								W				
			15	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 ☐

Page 1 of 2

Facility/Project Name IPL- Ottumwa Generating Station SCS#: 25215135.40		License/Permit/Monitoring Number		Boring Number MW-302	
Boring Drilled By: Name of crew chief (first, last) and Firm Todd Schmalfeld Cascade Drilling		Date Drilling Started 11/10/2015	Date Drilling Completed 11/10/2015	Drilling Method 4-1/4 hollow stem auger	
Unique Well No.	DNR Well ID No.	Common Well Name MW-302	Final Static Water Level Feet	Surface Elevation 671.6 Feet	Borehole Diameter 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
Feet ☐ N ☐ S
Feet ☐ E ☐ W

Facility ID

County: Wapello

Civil Town/City/ or Village: 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	U S C S	Soil Properties: Standard Penetration	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
			0–1	TOPSOIL.	TOPSOIL						
			1–14	LEAN CLAY WITH SAND, dark gray (10YR 4/1).	CL						
S1	19	1 4 5 7	10–12				M				
S2	19	2 4 7 11	12.5–14.5				M				
			14–16	LEAN CLAY WITH SAND, very dark gray (5Y 3/1).	CL						

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-302

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

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SOIL BORING LOG INFORMATION

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

Page 1 of 1

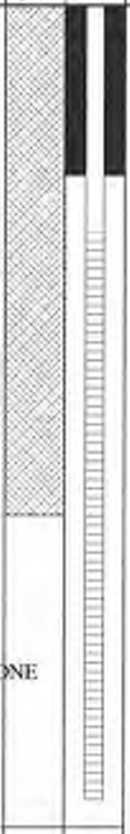
Facility/Project Name IPL- Ottumwa Generating Station SCS#: 25215135.40	License/Permit/Monitoring Number	Boring Number MW-303

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

Unique Well No.	DNR Well ID No.	Common Well Name MW-303	Final Static Water Level Feet	Surface Elevation 659.0 Feet	Borehole Diameter 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
Feet ☐ N ☐ S
Feet ☐ E ☐ W

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



Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth in Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			1 2 3 4 5 6 7 8 9	FILL, boring location was cleared to 9' bgs by hydrovac, then back filled.	FILL									
			10	WEATHERED SANDSTONE, medium grained, brown (10YR 5/4).	SANDSTONE									
S1	1	50	11 12							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 ☐

Page 1 of 3

Facility/Project Name IPL- Ottumwa Generating Station SCS#: 25215135.40			License/Permit/Monitoring Number		Boring Number MW-304
Boring Drilled By: Name of crew chief (first, last) and Firm Todd Schmalfeld Cascade Drilling			Date Drilling Started 11/11/2015	Date Drilling Completed 11/11/2015	Drilling Method 4-1/4 hollow stem auger
Unique Well No.	DNR Well ID No.	Common Well Name MW-304	Final Static Water Level Feet	Surface Elevation 680.1 Feet	Borehole Diameter 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
Feet ☐ N ☐ S Feet ☐ E ☐ W

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

Sample		Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties					RQD/ Comments
Number and Type	Length Att. & Recovered (in)								Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	
			0-1	TOPSOIL.	TOPSOIL									
			1	FAT CLAY, black (10YR 2/1).	CH									
S1	23	4 5 4 5	11							M				
S2	19.5	4 4 5 5	13-14	FAT CLAY, yellowish brown (10YR 5/4).	CH					M				
			15-16	FAT CLAY, yellowish brown (10YR 3/4).	CH									

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

Page 2 of 3

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

Boring Number MW-304

Page 3 of 3

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

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SOIL BORING LOG INFORMATION

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

Page 1 of 3

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

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

Unique Well No.	DNR Well ID No.	Common Well Name MW-305	Final Static Water Level Feet	Surface Elevation 681.5 Feet	Borehole Diameter 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
Feet ☐ N ☐ S
Feet ☐ E ☐ W

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

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

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

Signature Per 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 SUPPLEMENT
Form 4400-122A

Boring Number MW-305

Page 2 of 3

Sample		Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties					RQD/ Comments
Number and Type	Length Att. & Recovered (in)								Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	
S3	22	5 15 14 15	17	FAT CLAY *(continued)*										
S4	20	3 5 13 15	18 19		CH									
			20	FAT CLAY WITH SILT, dark gray (10YR 4/1).										
S5	24	4 5 7 11	21 22							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									Soil Properties						
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			43	POORLY GRADED SAND, medium grained, yellowish brown (10YR 5/4), (weathered bedrock). *(continued)*	SP									
S14	22	23 50	44							S				
			45											
S15	6	5 10 50	46		SP					S				
			47											
			48											
S16	6	50	49							S				
			50	End of Boring at 50 ft bgs.										

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Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

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

Page 1 of 2

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

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

Unique Well No.	DNR Well ID No.	Common Well Name MW-306	Final Static Water Level Feet	Surface Elevation 681.1 Feet	Borehole Diameter 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
Feet ☐ N ☐ S
Feet ☐ E ☐ W

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

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

SOIL BORING LOG INFORMATION SUPPLEMENT

Form 4400-122A

Boring Number MW-306

Page 2 of 2

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

ATTACHMENT B

Well Construction and Development Forms

Print Form

IOWA DEPARTMENT OF NATURAL RESOURCES

MONITORING WELL/PIEZOMETER CONSTRUCTION DOCUMENTATION FORM

Disposal Site Name: IPL - Ottumwa Generating Station
Permit No.:
Well or Piezometer No: MW-301
Dates Started: 11/10/15
Date Completed: 11/10/15

A. SURVEYED LOCATIONS AND ELEVATIONS

Locations (± 0.5 ft):
Specify corner of site: SE of Parcel 003052640340000
Distance & direction along boundary: 106' W
Distance & direction from boundary to wall: 306' N
Elevations (± 0.01 ft MSL):
Ground Surface: 684.28
Top of protective casing: 687.12
Top of well casing: 686.63
Benchmark elevation:
Benchmark description:

B. SOIL BORING INFORMATION

Name & Address of Construction Company:
Cascade Drilling, LP
301 Alderson St
Schofield, WI 54476
Name of Driller: Todd Schmalfeld
Drilling Method: HSA
Drilling Fluid: NA
Bore Hole Diameter: 8 inch
Soil Sampling Method: Spoon
Depth of Boring: 15 ft

C. MONITORING WELL INSTALLATION

Casing material: PVC sch 40
Length of casing: 4 ft
Outside casing diameter: 2.38"
Inside casing diameter: 2"
Casing joint type: threaded
Casing/screen joint type: threaded
Screen material: PVC
Screen opening size: 0.010"
Screen length: 10 ft
Depth of well: 14 ft
Filter Pack:
Material: Red Flint
Grain size: #40
Volume: 4 cu. ft.
Seal (minimum 3 ft length above filter pack):
Material: 3/8 inch bentonite chips

Placement method: Gravity
Volume: 8 cu. ft.
Backfill (if different from seal):
Material:
Placement method:
Volume:
Surface seal design:
Material of protective casing: Steel 6 inch
Material of grout between protective casing and well casing: sand
Protective cap:
Material: Steel, vented
Vented: ☐ Yes ☐ No Locking: ☒ Yes ☐ No
Well Cap:
Material: PVC
Vented: ☐ Yes ☒ No

D. GROUNDWATER MEASURMENT (± 0.01 ft below top of inner well casing)

Water level: 3.09 ft
Stabilization Time: <5 minutes
Well development method: Surged with block and pumped to reduce turbidity. 435 gallons pumped.
Average depth of frostline: 3.5'

Attachments: Driller's log. Pipe schedules and grouting schedules. 8 ½x11 inch map showing locations of all monitoring wells and piezometers.

Please mail completed for to: Iowa Department of Natural Resources, Land Quality Bureau, 502 E 9th St, Des Moines IA 50319-0034.

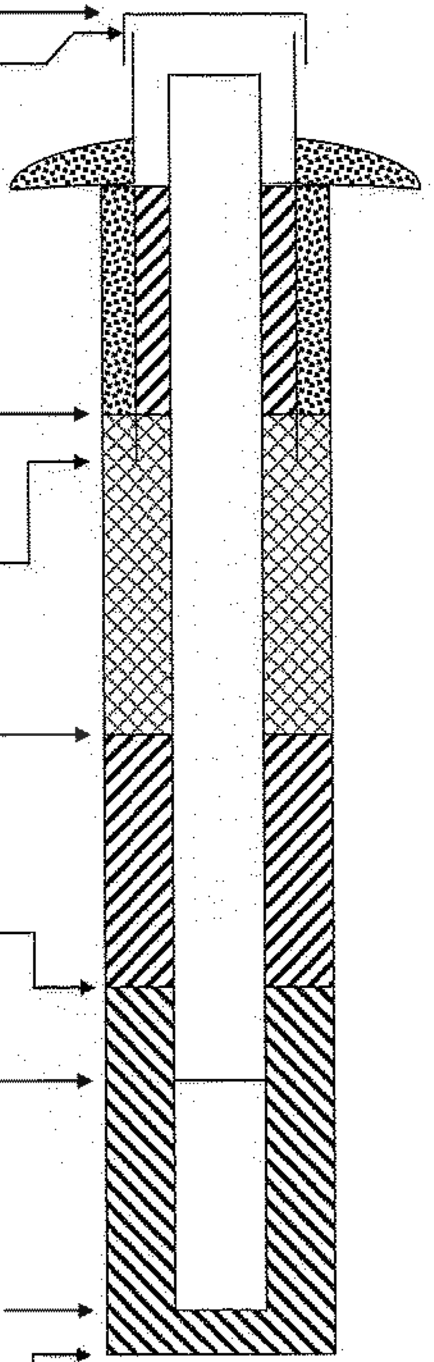
Questions? Call or Email: Nina Koger, Environmental Engineer Sr., 515-281-8986, Nina.Koger@dnr.iowa.gov

06/2011 cmz

DNR Form 542-1277

ELEVATIONS: ± 0.01 ft MSL
DEPTHS: ± 0.1 ft FROM GROUND SURFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL.)



TOP OF PROTECTIVE CASING
ELEVATION 687.12

TOP OF WELL CASING
ELEVATION 686.63

GROUND SURFACE
ELEVATION 684.28

TOP OF BACKFILL
BASE OF CONCRETE PLUG
AND BENTONITE GROUT
ELEVATION 683.28
DEPTH 1

BASE OF PROTECTIVE CASING
ELEVATION 681.78
DEPTH 2.5

BASE OF BACKFILL
TOP OF SEAL
ELEVATION
DEPTH

TOP OF FILTER PACK
BASE OF SEAL
ELEVATION 681.28
DEPTH 3

TOP OF SCREEN
ELEVATION 680.28
DEPTH 4

BOTTOM OF SCREEN
ELEVATION 670.28
DEPTH 14

BASE OF FILTER PACK
ELEVATION 669.28
DEPTH 15

Print Form

IOWA DEPARTMENT OF NATURAL RESOURCES

MONITORING WELL/PIEZOMETER CONSTRUCTION DOCUMENTATION FORM

Disposal Site Name: IPL - Ottumwa Generating Station
Permit No.:
Well or Piezometer No: MW-302
Dates Started: 11/10/15
Date Completed: 11/11/15

A. SURVEYED LOCATIONS AND ELEVATIONS

Locations (± 0.5 ft):
Specify corner of site: NW of Parcel 003052630215000
Distance & direction along boundary: 844' NE
Distance & direction from boundary to wall: 4.5' S
Elevations (± 0.01 ft MSL):
Ground Surface: 671.55
Top of protective casing: 674.39
Top of well casing: 673.90
Benchmark elevation:
Benchmark description:

B. SOIL BORING INFORMATION

Name & Address of Construction Company:
Cascade Drilling, LP
301 Alderson St
Schofield, WI 54476
Name of Driller: Todd Schmalfeld
Drilling Method: HSA
Drilling Fluid: NA
Bore Hole Diameter: 8 inch
Soil Sampling Method: Spoon
Depth of Boring: 24 ft

C. MONITORING WELL INSTALLATION

Casing material: PVC sch 40
Length of casing: 13 ft
Outside casing diameter: 2.38"
Inside casing diameter: 2"
Casing joint type: threaded
Casing/screen joint type: threaded
Screen material: PVC
Screen opening size: 0.010
Screen length: 10 ft
Depth of well: 23 ft
Filter Pack:
Material: Red Flint
Grain size: #40
Volume: 3.5 cu. ft
Seal (minimum 3 ft length above filter pack):
Material: 3/8" bentonite chips

Placement method: Gravity
Volume: 2.6 cu. ft
Backfill (if different from seal):
Material: 3/8" bentonite chips
Placement method: Gravity
Volume: 1 cu. ft.
Surface seal design:
Material of protective casing: Steel
Material of grout between protective casing and well casing: sand
Protective cap:
Material: Steel, vented
Vented: ☐ Yes ☐ No Locking: ☒ Yes ☐ No
Well Cap:
Material: PVC
Vented: ☐ Yes ☒ No

D. GROUNDWATER MEASURMENT (± 0.01 ft below top of inner well casing)

Water level: 18.19
Stabilization Time: < 5 min
Well development method: Surged with block and pumped to remove turbidity. 183 gallons purged
Average depth of frostline: 3.5'

Attachments: Driller's log. Pipe schedules and grouting schedules. 8 ½x11 inch map showing locations of all monitoring wells and piezometers.

Please mail completed for to: Iowa Department of Natural Resources, Land Quality Bureau, 502 E 9th St, Des Moines IA 50319-0034.

Questions? Call or Email: Nina Koger, Environmental Engineer Sr., 515-281-8986, Nina.Koger@dnr.iowa.gov

ELEVATIONS: ± 0.01 ft MSL
DEPTHS: ± 0.1 ft FROM GROUND SURFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL.)

TOP OF PROTECTIVE CASING
ELEVATION 674 39

TOP OF WELL CASING
ELEVATION 673.90

GROUND SURFACE
ELEVATION 671.55

TOP OF BACKFILL
BASE OF CONCRETE PLUG
AND BENTONITE GROUT
ELEVATION 670.55
DEPTH 1

BASE OF PROTECTIVE CASING
ELEVATION 669.05
DEPTH 2.5

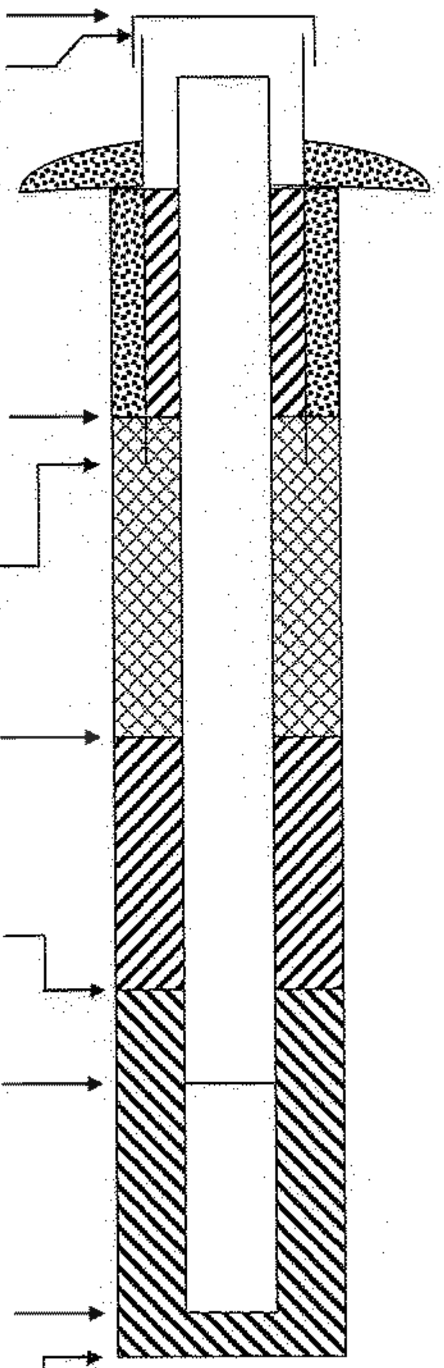
BASE OF BACKFILL
TOP OF SEAL
ELEVATION 661.55
DEPTH 10

TOP OF FILTER PACK
BASE OF SEAL
ELEVATION 660.55
DEPTH 11

TOP OF SCREEN
ELEVATION 657.55
DEPTH 13

BOTTOM OF SCREEN
ELEVATION 647.55
DEPTH 23

BASE OF FILTER PACK
ELEVATION 646.55
DEPTH 24



06/2011 cmz

DNR Form 542-1277

Print Form

IOWA DEPARTMENT OF NATURAL RESOURCES

MONITORING WELL/PIEZOMETER CONSTRUCTION DOCUMENTATION FORM

Disposal Site Name: IPL - Ottumwa Generating Station Permit No.:

Well or Piezometer No: MW-303

Dates Started: 12/8/15 Date Completed: 12/8/15

A. SURVEYED LOCATIONS AND ELEVATIONS

Locations (± 0.5 ft):

Specify corner of site: SE of parcel 003052630207000

Distance & direction along boundary: 181' NW

Distance & direction from boundary to wall: 0

Elevations (± 0.01 ft MSL):

Ground Surface: 658.95

Top of protective casing: 661.67

Top of well casing: 661.07

Benchmark elevation:

Benchmark description:

B. SOIL BORING INFORMATION

Name & Address of Construction Company:

Cascade Drilling, LP
301 Alderson St
Schofield, WI 54476

Name of Driller: Todd Schmalfeld

Drilling Method: HSA

Drilling Fluid: NA

Bore Hole Diameter: 8 inch

Soil Sampling Method: Spoon

Depth of Boring: 14.5 ft

C. MONITORING WELL INSTALLATION

Casing material: PVC sch 80

Length of casing: 3 ft

Outside casing diameter: 2.38"

Inside casing diameter: 2"

Casing joint type: threaded

Casing/screen joint type: threaded

Screen material: PVC

Screen opening size: 0.010

Screen length: 10 ft

Depth of well: 14 ft

Filter Pack:

Material: Red Flint

Grain size: #40

Volume: 7.5 cu. ft.

Seal (minimum 3 ft length above filter pack):

Material: 3/8" bentonite chips

Placement method: Gravity

Volume: 10 cu. ft.

Backfill (if different from seal):

Material:

Placement method:

Volume:

Surface seal design:

Material of protective casing: Steel 6 inch

Material of grout between protective casing and well casing: sand

Protective cap:

Material: Steel, vented

Vented: ☐ Yes ☐ No Locking: ☒ Yes ☐ No

Well Cap:

Material: PVC

Vented: ☐ Yes ☒ No

D. GROUNDWATER MEASURMENT (± 0.01 ft below top of inner well casing)

Water level: 7.71' Stabilization Time: ~ 1 day (bails dry)

Well development method: Bailed dry 3 times to reduce turbidity

Average depth of frostline: 3.5'

Attachments: Driller's log. Pipe schedules and grouting schedules. 8 ½x11 inch map showing locations of all monitoring wells and piezometers.

Please mail completed for to: Iowa Department of Natural Resources, Land Quality Bureau, 502 E 9th St, Des Moines IA 50319-0034.

Questions? Call or Email: Nina Koger, Environmental Engineer Sr., 515-281-8986, Nina.Koger@dnr.iowa.gov

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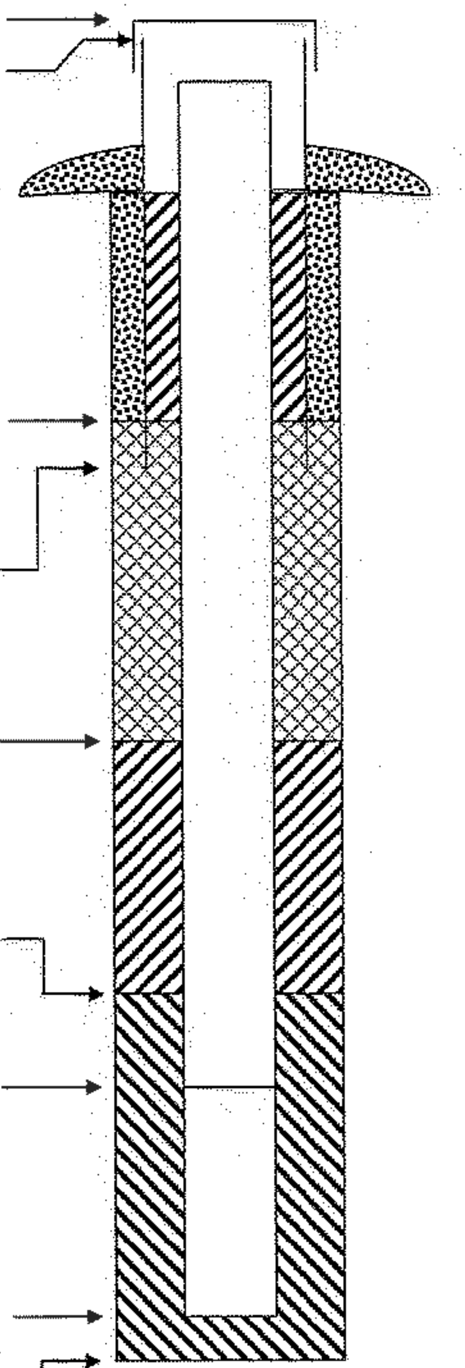
ELEVATIONS: ± 0.01 ft MSL
DEPTHS: ± 0.1 ft FROM GROUND SURFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL.)



TOP OF PROTECTIVE CASING
ELEVATION 661.67

TOP OF WELL CASING
ELEVATION 661.07

GROUND SURFACE
ELEVATION 658.95

TOP OF BACKFILL
BASE OF CONCRETE PLUG
AND BENTONITE GROUT
ELEVATION 658.95
DEPTH 0

BASE OF PROTECTIVE CASING
ELEVATION 656.45
DEPTH 2.5

BASE OF BACKFILL
TOP OF SEAL
ELEVATION 655.95
DEPTH 3

TOP OF FILTER PACK
BASE OF SEAL
ELEVATION 655.95
DEPTH 3

TOP OF SCREEN
ELEVATION 654.95
DEPTH 4

BOTTOM OF SCREEN
ELEVATION 644.95
DEPTH 14

BASE OF FILTER PACK
ELEVATION 644.45
DEPTH 14.5

06/2011 cmz

DNR Form 542-1277

Print Form

IOWA DEPARTMENT OF NATURAL RESOURCES

MONITORING WELL/PIEZOMETER CONSTRUCTION DOCUMENTATION FORM

Disposal Site Name: IPL - Ottumwa Generating Station

Permit No.:

Well or Piezometer No: MW-304

Dates Started: 11/11/15

Date Completed: 11/12/15

A. SURVEYED LOCATIONS AND ELEVATIONS

Locations (± 0.5 ft):

Specify corner of site: SE of Parcel 003052620200000

Distance & direction along boundary: 502' W

Distance & direction from boundary to wall: 44' N

Elevations (± 0.01 ft MSL):

Ground Surface: 680.09

Top of protective casing: 683.36

Top of well casing: 682.84

Benchmark elevation:

Benchmark description:

B. SOIL BORING INFORMATION

Name & Address of Construction Company:

Cascade Drilling, LP
301 Alderson St
Schofield, WI 54476

Name of Driller: Todd Schmalfeld

Drilling Method: HSA

Drilling Fluid: NA

Bore Hole Diameter: 8 inch

Soil Sampling Method: Spoon

Depth of Boring: 52 ft

C. MONITORING WELL INSTALLATION

Casing material: PVC sch 40

Length of casing: 40 ft

Outside casing diameter: 2.38"

Inside casing diameter: 2"

Casing joint type: threaded

Casing/screen joint type: threaded

Screen material: PVC

Screen opening size: 0.010"

Screen length: 5 ft

Depth of well: 50 ft

Filter Pack:

Material: Red Flint

Grain size: #40

Volume: 2 cu. ft.

Seal (minimum 3 ft length above filter pack):

Material: 3/8" bentonite chips

Placement method: gravity

Volume: .3 cu. ft.

Backfill (if different from seal):

Material: AquaGuard Grout

Placement method: tremie

Volume: 75 gallons

Surface seal design:

Material of protective casing: Steel

Material of grout between protective casing and well casing: sand

Protective cap:

Material: Steel, vented

Vented: ☐ Yes ☐ No Locking: ☒ Yes ☐ No

Well Cap:

Material: PVC

Vented: ☐ Yes ☒ No

D. GROUNDWATER MEASURMENT (± 0.01 ft below top of inner well casing)

Water level: 24.5 ft

Stabilization Time: ~1 day (bails dry)

Well development method: bailed dry 3 times to reduce turbidity

Average depth of frostline: 3.5'

Attachments: Driller's log. Pipe schedules and grouting schedules. 8 ½x11 inch map showing locations of all monitoring wells and piezometers.

Please mail completed for to: Iowa Department of Natural Resources, Land Quality Bureau, 502 E 9th St, Des Moines IA 50319-0034.

Questions? Call or Email: Nina Koger, Environmental Engineer Sr., 515-281-8986, Nina.Koger@dnr.iowa.gov

ELEVATIONS: ± 0.01 ft MSL
DEPTHS: ± 0.1 ft FROM GROUND SURFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL.)

TOP OF PROTECTIVE CASING
ELEVATION 683.36

TOP OF WELL CASING
ELEVATION 682.84

GROUND SURFACE
ELEVATION 680.09

TOP OF BACKFILL
BASE OF CONCRETE PLUG
AND BENTONITE GROUT
ELEVATION 679.09
DEPTH 1

BASE OF PROTECTIVE CASING
ELEVATION 677.59
DEPTH 2.5

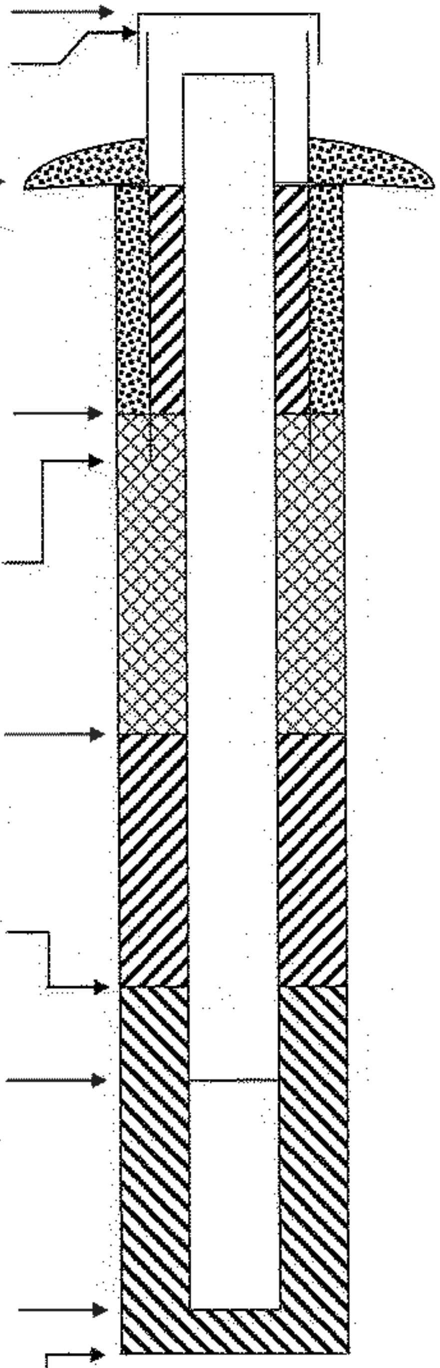
BASE OF BACKFILL
TOP OF SEAL
ELEVATION 638.09
DEPTH 42

TOP OF FILTER PACK
BASE OF SEAL
ELEVATION 637.09
DEPTH 43

TOP OF SCREEN
ELEVATION 635.09
DEPTH 45

BOTTOM OF SCREEN
ELEVATION 630.09
DEPTH 50

BASE OF FILTER PACK
ELEVATION 628.09
DEPTH 52



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DNR Form 542-1277

Print Form

IOWA DEPARTMENT OF NATURAL RESOURCES

MONITORING WELL/PIEZOMETER CONSTRUCTION DOCUMENTATION FORM

Disposal Site Name: IPL - Ottumwa Generating Station Permit No.:

Well or Piezometer No: MW-305

Dates Started: 12/7/15 Date Completed: 12/8/15

A. SURVEYED LOCATIONS AND ELEVATIONS

Locations (± 0.5 ft):

Specify corner of site: SW of Parcel 003052620200000

Distance & direction along boundary: 539' E

Distance & direction from boundary to wall: 404' N

Elevations (± 0.01 ft MSL):

Ground Surface: 681.54

Top of protective casing: 684.53

Top of well casing: 683.91

Benchmark elevation:

Benchmark description:

B. SOIL BORING INFORMATION

Name & Address of Construction Company:

Cascade Drilling, LP
301 Alderson St
Schofield, WI 54476

Name of Driller: Todd Schmalfeld

Drilling Method: HSA

Drilling Fluid: NA

Bore Hole Diameter: 8 inch

Soil Sampling Method: Spoon

Depth of Boring: 50 ft

C. MONITORING WELL INSTALLATION

Casing material: PVC sch 80

Length of casing: 44 ft

Outside casing diameter: 2.38"

Inside casing diameter: 2"

Casing joint type: threaded

Casing/screen joint type: threaded

Screen material: PVC

Screen opening size: 0.010

Screen length: 5 ft

Depth of well: 49 ft

Filter Pack:

Material: Red Flint

Grain size: #40

Volume: 2 cu. ft.

Seal (minimum 3 ft length above filter pack):

Material: 3/8" bentonite chips

Placement method: gravity

Volume: .3 cu. ft.

Backfill (if different from seal):

Material: AquaGuard grou

Placement method: tremie

Volume: 80 gallons

Surface seal design:

Material of protective casing: Steel

Material of grout between protective casing and well casing: sand

Protective cap:

Material: Steel, vented

Vented: ☐ Yes ☐ No Locking: ☒ Yes ☐ No

Well Cap:

Material: PVC

Vented: ☐ Yes ☒ No

D. GROUNDWATER MEASURMENT (± 0.01 ft below top of inner well casing)

Water level: 22.02 Stabilization Time: < 5 min

Well development method: Surged with block and pumped to reduce turbidity

Average depth of frostline: 3.5'

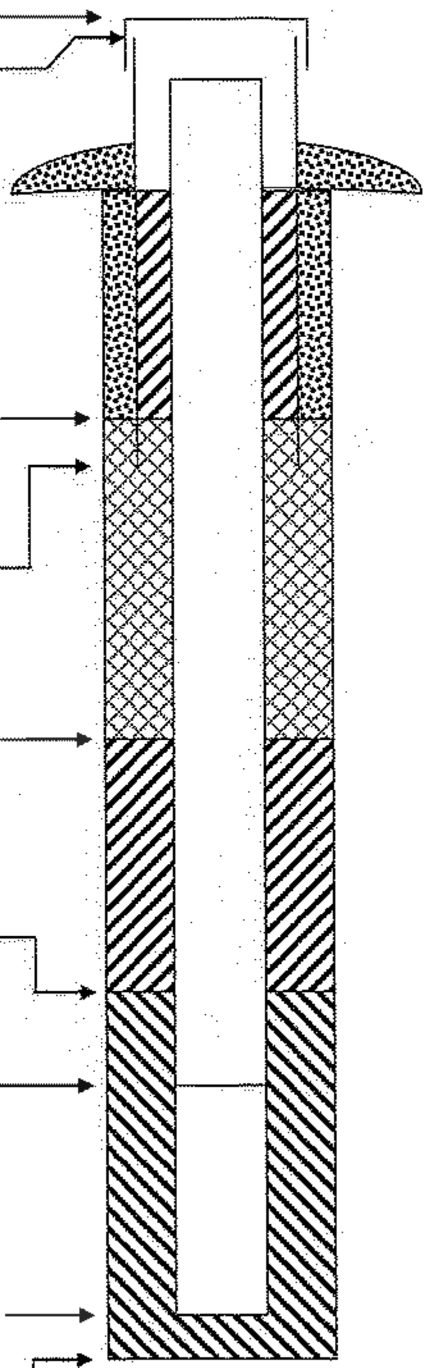
Attachments: Driller's log. Pipe schedules and grouting schedules. 8 ½x11 inch map showing locations of all monitoring wells and piezometers.

Please mail completed for to: Iowa Department of Natural Resources, Land Quality Bureau, 502 E 9th St, Des Moines IA 50319-0034.

Questions? Call or Email: Nina Koger, Environmental Engineer Sr., 515-281-8986, Nina.Koger@dnr.iowa.gov

ELEVATIONS: ± 0.01 ft MSL
DEPTHS: ± 0.1 ft FROM GROUND SURFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL.)



TOP OF PROTECTIVE CASING
ELEVATION 684.53

TOP OF WELL CASING
ELEVATION 683.91

GROUND SURFACE
ELEVATION 681.54

TOP OF BACKFILL
BASE OF CONCRETE PLUG
AND BENTONITE GROUT
ELEVATION 380.54
DEPTH 1

BASE OF PROTECTIVE CASING
ELEVATION 679.04
DEPTH 2.5

BASE OF BACKFILL
TOP OF SEAL
ELEVATION 640.54
DEPTH 41

TOP OF FILTER PACK
BASE OF SEAL
ELEVATION 639.54
DEPTH 42

TOP OF SCREEN
ELEVATION 636.54
DEPTH 44

BOTTOM OF SCREEN
ELEVATION 632.54
DEPTH 49

BASE OF FILTER PACK
ELEVATION 631.54
DEPTH 50

Print Form

IOWA DEPARTMENT OF NATURAL RESOURCES
MONITORING WELL/PIEZOMETER CONSTRUCTION DOCUMENTATION FORM

Disposal Site Name: IPL - Ottumwa Generating Station
Permit No.:
Well or Piezometer No: MW-306
Dates Started: 11/12/15
Date Completed: 11/12/15

A. SURVEYED LOCATIONS AND ELEVATIONS

Locations (± 0.5 ft):
Specify corner of site: NW of Parcel 003052620200000
Distance & direction along boundary: 137.5' E
Distance & direction from boundary to wall: 321' S
Elevations (± 0.01 ft MSL):
Ground Surface: 681.05
Top of protective casing: 683.98
Top of well casing: 683.47
Benchmark elevation:
Benchmark description:

B. SOIL BORING INFORMATION

Name & Address of Construction Company:
Cascade Drilling, LP
301 Alderson St
Schofield, WI 54476
Name of Driller: Todd Schmalfeld
Drilling Method: HSA
Drilling Fluid: NA
Bore Hole Diameter: 8 inch
Soil Sampling Method: Spoon
Depth of Boring: 34.5 ft

C. MONITORING WELL INSTALLATION

Casing material: PVC sch 80
Length of casing: 29 ft
Outside casing diameter: 2.38"
Inside casing diameter: 2"
Casing joint type: threaded
Casing/screen joint type: threaded
Screen material: PVC
Screen opening size: 0.010"
Screen length: 5 ft
Depth of well: 34 ft
Filter Pack:
Material: Red Flint
Grain size: #40
Volume: 2 cu. ft.
Seal (minimum 3 ft length above filter pack):

Placement method: Gravity
Volume: 10.5 cu. ft.
Backfill (if different from seal):
Material:
Placement method:
Volume:
Surface seal design:
Material of protective casing: Steel
Material of grout between protective casing and well casing: sand
Protective cap:
Material: Steel, vented
Vented: ☐ Yes ☐ No Locking: ☒ Yes ☐ No
Well Cap:
Material: PVC
Vented: ☐ Yes ☒ No

Material: 3/8" bentonite chips

D. GROUNDWATER MEASURMENT (± 0.01 ft below top of inner well casing)

Water level: 12.96'
Stabilization Time: < 5 min
Well development method: Surged with block and pumped. 193 gallons purged.
Average depth of frostline: 3.5'

Attachments: Driller's log. Pipe schedules and grouting schedules. 8 ½x11 inch map showing locations of all monitoring wells and piezometers.

Please mail completed for to: Iowa Department of Natural Resources, Land Quality Bureau, 502 E 9th St, Des Moines IA 50319-0034.

Questions? Call or Email: Nina Koger, Environmental Engineer Sr., 515-281-8986, Nina.Koger@dnr.iowa.gov

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ELEVATIONS: ± 0.01 ft MSL
DEPTHS: ± 0.1 ft FROM GROUND SURFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL)

TOP OF PROTECTIVE CASING
ELEVATION 683.98

TOP OF WELL CASING
ELEVATION 683.47

GROUND SURFACE
ELEVATION 681.05

TOP OF BACKFILL
BASE OF CONCRETE PLUG
AND BENTONITE GROUT
ELEVATION 680 05
DEPTH 1

BASE OF PROTECTIVE CASING
ELEVATION 678.55
DEPTH 2.5

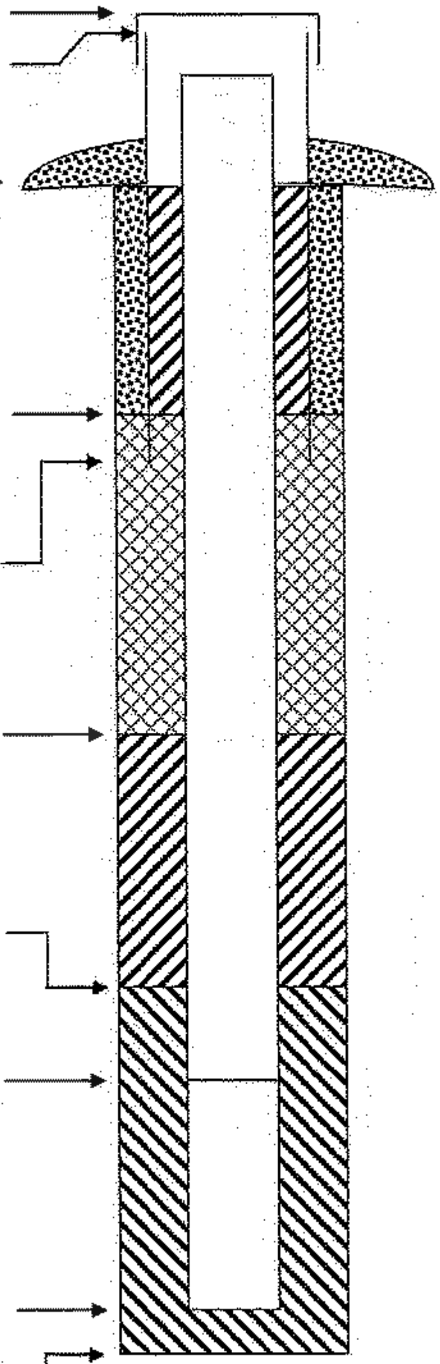
BASE OF BACKFILL
TOP OF SEAL
ELEVATION 655.05
DEPTH 26

TOP OF FILTER PACK
BASE OF SEAL
ELEVATION 654.05
DEPTH 27

TOP OF SCREEN
ELEVATION 652.05
DEPTH 29

BOTTOM OF SCREEN
ELEVATION 647.05
DEPTH 34

BASE OF FILTER PACK
ELEVATION 646.55
DEPTH 34.5



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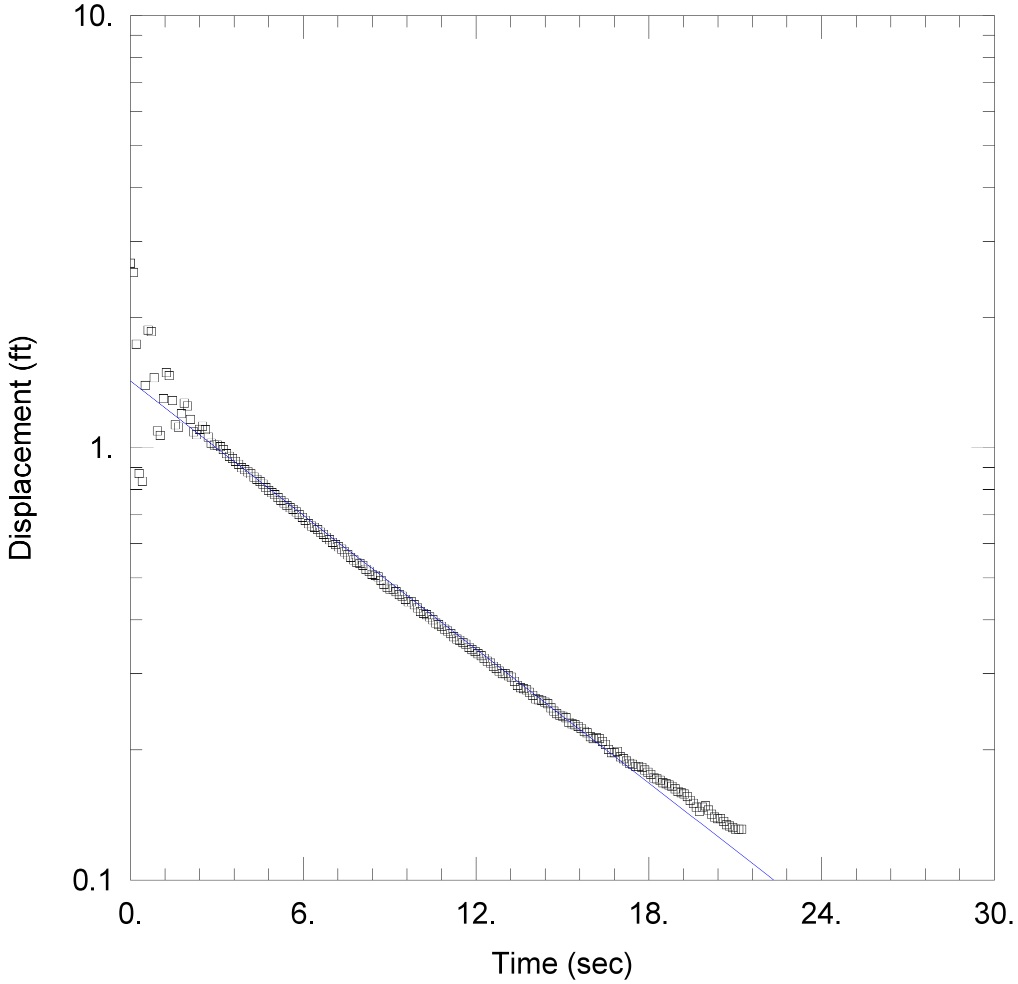
ATTACHMENT C

Hydraulic Conductivity Testing Results



WELL TEST ANALYSIS

Data Set: I:\25215135\Data\Hydraulic Conductivity Testing\OGS Slug 160218\MW-301.aqt
Date: 03/22/16 Time: 10:30:28

PROJECT INFORMATION

Company: SCS Engineers
Client: IPL-OGS
Project: 25215135.40
Location: Ottumwa
Test Well: MW-301
Test Date: 2/18/2016

AQUIFER DATA

Saturated Thickness: 500. ft
Anisotropy Ratio (Kz/Kr): 0.1

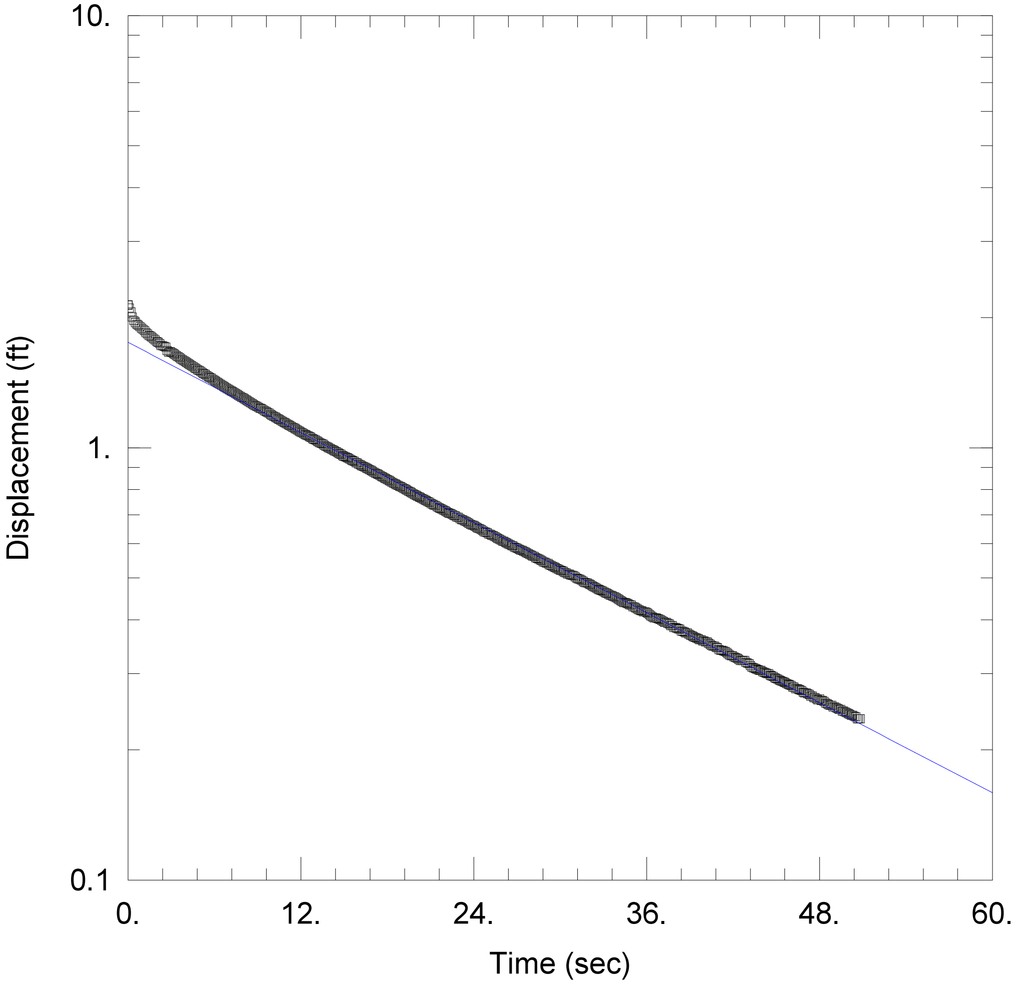
WELL DATA (MW-301)

Initial Displacement: 2.675 ft
Static Water Column Height: 14.01 ft
Total Well Penetration Depth: 14.01 ft
Screen Length: 10. ft
Casing Radius: 0.09 ft
Well Radius: 0.35 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.004611 cm/sec
y0 = 1.426 ft



WELL TEST ANALYSIS

Data Set: I:\25215135\Data\Hydraulic Conductivity Testing\OGS Slug 160218\MW-302.aqt
Date: 03/22/16 Time: 10:30:47

PROJECT INFORMATION

Company: SCS Engineers
Client: IPL-OGS
Project: 25215135.40
Location: Ottumwa
Test Well: MW-302
Test Date: 2/18/2016

AQUIFER DATA

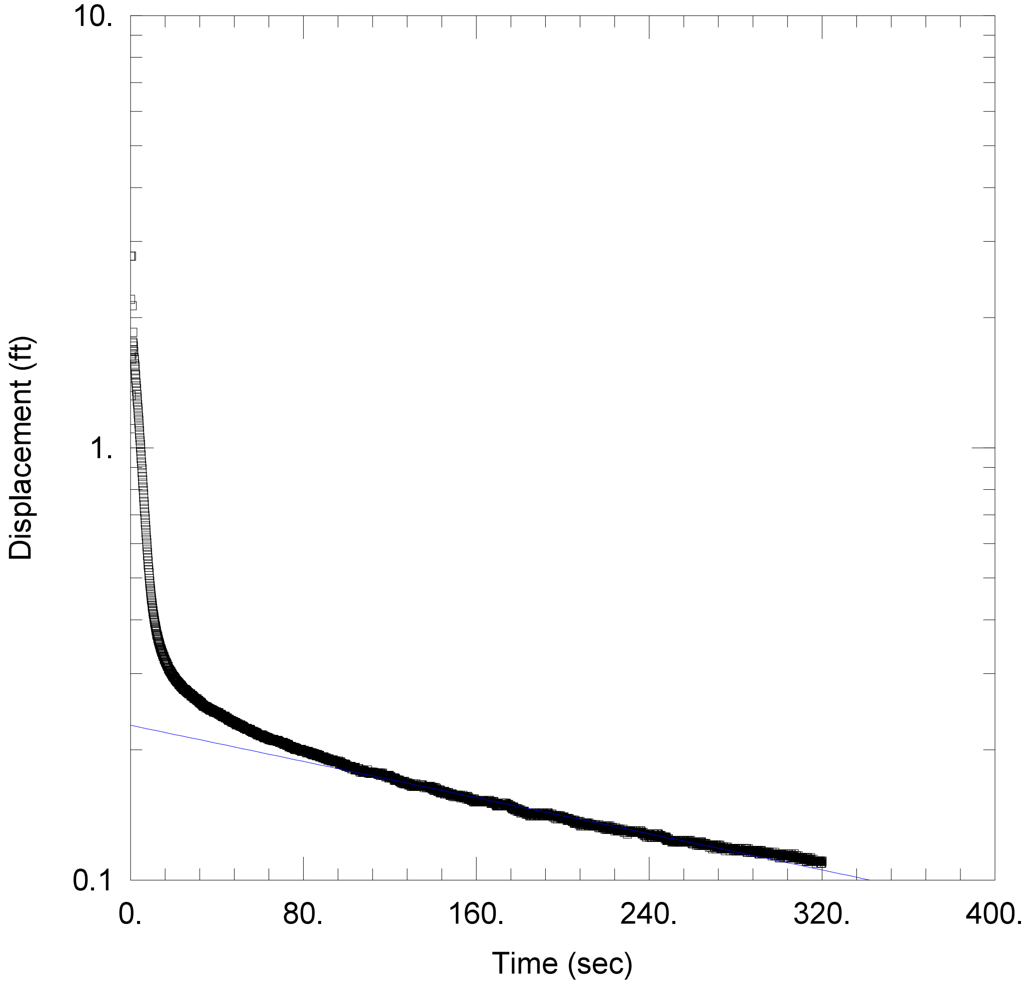
Saturated Thickness: 500. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (MW-302)

Initial Displacement: 2.14 ft
Static Water Column Height: 7.61 ft
Total Well Penetration Depth: 7.61 ft
Screen Length: 7.61 ft
Casing Radius: 0.09 ft
Well Radius: 0.35 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 0.003195 cm/sec
y0 = 1.753 ft



WELL TEST ANALYSIS

Data Set: I:\25215135\Data\Hydraulic Conductivity Testing\OGS Slug 160218\MW-303.aqt
Date: 03/22/16 Time: 10:55:52

PROJECT INFORMATION

Company: SCS Engineers
Client: IPL-OGS
Project: 25215135.40
Location: Ottumwa
Test Well: MW-303
Test Date: 2/18/2016

AQUIFER DATA

Saturated Thickness: 500. ft
Anisotropy Ratio (Kz/Kr): 0.1

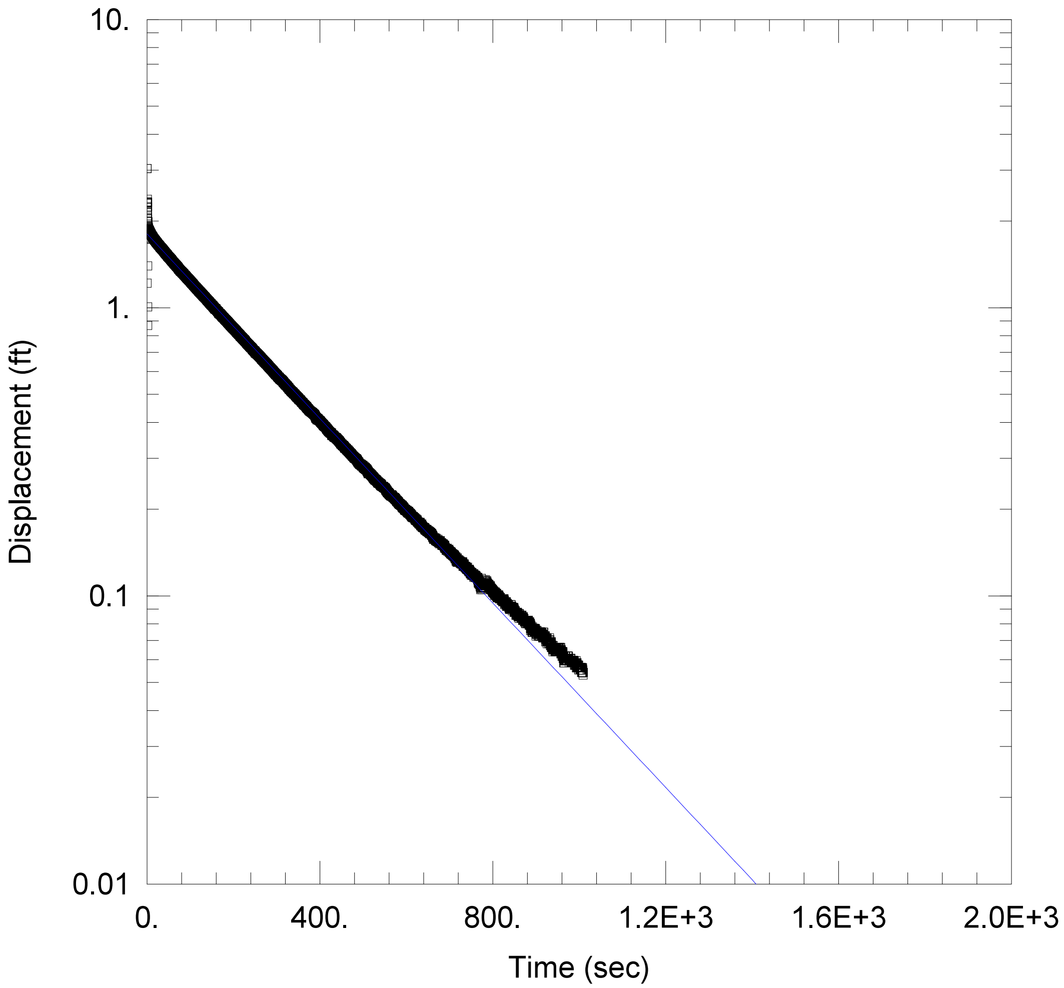
WELL DATA (MW-303)

Initial Displacement: 2.775 ft
Static Water Column Height: 9.79 ft
Total Well Penetration Depth: 9.79 ft
Screen Length: 9.79 ft
Casing Radius: 0.08 ft
Well Radius: 0.35 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev

K = 0.0001242 cm/sec
y0 = 0.228 ft



WELL TEST ANALYSIS

Data Set: I:\25215135\Data\Hydraulic Conductivity Testing\OGS Slug 160218\MW-304.aqt
Date: 04/15/16 Time: 12:17:22

PROJECT INFORMATION

Company: SCS Engineers
Client: IPL-OGS
Project: 25215135.40
Location: Ottumwa
Test Well: MW-304
Test Date: 2/18/2016

AQUIFER DATA

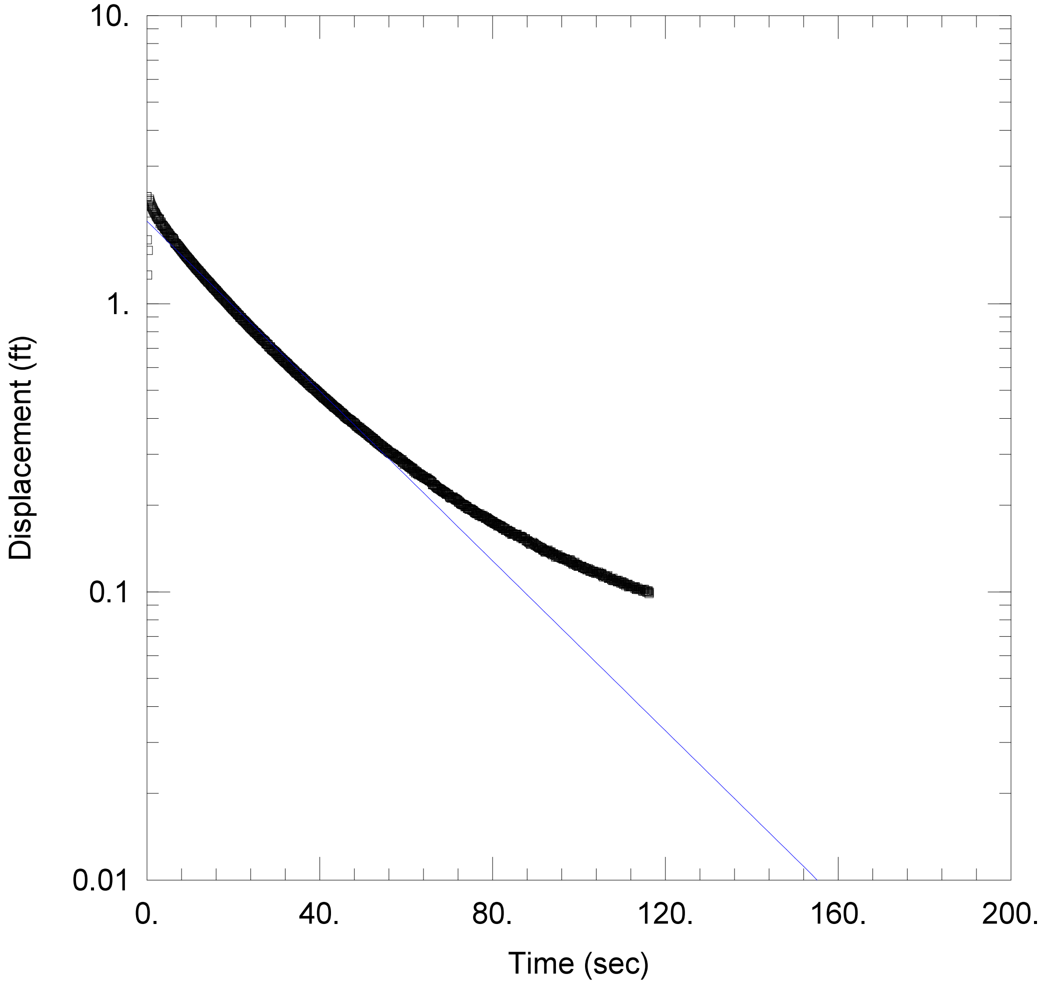
Saturated Thickness: 500. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (MW-304)

Initial Displacement: 3.04 ft
Static Water Column Height: 22.6 ft
Total Well Penetration Depth: 6. ft
Screen Length: 5. ft
Casing Radius: 0.09 ft
Well Radius: 0.35 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 0.0003468 cm/sec
y0 = 1.801 ft



WELL TEST ANALYSIS

Data Set: I:\25215135\Data\Hydraulic Conductivity Testing\OGS Slug 160218\MW-305.aqt
Date: 04/15/16 Time: 12:17:47

PROJECT INFORMATION

Company: SCS Engineers
Client: IPL-OGS
Project: 25215135.40
Location: Ottumwa
Test Well: MW-305
Test Date: 2/18/2016

AQUIFER DATA

Saturated Thickness: 500. ft
Anisotropy Ratio (Kz/Kr): 0.1

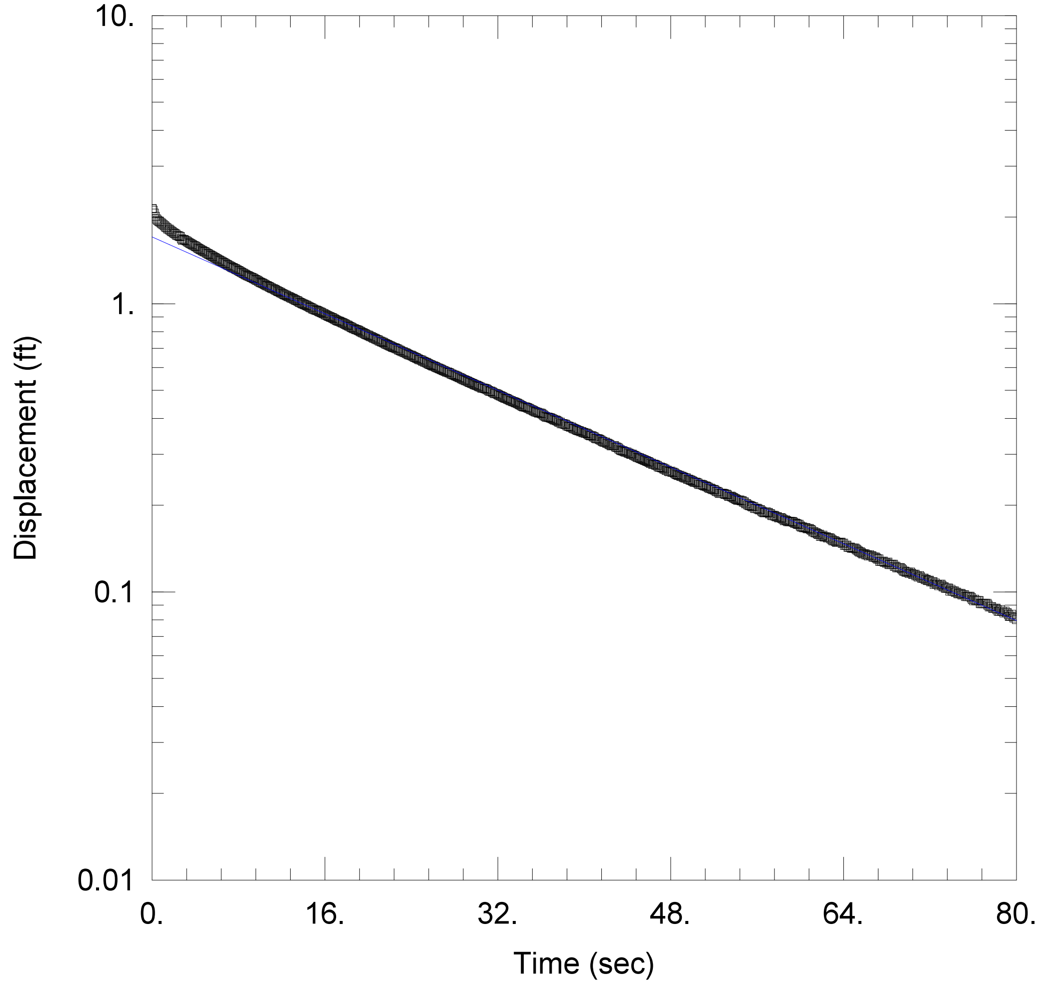
WELL DATA (MW-305)

Initial Displacement: 2.354 ft
Static Water Column Height: 29.48 ft
Total Well Penetration Depth: 7. ft
Screen Length: 5. ft
Casing Radius: 0.08 ft
Well Radius: 0.35 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev

K = 0.002522 cm/sec
y0 = 1.934 ft



WELL TEST ANALYSIS

Data Set: I:\25215135\Data\Hydraulic Conductivity Testing\OGS Slug 160218\MW-306_update.aqt
Date: 04/15/16 Time: 12:18:23

PROJECT INFORMATION

Company: SCS Engineers
Client: IPL-OGS
Project: 25215135.40
Location: Ottumwa
Test Well: MW-306
Test Date: 2/18/2016

AQUIFER DATA

Saturated Thickness: 500. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (MW-306)

Initial Displacement: 2.137 ft
Static Water Column Height: 23.64 ft
Total Well Penetration Depth: 8. ft
Screen Length: 5. ft
Casing Radius: 0.08 ft
Well Radius: 0.35 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 0.002847 cm/sec
y0 = 1.704 ft

SCS ENGINEERS Environmental Consultants & Contractors

November 12, 2019
File No. 25219028.00

Mr. Rob Saunders
Ottumwa Generating Station
20775 Power Plant Road
Ottumwa, IA 52501

Subject: Ottumwa Generating Station – Monitoring Well Construction Documentation

Dear Mr. Saunders:

SCS Engineers (SCS) has completed the installation of two groundwater monitoring wells at the Ottumwa Generating Station in Burlington, Iowa (**Figure 1**). These wells were installed to support compliance with the final Coal Combustion Residuals Rule (40 CFR 257.50-107). The monitoring well locations are shown on **Figure 2**.

BORING LOGS

The borings for monitoring wells MW-310 and MW-311 were drilled on August 27, 2019, by Roberts Environmental Drilling (Roberts) of Millstadt, Illinois. All drilling and well construction was performed under the supervision of SCS. Boring logs are included in **Appendix A**.

The monitoring wells were installed to intersect the uppermost aquifer at the site. The uppermost aquifer has been identified as the Mississippian bedrock unit, consisting of limestone with minor shale and sandstone. Where alluvial sand overlies and is hydraulically connected to the bedrock, it is considered to be part of the uppermost aquifer. Soils encountered in monitoring well borings MW-310 and MW-311 were clay, silt, and alluvial sand. Past boring logs from the area show that the alluvial sand is in contact with the bedrock surface in the areas where MW-310 and MW-311 are located.

MONITORING WELL CONSTRUCTION/DEVELOPMENT

Monitoring wells MW-310 and MW-311 were installed on August 27, 2019. The well locations were surveyed by French-Reneker Associates of Fairfield, Iowa, on September 24, 2019.

Well construction forms for the two new wells are included in **Appendix B**. Well development was performed by SCS on August 28, 2019. Photographs of the monitoring wells are included in **Appendix C**.

Hydraulic conductivity testing at MW-310 and MW-311 was completed on August 28, 2019. Conductivity test results are included in **Appendix D** and are summarized below. These values are within the typical range for the soil types observed in the borings.

Well	Calculated Hydraulic Conductivity (cm/sec)
MW-310	2.89×10^{-3}
MW-311	2.25×10^{-2}

Please contact us at 608-224-2830 if you have any questions about the well documentation.

Sincerely,

Meghan Blodgett
Hydrogeologist
SCS Engineers

Thomas J. Karwoski
Project Manager
SCS Engineers

MDB/AJR/TK

cc: Rob Saunders, Interstate Power and Light Company – Ottumwa Generating Station
Matt Hanson, Director of Operations – IPL South Region

Encl. Figure 1 – Site Location Map
Figure 2 – Site Plan and Monitoring Well Locations
Appendix A – Boring Logs
Appendix B – Well Construction Forms
Appendix C – Site Photographs
Appendix D – Hydraulic Conductivity Testing Results

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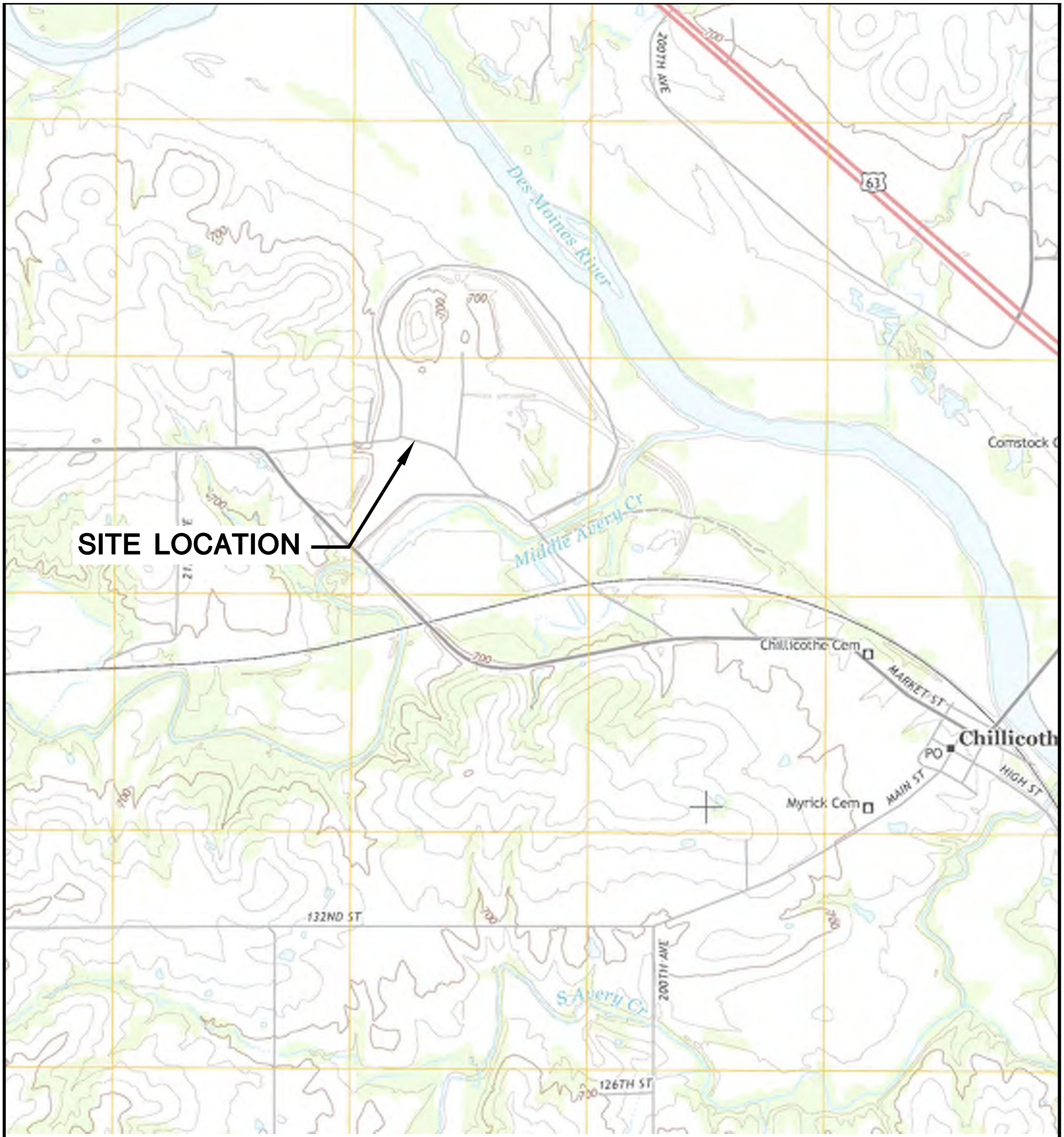
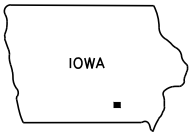
Figures



SITE LOCATION

N

CHILLICOTHE QUADRANGLE
IOWA–WAPELLO CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
2013
SCALE: 1" = 2,000'



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

SITE
OTTUMWA GENERATING STATION
OTTUMWA, IOWA

SITE LOCATION MAP

PROJECT NO.	25216148.00	DRAWN BY:	AHB
DRAWN:	05/29/15	CHECKED BY:	KK
REVISED:	12/29/16	APPROVED BY:	TK 11/12/19

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

FIGURE
1

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PROJECT NO.	25219028.00	DRAWN BY:	MBH
DRAWN:	10/16/19	CHECKED BY:	MDB
REVISED:	01/26/17	APPROVED BY:	TK 11/12/19

ENGINEER

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

CLIENT

INTERSTATE POWER AND LIGHT CO.
15300 130th STREET
OTTUMWA, IA 52501

SITE

OTTUMWA GENERATING STATION
20775 POWER PLANT ROAD
OTTUMWA, IOWA

MONITORING WELL LOCATIONS MAP

FIGURE
2

I:\25219028.00\Drawings\Site an.dwg, 11/12/2019 1: 5:20 M

Appendix A

Boring Logs

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION

Form 4400-122 Rev. 7-98

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

Page 1 of 2

Facility/Project Name IPL - Ottumwa Generating Station SCS#: 25219028.00	**License/Permit/Monitoring Number**	**Boring Number** MW-310

Boring Drilled By: Name of crew chief (first, last) and Firm Eric Wetzel Roberts Environmental Drilling, Inc.	**Date Drilling Started** 8/27/2019	**Date Drilling Completed** 8/27/2019	**Drilling Method** 4 1/4 hollow stem auger

WI Unique Well No.	**DNR Well ID No.**	**Common Well Name** MW-310	**Final Static Water Level** Feet MSL	**Surface Elevation** 655.76 Feet MSL	**Borehole Diameter** 8.5 in.

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒ State Plane 401,502 N, 1,904,206 E S/C/N 1/4 of 1/4 of Section , T N, R	Lat ° ' " Long ° ' "	**Local Grid Location** Feet ☐ N ☐ S Feet ☐ E ☐ W

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

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				Hydrovac through clay for utility clearances.										
			8	LEAN CLAY, brown, massive										
S1	11	WOH 10 3 10	9							M				
				Some reddish brown and grey mottling, some silt.										
S2	15	2 2 3 3	11		CL					M				
S3	20	1 1 1 9	13							M/W				
			14	SILT, brown, with clay	ML									
			15											

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

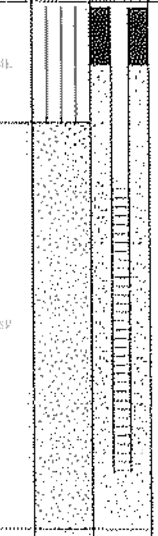
Signature	Firm SCS Engineers 2830 Dairy Drive Madison, WI 53718 Tel: 608-224-2830 Fax

This form is authorized by Chapters 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats. Completion of this form is mandatory. Failure to file this form may result in forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on this form is not intended to be used for any other purpose. NOTE: See instructions for more information, including where the completed form should be sent.

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number MW-310 Use only as an attachment to Form 4400-122 Page 2 of 2

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
S4	24	WOR			ML					M/W				
			16											
S5	18	1 3 2 3	17	POORLY GRADED SAND, fine to medium, 1/2" coarse sand seam at 17.75'	SP					W				
			18											
S6	14	WOR WOR 2 3	19							W				
			20											
S7	10	WOR 2 4 2	21							W				
			22	Trace small rounded gravel										
S8	24	6 6 11 20	23							W				
			24	End of boring at 24'										

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION

Form 4400-122 Rev. 7-98

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

Page 1 of 2

Facility/Project Name: IPL - Ottumwa Generating Station SCS#: 25219028.00

License/Permit/Monitoring Number:

Boring Number: MW-311

Boring Drilled By: Name of crew chief (first, last) and Firm: Eric Wetzel
Roberts Environmental Drilling, Inc.

Date Drilling Started: 8/27/2019

Date Drilling Completed: 8/27/2019

Drilling Method: 4 1/4 hollow stem auger

WI Unique Well No.:

DNR Well ID No:

Common Well Name: MW-311

Final Static Water Level: Feet MSL

Surface Elevation: 651.24 Feet MSL

Borehole Diameter: 8.5 in.

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒

State Plane 399,350 N, 1,907,603 E S/C/N

1/4 of 1/4 of Section , T N, R

Lat ° ' "

Long ° ' "

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

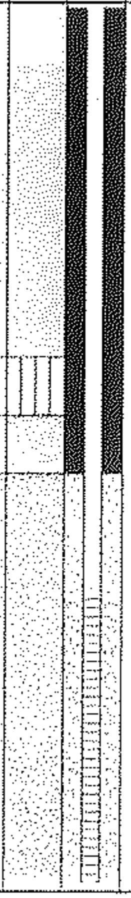
Facility ID:

County: Wapello

County Code:

Civil Town/City/ or Village: Ottumwa

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth in Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
S1	14	2 3 4 6	1 2	LEAN CLAY, brown, massive, trace fine to medium sand, roots, 1" sand seam at 1.5'.						M				
S2	14	3 3 4 6	3 4		CL					M				
S3	6	2 3 4 6	5 6	SILT, brown, massive.	ML					M				
			7	LEAN CLAY, brown, massive.	CL									
S4	20	2 3 4 4	8 9	POORLY GRADED SAND, fine to medium, brown massive						M/W				
S5	12	2 3 4 5	10 11	2" clay seam at 10.5'						W				
S6	14	1 2 4 2	12 13		SP					W				
S7	14	1 2 3 3	14 15							W				



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

Signature

Firm: SCS Engineers
2830 Dairy Drive Madison, WI 53718

Tel: 608-224-2830
Fax

This form is authorized by Chapters 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats. Completion of this form is mandatory. Failure to file this form may result in forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on this form is not intended to be be used for any other purpose. NOTE: See instructions for more information, including where the completed form should be sent.

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number MW-311 Use only as an attachment to Form 4400-122 Page 2 of 2

Sample		Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties					RQD/ Comments
Number and Type	Length Att. & Recovered (in)								Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	
					SP	▨	▨							
			16	End of boring at 16'.										

Appendix B

Well Construction Forms

MONITORING WELL / PIEZOMETER CONSTRUCTION DOCUMENTATION FORM

Disposal Site Name IPL - Ottumwa Generating Station Permit No.

Well or Piezometer No. MW-310 Dates Started 8/27/2019 Date Completed 8/27/2019

A. SURVEYED LOCATION AND ELEVATION OF POINT (+0.5 ft.)

Specify corner of site Middle Avery Creek @ ~~Des Moines River~~ Distance and direction along boundary 340' NW

Distance and direction from boundary to surface monitoring well 45' SW

Elevation (+0.01 ft. MSL)

Ground Surface 655.76 Top of protective casing 658.97

Top of well casing 658.63 Benchmark elevation

Benchmark description

B. SOIL BORING INFORMATION

Construction Company Name Roberts Environmental Drilling Inc.

Address 1107 South Mulberry Street City, State, Zip Code Millstadt, IL, 62260

Name of driller Eric Wetzel

Drilling method 4 1/4" HSA Drilling fluid Bore Hole diameter 8.5"

Soil sampling method Split Spoon Depth of boring 24'

C. MONITORING WELL INSTALLATION

Casing material PVC - Sch. 40

Length of casing 20.87

Outside casing diameter 2.4"

Inside casing diameter 2.0"

Casing joint type Threaded

Casing/screen joint type Threaded

Screen material PVC - Sch. 40

Screen opening size 0.01'

Screen length 5'

Depth of Well 23'

Filter Pack:

Material Filter Sand

Grain Size #5

Volume 1.25 cubic feet

Seal (minimum 3 ft. length above filter pack):

Material 3/8" Bentonite Chips

Placement method Gravity

Volume 4 cubic feet

Backfill (if different from seal):

Material

Placement method

Volume

Surface seal design: Concrete

Material of protective casing: Steel

Material of grout between protective casing and well casing: Bentonite/Filter Sand

Protective cap:

Material Steel

Vented?: ☒ Y ☐ N Locking?: ☒ Y ☐ N

Well cap:

Material Plastic

Vented?: ☐ Y ☒ N

D. GROUNDWATER MEASUREMENT (+0.01 foot below top of inner well casing)

Water level 16.67 **Stabilization time** 5 min

Well development method surge and purge with pump to remove turbidity

Average depth of frost line 3.5'

DRILLER'S CERTIFICATION

I certify under penalty of law I believe the information reported above is true, accurate, and complete.

Signature **Certification #** 11509 **Date** 10-3-19

Attachments: Driller's log. Pipe schedules and grouting schedules. 8 ½ inch x 11 inch map showing locations of all monitoring wells and piezometers.

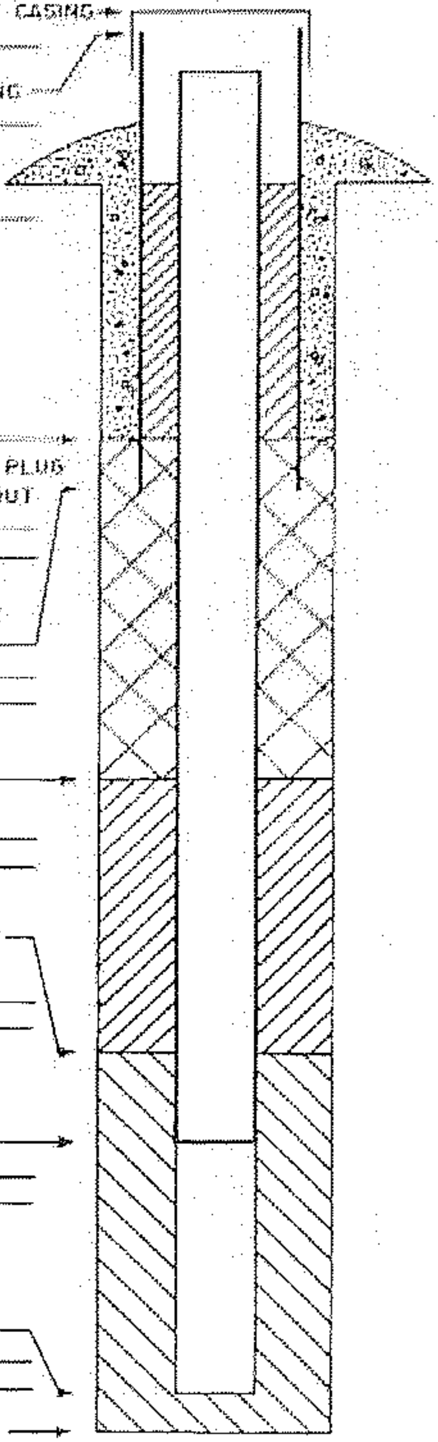
Please mail completed form to: Iowa Department of Natural Resources, Land Quality Bureau, 502 E. 9th St, Des Moines, IA 50319.

Questions? Call or Email: Nina Booker Environmental Engineer Sr., 515-725-8309, nina.booker@dnr.iowa.gov

ELEVATIONS: ± 0.01 FT. MSL

DEPTHS: ± 0.1 FT. FROM
GROUND SERFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL).



TOP OF PROTECTIVE CASING
ELEVATION 658.97

TOP OF WELL CASING
ELEVATION 658.63

GROUND SURFACE
ELEVATION 655.76

TOP OF BACKFILL
BASE OF CONCRETE PLUG
AND BENTONITE GROUT
ELEVATION 651.76
DEPTH 4

BASE OF PROTECTIVE
CASING
ELEVATION 651.76
DEPTH 4

BASE OF BACKFILL
TOP OF SEAL
ELEVATION
DEPTH N/A

TOP OF FILTER PACK
BASE OF SEAL
ELEVATION 639.76
DEPTH 16

TOP OF SCREEN
ELEVATION 637.76
DEPTH 18

BOTTOM OF SCREEN
ELEVATION 632.76
DEPTH 23

BASE OF FILTER PACK
ELEVATION 631.76
DEPTH 24

MONITORING WELL / PIEZOMETER CONSTRUCTION DOCUMENTATION FORM

Disposal Site Name IPL - Ottumwa Generating Station Permit No.

Well or Piezometer No. MW-311 Dates Started 8/27/2019 Date Completed 8/27/2019

A. SURVEYED LOCATION AND ELEVATION OF POINT (+0.5 ft.)

Specify corner of site SE Distance and direction along boundary 730' W

Distance and direction from boundary to surface monitoring well 160' N

Elevation (+0.01 ft. MSL)

Ground Surface 651.24 Top of protective casing 654.49

Top of well casing 654.18 Benchmark elevation

Benchmark description

B. SOIL BORING INFORMATION

Construction Company Name Roberts Environmental Drilling Inc.

Address 1107 South Mulberry Street City, State, Zip Code Millstadt, IL, 62260

Name of driller Eric Wetzel

Drilling method 4 1/4" HSA Drilling fluid Bore Hole diameter 8.5"

Soil sampling method Split Spoon Depth of boring 16'

C. MONITORING WELL INSTALLATION

Casing material PVC - Sch. 40

Length of casing 12.94'

Outside casing diameter 2.4"

Inside casing diameter 2.0"

Casing joint type Threaded

Casing/screen joint type Threaded

Screen material PVC - Sch. 40

Screen opening size 0.01'

Screen length 5'

Depth of Well 15'

Filter Pack:

Material Filter Sand

Grain Size #5

Volume 1.5 cubic feet

Seal (minimum 3 ft. length above filter pack):

Material 3/8" Bentonite Chips

Placement method Gravity

Volume 2 cubic feet

Backfill (if different from seal):

Material

Placement method

Volume

Surface seal design: Concrete

Material of protective casing: Steel

Material of grout between protective casing and well casing: Bentonite/Filter Sand

Protective cap:

Material Steel

Vented?: ☒ Y ☐ N Locking?: ☒ Y ☐ N

Well cap:

Material Plastic

Vented?: ☐ Y ☒ N

D. GROUNDWATER MEASUREMENT (±0.01 foot below top of inner well casing)

Water level 12.04 **Stabilization time** 5 min

Well development method surge and purge with pump to remove turbidity

Average depth of frost line 3.5'

DRILLER'S CERTIFICATION

I certify under penalty of law I believe the information reported above is true, accurate, and complete.

Signature **Certification #** 11509 **Date** 11.3.19

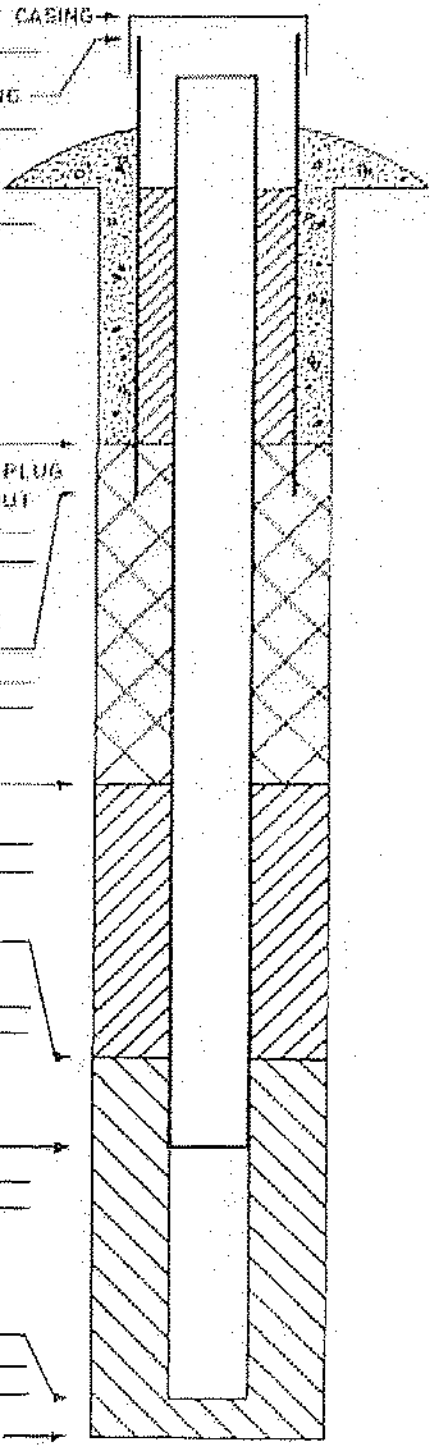
Attachments: Driller's log. Pipe schedules and grouting schedules. 8 ½ inch x 11 inch map showing locations of all monitoring wells and piezometers.

Please mail completed form to: Iowa Department of Natural Resources, Land Quality Bureau, 502 E. 9th St, Des Moines, IA 50319.

Questions? Call or Email: Nina Booker Environmental Engineer Sr., 515-725-8309, nina.booker@dnr.iowa.gov

ELEVATIONS: ± 0.01 FT. MSL
DEPTHS: ± 0.1 FT. FROM
GROUND SURFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL)



TOP OF PROTECTIVE CASING
ELEVATION 654.49

TOP OF WELL CASING
ELEVATION 654.18

GROUND SURFACE
ELEVATION 651.24

TOP OF BACKFILL
BASE OF CONCRETE PLUG
AND BENTONITE GROUT
ELEVATION 647.24
DEPTH 4

BASE OF PROTECTIVE
CASING
ELEVATION 647.24
DEPTH 4

BASE OF BACKFILL
TOP OF SEAL
ELEVATION
DEPTH N/A

TOP OF FILTER PACK
BASE OF SEAL
ELEVATION 643.24
DEPTH 8

TOP OF SCREEN
ELEVATION 641.24
DEPTH 10

BOTTOM OF SCREEN
ELEVATION 636.24
DEPTH 15

BASE OF FILTER PACK
ELEVATION 635.24
DEPTH 16

Appendix C

Site Photographs

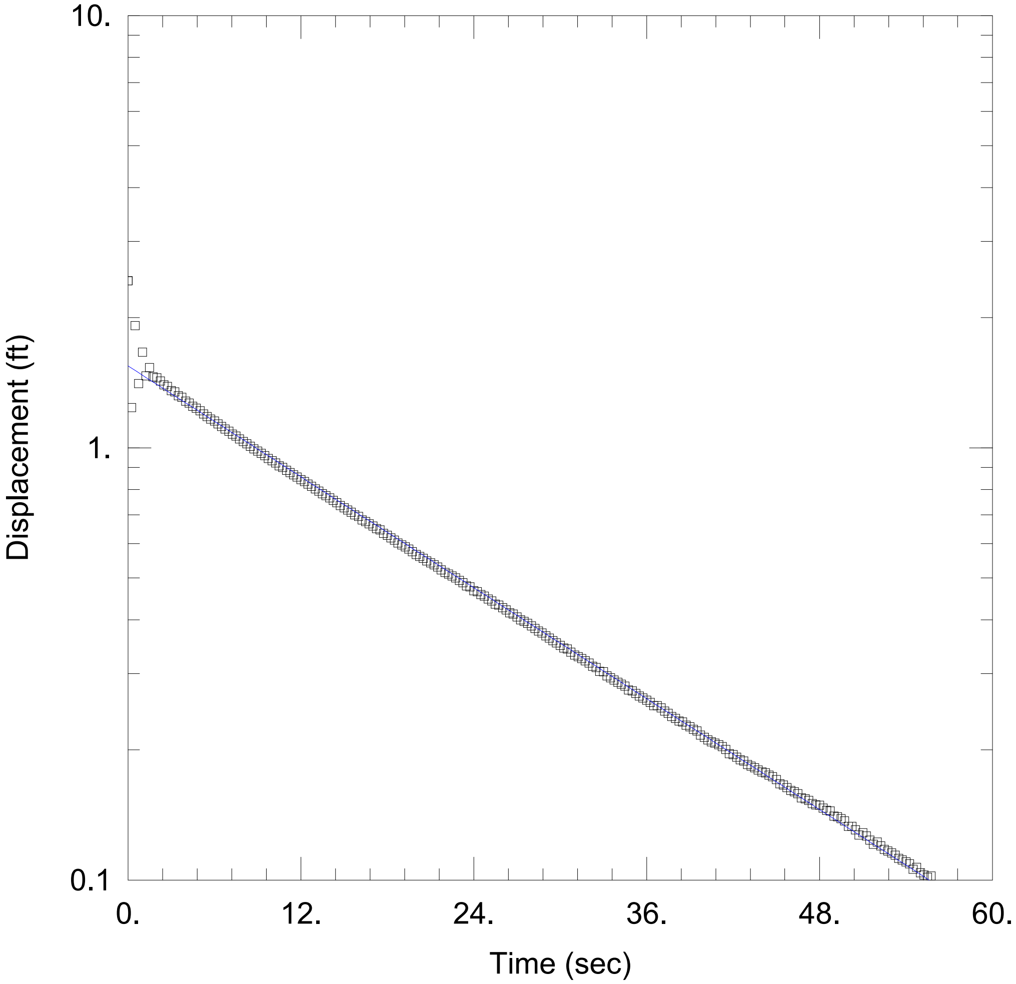
Ottumwa Generating Station
20775 Power Plant Road, Ottumwa, Iowa
SCS Engineers Project #25219028.00

Photo 1: MW-310, looking east.

Photo 2: MW-311, looking east.

Appendix D

Hydraulic Conductivity Testing Results



WELL TEST ANALYSIS

Data Set: I:\25219028.00\Data and Calculations\K Tests\MW310.aqt
Date: 10/15/19 Time: 14:27:03

PROJECT INFORMATION

Company: SCS Engineers
Client: IPL
Project: 25219028
Location: Ottumwa, IA
Test Well: MW310
Test Date: 8/28/2019

AQUIFER DATA

Saturated Thickness: 10. ft
Anisotropy Ratio (Kz/Kr): 1.

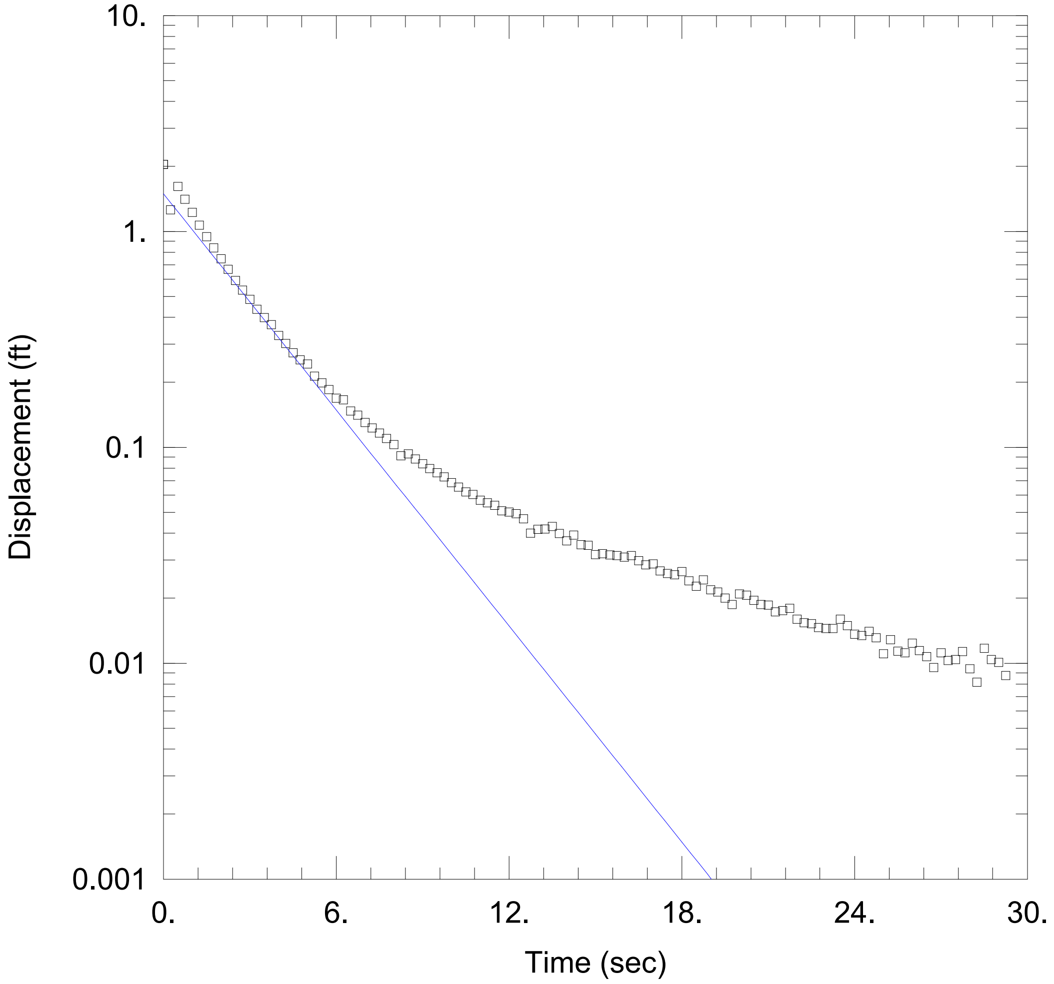
WELL DATA (MW310)

Initial Displacement: 2.435 ft
Total Well Penetration Depth: 6. ft
Casing Radius: 0.085 ft
Static Water Column Height: 8.15 ft
Screen Length: 5. ft
Well Radius: 0.35 ft
Gravel Pack Porosity: 0.25

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev

K = 0.002889 cm/sec
y0 = 1.546 ft



WELL TEST ANALYSIS

Data Set: I:\25219028.00\Data and Calculations\K Tests\MW311.aqt
Date: 10/15/19 Time: 15:00:06

PROJECT INFORMATION

Company: SCS Engineers
Client: IPL
Project: 25219028
Location: Ottumwa, IA
Test Well: MW311
Test Date: 8/28/2019

AQUIFER DATA

Saturated Thickness: 20. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW310)

Initial Displacement: 2.043 ft
Total Well Penetration Depth: 7. ft
Casing Radius: 0.085 ft
Static Water Column Height: 5.98 ft
Screen Length: 5. ft
Well Radius: 0.35 ft
Gravel Pack Porosity: 0.25

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 0.02254 cm/sec
y0 = 1.493 ft

SCS ENGINEERS Environmental Consultants & Contractors

September 30, 2020
File No. 25220056.00

Mr. Rob Saunders
Ottumwa Generating Station
20775 Power Plant Road
Ottumwa, IA 52501

Subject: Ottumwa Generating Station – Monitoring Well Construction Documentation

Dear Mr. Saunders:

SCS Engineers (SCS) has completed the installation of three groundwater monitoring wells at the Ottumwa Generating Station in Lansing, Iowa (**Figure 1**). These wells were installed to support compliance with the final Coal Combustion Residuals Rule (40 CFR 257.50-107). The monitoring well locations are shown on **Figure 2**.

BORING LOGS

Monitoring wells MW-305A, MW-310A, and MW-311A were installed on February 25 through March 3, 2020, by Roberts Environmental Drilling (Roberts) of Millstadt, Illinois. All drilling and well construction was performed under the supervision of SCS. Boring logs are included in **Appendix A**.

The monitoring wells were installed to provide information on vertical groundwater flow and the vertical distribution of target groundwater quality parameters. Each of the new wells was installed adjacent to a pre-existing well (MW-305, MW-310, and MW-311), and is 30 feet deeper than the adjacent well. The new wells intersect the Mississippian bedrock unit, which includes intervals of limestone, sandstone, and shale.

MONITORING WELL CONSTRUCTION/DEVELOPMENT

Monitoring wells MW-305A, MW-310A, and MW-311A were installed by Roberts on February 25 through March 3, 2020. The well locations were surveyed by French-Reneker of Fairfield, Iowa, on May 8, 2020.

Well construction forms for the three new wells are included in **Appendix B**. Well development was performed by SCS on March 4 and 5, 2020. Photographs of the monitoring wells are included in **Appendix C**.

Hydraulic conductivity testing at MW-305A, MW-310A, and MW-311A was completed on August 4, 2020. Conductivity test results are included in **Appendix D** and are summarized below. These values are within the typical range for the bedrock type in which the wells are screened.

Well	Calculated Hydraulic Conductivity (cm/sec)
MW-305A	5.63×10^{-6}
MW-310A	4.18×10^{-7}
MW-311A	5.38×10^{-7}

Please contact us at 608-224-2830 if you have any questions about this well documentation.

Sincerely,

Adam Watson	Thomas J. Karwoski
Staff Geologist	Project Manager
SCS Engineers	SCS Engineers

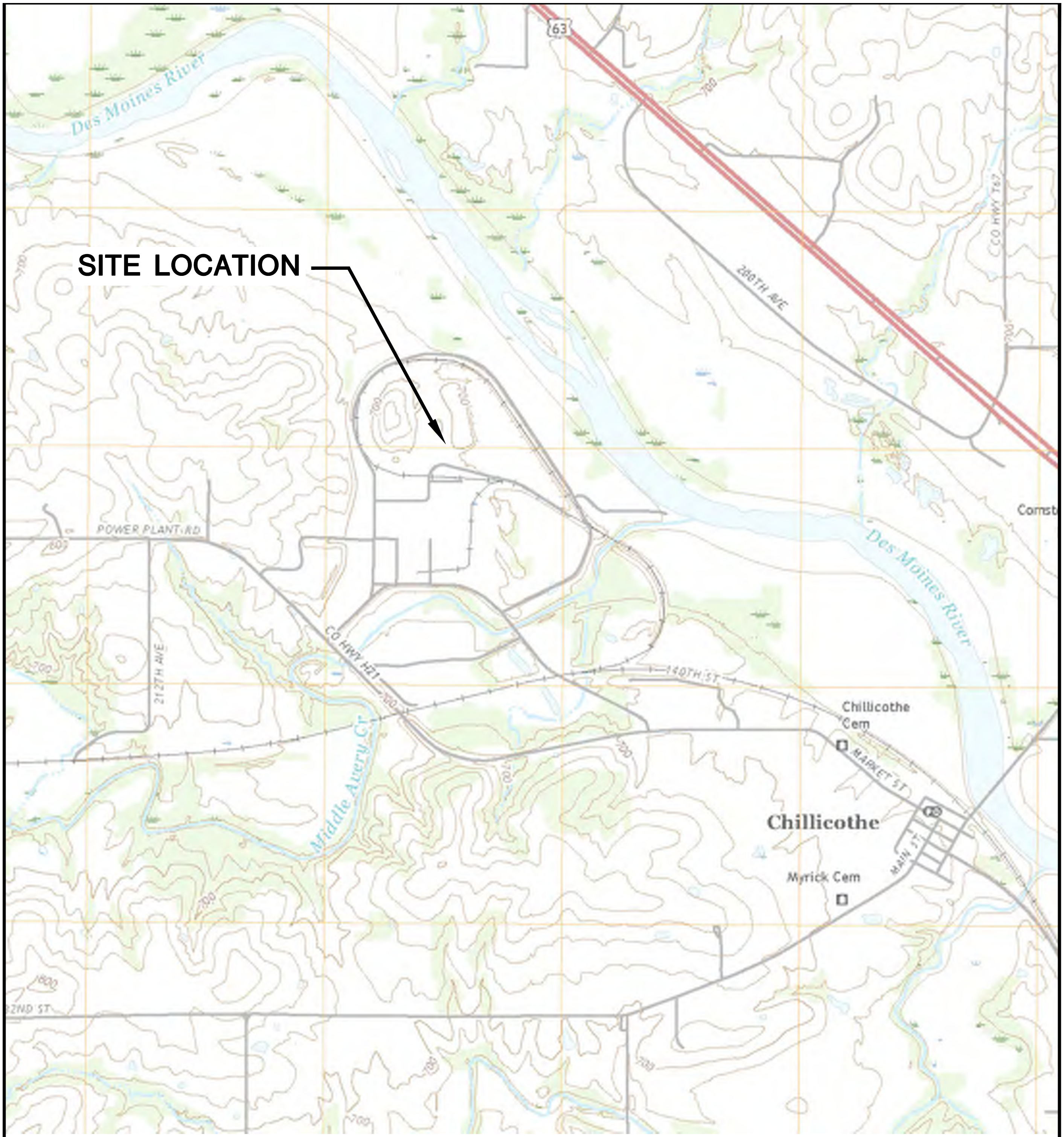
ACW/jsn_ajr/MDB/TK

cc: Jeff Maxted, Alliant Energy
Tasha Campbell, Alliant Energy

Encl. Figure 1 – Site Location Map
Figure 2 – Site Plan and Monitoring Well Location Map
Appendix A – Boring Logs
Appendix B – Well Construction Forms
Appendix C – Site Photographs
Appendix D – Hydraulic Conductivity Test Results

I:\25220056.00\Deliverables\Well Documentation Report\200930_Well Documentation Letter_OGS.docx

Figures



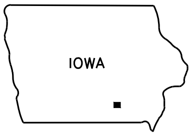
CHILLICOTHE QUADRANGLE

IOWA–WAPELLO CO.

7.5 MINUTE SERIES (TOPOGRAPHIC)

2018

SCALE: 1" = 2,000'



CLIENT

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

SITE

ALLIANT ENERGY
OTTUMWA GENERATING STATION
OTTUMWA, IOWA

SITE LOCATION MAP

PROJECT NO.	25219072.00	DRAWN BY:	BSS
DRAWN:	11/15/2019	CHECKED BY:	MDB
REVISED:	01/10/2020	APPROVED BY:	TK 9/30/2020

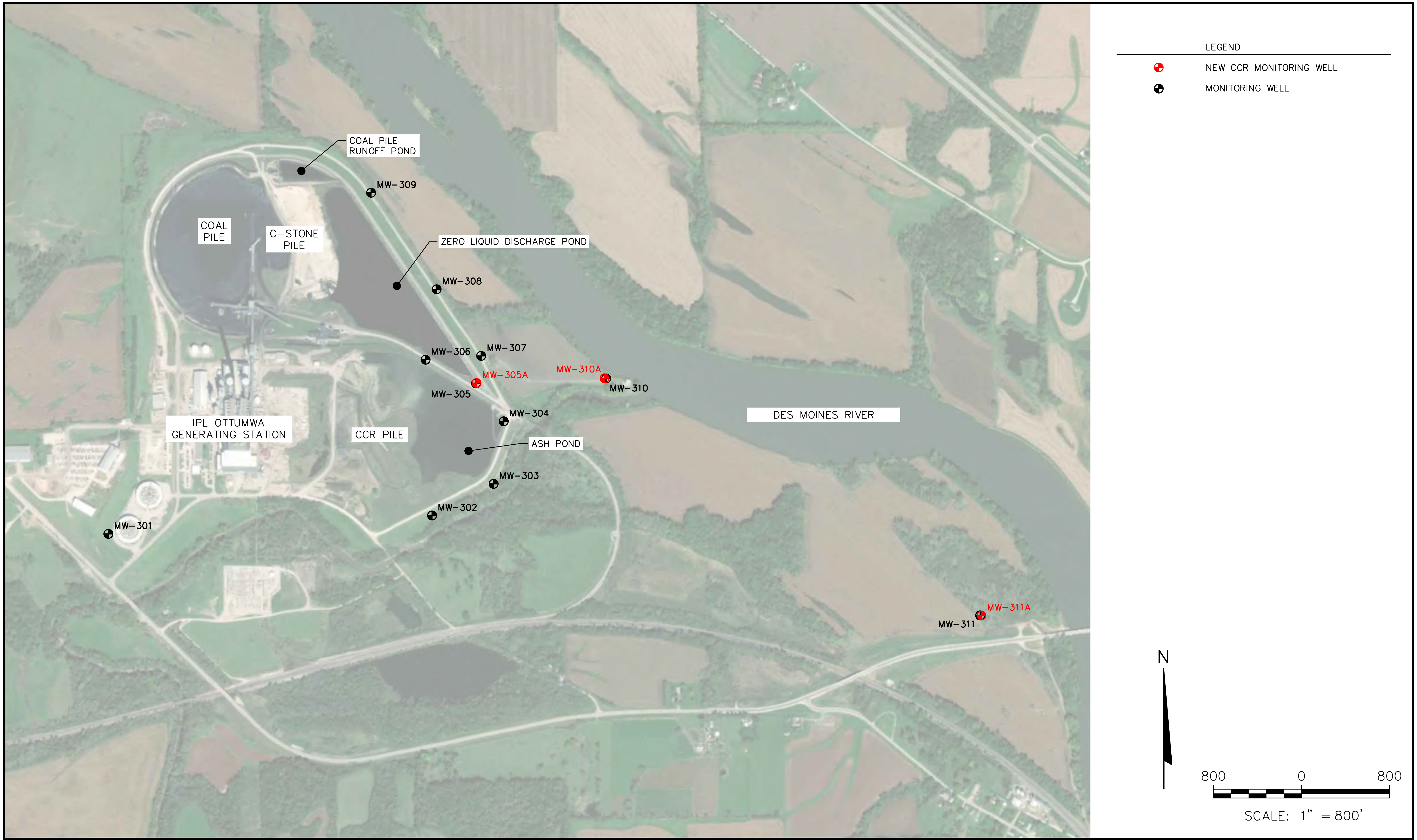
ENGINEER

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

FIGURE

1

I:\25219072.00\Drawings\□□□ 2019 Annua□□e□ort\Site Location Ma□.dwg, 1/15/2020 6:15:□7 □M



PROJECT NO. 25220056.00	DRAWN BY: KP/BSS/RJG	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	ALLIANT ENERGY OTTUMWA GENERATING STATION OTTUMWA, IOWA
DRAWN: 04/28/2020	CHECKED BY: NDK/SCC						
REVISED: 08/18/2020	APPROVED BY: TK 9/30/2020						

SITE PLAN AND MONITORING WELL LOCATIONS

FIGURE 2

I:\25220056.00\Drawings\Site an.dwg, 8/18/2020 8:21:20 AM

Appendix A

Boring Logs

SOIL BORING LOG INFORMATIO

Page 1 of 4

Facility/Project Name IPL-Ottumwa Generating Station SCS#: 25220056.00	License/Permit/Monitoring Number	Boring Number MW-305A	
Boring Drilled By: Name of crew chief (first, last) and Firm Jeff Crank Roberts Environmental Services	Date Drilling Started 2/25/2020	Date Drilling Completed 2/27/2020	Drilling Method 6 1/4" HSA and air/mud rotary

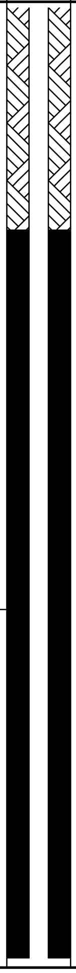
	DNR Well ID No.	Common Well Name MW-305A	Final Static Water Level 32.7 Feet	Surface Elevation 681.76 Feet	Borehole Diameter 10" and 6" in.

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 401,461 N, 1,903,028 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
Feet ☐ N ☐ S
Feet ☐ E ☐ W

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

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			0–9.5	Hydrovaced to 9.5 feet for utility clearance.										Drilled using hollow stem augers to 55 feet
			9.5–15	Blind drilled to 46 feet. See boring log MW-305 for lithology.										

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

Signature	Firm scs engineers	Tel: Fax:

This form is authorized by Chapters 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats. Completion of this form is mandatory. Failure to file this form may result in forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on this form is not intended to be be used for any other purpose. NOTE: See instructions for more information, including where the completed form should be sent.

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number MW-305A Use only as an attachment to Form 4400-122. Page 2 of 4

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			16											
			17											
			18											
			19											
			20											
			21											
			22											
			23											
			24											
			25											
			26											
			27											
			28											
			29											
			30											
			31											
			32											
			33											
			34											
			35											
			36											
			37											
			38											
			39											
			40											

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number MW-305A Use only as an attachment to Form 4400-122. Page 3 of 4

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
														Bagged auger samples to ~40 feet
			41											
			42											
			43											
			44											
			45											Swithched to mud rotary drilling at 45 feet
S1	5	50/5	46	POORLY GRADED SAND, fine, light brown, (weathered sandstone bedrock).						W				
			47											
			48											
			49											
			50											
			51											
			52											
			53		SP									
			54											
			55	Same as above but very fine, light brown to light gray, with pieces of rock.										Switched to air rotary drilling at 55 feet
			56											
			57											
			58											
			59											Driller noted rock became more compitant at 59' bgs.
			60	SANDSTONE, fine to medium, light brown, trace gravel and light gray to gray limestone, (bedrock).										
			61											
			62											
			63											
			64											
			65											

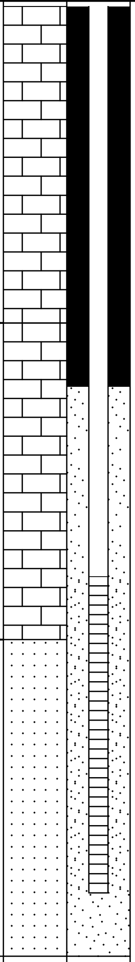
State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION SUPPLEMENT

Form 4400-122A

Boring Number MW-305A Use only as an attachment to Form 4400-122. Page 4 of 4

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			66 67 68 69	LIMESTONE, light gray, with fine, light brown sandstone, (bedrock).										At 68 feet, driller noted a fracture in the bedrock.
			70 71 72 73 74	LIMESTONE, gray, with dark brownish gray shale, (bedrock).										
			75 76 77 78 79	SANDSTONE, fine, light grayish white, with gray limestone, (bedrock).										
			80	End of boring at 80 feet below ground surface.										



SOIL BORING LOG INFORMATION

Page 1 of 3

Facility/Project Name IPL-Ottumwa Generating Station SCS#: 25220056.00	License/Permit/Monitoring Number	Boring Number MW-310A

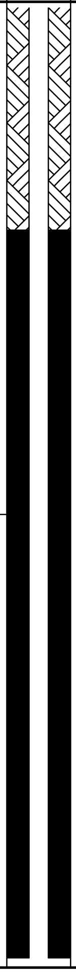
Boring Drilled By: Name of crew chief (first, last) and Firm Jeff Crank Roberts Environmental Services	Date Drilling Started 2/27/2020	Date Drilling Completed 3/2/2020	Drilling Method 6 1/4" HSA & air rotary

DNR Well ID No.	Common Well Name MW-310A	Final Static Water Level 12.0 Feet	Surface Elevation 655.26 Feet	Borehole Diameter 10" and 6" in.

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 401,504 N, 1,904,191 E S/C/N
SW 1/4 of NW 1/4 of Section 25, T 73 N, R 15 W
Lat ____° ____' ______"
Long ____° ____' ______"
Local Grid Location
Feet ☐ N ☐ S
Feet ☐ E ☐ W

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

Sample		Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties					RQD/ Comments
Number and Type	Length Att. & Recovered (in)								Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	
			0–8	Hydrovaced to 8 feet for utility clearance.										Drilled using hollow stem augers to 40 feet
			8–15	Blind drilled to 24 feet. See boring log MW-310 for lithology.										



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

Signature	Firm scs engineers Tel: Fax:

This form is authorized by Chapters 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats. Completion of this form is mandatory. Failure to file this form may result in forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on this form is not intended to be be used for any other purpose. NOTE: See instructions for more information, including where the completed form should be sent.

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION SUPPLEMENT

Form 4400-122A

Boring Number MW-310A Use only as an attachment to Form 4400-122. Page 2 of 3

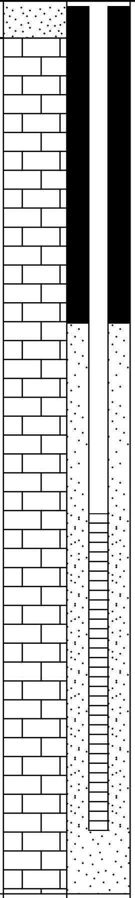
Sample		Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties					RQD/ Comments
Number and Type	Length Att. & Recovered (in)								Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	
			16											
			17											
			18											
			19											
			20											
			21											
			22											
			23											
			24	POORLY GRADED SAND, fine to coarse, brown, trace gravel and lenses of lean clay.										
S1	14	7 20 23 21	25		SP					W				Began collecting split spoon samples at 24 feet
			26	POORLY GRADED SAND, fine, light gray, trace lean clay, (weathered sandstone bedrock).										
S2	17	9 11 12 13	27							W				
			28	Same as above but brown with small gravel.										
S3	13	14 36 50/5	29							W				
			30	Same as above but fine to medium and brown to light gray.										
S4	5	50/5	31							W				
			32	Same as above but fine and light gray.										
S5	5	50/5	33		SP					W				
			34											
S6	5	50/5	35							W				
			36											
S7	5	50/5	37							W				
			38											
S8	4	50/4	39							W				Auger refusal at 39 fet
			40	Same as above but much more competent.										

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number MW-310A Use only as an attachment to Form 4400-122. Page 3 of 3

Sample		Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties					RQD/ Comments
Number and Type	Length Att. & Recovered (in)								Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	
					SP									
			41	LIMESTONE, light brownish gray, with fine to medium light gray sandstone, (bedrock).										
S9			42							W				Switching to air rotary drilling at 40 feet
			43	Same as above but with gravel and very little sand.										Intermittent gravel between 43 to 54 feet
			44											
			45											
			46											
			47											
			48											
			49											
			50											
			51											
			52											
			53											
			54	End of boring at 54 feet below ground surface.										



SOIL BORING LOG INFORMATION

Page 1 of 3

Facility/Project Name IPL-Ottumwa Generating Station SCS#: 25220056.00	License/Permit/Monitoring Number	Boring Number MW-311A

Boring Drilled By: Name of crew chief (first, last) and Firm Jeff Crank Roberts Environmental Services	Date Drilling Started 3/2/2020	Date Drilling Completed 3/3/2020	Drilling Method 6 1/4" auger & air rotary

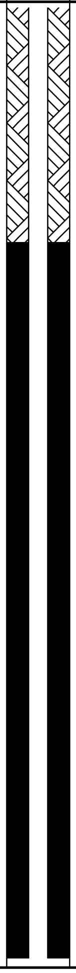
	DNR Well ID No.	Common Well Name MW-311A	Final Static Water Level 8.9 Feet	Surface Elevation 651.16 Feet	Borehole Diameter 10" and 6" in.

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 399,349 N, 1,907,615 E S/C/N
SW 1/4 of SE 1/4 of Section 25, T 73 N, R 15 W

Lat ___° ___' ____"
Long ___° ___' ____"

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

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

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				Blind drilled to 16 feet. See boring log MW-311 for lithology.										Drilled using hollow stem augers to 28 feet
			1											
			2											
			3											
			4											
			5											
			6											
			7											
			8											
			9											
			10											
			11											
			12											
			13											
			14											
			15											

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

Signature	Firm scs engineers	Tel: Fax:

This form is authorized by Chapters 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats. Completion of this form is mandatory. Failure to file this form may result in forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on this form is not intended to be be used for any other purpose. NOTE: See instructions for more information, including where the completed form should be sent.

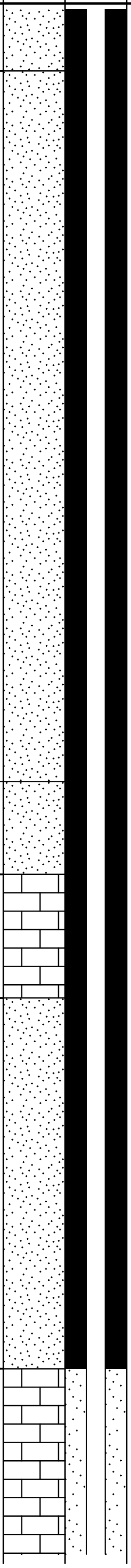
State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION SUPPLEMENT

Form 4400-122A

Boring Number MW-311A Use only as an attachment to Form 4400-122. Page 2 of 3

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				POORLY GRADED SAND, fine to coarse, brown, with trace gravel and silt.										
			16											
S1	2		17							W				Began collecting split spoon samples at 16 feet
			18											
S2	11	4 5 6 7	19							W				
			20											
S3	12	5 5 6 7	21		SP					W				
			22											
S4		7 8 9 8	23							W				No return
			24											
S5		3 3 5 10	25							W				No return
			26											
S6	14	5 9 50/5	27							W				Driller noted bedrock at 27.5 feet
			28	POORLY GRADED SAND, very fine, white, with pieces of competent rock, (weatherd sandstone bedrock).	SP									Switched to air rotary drilling at 28 feet
			29	LIMESTONE, gray with fine, light gray to white sandstone, (bedrock).										
			30											
			31	POORLY GRADED SAND, fine to medium, brown, with trace brown limestone, (bedrock).										
			32											
			33											
			34		SP									
			35											
			36											
			37	LIMESTONE, gray, with fine to medium browinsh gray sandstone, (bedrock).										
			38											
			39											
			40											

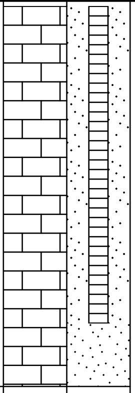


State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION SUPPLEMENT

Form 4400-122A

Boring Number MW-311A Use only as an attachment to Form 4400-122. Page 3 of 3

Sample		Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties					RQD/ Comments
Number and Type	Length Att. & Recovered (in)								Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	
			41 42 43 44 45 46											
				End of boring at 46 feet below ground surface.										

Appendix B

Well Construction Forms

MONITORING WELL / PIEZOMETER CONSTRUCTION DOCUMENTATION FORM

Disposal Site Name: IPL-Ottumwa Generating Station
Permit No.:

Well or Piezometer No.: MW-305A
Dates Started: 2/25/2020
Date Completed: 3/4/2020

A. SURVEYED LOCATION AND ELEVATION OF POINT (+0.5 ft.)

Specify corner of site: SW of Parcel 00305262020
Distance and direction along boundary: 539' E
Distance and direction from boundary to surface monitoring well: 404' N
Elevation (+0.01 ft. MSL):
Ground Surface: 681.76'
Top of protective casing: 684.35'
Top of well casing: 684.03'
Benchmark elevation: 654.48'
Benchmark description: Intake Structure Mag-Nail

B. SOIL BORING INFORMATION

Construction Company Name: Roberts Environmental Services
Address: 1107 South Mulberry Street
City, State, Zip Code: Millstadt, IL 62260
Name of driller: Jeff Crank
Drilling method: 6 1/4" HSA,6"Air Rotary
Drilling fluid:
Bore Hole diameter: 10"/6"
Soil sampling method: Split spoon/Sample catch from augers
Depth of boring: 80'

C. MONITORING WELL INSTALLATION

Casing material: PVC-Sch. 80
Length of casing: 82'
Outside casing diameter: 2.4"
Inside casing diameter: 1.9
Casing joint type: Threaded
Casing/screen joint type: Threaded
Screen material: PVC Sch. 80
Screen opening size: 0.01"
Screen length: 5'
Depth of Well: 79'
Filter Pack:
- Material: Filter sand
- Grain Size: #18
- Volume: 3 bags (50 lbs bags, Sil filter sand)

Seal (minimum 3 ft. length above filter pack):
- Material: 3/8" Bentonite chips

Placement method: Gravity
Volume: 2 cu. ft.
Backfill (if different from seal):
- Material: Bentonite grout
- Placement method: pumped
- Volume: 300 gallons

Surface seal design:
- Material of protective casing: Steel
- Material of grout between protective casing and well casing: Sand

Protective cap:
- Material: Steel
- Vented?: ☒ Y ☐ N
- Locking?: ☒ Y ☐ N

Well cap:
- Material: Plastic
- Vented?: ☒ Y ☐ N

D. GROUNDWATER MEASUREMENT (+0.01 foot below top of inner well casing)

Water level: 32.7'
Stabilization time: ~1 day
Well development method: Pump and surge
Average depth of frost line: 40"

DRILLER'S CERTIFICATION

I certify under penalty of law I believe the information reported above is true, accurate, and complete.

Signature: Jeff Crank
Certification #: 8515
Date: 9-16-20

Attachments: Driller's log, Pipe schedules and grouting schedules. 8 ½ inch x 11 inch map showing locations of all monitoring wells and piezometers.

Please mail completed form to: Iowa Department of Natural Resources, Land Quality Bureau, 502 E. 9th St, Des Moines, IA 50319.
Questions? Call or Email: Nina Booker Environmental Engineer Sr., 515-725-8309, nina.booker@dnr.iowa.gov

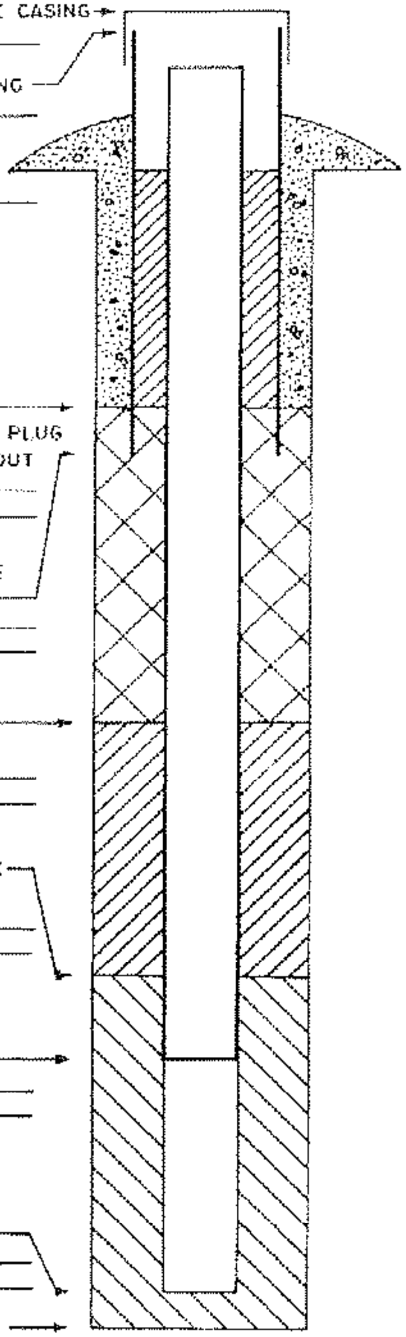
09/2017 cmc

DNR Form 542-1277

ELEVATIONS: ± 0.01 FT. MSL

DEPTHS: ± 0.1 FT. FROM
GROUND SERFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL).



TOP OF PROTECTIVE CASING
ELEVATION 684.35

TOP OF WELL CASING
ELEVATION 684.03

GROUND SURFACE
ELEVATION 681.76

TOP OF BACKFILL
BASE OF CONCRETE PLUG
AND BENTONITE GROUT
ELEVATION 678.26
DEPTH 3'6"

BASE OF PROTECTIVE
CASING
ELEVATION 678.26
DEPTH 3'6"

BASE OF BACKFILL
TOP OF SEAL
ELEVATION 620.76
DEPTH 61'

TOP OF FILTER PACK
BASE OF SEAL
ELEVATION 610.76
DEPTH 71'

TOP OF SCREEN
ELEVATION 607.76
DEPTH 607.76

BOTTOM OF SCREEN
ELEVATION 602.76
DEPTH 79'

BASE OF FILTER PACK
ELEVATION 601.76
DEPTH 80'

MONITORING WELL / PIEZOMETER CONSTRUCTION DOCUMENTATION FORM

Disposal Site Name IPL-Ottumwa Generating Station Permit No.

Well or Piezometer No. MW-310A Dates Started 2/27/2020 Date Completed 3/4/2020

A. SURVEYED LOCATION AND ELEVATION OF POINT (+0.5 ft.)

Specify corner of site Distance and direction along boundary 340' NW

Distance and direction from boundary to surface monitoring well 45' SW

Elevation (+0.01 ft. MSL)

Ground Surface 655.26' Top of protective casing 658.25'

Top of well casing 657.93' Benchmark elevation 654.48'

Benchmark description Intake Structure Mag-Nail

B. SOIL BORING INFORMATION

Construction Company Name Roberts Environmental Services

Address 1107 South Mulberry Street City, State, Zip Code Millstadt, IL 62260

Name of driller Jeff Crank

Drilling method 6 1/4" HSA,6"Air Rotary Drilling fluid Bore Hole diameter 10"/6"

Soil sampling method Split spoon/Sample catch from augers Depth of boring 54'

C. MONITORING WELL INSTALLATION

Casing material PVC-Sch. 80

Length of casing 55.5'

Outside casing diameter 2.4"

Inside casing diameter 1.9"

Casing joint type Threaded

Casing/screen joint type Threaded

Screen material PVC-Sch. 80

Screen opening size 0.1

Screen length 5'

Depth of Well 53'

Filter Pack:

Material Filter sand

Grain Size #18

Volume 3 bags (50 lbs bags, Sil filter sand)

Seal (minimum 3 ft. length above filter pack):

Material 3/8" Bentonite chips

Placement method Gravity

Volume 2 cu. ft.

Backfill (if different from seal):

Material Bentonite grout

Placement method pumped

Volume 200 gallons

Surface seal design:

Material of protective casing: Steel

Material of grout between protective casing and well casing: Sand

Protective cap:

Material Steel

Vented?: ☒ Y ☐ N Locking?: ☒ Y ☐ N

Well cap:

Material Plastic

Vented?: ☐ Y ☒ N

D. GROUNDWATER MEASUREMENT (+0.01 foot below top of inner well casing)

Water level 12' **Stabilization time** ~1 week

Well development method Pump and surge

Average depth of frost line 40"

DRILLER'S CERTIFICATION

I certify under penalty of law I believe the information reported above is true, accurate, and complete.

Signature Jeff Crank **Certification #** 8515 **Date** 9-16-20

Attachments: Driller's log. Pipe schedules and grouting schedules. 8 ½ inch x 11 inch map showing locations of all monitoring wells and piezometers.

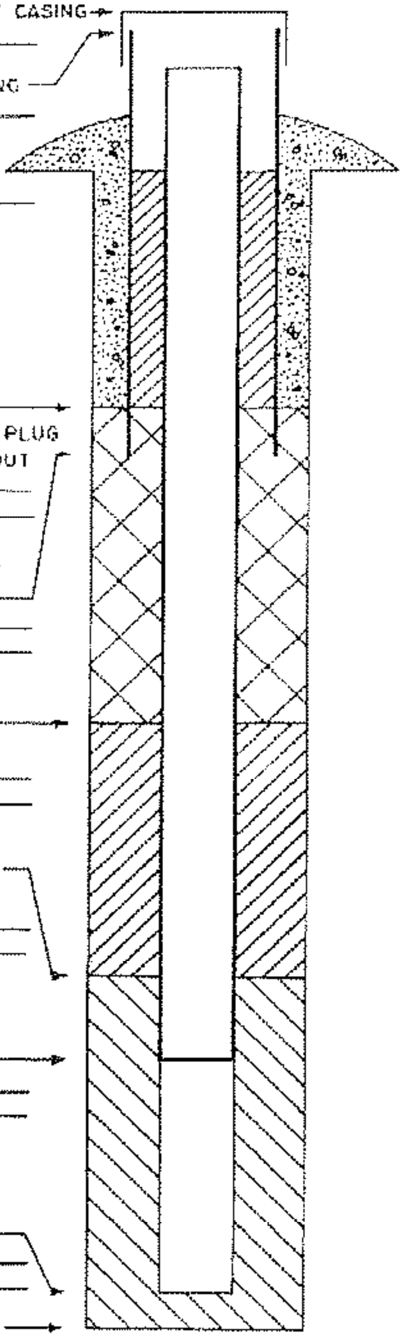
Please mail completed form to: Iowa Department of Natural Resources, Land Quality Bureau, 502 E. 9th St, Des Moines, IA 50319.
Questions? Call or Email: Nina Booker Environmental Engineer Sr., 515-725-8309, nina.booker@dnr.iowa.gov

09/2017 cmc DNR Form 542-1277

ELEVATIONS: ± 0.01 FT. MSL

DEPTHS: ± 0.1 FT. FROM
GROUND SERFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL).



TOP OF PROTECTIVE CASING
ELEVATION 658.25

TOP OF WELL CASING
ELEVATION 657.93

GROUND SURFACE
ELEVATION 655.26

TOP OF BACKFILL
BASE OF CONCRETE PLUG
AND BENTONITE GROUT
ELEVATION 651.60
DEPTH 3'8"

BASE OF PROTECTIVE
CASING
ELEVATION 648.60
DEPTH 3'0"

BASE OF BACKFILL
TOP OF SEAL
ELEVATION 620.26
DEPTH 35'

TOP OF FILTER PACK
BASE OF SEAL
ELEVATION 610.26
DEPTH 45'

TOP OF SCREEN
ELEVATION 48'
DEPTH 48'

BOTTOM OF SCREEN
ELEVATION 602.26
DEPTH 53'

BASE OF FILTER PACK
ELEVATION 601.26
DEPTH 54'

MONITORING WELL / PIEZOMETER CONSTRUCTION DOCUMENTATION FORM

Disposal Site Name IPL-Ottumwa Generating Station Permit No.
Well or Piezometer No. MW-311A Dates Started 3/2/2020 Date Completed 3/4/2020

A. SURVEYED LOCATION AND ELEVATION OF POINT (+0.5 ft.)

Specify corner of site SE Distance and direction along boundary 730' W
Distance and direction from boundary to surface monitoring well 160' N
Elevation (+0.01 ft. MSL)
Ground Surface 651.16' Top of protective casing 653.88
Top of well casing 653.54' Benchmark elevation 654.48
Benchmark description Intake Structure Mag-Nail

B. SOIL BORING INFORMATION

Construction Company Name Roberts Environmental Services
Address 1107 South Mulberry Street City, State, Zip Code Millstadt, IL 62260
Name of driller Jeff Crank
Drilling method 6 1/4" HSA,6"Air Rotary Drilling fluid Bore Hole diameter 10"/6"
Soil sampling method Split spoon/Sample catch from augers Depth of boring 46'

C. MONITORING WELL INSTALLATION

Casing material PVC-Sch. 40 Placement method Gravity
Length of casing 47.68' Volume 2 cu. ft.
Outside casing diameter 2.4" Backfill (if different from seal):
Inside casing diameter 2.1" Material Bentonite grout
Casing joint type Threaded Placement method pumped
Casing/screen joint type Threaded Volume 200 gallons
Screen material PVC-Sch. 40 Surface seal design:
Screen opening size 0.1 Material of protective casing: Steel
Material of grout between
Screen length 5' protective casing and well casing: Sand
Depth of Well 45' Protective cap:
Filter Pack: Material Steel
Material Filter sand Vented?: ☒ Y ☐ N Locking?: ☒ Y ☐ N
Grain Size #18 Well cap:
Volume 3 bags (50 lbs bags, Sil filter sand) Material Plastic
Seal (minimum 3 ft. length above filter pack): Vented?: ☐ Y ☒ N
Material 3/8" Bentonite chips

D. GROUNDWATER MEASUREMENT (+0.01 foot below top of inner well casing)

Water level 8.89' **Stabilization time** ~ 1 week
Well development method Pump and surge
Average depth of frost line 40"

DRILLER'S CERTIFICATION

I certify under penalty of law I believe the information reported above is true, accurate, and complete.

Signature Jeff Crank **Certification #** 8515 **Date** 9-16-20

Attachments: Driller's log. Pipe schedules and grouting schedules. 8 ½ inch x 11 inch map showing locations of all monitoring wells and piezometers.

Please mail completed form to: Iowa Department of Natural Resources, Land Quality Bureau, 502 E. 9th St, Des Moines, IA 50319.
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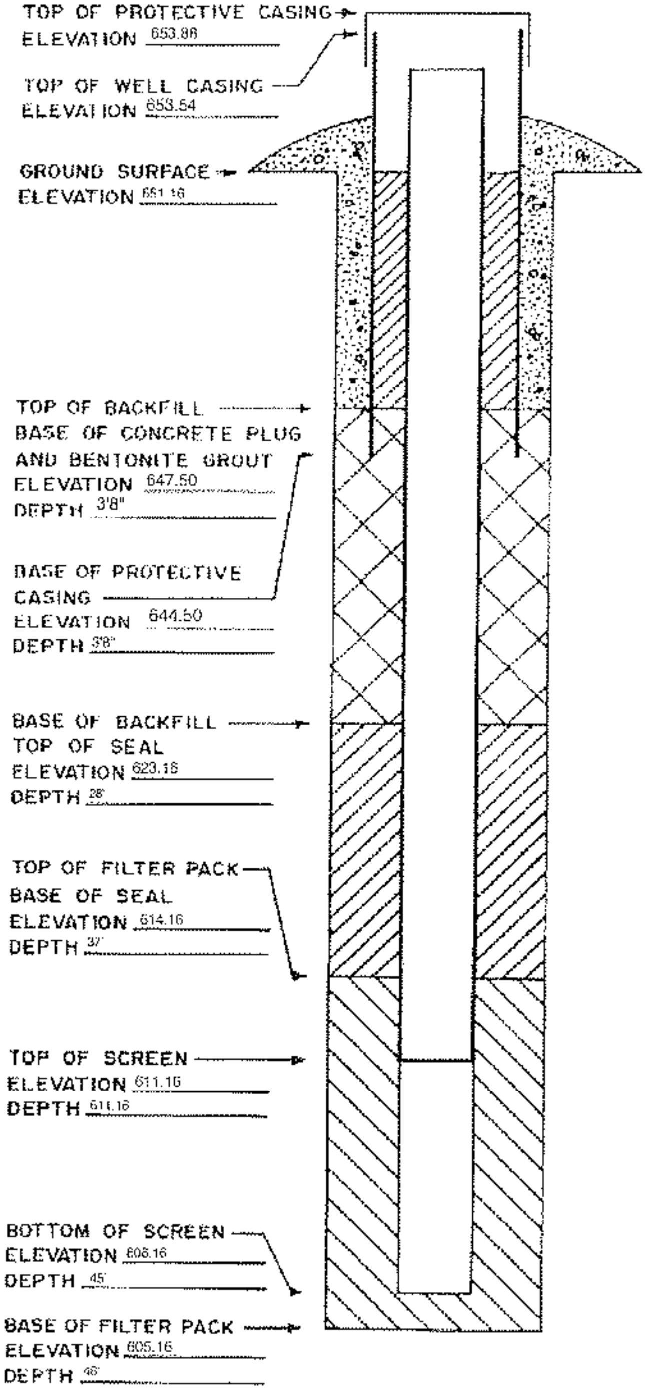
09/2017 cmc DNR Form 542-1277

ELEVATIONS: ± 0.01 FT. MSL

DEPTHS: ± 0.1 FT. FROM
GROUND SERFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL).



Appendix C

Site Photographs

10/16/2020 - Classification: Internal - ECRM7804006

Ottumwa Generating Station
Ottumwa, Iowa
SCS Engineers Project #25220056.00

Photo 1: MW-305A, looking northwest.

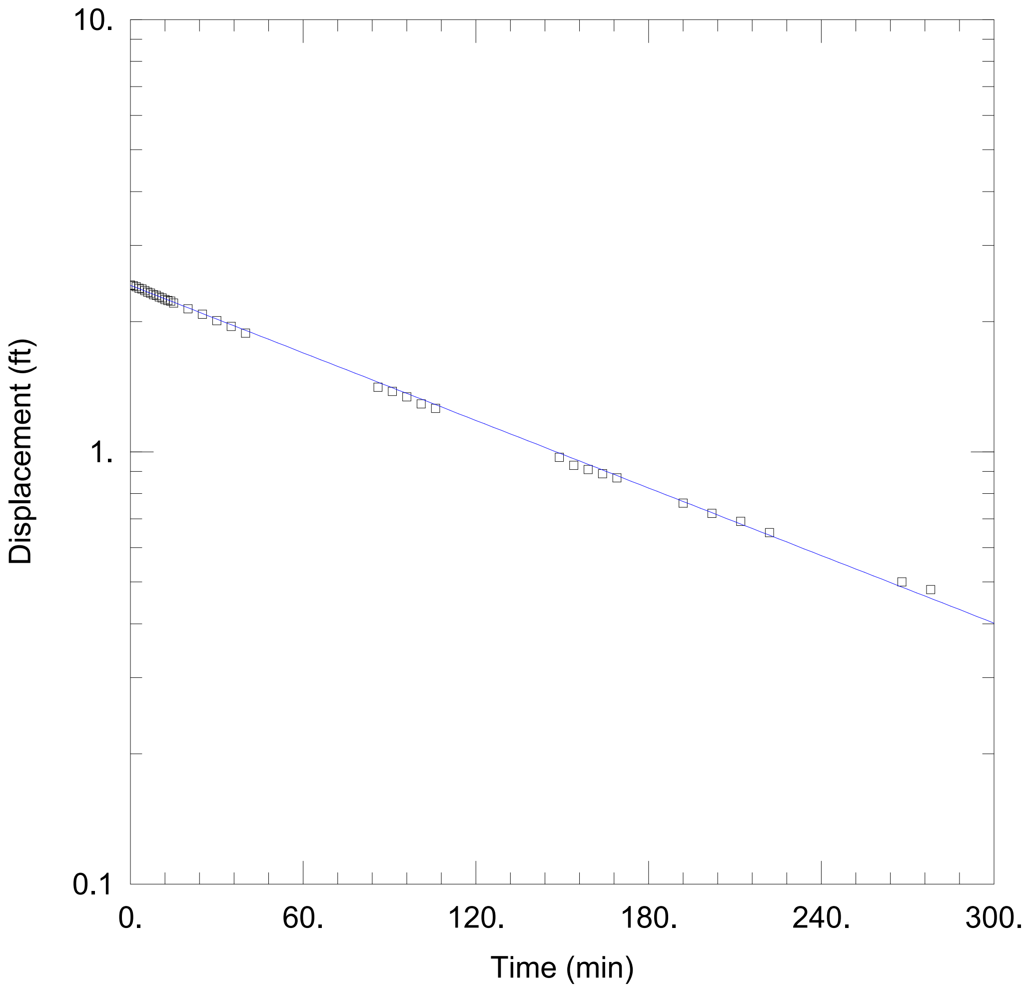
Photo 2: MW-310A, looking west-northwest with the Des Moines River in the background.

Ottumwa Generating Station
Ottumwa, Iowa
SCS Engineers Project #25220056.00

Photo 3: MW-311A, looking west-northwest.

Appendix D

Hydraulic Conductivity Test Results



WELL TEST ANALYSIS

Data Set: I:\25220056.00\Data and Calculations\K tests\MW305A.aqt
Date: 08/15/20 Time: 17:13:38

PROJECT INFORMATION

Company: SCS Engineers
Client: Alliant-OGS
Project: 25220056
Test Well: MW-305A
Test Date: 8/4/20

AQUIFER DATA

Saturated Thickness: 300. ft
Anisotropy Ratio (Kz/Kr): 0.1

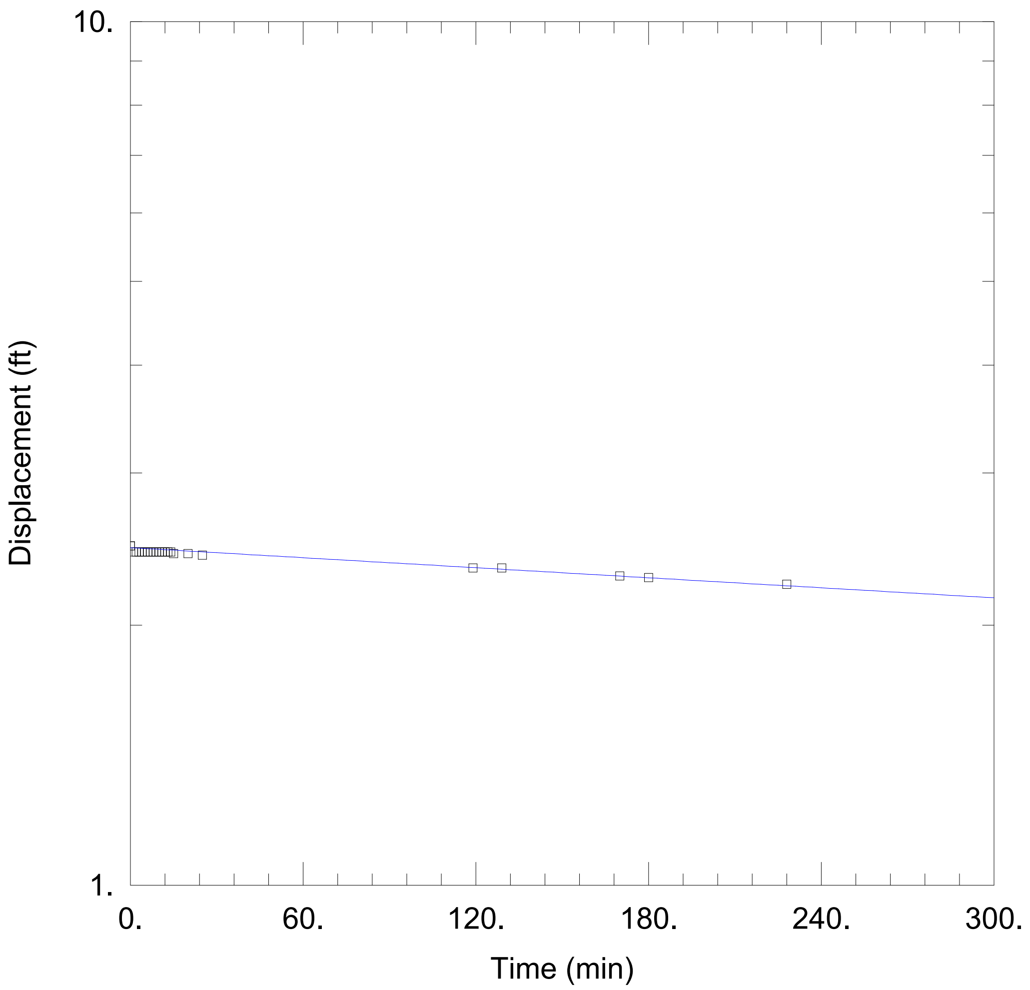
WELL DATA (MW-305A)

Initial Displacement: 2.43 ft
Total Well Penetration Depth: 46.59 ft
Casing Radius: 0.08 ft
Static Water Column Height: 46.6 ft
Screen Length: 8. ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.25

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev

K = 5.628E-6 cm/sec
y0 = 2.427 ft



WELL TEST ANALYSIS

Data Set: I:\25220056.00\Data and Calculations\K tests\MW310A.aqt
Date: 08/15/20
Time: 17:17:32

PROJECT INFORMATION

Company: SCS Engineers
Client: Alliant-OGS
Project: 25220056
Test Well: MW-310A
Test Date: 8/4/20

AQUIFER DATA

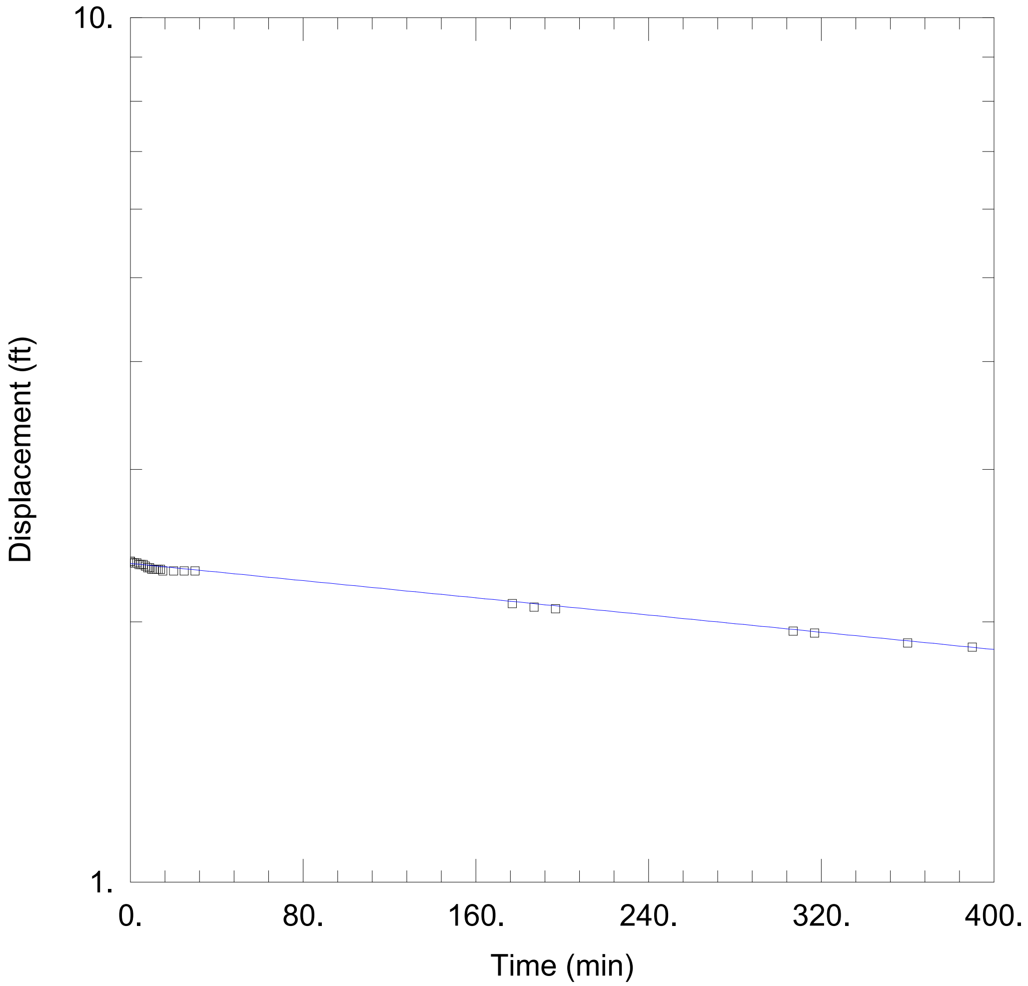
Saturated Thickness: 300. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (MW-310A)

Initial Displacement: 2.47 ft
Total Well Penetration Depth: 39.73 ft
Casing Radius: 0.08 ft
Static Water Column Height: 39.73 ft
Screen Length: 8. ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.25

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 4.182E-7 cm/sec
y0 = 2.459 ft



WELL TEST ANALYSIS

Data Set: I:\25220056.00\Data and Calculations\K tests\MW311A.aqt
Date: 08/15/20 Time: 17:15:02

PROJECT INFORMATION

Company: SCS Engineers
Client: Alliant-OGS
Project: 25220056
Test Well: MW-311A
Test Date: 8/4/20

AQUIFER DATA

Saturated Thickness: 300. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (MW-311A)

Initial Displacement: 2.35 ft
Total Well Penetration Depth: 37.22 ft
Casing Radius: 0.08 ft
Static Water Column Height: 37.22 ft
Screen Length: 8. ft
Well Radius: 0.25 ft
Gravel Pack Porosity: 0.25

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 5.376E-7 cm/sec
y0 = 2.336 ft

SCS ENGINEERS

Environmental Consultants & Contractors

April 17, 2019
File No. 25216072.18

Mr. Rob Saunders
Ottumwa Generating Station
20775 Power Plant Road
Ottumwa, Iowa, 52051

Subject: Ottumwa Generating Station – Zero Liquid Discharge Pond Monitoring Well Construction Documentation

Dear Mr. Saunders:

SCS Engineers has completed the installation of three groundwater monitoring wells (MW-307 through MW-309) at the Ottumwa Generating Station (OGS) in Ottumwa, Iowa (**Figure 1**). These wells are downgradient of the Zero Liquid Discharge Pond (ZLDP). In addition, the monitoring network includes pre-existing monitoring well (MW-301), which is used to provide background information.

The wells were installed to support compliance with the final Coal Combustion Residuals (CCR) Rule (40 CFR 257.50-107). The monitoring well locations are shown on **Figure 2**. **Appendix A** through **Appendix C** include documentation of well design and installation as required by 40 CFR 257.91(e)(1).

This monitoring well construction documentation report is ready to be entered into the operating record as required by 40 CFR 257.105(h)(2).

Please contact us at 608-224-2830 if you have any questions about the well documentation.

Sincerely,

Nicole Kron
Hydrogeologist
SCS Engineers

Thomas J. Karwoski
Project Manager
SCS Engineers

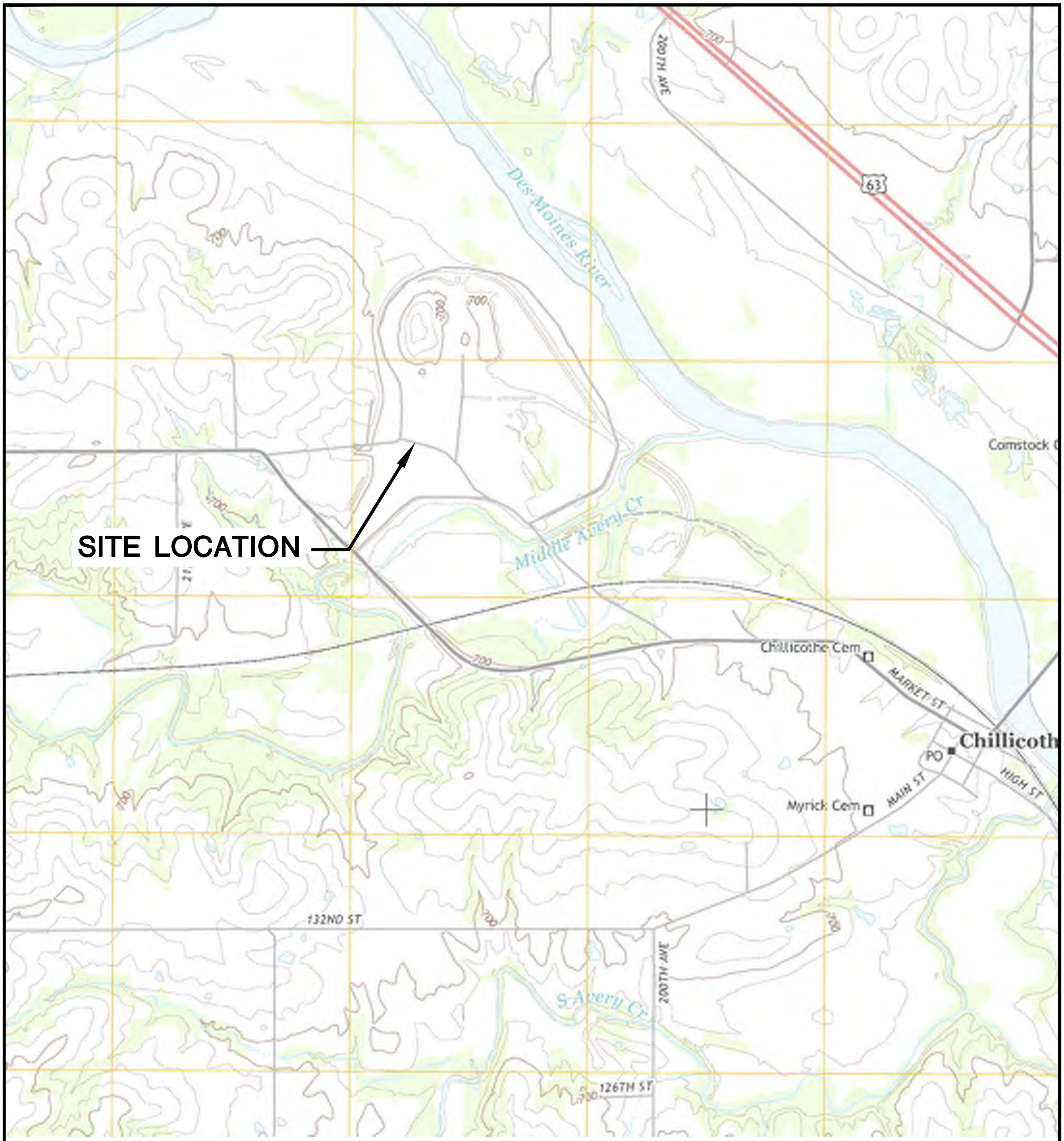
NDK/AJR/TK/SCC

cc: Matt Hanson, Ottumwa Generating Station
Jeff Maxted, Alliant Energy

Encl. Figure 1 – Site Location Map
Figure 2 – Monitoring Well Location Map
Appendix A – Boring Logs
Appendix B – Well Construction Documentation
Appendix C – Hydraulic Conductivity Testing Results

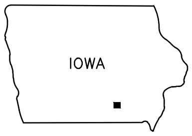
I:\25216072.00\Deliverables\ZDP Documentation\Operating record well documentation\190417_ZLDP_oper_record_well documentation.docx

Figures



N

CHILLICOTHE QUADRANGLE
IOWA–WAPELLO CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
2013
SCALE: 1" = 2,000'



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

SITE
OTTUMWA GENERATING STATION
OTTUMWA, IOWA

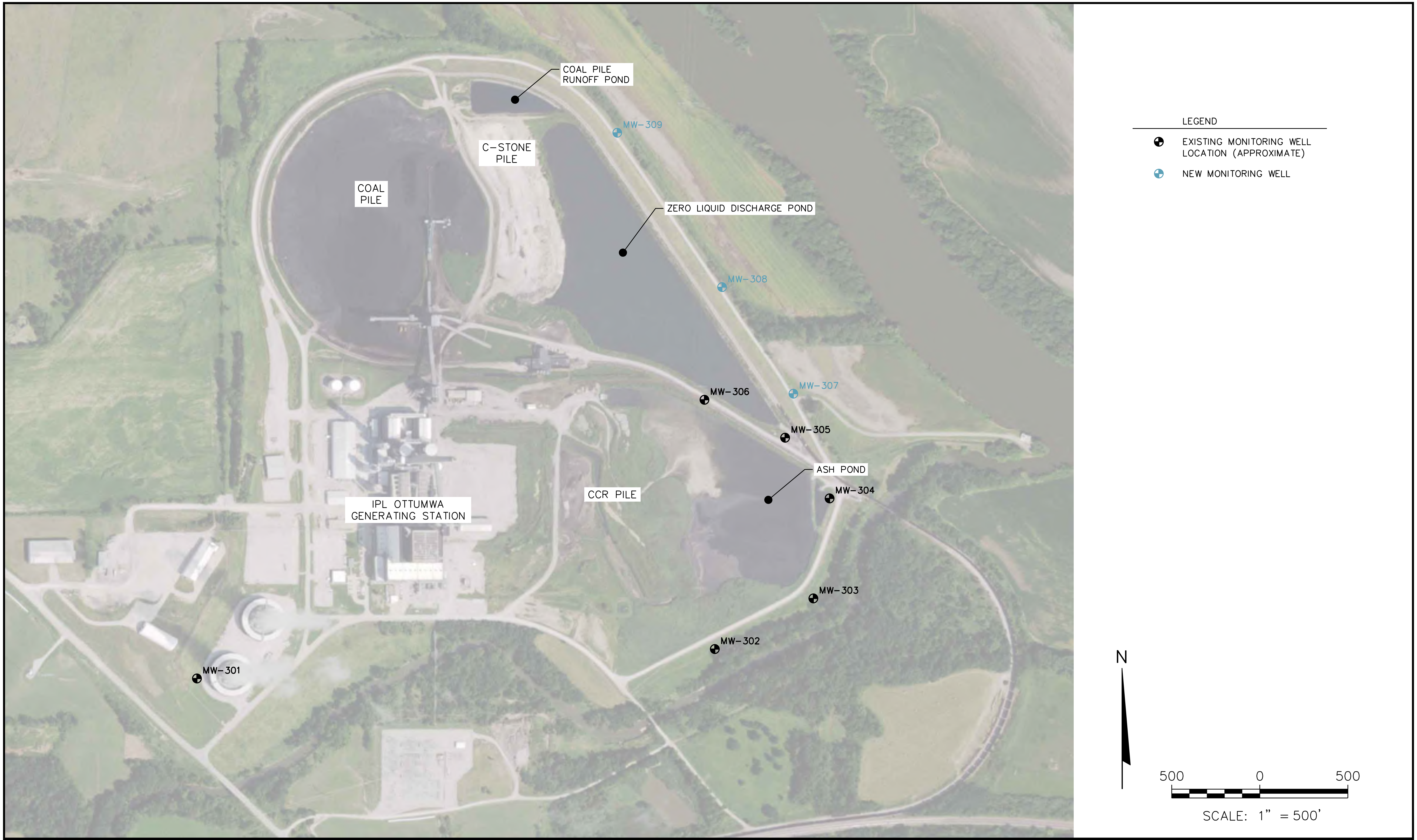
SITE LOCATION MAP

PROJECT NO.	25216148.00	DRAWN BY:	AHB
DRAWN:	05/29/15	CHECKED BY:	KK
REVISED:	12/29/16	APPROVED BY:	

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

FIGURE
1

I:\252161□8.00\Drawings\Site Loc.dwg, 12/29/2016 10:25:2□ AM



PROJECT NO.	25216148.00	DRAWN BY:	KP
DRAWN:	05/29/15	CHECKED BY:	MDB
REVISED:	03/15/19	APPROVED BY:	

ENGINEER

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

CLIENT

INTERSTATE POWER AND LIGHT CO.
15300 130th STREET
OTTUMWA, IA 52501

SITE

OTTUMWA GENERATING STATION
20775 POWER PLANT ROAD
OTTUMWA, IOWA

MONITORING WELL LOCATIONS MAP

FIGURE
2

I:\252161 8.00\Drawings\Site an new we s dwg. /15/2019 1:5 : 7 M

11/25/2020 - Classification: Internal - ECRM7804236

Appendix A

Boring Logs

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

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

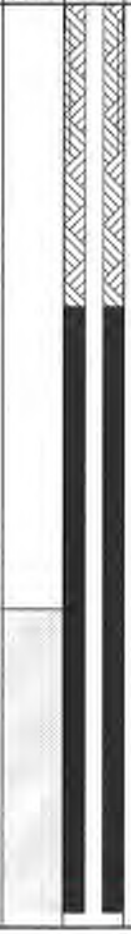
Page 1 of 2

Facility/Project Name IPL-Ottumwa Generating Station SCS#: 25216148.00		License/Permit/Monitoring Number		Boring Number MW-307	
Boring Drilled By: Name of crew chief (first, last) and Firm Mike Mueller Cascade Drilling		Date Drilling Started 10/25/2016	Date Drilling Completed 10/25/2016		Drilling Method HSA
Unique Well No.	DNR Well ID No.	Common Well Name MW-307	Final Static Water Level Feet	Surface Elevation 655.1 Feet	Borehole Diameter 8.5 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 401,707 N, 1,903,070 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									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			0–10	POORLY GRADED SAND WITH GRAVEL, tan, fine to coarse sand and gravel, (construction fill sand to fill in hydrovac hole cleared to 8.5 ft bgs).	SP									
			6.5											water level 6.5 ft bgs.
S1	24	2 2 3 2	9–10							W				
			10–15	LEAN CLAY, dark yellowish brown (10YR 4/4), slightly dense.	CL									
S2	14	4 1 4 4	13–14							W				



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

Signature

Firm SCS Engineers
2830 Dairy Drive Madison, WI 53711
Tel: (608) 224-2830
Fax:

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number MW-307

Page 2 of 2

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				LEAN CLAY, dark yellowish brown (10YR 4/4), slightly dense. *(continued)*	CL									
S3	24	1 2 2 4	16	SILT, dark yellowish brown (10YR 3/4), fine to medium sand.						W				
			17											
			18		ML									
S4	17	3 3 3	19							W				Bedrock @19.5 ft bgs.
				SANDSTONE, dark brown (10YR 3/3),										
			20											
S5	5	50/0.5	21							W				More competent @20.5' -24.5' bgs.
			22											
			23											
			24											
			25	more weathered										
			26											
			27											
S6	1	100	28	Same as above except, gray (10YR 6/1).										
				End of boring at 28 ft bgs.										

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

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

Page 1 of 2

Facility/Project Name IPL-Ottumwa Generating Station SCS#: 25216148.00		License/Permit/Monitoring Number		Boring Number MW-308	
Boring Drilled By: Name of crew chief (first, last) and Firm Mike Mueller Cascade Drilling		Date Drilling Started 10/25/2016	Date Drilling Completed 10/25/2016		Drilling Method HSA
Unique Well No.	DNR Well ID No.	Common Well Name MW-308	Final Static Water Level Feet	Surface Elevation 652.9 Feet	Borehole Diameter 8.5 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 402,312 N, 1,902,665 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
Feet ☐ N ☐ S
Feet ☐ E ☐ W

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

Sample: Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			0–9.5	POORLY GRADED SAND WITH GRAVEL, tan, fine to coarse sand and gravel, (construction fill sand to fill in hydrovac hole cleared to 9.5 ft bgs).	SP									water @ 6.5 ft bgs.
			9.5–13	LEAN CLAY, brown (10YR 4/3), dense.	CL									
S1	24	19 4 2 2	11							W				
			13–15	SILT, brown (10YR 4/3), some clay.	ML									
S2	13	1 2 2 2	14							W				

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

Signature

Firm SCS Engineers
2830 Dairy Drive Madison, WI 53711
Tel: (608) 224-2830
Fax:

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number MW-308

Page 2 of 2

Sample		Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties					RQD/ Comments
Number and Type	Length Att. & Recovered (in)								Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	
				SILT, brown (10YR 4/3), some clay. *(continued)*	ML									
S3	18	1 2 1 3	16	SILTY SAND, brown (10YR 4/3).	SM					W				
			17	POORLY GRADED SAND, brown (10YR 4/3), fine grained.	SP									
S4	13	4 12 13 3	18	WELL GRADED SAND AND GRAVEL, dark grayish brown (10YR 3/2), fine to coarse grained, (weathered bedrock).	SW					W				
			19	SANDSTONE, dark grayish brown (10YR 4/2), weathered bedrock.										
S5	6	12 26 50/0.4	20	Same as above except, brown (10YR 4/3).						W				
			21											
			22											
			23											
			24	Same as above except, dark grayish brown (10YR 4/2).										
S6	4	50/0.4	25							W				
				End of boring at 25 ft bgs.										

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

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

Page 1 of 2

Facility/Project Name IPL-Ottumwa Generating Station SCS#: 25216148.00	License/Permit/Monitoring Number	Boring Number MW-309

Boring Drilled By: Name of crew chief (first, last) and Firm Mike Mueller Cascade Drilling	Date Drilling Started 10/27/2016	Date Drilling Completed 10/27/2016	Drilling Method HSA

Unique Well No.	DNR Well ID No.	Common Well Name MW-309	Final Static Water Level Feet	Surface Elevation 652.5 Feet	Borehole Diameter 8.5 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 403,189 N, 1,902,070 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 Feet ☐ S ☐ E Feet ☐ W

Facility ID	County Wapello	Civil Town/City/ or Village 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	U S C S	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
			0–10	Hydrovac borehole to 10 ft bgs.										
			10	LEAN CLAY, very dark grayish brown (10YR 3/2), trace sand.	CL									
S1		3 3 6 7	11							W				
S2		2 2 2 2	13.5							W				
			15											

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

Signature

Firm SCS Engineers
2830 Dairy Drive Madison, WI 53711
Tel: (608) 224-2830
Fax:

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number MW-309 Page 2 of 2

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				SILTY SAND, very dark grayish brown (10YR 3/2), fine to medium grained.										
S3		1 1 1 1	16							W				
			17		SM									
			18											
S4		3 5 4 6								W				
			19	POORLY GRADED SAND, yellowish brown (10YR 5/4), coarse grained.										
			20		SP									
S5		2 3 7 50	21							W				
				WEATHERED SANDSTONE.										
			22											
			23											
			24											
S6			25							W				
			26											
			27											
				End of boring at 27.5 ft bgs.										

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

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

Page 1 of 2

Facility/Project Name IPL-Ottumwa Generating Station SCS#: 25216148.00		License/Permit/Monitoring Number		Boring Number B-309X	
Boring Drilled By: Name of crew chief (first, last) and Firm Mike Mueller Cascade Drilling		Date Drilling Started 10/26/2016	Date Drilling Completed 10/26/2016		Drilling Method HSA
Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level Feet	Surface Elevation Feet	Borehole Diameter 8.5 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane N, 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 Feet ☐ S ☐ E Feet ☐ W

Facility ID
County: Wapello
Civil Town/City/ or Village: 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	U S C S	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
			0–9	POORLY GRADED SAND WITH GRAVEL, tan, fine to coarse sand and gravel, (construction fill sand to fill in hydrovac hole cleared to 9 ft bgs).	SP									Water at 6.5 ft bgs
S1	12	1 3 3 4	9–12.5	LEAN CLAY, dark brown (10YR 3/3), medium dense.	CL					W				
S2	18	3 3 3 3	12.5–15	SILT, dark brown (10YR 3/3), some clay.	ML					W				

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

Signature

Firm SCS Engineers
2830 Dairy Drive Madison, WI 53711
Tel: (608) 224-2830
Fax:

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number B-309X

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				SILT, dark brown (10YR 3/3), some clay. *(continued)*	ML									
S3	20	3 3 3 2	16	POORLY GRADED SAND, very dark grayish brown (10YR 3/2), fine grained.	SP					W				
			17	SILT, dark brown (10YR 3/3).	ML									
			18	POORLY GRADED SAND, brown (10YR 4/3).	SP									
S4	15	1 17 50/0.2	19	WEATHERED SANDSTONE, grayish brown (10YR 5/2).						W				Bedrock at18.5 ft bgs
S5	6	50/0.3	20							W				
			21											
			22											
			23											
			24											
			25											
			26											
				End of boring at 26.5 ft bgs.										

Appendix B

Well Construction Documentation

Print Form

IOWA DEPARTMENT OF NATURAL RESOURCES
MONITORING WELL/PIEZOMETER CONSTRUCTION DOCUMENTATION FORM

Disposal Site Name: IPL - Ottumwa Generating Station
Permit No.:
Well or Piezometer No: MW-307
Dates Started: 10/25/16
Date Completed: 10/25/16

A. SURVEYED LOCATIONS AND ELEVATIONS

Locations (± 0.5 ft):
Specify corner of site: NE of Parcel 003052620200000
Distance & direction along boundary: 683' W
Distance & direction from boundary to wall: 296' S
Elevations (± 0.01 ft MSL):
Ground Surface: 655.08
Top of protective casing: 657.58
Top of well casing: 657.56
Benchmark elevation:
Benchmark description:

B. SOIL BORING INFORMATION

Name & Address of Construction Company:
Cascade Drilling, LP
301 Alderson St
Schofield, WI 54476
Name of Driller: Mike Mueller
Drilling Method: HSA
Drilling Fluid: NA
Bore Hole Diameter: 8 inch
Soil Sampling Method: Spoon
Depth of Boring: 28 ft

C. MONITORING WELL INSTALLATION

Casing material: PVC sch 40
Length of casing: 22 ft
Outside casing diameter: 2.38"
Inside casing diameter: 2"
Casing joint type: threaded
Casing/screen joint type: threaded
Screen material: PVC
Screen opening size: 0.010"
Screen length: 5 ft
Depth of well: 27 ft
Filter Pack:
Material: Red Flint
Grain size: #40
Volume: 200 lbs
Seal (minimum 3 ft length above filter pack):
Material: 3/8 inch bentonite chips

Placement method: Gravity
Volume: 250 lbs
Backfill (if different from seal):
Material:
Placement method:
Volume:
Surface seal design:
Material of protective casing: Steel 6 inch
Material of grout between protective casing and well casing: sand
Protective cap:
Material: Steel, vented
Vented: ☒ Yes ☐ No Locking: ☐ Yes ☐ No
Well Cap:
Material: PVC
Vented: ☐ Yes ☒ No

D. GROUNDWATER MEASURMENT (± 0.01 ft below top of inner well casing)

Water level: 8.12
Stabilization Time: 5 minutes
Well development method: surged with bailer and pumped
Average depth of frostline: 3.5'

Attachments: Driller's log. Pipe schedules and grouting schedules. 8 ½x11 inch map showing locations of all monitoring wells and piezometers.

Please mail completed for to: Iowa Department of Natural Resources, Land Quality Bureau, 502 E 9th St, Des Moines IA 50319-0034.

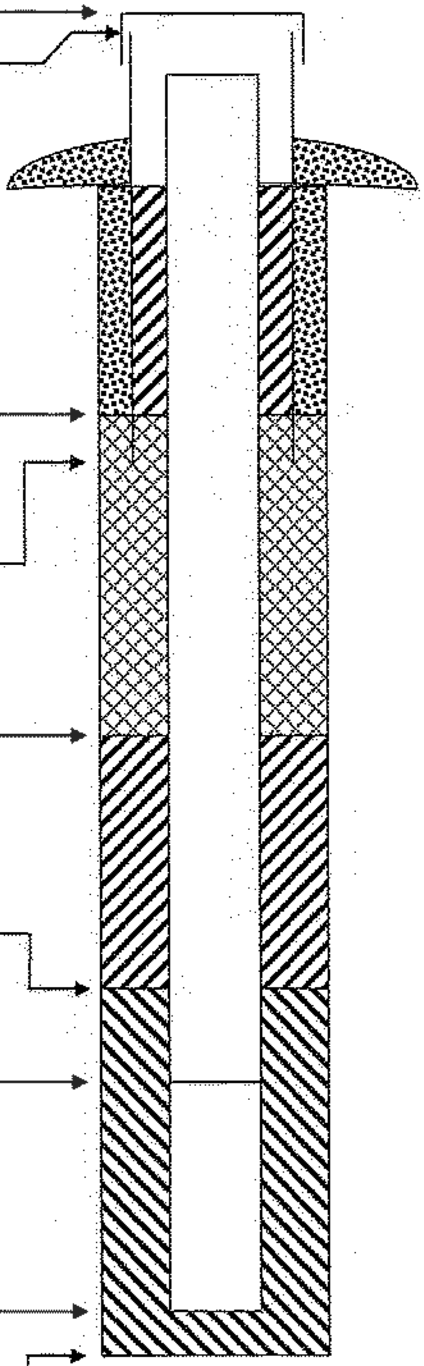
Questions? Call or Email: Nina Koger, Environmental Engineer Sr., 515-281-8986, Nina.Koger@dnr.iowa.gov

06/2011 cmz

DNR Form 542-1277

ELEVATIONS: ± 0.01 ft MSL
DEPTHS: ± 0.1 ft FROM GROUND SURFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL.)



TOP OF PROTECTIVE CASING
ELEVATION 657 58

TOP OF WELL CASING
ELEVATION 657.56

GROUND SURFACE
ELEVATION 655.08

TOP OF BACKFILL
BASE OF CONCRETE PLUG
AND BENTONITE GROUT
ELEVATION 650.08
DEPTH 5

BASE OF PROTECTIVE CASING
ELEVATION 652.58
DEPTH 2.5

BASE OF BACKFILL
TOP OF SEAL
ELEVATION
DEPTH

TOP OF FILTER PACK
BASE OF SEAL
ELEVATION 636.08
DEPTH 19

TOP OF SCREEN
ELEVATION 633.08
DEPTH 22

BOTTOM OF SCREEN
ELEVATION 628 08
DEPTH 27

BASE OF FILTER PACK
ELEVATION 627.08
DEPTH 28

Print Form

IOWA DEPARTMENT OF NATURAL RESOURCES
MONITORING WELL/PIEZOMETER CONSTRUCTION DOCUMENTATION FORM

Disposal Site Name: IPL - Ottumwa Generating Station
Permit No.:
Well or Piezometer No: MW-308
Dates Started: 10/26/16
Date Completed: 10/26/16

A. SURVEYED LOCATIONS AND ELEVATIONS

Locations (± 0.5 ft):
Specify corner of site: SW of Parcel 0030502620203000
Distance & direction along boundary: 158' E
Distance & direction from boundary to well: 417' N
Elevations (± 0.01 ft MSL):
Ground Surface: 652.87
Top of protective casing: 655.23
Top of well casing: 655.39
Benchmark elevation:
Benchmark description:

B. SOIL BORING INFORMATION

Name & Address of Construction Company:
Cascade Drilling, LP
301 Alderson St
Schofield, WI 54476
Name of Driller: Mike Mueller
Drilling Method: HSA
Drilling Fluid: NA
Bore Hole Diameter: 8 inch
Soil Sampling Method: Spoon
Depth of Boring: 25 ft

C. MONITORING WELL INSTALLATION

Casing material: PVC sch 40
Length of casing: 19 ft
Outside casing diameter: 2.38"
Inside casing diameter: 2"
Casing joint type: threaded
Casing/screen joint type: threaded
Screen material: PVC
Screen opening size: 0.010"
Screen length: 5 ft
Depth of well: 24 ft
Filter Pack:
Material: Red Flint
Grain size: #40
Volume: 200 lbs
Seal (minimum 3 ft length above filter pack):
Placement method: Gravity
Volume: 200 lbs
Backfill (if different from seal):
Material:
Placement method:
Volume:
Surface seal design:
Material of protective casing: Steel 6 inch
Material of grout between protective casing and well casing: sand
Protective cap:
Material: Steel, vented
Vented: ☒ Yes ☐ No Locking: ☐ Yes ☐ No
Well Cap:
Material: PVC
Vented: ☐ Yes ☒ No
Material: 3/8 inch bentonite chips

D. GROUNDWATER MEASURMENT (± 0.01 ft below top of inner well casing)

Water level: 9.85
Stabilization Time: 5 minutes
Well development method: surged with bailer and pumped
Average depth of frostline: 3.5'

Attachments: Driller's log. Pipe schedules and grouting schedules. 8 ½x11 inch map showing locations of all monitoring wells and piezometers.

Please mail completed for to: Iowa Department of Natural Resources, Land Quality Bureau, 502 E 9th St, Des Moines IA 50319-0034.

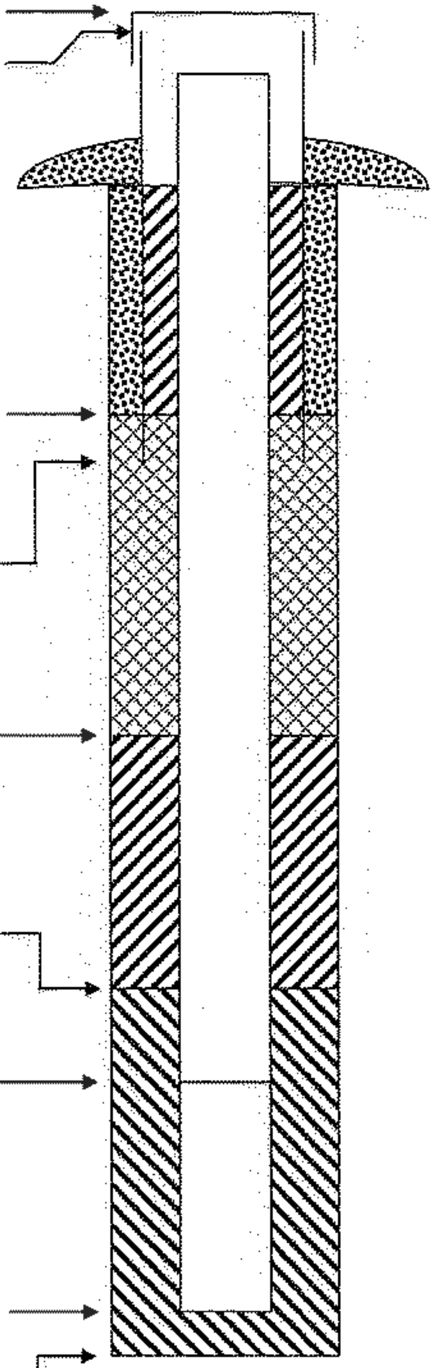
Questions? Call or Email: Nina Koger, Environmental Engineer Sr., 515-281-8986, Nina.Koger@dnr.iowa.gov

06/2011 cmz

DNR Form 542-1277

ELEVATIONS: ± 0.01 ft MSL
DEPTHS: ± 0.1 ft FROM GROUND SURFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL.)



TOP OF PROTECTIVE CASING
ELEVATION 655.23

TOP OF WELL CASING
ELEVATION 655.39

GROUND SURFACE
ELEVATION 652.87

TOP OF BACKFILL
BASE OF CONCRETE PLUG
AND BENTONITE GROUT
ELEVATION 647.87
DEPTH 5

BASE OF PROTECTIVE CASING
ELEVATION 650.37
DEPTH 2.5

BASE OF BACKFILL
TOP OF SEAL
ELEVATION
DEPTH

TOP OF FILTER PACK
BASE OF SEAL
ELEVATION 635.87
DEPTH 17

TOP OF SCREEN
ELEVATION 633.87
DEPTH 19

BOTTOM OF SCREEN
ELEVATION 628.87
DEPTH 24

BASE OF FILTER PACK
ELEVATION 627.87
DEPTH 25

Print Form

IOWA DEPARTMENT OF NATURAL RESOURCES

MONITORING WELL/PIEZOMETER CONSTRUCTION DOCUMENTATION FORM

Disposal Site Name: IPL - Ottumwa Generating Station
Permit No.:
Well or Piezometer No: MW-309
Dates Started: 10/27/16
Date Completed: 10/27/16

A. SURVEYED LOCATIONS AND ELEVATIONS

Locations (± 0.5 ft):
Specify corner of site: NE of Parcel 003052620204000
Distance & direction along boundary: 480' W
Distance & direction from boundary to wall: 438' S
Elevations (± 0.01 ft MSL):
Ground Surface: 652.45
Top of protective casing: 654.97
Top of well casing: 654.94
Benchmark elevation:
Benchmark description:

B. SOIL BORING INFORMATION

Name & Address of Construction Company:
Cascade Drilling, LP
301 Alderson St
Schofield, WI 54476
Name of Driller: Mike Mueller
Drilling Method: HSA
Drilling Fluid: NA
Bore Hole Diameter: 8 inch
Soil Sampling Method: Spoon
Depth of Boring: 27.5 ft

C. MONITORING WELL INSTALLATION

Casing material: PVC sch 40
Length of casing: 21.5 ft
Outside casing diameter: 2.38"
Inside casing diameter: 2"
Casing joint type: threaded
Casing/screen joint type: threaded
Screen material: PVC
Screen opening size: 0.010"
Screen length: 5 ft
Depth of well: 26.5 ft
Filter Pack:
Material: Red Flint
Grain size: #40
Volume: 200 lbs
Seal (minimum 3 ft length above filter pack):
Material: 3/8 inch bentonite chips

Placement method: Gravity
Volume: 600 lbs
Backfill (if different from seal):
Material:
Placement method:
Volume:
Surface seal design:
Material of protective casing: Steel 6 inch
Material of grout between protective casing and well casing: sand
Protective cap:
Material: Steel, vented
Vented: ☒ Yes ☐ No Locking: ☐ Yes ☐ No
Well Cap:
Material: PVC
Vented: ☐ Yes ☒ No

D. GROUNDWATER MEASURMENT (± 0.01 ft below top of inner well casing)

Water level: 9.87
Stabilization Time: 5 minutes
Well development method: surged with bailer and pumped
Average depth of frostline: 3.5'

Attachments: Driller's log. Pipe schedules and grouting schedules. 8 ½x11 inch map showing locations of all monitoring wells and piezometers.

Please mail completed for to: Iowa Department of Natural Resources, Land Quality Bureau, 502 E 9th St, Des Moines IA 50319-0034.

Questions? Call or Email: Nina Koger, Environmental Engineer Sr., 515-281-8986, Nina.Koger@dnr.iowa.gov

06/2011 cmz DNR Form 542-1277

ELEVATIONS: ± 0.01 ft MSL
DEPTHS: ± 0.1 ft FROM GROUND SURFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL.)

TOP OF PROTECTIVE CASING
ELEVATION 654.97

TOP OF WELL CASING
ELEVATION 654.94

GROUND SURFACE
ELEVATION 652.45

TOP OF BACKFILL
BASE OF CONCRETE PLUG
AND BENTONITE GROUT
ELEVATION 647.45
DEPTH 5

BASE OF PROTECTIVE CASING
ELEVATION 649.95
DEPTH 2.5

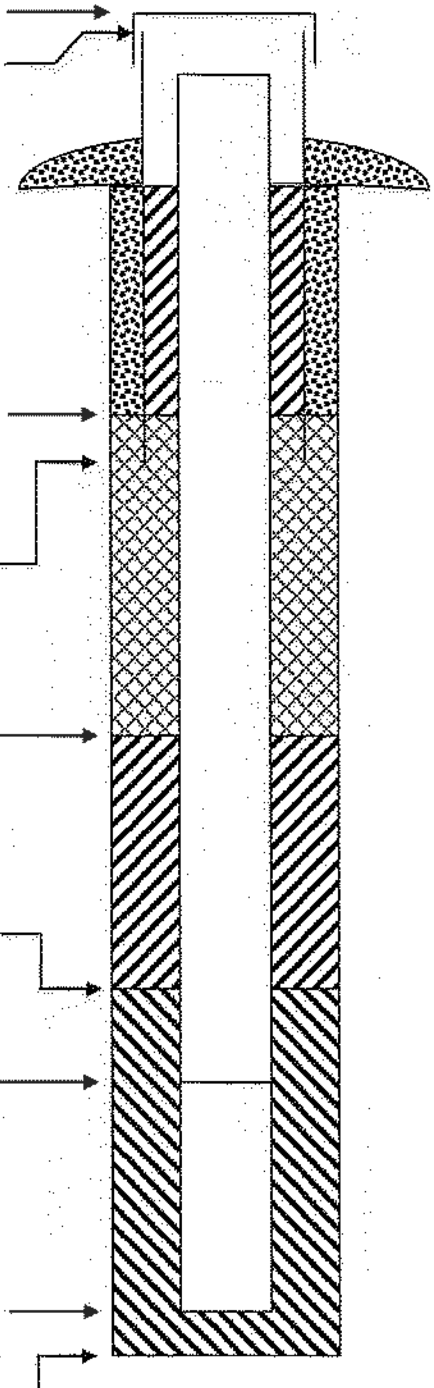
BASE OF BACKFILL
TOP OF SEAL
ELEVATION
DEPTH

TOP OF FILTER PACK
BASE OF SEAL
ELEVATION 632.95
DEPTH 19.5

TOP OF SCREEN
ELEVATION 630.95
DEPTH 21.5

BOTTOM OF SCREEN
ELEVATION 625.95
DEPTH 26.5

BASE OF FILTER PACK
ELEVATION 624.95
DEPTH 27 5

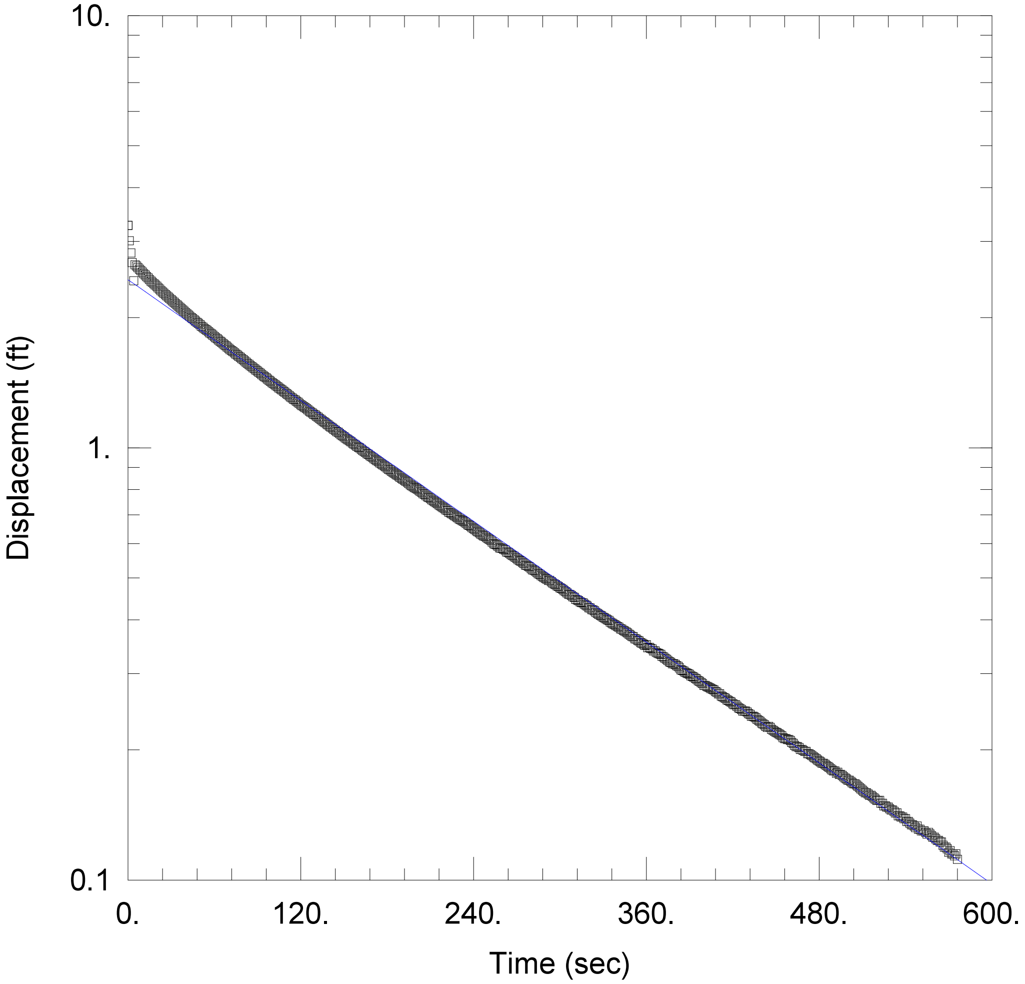


06/2011 cmz

DNR Form 542-1277

Appendix C

Hydraulic Conductivity Testing Results



WELL TEST ANALYSIS

Data Set: I:\25216148.00\Data and Calculations\Slug Test\MW-307.aqt
Date: 01/25/17 Time: 16:48:43

PROJECT INFORMATION

Company: SCS Engineers
Client: IPL-OGS
Project: 25216148.00
Location: Ottumwa
Test Well: MW-307
Test Date: 12/12/2016

AQUIFER DATA

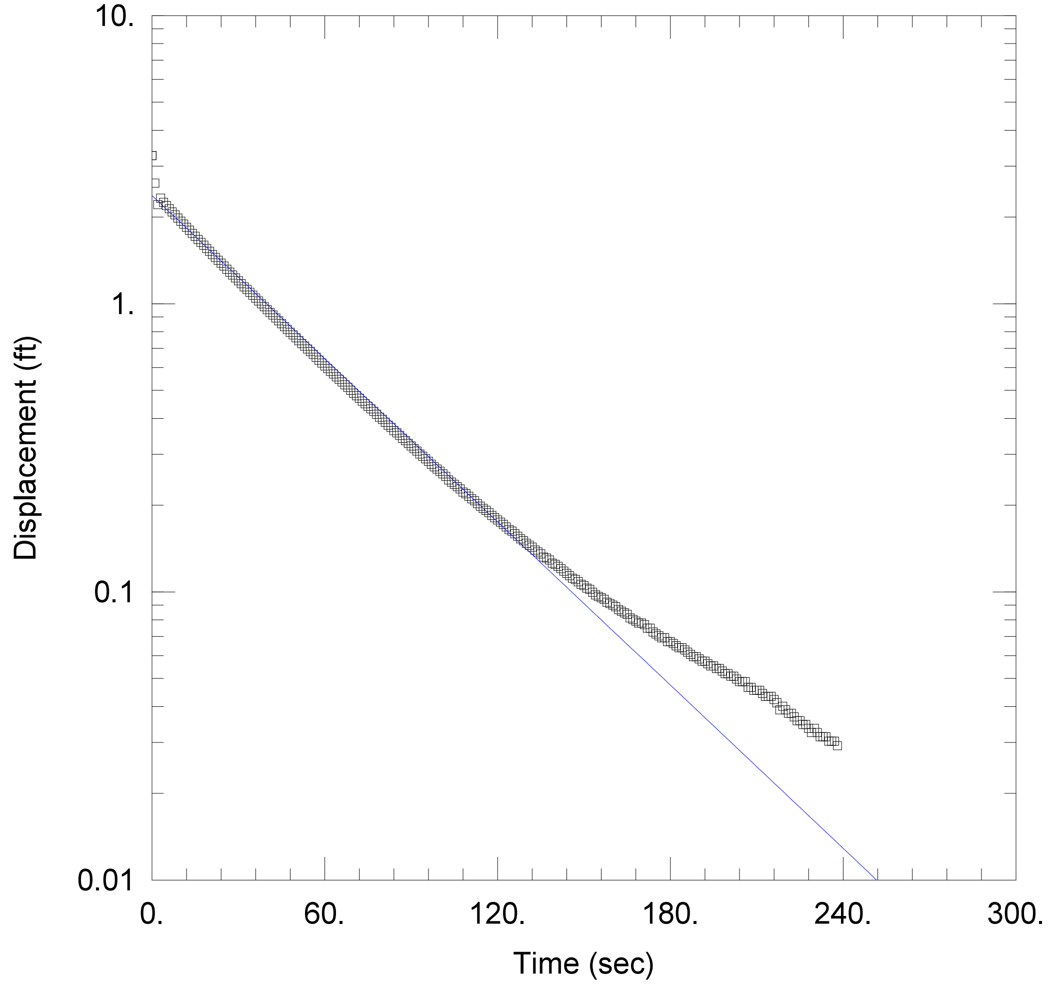
Saturated Thickness: 500. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (MW-307)

Initial Displacement: 3.27 ft
Total Well Penetration Depth: 8.5 ft
Casing Radius: 0.09 ft
Static Water Column Height: 19.29 ft
Screen Length: 5. ft
Well Radius: 0.35 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 0.0005047 cm/sec
y0 = 2.448 ft



WELL TEST ANALYSIS

Data Set: I:\25216148.00\Data and Calculations\Slug Test\MW-308.aqt
Date: 01/25/17 Time: 16:49:23

PROJECT INFORMATION

Company: SCS Engineers
Client: IPL-OGS
Project: 25216148.00
Location: Ottumwa
Test Well: MW-308
Test Date: 12/12/2016

AQUIFER DATA

Saturated Thickness: 500. ft
Anisotropy Ratio (Kz/Kr): 0.1

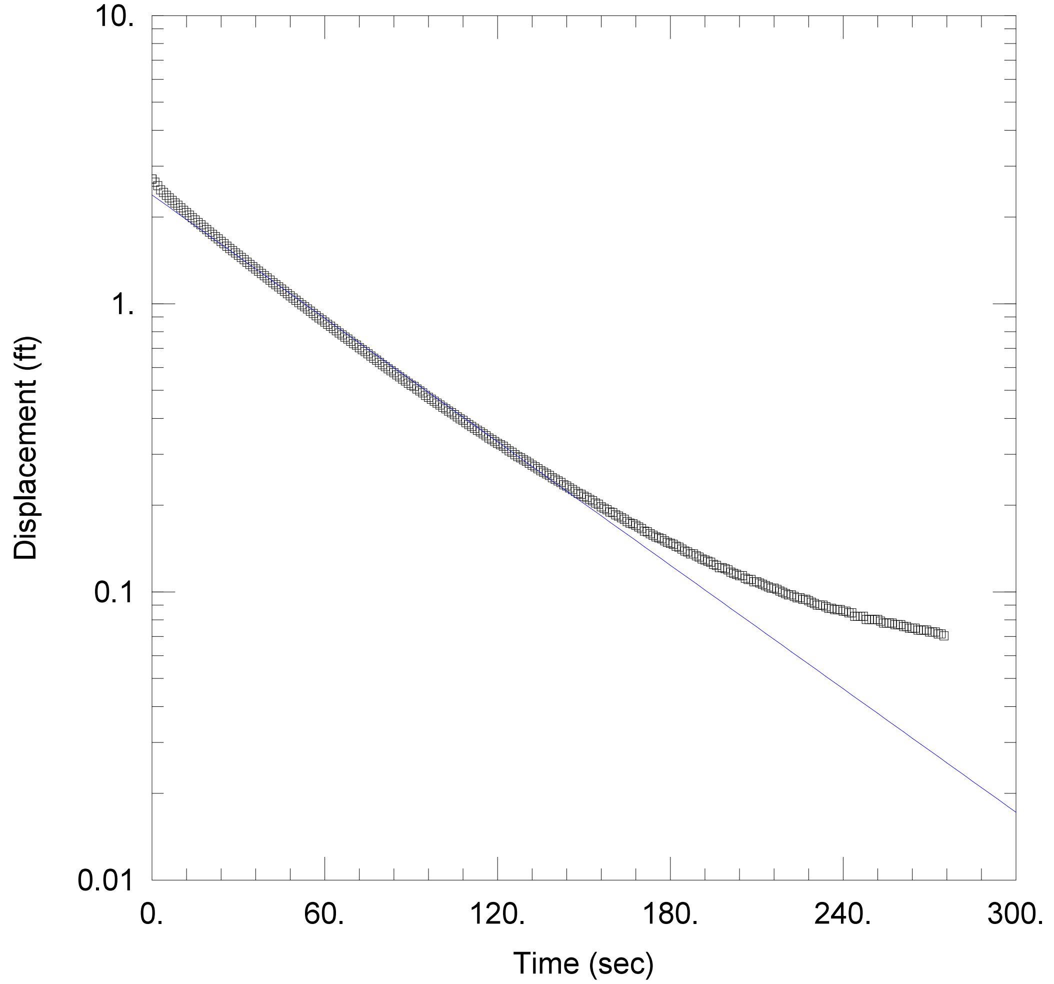
WELL DATA (MW-308)

Initial Displacement: 3.265 ft
Total Well Penetration Depth: 8. ft
Casing Radius: 0.09 ft
Static Water Column Height: 17.33 ft
Screen Length: 5. ft
Well Radius: 0.35 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev

K = 0.002045 cm/sec
y0 = 2.371 ft



WELL TEST ANALYSIS

Data Set: I:\25216148.00\Data and Calculations\Slug Test\MW-309.aqt
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PROJECT INFORMATION

Company: SCS Engineers
Client: IPL-OGS
Project: 25216148.00
Location: Ottumwa
Test Well: MW-309
Test Date: 12/12/2016

AQUIFER DATA

Saturated Thickness: 500. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (MW-309)

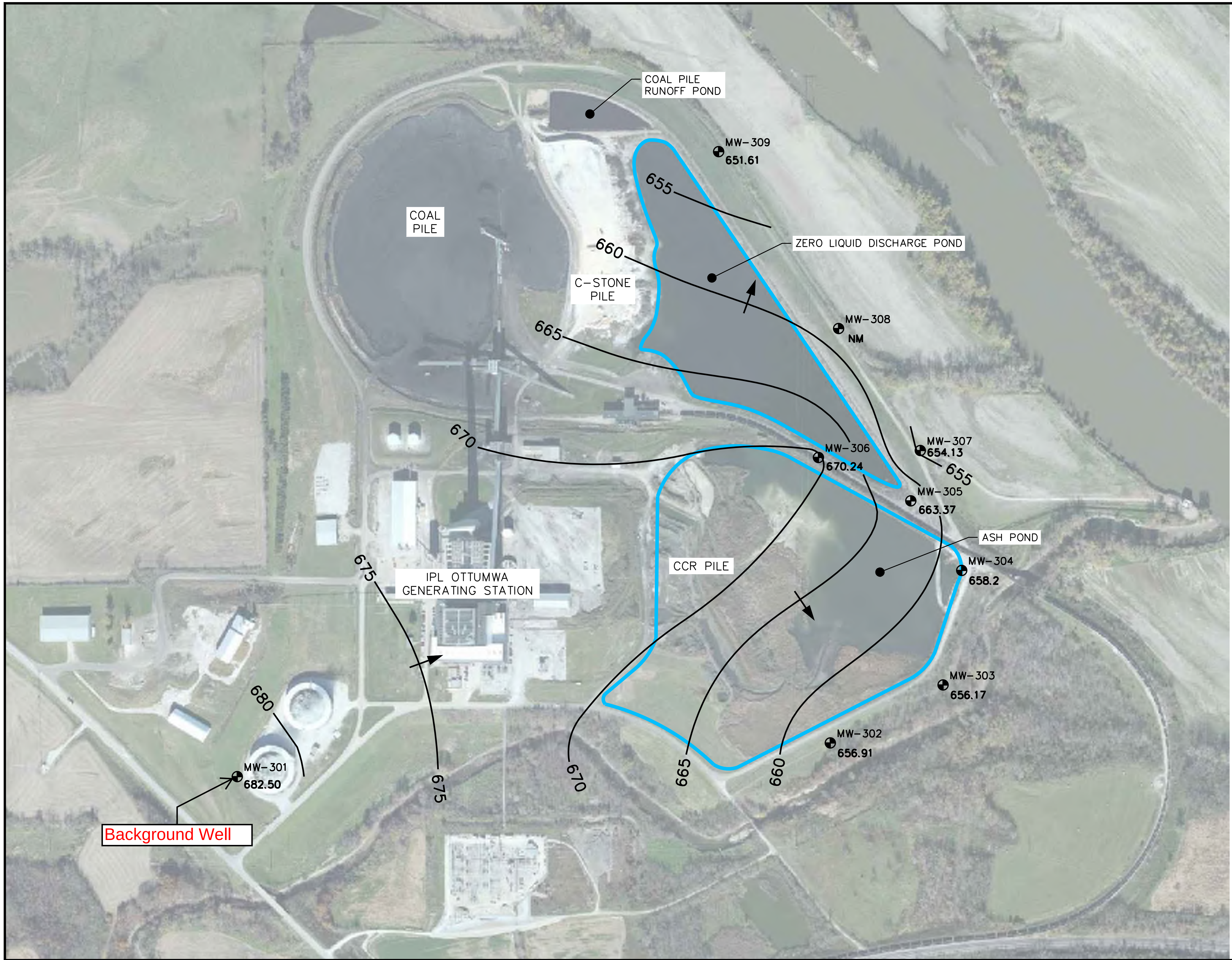
Initial Displacement: 2.707 ft
Static Water Column Height: 20. ft
Total Well Penetration Depth: 8. ft
Screen Length: 5. ft
Casing Radius: 0.09 ft
Well Radius: 0.35 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev

K = 0.001547 cm/sec
y0 = 2.386 ft

APPENDIX C3– GROUNDWATER FLOW DIRECTION



LEGEND

▬	CCR UNIT
●	MONITORING WELL
854.75	WATER TABLE ELEVATION MEASURED OCTOBER 2018
NM	NOT MEASURED
—	WATER TABLE CONTOUR
→	GROUNDWATER FLOW DIRECTION

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.	25216072.18	DRAWN BY:	KP
DRAWN:	03/14/2019	CHECKED BY:	NK
REVISED:	10/23/2020	APPROVED BY:	TK 10/23/2020

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

ALLIANT ENERGY
OTTUMWA GENERATING STATION
OTTUMWA, IOWA

POTENTIOMETRIC SURFACE
OCTOBER 2018

FIGURE
1

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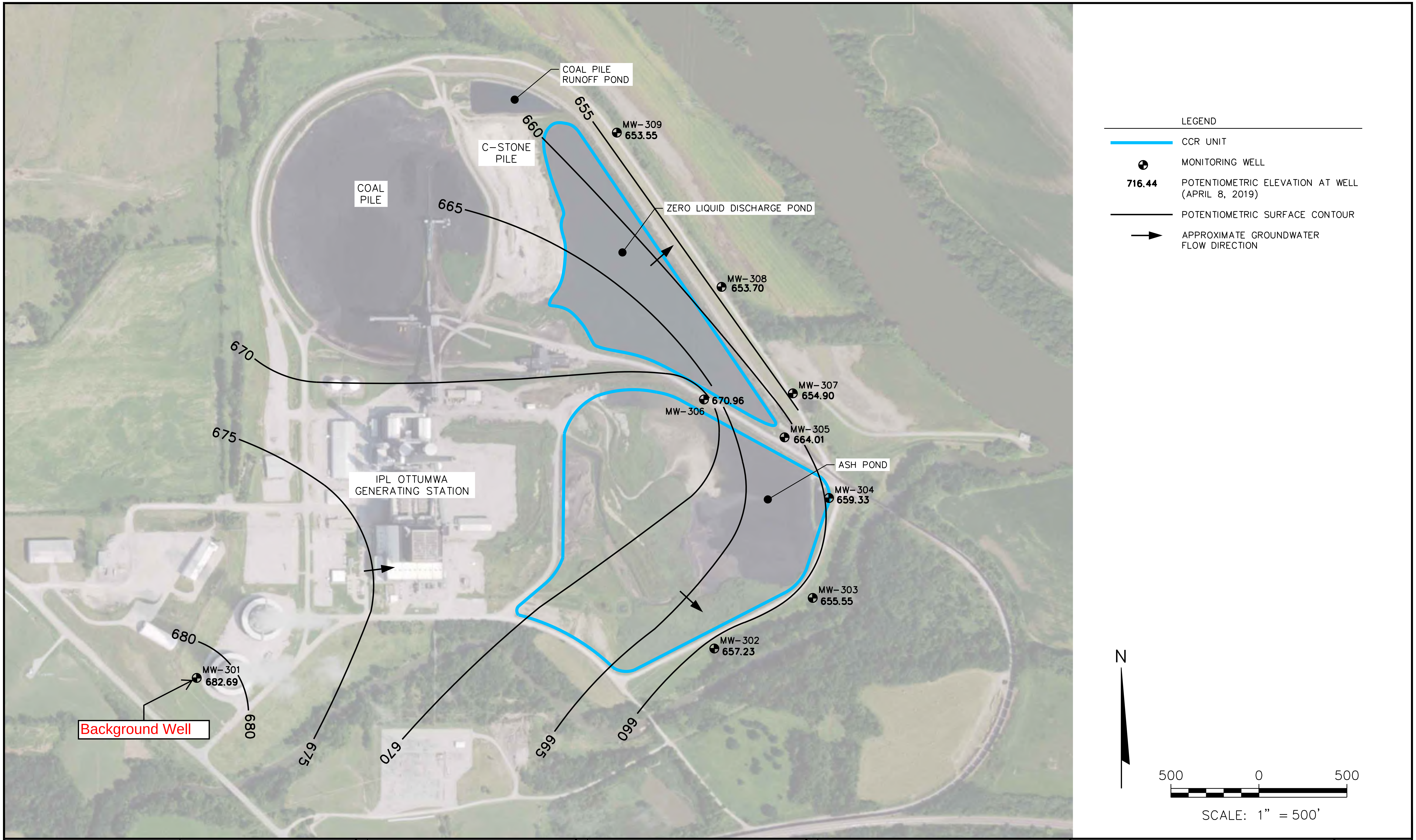

PROJECT NO.	25219072.00	DRAWN BY:	BSS
DRAWN:	07/03/2019	CHECKED BY:	NDK
REVISED:	10/23/2020	APPROVED BY:	TK 10/23/2020

ENGINEER

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

CLIENT

INTERSTATE POWER AND LIGHT CO.
15300 130th STREET
OTTUMWA, IA 52501

SITE

ALLIANT ENERGY
OTTUMWA GENERATING STATION
OTTUMWA, IOWA

POTENTIOMETRIC SURFACE
APRIL 2019

FIGURE
2

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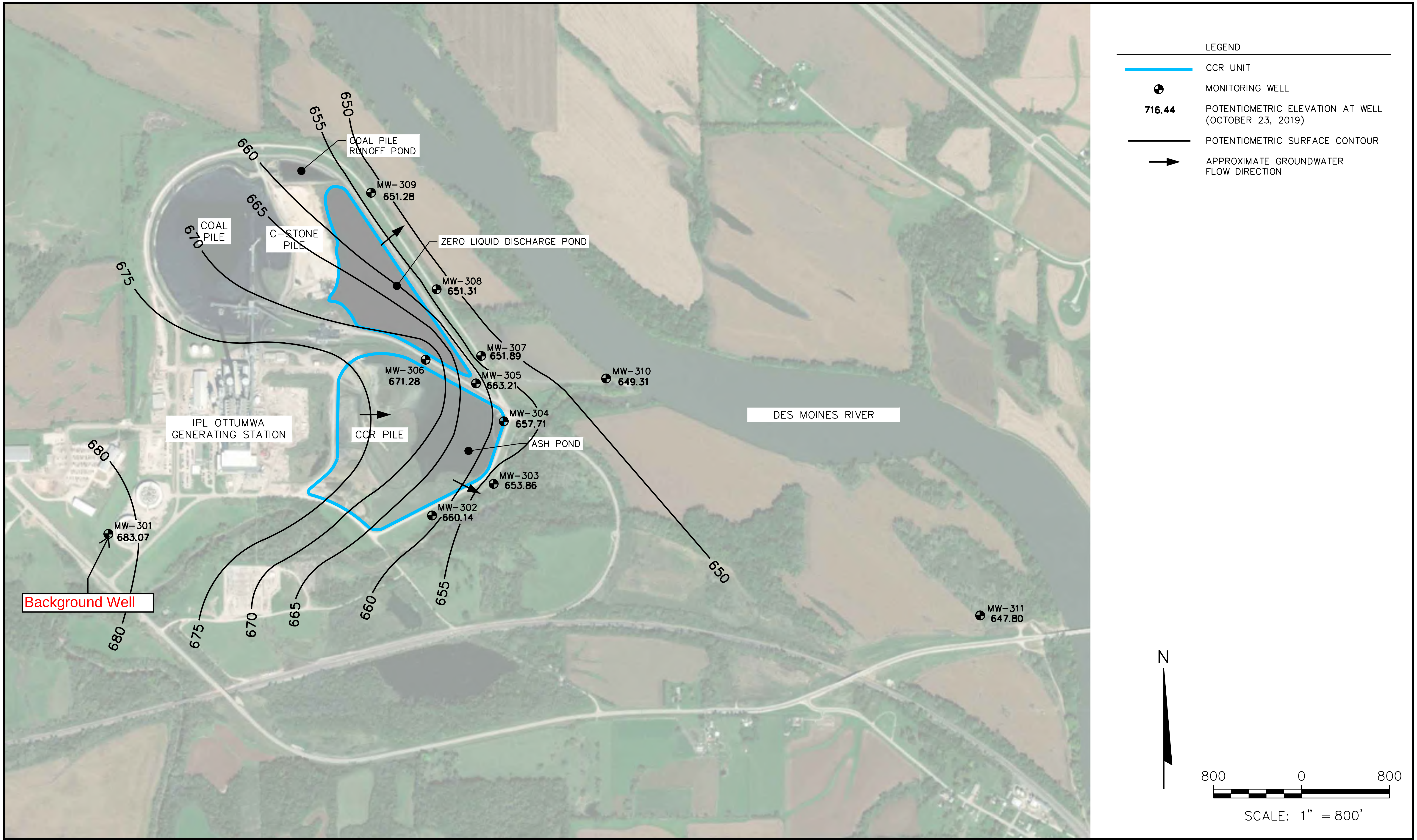

PROJECT NO.	25220072.00	DRAWN BY:	BSS
DRAWN:	11/15/2019	CHECKED BY:	NDK/SCC
REVISED:	10/23/2020	APPROVED BY:	TK 10/23/2020

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

ALLIANT ENERGY
OTTUMWA GENERATING STATION
OTTUMWA, IOWA

POTENTIOMETRIC SURFACE
OCTOBER 2019

FIGURE
3

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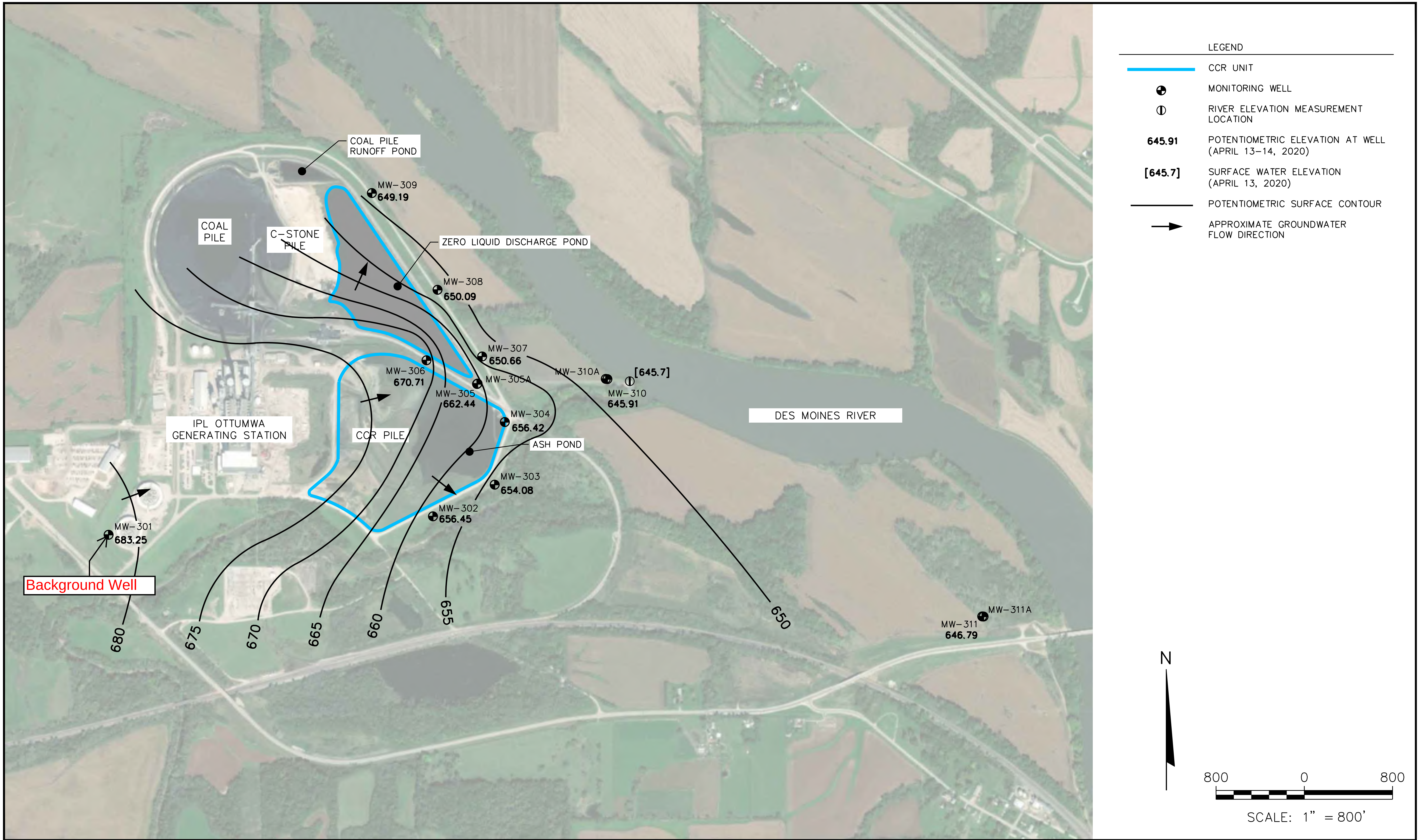

PROJECT NO.	25220072.00	DRAWN BY:	KP/BSS/RJG/ZTW
DRAWN:	04/28/2020	CHECKED BY:	NDK/SCC
REVISED:	10/23/2020	APPROVED BY:	TK 10/23/2020

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

ALLIANT ENERGY
OTTUMWA GENERATING STATION
OTTUMWA, IOWA

SHALLOW POTENTIOMETRIC SURFACE
APRIL 13–14, 2020

FIGURE
4

I:\Client\Generator\Newforma\20102 Alliant Energy\O S\Drawings\ 2020.dwg, 10/2 /2020

APPENDIX C4– GROUND WATER MONITORING WELL CONSTITUENT CONCENTRATIONS TABLES

Single Location

Name: IPL - Ottumwa Generating Station

Location ID: MW-301
Number of Sampling Dates: 19

Parameter Name	Units	4/26/2016	6/23/2016	8/10/2016	10/26/2016	1/18/2017	4/19/2017	6/20/2017	8/23/2017	11/8/2017	4/18/2018	8/14/2018	8/29/2018	10/16/2018	1/8/2019	4/8/2019	10/24/2019	2/5/2020	3/12/2020	4/14/2020
Boron	ug/L	574	612	597	620	599	565	657	779	488	480	735	--	410	--	380	680	540	--	700
Calcium	mg/L	66.9	62.5	65.6	71.9	74.1	61.5	59.3	66.8	65.2	63	72.5	--	47.2	--	43	78	68	--	84
Chloride	mg/L	63.4	66.9	73.3	76.3	71.6	54.8	69.8	73.5	59.8	63.4	--	63.1	33.9	--	50	110	120	--	140
Fluoride	mg/L	0.22	0.2	0.44	0.27	0.17	0.24	0.26	0.34	0.27	0.22	--	0.27	0.3	--	0.44	<0.23	--	--	<0.23
Field pH	Std. Units	6.54	6.06	6.08	6.26	6.47	6.64	6.31	6.16	6.41	6.41	6.26	6.31	6.27	5.68	6.61	6.33	6.39	6.48	6.58
Sulfate	mg/L	150	157	159	169	171	190	166	162	178	186	--	181	164	--	81	130	130	--	140
Total Dissolved Solids	mg/L	500	531	576	545	545	499	490	557	448	514	--	532	392	--	340	510	570	--	550
Antimony	ug/L	<0.058	0.13	0.12	<0.058	0.11	<0.026	0.054	0.063	--	<0.026	0.2	--	<0.078	--	<0.53	<0.53	--	--	<0.58
Arsenic	ug/L	0.38	0.38	0.26	0.14	0.23	0.22	0.15	0.14	--	0.074	0.29	--	0.16	--	<0.75	<0.75	<0.88	--	<0.88
Barium	ug/L	51.6	55.8	52.3	53.3	42.4	35.5	39.9	44	--	31.6	44.5	--	28.1	--	25	56	43	--	54
Beryllium	ug/L	<0.08	<0.08	<0.08	<0.08	<0.08	<0.012	<0.012	<0.012	--	<0.012	0.14	--	<0.089	--	<0.27	<0.27	--	--	<0.27
Cadmium	ug/L	<0.029	<0.029	0.12	0.038	<0.029	0.035	0.044	0.037	--	0.023	0.16	--	<0.033	--	<0.077	0.04	<0.039	--	<0.039
Chromium	ug/L	0.59	0.74	0.64	<0.34	0.59	0.49	0.25	0.39	--	<0.054	0.25	--	0.11	--	<0.98	<0.98	<1.1	--	<1.1
Cobalt	ug/L	4.1	3.1	1.8	1.8	1.3	0.97	1	0.96	--	0.46	1.4	--	0.36	--	0.44	0.6	1.1	0.43	0.52
Lead	ug/L	<0.19	<0.19	<0.19	<0.19	<0.19	0.06	0.1	0.049	--	0.041	0.18	--	<0.13	--	<0.27	<0.27	<0.27	--	<0.27
Lithium	ug/L	22.8	28.7	27.6	25.5	20.1	21.8	24.9	27.9	--	19.1	26.5	--	19.4	--	15	24	17	21	24
Mercury	ug/L	<0.039	<0.039	<0.039	<0.039	<0.039	<0.046	<0.046	<0.046	--	<0.09	<0.083	--	--	<0.09	<0.1	<0.1	--	--	<0.1
Molybdenum	ug/L	1.2	1.2	0.89	1	0.76	0.54	0.79	1.3	--	0.67	1.3	--	0.72	--	<1.1	1.1	--	--	1.2
Selenium	ug/L	4.7	5.4	6.1	6.5	5.9	4.2	5.5	7.2	--	4.3	6.3	--	3.4	--	3.1	6.2	--	--	6.8
Thallium	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	0.14	<0.036	0.067	--	<0.036	0.16	--	<0.099	--	<0.27	<0.27	--	--	<0.26
Total Radium	pCi/L	0.51	0.614	1.56	1.24	0.143	0.631	1.06	0.725	--	0.513	1.19	--	1.16	--	0.0956	0.956	0.228	--	0.315
Radium-226	pCi/L	0.084	0	0.831	-0.13	0.143	0.139	0.501	0.123	--	0.145	0.417	--	0.529	--	0.0726	0.15	0.049	--	0.0921
Radium-228	pCi/L	0.426	0.614	0.732	1.24	-0.403	0.492	0.562	0.602	--	0.368	0.773	--	0.627	--	0.023	0.753	0.179	--	0.223
Collected By		--	--	0	--	0	0	0	0	--	--	--	--	--	--	--	--	--	--	--
Field Specific Conductance	umhos/cm	572	777	807	853	834	742	758	1107	743	770	867	781	599	310	501	902	966	962	939
Field Temperature	deg C	10.5	17.1	19.9	16.3	6.8	10.8	17.3	19.7	13.9	7.2	20.4	20.6	16.6	7.88	7.27	13.71	5.38	6.9	8.7
Groundwater Elevation	feet	682.8	682.58	682.27	682.04	681.67	682.15	681.91	681.28	681.54	681.53	680.91	681.09	682.5	682.22	682.69	683.07	683.3	682.82	683.25
Oxygen, Dissolved	mg/L	4.04	2.55	3.43	3.72	4.87	5.74	4.34	2.88	4.16	6.52	3.18	4.71	4.12	5.68	8.32	4.94	7.28	5.31	5.14
Turbidity	NTU	1.82	1.51	0.52	0.9	0.6	0.47	0.38	0.79	1.03	0.66	0.52	0.63	2.91	0.77	1.87	1.6	1.43	1.33	0.87
pH at 25 Degrees C	Std. Units	6.5	6.4	6.5	6.7	6.8	6.7	6.5	6.4	6.4	6.6	--	6.5	6.6	--	7.1	7.1	6.7	--	6.6
Field Oxidation Potential	millivolts	244.1	74.6	58.6	91.3	30.2	148	67.2	41.4	200.7	105.5	-55.5	--	119.7	118.3	37.6	9.9	68	258.5	176.3
Manganese	ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	16	--

Single Location

Name: IPL - Ottumwa Generating Station

Location ID: MW-302

Number of Sampling Dates: 17

Parameter Name	Units	4/26/2016	6/23/2016	8/10/2016	10/26/2016	1/18/2017	4/19/2017	6/20/2017	8/22/2017	11/8/2017	4/18/2018	8/14/2018	8/29/2018	10/16/2018	1/8/2019	4/8/2019	10/24/2019	4/14/2020
Boron	ug/L	1110	1130	1110	1180	1250	1200	1180	1250	1320	1200	1240	--	1100	--	1300	1200	1200
Calcium	mg/L	193	177	171	184	188	184	175	179	183	177	185	--	146	--	200	180	180
Chloride	mg/L	258	258	276	270	259	281	253	264	254	246	--	259	214	--	240	220	220
Fluoride	mg/L	0.22	0.17	0.21	0.21	0.21	0.2	0.26	0.27	0.2	0.26	--	0.26	0.24	--	<0.23	<0.23	<0.23
Field pH	Std. Units	6.82	6.46	8.72	6.45	6.62	6.78	6.67	6.75	6.55	6.47	6.76	6.77	6.37	6.58	6.61	6.55	6.7
Sulfate	mg/L	752	865	835	819	777	907	858	858	786	899	--	847	785	--	840	810	790
Total Dissolved Solids	mg/L	1680	1480	1770	1650	1660	1670	1670	1620	1620	1690	--	1840	1400	--	1600	1600	1500
Antimony	ug/L	0.088	0.12	0.1	<0.058	0.11	<0.026	0.052	0.036	--	<0.026	<0.15	--	0.26	--	<0.53	<0.53	<0.58
Arsenic	ug/L	1.7	0.69	0.17	<0.1	0.23	0.25	0.083	0.19	--	0.16	0.3	--	1.9	--	<0.75	<0.75	<0.88
Barium	ug/L	31.5	23	20.7	21.2	20.4	19.4	18.2	18.5	--	17.7	18.3	--	28.9	--	19	21	23
Beryllium	ug/L	<0.08	<0.08	<0.08	<0.08	<0.08	<0.012	<0.012	<0.012	--	<0.012	<0.12	--	0.22	--	<0.27	<0.27	<0.27
Cadmium	ug/L	0.25	0.21	0.28	0.24	0.15	0.2	0.19	0.21	--	0.22	0.21	--	0.67	--	0.21	0.2	0.23
Chromium	ug/L	2.1	0.82	0.64	0.64	0.58	1	0.58	0.7	--	0.46	0.48	--	1.6	--	<0.98	<0.98	1.4
Cobalt	ug/L	2.6	1.4	1.1	1	0.94	0.95	0.86	0.88	--	0.9	1.5	--	4	--	1.2	2.7	5.3
Lead	ug/L	1.1	0.2	<0.19	<0.19	<0.19	0.2	0.081	<0.033	--	0.098	0.12	--	3.9	--	<0.27	0.29	1
Lithium	ug/L	11.3	14.1	12.2	11.9	9.7	10.1	9.7	13.8	--	7.5	6.9	--	8.6	--	10	10	11
Mercury	ug/L	<0.039	<0.039	<0.039	<0.039	<0.039	<0.046	<0.046	<0.046	--	0.096	<0.083	--	--	<0.09	<0.1	<0.1	<0.1
Molybdenum	ug/L	0.68	0.6	0.46	0.46	0.5	0.44	0.38	0.51	--	0.59	0.54	--	<0.57	--	<1.1	<1.1	<1.1
Selenium	ug/L	0.23	<0.18	<0.18	<0.18	<0.18	<0.086	<0.086	<0.086	--	<0.086	<0.16	--	0.84	--	<1	<1	<1
Thallium	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	0.049	<0.036	<0.036	--	<0.036	<0.14	--	0.16	--	<0.27	<0.27	<0.26
Total Radium	pCi/L	1.03	0.527	0.606	0.211	0.136	0.776	1.29	1.61	--	0.746	1.12	--	0.299	--	0.116	0.752	1.26
Radium-226	pCi/L	0.4	0.375	0.26	0.211	0.136	0.342	0.13	0.406	--	0.251	0.624	--	0.191	--	0.116	0.134	0.499
Radium-228	pCi/L	0.631	0.152	0.346	-0.0147	-0.0781	0.434	1.16	1.2	--	0.495	0.499	--	0.108	--	-0.0591	0.619	0.759
Collected By		--	--	0	--	0	0	0	0	--	--	--	--	--	--	--	--	--
Field Specific Conductance	umhos/cm	1747	2228	2222	2279	2247	2220	2085	2991	2274	2248	2304	2357	1912	1473	2159	2184	1971
Field Temperature	deg C	11.9	13.2	14.4	13.9	12.9	12.8	13.4	14	13.8	10.7	14.3	14.6	14.1	12.21	12.27	12.91	10.5
Groundwater Elevation	feet	655.63	655.65	655.52	655.67	655.46	656.35	655.65	655.13	655.4	655.71	656.05	655.89	656.91	656.03	657.23	660.14	656.45
Oxygen, Dissolved	mg/L	0.16	0.08	0.07	0.43	0.18	0.18	0.12	0.08	0.4	0.2	0.17	0.23	0.26	6.4	0.86	0.35	0.22
Turbidity	NTU	40.23	6.78	3.41	1.54	3.11	2.32	2.63	1.32	1.63	2.41	4.01	1.42	88.24	4.39	26.9	11.9	31.1
pH at 25 Degrees C	Std. Units	6.7	6.6	6.7	6.7	6.8	6.8	6.6	6.6	6.5	6.7	--	6.7	6.6	--	6.9	7.2	6.7
Field Oxidation Potential	millivolts	230.2	25	6.7	92.6	38.7	121.1	21	20.8	191.7	82.6	-336.6	--	114.2	70.2	68.3	-0.5	135.6

Single Location

Name: IPL - Ottumwa Generating Station

Location ID: MW-303

Number of Sampling Dates: 17

Parameter Name	Units	4/26/2016	6/23/2016	8/10/2016	10/26/2016	1/18/2017	4/19/2017	6/20/2017	8/22/2017	11/8/2017	4/18/2018	8/14/2018	8/29/2018	10/16/2018	1/8/2019	4/8/2019	10/24/2019	4/14/2020
Boron	ug/L	417	579	726	811	738	577	834	1180	1070	987	1010	--	549	--	290	440	420
Calcium	mg/L	179	172	180	204	173	226	210	200	234	212	213	--	195	--	170	170	170
Chloride	mg/L	109	155	234	230	190	141	186	268	185	198	--	64.8	57	--	22	35	47
Fluoride	mg/L	0.21	0.17	0.42	0.23	0.21	0.19	0.23	0.3	0.19	0.22	--	0.31	0.24	--	<0.23	<0.23	<0.23
Field pH	Std. Units	7.08	7.08	6.51	6.62	6.77	7.02	6.81	6.53	6.6	6.63	6.83	7.03	6.66	6.83	7	6.83	6.98
Sulfate	mg/L	183	190	200	208	168	333	284	215	348	328	--	164	389	--	260	180	180
Total Dissolved Solids	mg/L	856	988	1170	1120	1030	1170	1210	1220	1290	1300	--	832	1150	--	890	810	810
Antimony	ug/L	0.23	0.32	0.25	0.14	0.19	0.16	0.19	0.3	--	0.098	0.16	--	0.2	--	<0.53	<0.53	<0.58
Arsenic	ug/L	0.89	0.91	0.51	0.46	0.54	0.47	0.33	0.61	--	0.43	0.6	--	0.55	--	<0.75	<0.75	<0.88
Barium	ug/L	68.2	78.5	88.1	98.8	75.3	79.1	76.4	83.8	--	69.5	77.3	--	95.2	--	54	77	64
Beryllium	ug/L	<0.08	<0.08	<0.08	<0.08	<0.08	<0.012	<0.012	0.015	--	0.017	<0.12	--	<0.089	--	<0.27	<0.27	<0.27
Cadmium	ug/L	0.24	0.28	0.47	0.59	0.31	0.81	0.52	0.57	--	0.44	0.36	--	0.24	--	0.092	0.21	0.18
Chromium	ug/L	0.74	0.83	0.73	<0.34	0.52	0.27	0.37	0.61	--	0.12	0.19	--	0.15	--	<0.98	<0.98	<1.1
Cobalt	ug/L	2.2	2.5	2.6	3.1	2.6	1.8	1.9	2.8	--	2.1	2.2	--	1.7	--	0.42	1.2	0.87
Lead	ug/L	0.31	<0.19	<0.19	0.2	<0.19	0.068	0.07	0.19	--	0.069	0.13	--	<0.13	--	<0.27	<0.27	<0.27
Lithium	ug/L	<4.9	8.3	5	5.8	<4.9	<2.9	3.4	8.1	--	<4.6	6.9	--	<4.6	--	<2.7	<2.7	4.7
Mercury	ug/L	<0.039	<0.039	<0.039	<0.039	<0.039	<0.046	<0.046	<0.046	--	<0.09	<0.083	--	--	<0.09	<0.1	<0.1	<0.1
Molybdenum	ug/L	3.3	3.6	0.77	0.87	0.64	3.9	0.81	0.64	--	0.61	0.98	--	5.5	--	7.5	5.2	3.6
Selenium	ug/L	0.38	0.43	0.36	0.28	0.8	1.1	0.47	0.52	--	0.23	0.35	--	0.37	--	2.1	<1	5
Thallium	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	0.16	<0.036	<0.036	--	<0.036	<0.14	--	<0.099	--	<0.27	<0.27	<0.26
Total Radium	pCi/L	0.806	0.426	1.56	0.944	0.805	1.62	1.62	2.36	--	0.529	1.82	--	2.04	--	0.391	0.321	0.229
Radium-226	pCi/L	0.163	0.0636	0.716	0	0.145	1.06	0.556	1.4	--	-0.088	1.02	--	0.478	--	0.172	0.0551	0.149
Radium-228	pCi/L	0.643	0.362	0.842	0.944	0.66	0.556	1.06	0.958	--	0.529	0.799	--	1.56	--	0.22	0.265	0.0801
Collected By		--	--	0	--	0	0	0	0	--	--	--	--	--	--	--	--	--
Field Specific Conductance	umhos/cm	965	1176	1655	1730	1611	1687	1670	2474	1896	1862	1833	1161	1573	750	1181	1287	1097
Field Temperature	deg C	9.7	14.4	17.7	16.3	10.6	10.6	14.1	16.8	15.2	8.2	17.2	18.7	17.1	9.11	8.51	15.34	8.9
Groundwater Elevation	feet	652.42	652.89	651.76	652.17	651.74	654.57	652.42	650.58	651.34	652.47	652.57	655.07	656.17	654.65	655.55	653.86	654.08
Oxygen, Dissolved	mg/L	0.07	0.05	0.05	0.42	0.17	0.56	0.08	0.08	0.48	0.17	0.19	1.92	0.29	3.19	2.29	0.28	1.94
Turbidity	NTU	27.66	4.48	4.42	2.32	3.3	2.2	2.77	14.62	3.67	3.69	1.51	10.13	5.99	14.2	3.49	4.24	12.1
pH at 25 Degrees C	Std. Units	7	6.8	6.8	6.9	7.1	7.2	6.8	6.8	6.7	6.9	--	7.1	6.9	--	7.5	7.5	6.9
Field Oxidation Potential	millivolts	181.1	-20.5	31.5	14.8	21.3	99.5	8.6	20.9	176.8	3.2	-307.9	--	32.8	73.7	51.7	-5.1	104.3

Single Location

Name: IPL - Ottumwa Generating Station

Location ID: MW-304
Number of Sampling Dates: 17

Parameter Name	Units	4/26/2016	6/23/2016	8/11/2016	10/27/2016	1/18/2017	4/19/2017	6/21/2017	8/22/2017	11/8/2017	4/18/2018	8/15/2018	8/29/2018	10/16/2018	1/8/2019	4/8/2019	10/23/2019	4/13/2020
Boron	ug/L	965	968	911	991	995	1030	982	1040	1040	991	1000	--	930	--	1100	970	1000
Calcium	mg/L	124	123	112	125	122	129	126	130	136	131	138	--	123	--	130	120	130
Chloride	mg/L	311	316	336	364	383	430	382	409	417	400	--	375	410	--	320	280	250
Fluoride	mg/L	0.84	0.77	0.95	0.89	0.82	0.88	1	0.89	0.96	0.92	--	1	1	--	1.3	0.74	1.1
Field pH	Std. Units	7.3	7.07	7.34	6.96	7.05	7.27	7.29	6.72	7	6.9	7.34	7.22	6.86	7.16	7.17	7.05	7.12
Sulfate	mg/L	230	234	225	241	204	208	254	194	194	198	--	185	184	--	180	190	220
Total Dissolved Solids	mg/L	1190	1160	1180	1270	1230	1310	1240	1250	1270	1300	--	3680	1180	--	1100	1100	1000
Antimony	ug/L	0.069	0.13	0.1	<0.058	0.1	<0.026	0.06	0.035	--	<0.026	0.19	--	<0.078	--	<0.53	<0.53	<0.58
Arsenic	ug/L	2.1	2.2	0.78	0.69	0.82	0.73	0.57	0.67	--	0.68	1.3	--	0.96	--	<0.75	0.83	0.96
Barium	ug/L	104	106	86.4	97.6	92.4	94.9	87.1	91.5	--	88.5	87.4	--	91	--	80	80	80
Beryllium	ug/L	<0.08	<0.08	<0.08	<0.08	<0.08	<0.012	<0.012	<0.012	--	0.026	0.21	--	<0.089	--	<0.27	<0.27	<0.27
Cadmium	ug/L	<0.029	<0.029	0.072	<0.029	<0.029	<0.018	<0.018	<0.018	--	<0.018	0.17	--	0.073	--	<0.077	<0.039	<0.039
Chromium	ug/L	4.5	7.1	0.92	0.79	0.69	0.56	0.6	0.43	--	2	5.9	--	1.4	--	1.6	2	3.5
Cobalt	ug/L	0.89	1.1	<0.5	<0.5	<0.5	0.37	0.36	0.3	--	0.39	0.92	--	0.45	--	0.4	0.5	0.57
Lead	ug/L	0.5	0.82	<0.19	<0.19	<0.19	0.13	0.081	0.041	--	0.37	0.81	--	0.66	--	<0.27	0.27	0.5
Lithium	ug/L	5.1	7.5	<4.9	<4.9	<4.9	<2.9	<2.9	5.3	--	<4.6	<4.6	--	<4.6	--	3.3	2.8	4.8
Mercury	ug/L	<0.039	<0.039	<0.039	<0.039	<0.039	<0.046	<0.046	<0.046	--	<0.09	<0.083	--	--	<0.09	<0.1	<0.1	<0.1
Molybdenum	ug/L	2.5	2.4	1.6	1.4	1.5	1.5	1.5	1.6	--	2	2.4	--	1.9	--	1.5	2.3	2
Selenium	ug/L	0.23	0.32	<0.18	0.19	<0.18	0.17	0.14	0.21	--	<0.086	0.5	--	0.26	--	<1	<1	<1
Thallium	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	0.042	<0.036	<0.036	--	<0.036	0.15	--	<0.099	--	<0.27	<0.27	<0.26
Total Radium	pCi/L	1.66	1.56	2.39	1.52	2.94	2.44	3.55	3.2	--	2.08	3.74	--	2.76	--	2.42	2.58	2.46
Radium-226	pCi/L	0.706	0.431	0.465	0.327	1.33	0.894	1.62	1.2	--	1.22	1.78	--	1.21	--	1.23	1.08	1.2
Radium-228	pCi/L	0.952	1.13	1.92	1.19	1.61	1.55	1.93	2	--	0.862	1.96	--	1.55	--	1.19	1.5	1.26
Collected By		--	--	0	--	0	0	0	0	--	--	--	--	--	--	--	--	--
Field Specific Conductance	umhos/cm	1580	1958	1948	2057	2052	2139	2029	2881	2205	2141	2085	2123	2058	1368	1876	1871	1764
Field Temperature	deg C	13	13.3	13.4	13	12.9	13.4	13.3	13.4	13.3	12.8	15.1	13.7	13.5	12.81	13.75	13.64	11.9
Groundwater Elevation	feet	655.37	656.53	653.79	655.03	654.5	657.48	654.75	652.39	653.03	655.55	656.35	657.82	658.2	656.28	659.33	657.71	656.42
Oxygen, Dissolved	mg/L	0.13	0.05	0.06	0.47	0.16	0.12	0.1	0.08	0.25	0.15	0.21	0.16	0.11	0.72	0.41	0.44	0.24
Turbidity	NTU	61.01	92.4	2.66	1.46	1.17	1.95	1.64	0.92	3.88	39.29	81.42	55.94	17.12	4.38	57.9	18.9	54.1
pH at 25 Degrees C	Std. Units	7	7	7.1	7	7.2	7.2	7.2	7	6.9	7	--	7.1	7	--	7.5	7.7	7.1
Field Oxidation Potential	millivolts	-97.5	-109	67.9	-105.1	-79.3	-40.5	-66.6	-10.1	162.7	137.5	35.5	--	-114.5	-62.1	-58.3	-57.5	-119.8

Single Location

Name: IPL - Ottumwa Generating Station

Location ID: MW-305
Number of Sampling Dates: 17

Parameter Name	Units	4/26/2016	6/23/2016	8/11/2016	10/27/2016	1/18/2017	4/19/2017	6/21/2017	8/23/2017	11/8/2017	4/18/2018	8/15/2018	10/16/2018	1/8/2019	4/8/2019	10/23/2019	3/13/2020	4/13/2020
Boron	ug/L	888	906	832	878	956	907	889	903	925	886	911	835	--	1000	880	--	920
Calcium	mg/L	98.1	92.1	88.8	93.2	98.5	96.2	93.8	95.8	99.5	97.6	102	96.2	--	110	100	--	100
Chloride	mg/L	310	312	316	325	289	312	290	295	282	289	265	281	--	250	280	--	270
Fluoride	mg/L	0.35	0.29	0.33	0.37	0.35	0.38	0.4	0.48	0.4	0.4	0.44	0.4	--	0.75	<0.23	--	0.35
Field pH	Std. Units	7.23	6.94	7.18	6.94	6.96	7.3	7.06	6.88	7.01	6.9	7.21	6.86	6.99	7.06	6.91	7.02	7
Sulfate	mg/L	65.7	71.3	74	79.5	90	109	121	124	138	147	139	129	--	110	76	--	63
Total Dissolved Solids	mg/L	1040	982	1040	1010	1020	1040	1010	1040	1040	1070	1060	1070	--	1000	1000	--	960
Antimony	ug/L	0.14	0.2	0.19	0.094	0.18	0.063	0.12	0.12	--	0.089	<0.15	0.096	--	<0.53	<0.53	--	<0.58
Arsenic	ug/L	2.4	1.7	0.57	0.52	0.57	0.61	0.37	0.51	--	0.51	0.72	0.66	--	<0.75	<0.75	--	<0.88
Barium	ug/L	131	120	108	115	117	115	110	114	--	116	118	125	--	120	110	--	110
Beryllium	ug/L	<0.08	<0.08	<0.08	<0.08	<0.08	<0.012	<0.012	<0.012	--	<0.012	<0.12	<0.089	--	<0.27	<0.27	--	<0.27
Cadmium	ug/L	0.051	<0.029	0.1	<0.029	<0.029	0.052	0.039	0.034	--	0.054	0.086	0.044	--	<0.077	0.087	--	0.14
Chromium	ug/L	1.3	0.8	0.62	1.3	<0.34	0.36	0.22	0.45	--	0.26	0.41	0.3	--	<0.98	<0.98	--	<1.1
Cobalt	ug/L	14.8	15.1	13.7	14.8	15.2	14.6	14.4	14.7	--	14.5	15.6	17.2	16.4	17	17	18	16
Lead	ug/L	0.53	<0.19	<0.19	0.25	<0.19	0.093	<0.033	0.039	--	0.12	0.31	<0.13	--	<0.27	<0.27	--	0.27
Lithium	ug/L	<4.9	<4.9	<4.9	<4.9	<4.9	<2.9	<2.9	<2.9	--	<4.6	<4.6	<4.6	--	<2.7	<2.7	2.3	3.2
Mercury	ug/L	<0.039	<0.039	<0.039	<0.039	<0.039	<0.046	<0.046	<0.046	--	<0.09	<0.09	--	<0.09	<0.1	<0.1	--	<0.1
Molybdenum	ug/L	4.9	5.2	4.9	5.6	5.9	5.8	5.8	6	--	7.1	6.5	7.3	--	7.2	7.2	--	6.9
Selenium	ug/L	0.38	0.37	0.28	0.32	0.34	0.39	0.16	0.26	--	0.12	0.36	0.33	--	<1	<1	--	<1
Thallium	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	0.34	0.29	0.36	--	0.32	0.33	0.33	--	0.33	0.38	--	0.35
Total Radium	pCi/L	0.693	0.716	2.17	1.3	1.46	0.673	0.996	1.08	--	0.676	1.33	1.56	--	0.685	0.383	--	0.909
Radium-226	pCi/L	0.281	0.127	0.583	0.714	0.162	0.494	0.301	0.291	--	0.278	0.96	0.635	--	0.339	0.186	--	0.42
Radium-228	pCi/L	0.412	0.589	1.59	0.589	1.3	0.179	0.695	0.793	--	0.398	0.366	0.921	--	0.347	0.197	--	0.489
Collected By		--	--	0	--	0	0	0	0	--	--	--	--	--	--	--	--	--
Field Specific Conductance	umhos/cm	1469	1796	1769	1831	1794	1822	1730	2422	1738	1840	1832	1836	1235	1728	1794	1788	1772
Field Temperature	deg C	13.1	13.2	13.1	13	12.8	13.2	13.3	13.3	13.2	12.8	14.8	13.9	12.43	13.8	13.2	12.4	9.1
Groundwater Elevation	feet	661.67	662.36	660.78	661.37	660.87	663.27	661.26	659	659.76	660.99	661.56	663.37	662.13	664.01	663.21	661.41	662.44
Oxygen, Dissolved	mg/L	0.11	0.05	0.07	0.47	0.09	0.15	0.06	0.12	0.2	0.15	0.18	0.09	0.81	0.59	0.42	0.2	0.28
Turbidity	NTU	35.09	5.77	1.32	0.84	0.5	0.51	1.9	0.58	2.68	7.37	14.9	6.96	4.76	21.7	6.21	42.68	21.7
pH at 25 Degrees C	Std. Units	7.1	7	7.1	7.2	7.3	7.4	7.1	7.1	7	7.3	7	7.1	--	7	7.5	--	7.2
Field Oxidation Potential	millivolts	52.5	-20.2	-38.9	5.8	24.2 mV	17.6	-4.5	-51.3	146.1	-32.7	31	-26.8	36.4	32.6	-6.7	192.6	6.6
Iron	ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	390	--
Manganese	ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3200	--

Single Location

Name: IPL - Ottumwa Generating Station

Location ID: MW-305A

Number of Sampling Dates: 2

Parameter Name	Units	3/13/2020	4/14/2020
Boron	ug/L	250	280
Calcium	mg/L	100	130
Chloride	mg/L	40	89
Fluoride	mg/L	0.77	0.73
Field pH	Std. Units	8.09	7.63
Sulfate	mg/L	40	93
Total Dissolved Solids	mg/L	400	570
Antimony	ug/L	1.3	0.88
Arsenic	ug/L	<0.88	<0.88
Barium	ug/L	70	80
Beryllium	ug/L	<0.27	<0.27
Cadmium	ug/L	<0.039	<0.039
Chromium	ug/L	<1.1	<1.1

Location ID: MW-305A

Number of Sampling Dates: 2

Parameter Name	Units	3/13/2020	4/14/2020
Cobalt	ug/L	2.4	2.7
Lead	ug/L	0.68	<0.27
Lithium	ug/L	14	16
Mercury	ug/L	<0.1	<0.1
Molybdenum	ug/L	9	17
Selenium	ug/L	2.3	1.7
Thallium	ug/L	<0.26	<0.26
Total Radium	pCi/L	1.97	1.26
Radium-226	pCi/L	1.23	1.03
Radium-228	pCi/L	0.735	0.23
Field Specific Conductance	umhos/cm	745	807
Field Temperature	deg C	11.8	11.2
Oxygen, Dissolved	mg/L	3.79	2.26
Turbidity	NTU	63.2	4.91
pH at 25 Degrees C	Std. Units	--	7.3
Field Oxidation Potential	millivolts	204.2	106.7
Iron	ug/L	720	--

Location ID: MW-305A

Number of Sampling Dates: 2

Parameter Name	Units	3/13/2020	4/14/2020
Manganese	ug/L	180	--

Single Location

Name: IPL - Ottumwa Generating Station

Location ID: MW-306
Number of Sampling Dates: 16

Parameter Name	Units	4/26/2016	6/23/2016	8/11/2016	10/27/2016	1/18/2017	4/19/2017	6/21/2017	8/23/2017	11/8/2017	4/18/2018	8/15/2018	10/16/2018	1/8/2019	4/8/2019	10/23/2019	4/14/2020
Boron	ug/L	540	575	574	702	809	814	784	822	881	919	915	862	--	1100	980	1000
Calcium	mg/L	101	88.5	85	90	85.9	81.3	75.6	73.9	73.1	74.1	78.9	80	--	95	77	73
Chloride	mg/L	85.8	77.6	67.9	64.9	57.2	58.5	56	54.4	50.4	54.4	58.2	83.3	--	98	47	41
Fluoride	mg/L	0.11	<0.073	0.086	0.11	0.087	0.11	<0.1	0.15	0.11	0.11	0.13	<0.19	--	0.27	<0.23	<0.23
Field pH	Std. Units	7.08	6.17	6.72	6.44	6.51	6.79	6.71	6.46	6.49	6.42	6.74	6.42	6.65	6.66	6.74	6.68
Sulfate	mg/L	264	271	266	277	285	300	282	264	274	289	275	285	--	270	280	310
Total Dissolved Solids	mg/L	899	849	846	864	828	819	775	769	773	805	840	884	--	930	870	820
Antimony	ug/L	0.2	0.25	0.18	0.12	0.18	0.051	0.13	0.1	--	0.094	<0.15	0.1	--	<0.53	<0.53	<0.58
Arsenic	ug/L	2.2	1.7	0.44	0.4	0.47	0.42	0.41	0.38	--	0.38	0.65	0.6	--	<0.75	0.78	<0.88
Barium	ug/L	93	80.5	58	60.5	56.4	54.3	48.7	47.4	--	48.2	51.6	56	--	58	51	48
Beryllium	ug/L	<0.08	<0.08	<0.08	<0.08	<0.08	<0.012	<0.012	<0.012	--	<0.012	<0.12	<0.089	--	<0.27	<0.27	<0.27
Cadmium	ug/L	0.87	0.98	0.93	0.91	0.74	0.72	0.65	0.72	--	0.88	0.76	0.96	--	1.1	0.89	0.83
Chromium	ug/L	1.9	2.3	0.82	0.6	0.68	0.52	0.57	0.58	--	0.37	0.7	0.46	--	<0.98	1	<1.1
Cobalt	ug/L	8.3	7.7	6.4	6.6	6	5.7	5.2	5	--	4.8	5.5	6.4	6.2	6.9	6.2	5.5
Lead	ug/L	0.74	0.74	<0.19	<0.19	<0.19	0.038	0.1	<0.033	--	0.04	0.2	<0.13	--	<0.27	0.34	0.37
Lithium	ug/L	<4.9	<4.9	<4.9	<4.9	<4.9	<2.9	<2.9	<2.9	--	<4.6	<4.6	<4.6	--	<2.7	<2.7	<2.3
Mercury	ug/L	<0.039	<0.039	<0.039	<0.039	<0.039	<0.046	<0.046	<0.046	--	<0.09	<0.083	--	<0.09	<0.1	<0.1	<0.1
Molybdenum	ug/L	4.8	4.8	4.5	4.8	4.7	4.7	4.6	4.4	--	5.7	4.7	5.1	--	4.3	4.9	4.4
Selenium	ug/L	0.3	0.3	<0.18	0.24	0.2	<0.086	0.088	0.13	--	<0.086	0.21	0.22	--	<1	<1	<1
Thallium	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	0.14	0.082	<0.036	--	0.083	<0.14	0.12	--	<0.27	<0.27	<0.26
Total Radium	pCi/L	1.14	1.25	0.958	0.868	0.435	0.213	1.03	1.3	--	0.305	0.985	0.693	--	0.155	0.624	0.0738
Radium-226	pCi/L	0.179	0.475	0	0.253	-0.15	0.0761	0	0.517	--	0.305	0.482	0.263	--	0.0529	-0.00408	0.0738
Radium-228	pCi/L	0.962	0.774	0.958	0.615	0.435	0.137	1.03	0.784	--	-0.109	0.503	0.43	--	0.102	0.624	-0.118
Collected By		--	--	0	--	0	0	0	0	--	--	--	--	--	--	--	--
Field Specific Conductance	umhos/cm	960	1271	1228	1262	1215	1210	1151	1576	1186	1228	1271	1340	965	1350	1266	1158
Field Temperature	deg C	9.7	12.7	12.8	13.5	13.6	13.2	13.4	13.2	13.6	13.1	14.6	13.4	13.31	13.63	13.12	11.7
Groundwater Elevation	feet	670.86	670.64	670.35	670.21	669.89	670.69	669.94	668.77	669.04	668.92	668.66	670.24	669.84	670.96	671.28	670.71
Oxygen, Dissolved	mg/L	0.07	0.07	0.02	0.4	0.13	0.21	0.07	0.08	0.18	0.14	0.15	0.08	0.47	0.92	0.29	0.21
Turbidity	NTU	25.21	8.19	1.89	1	0.49	0.13	0.14	0.74	0.82	0.59	3.95	7.07	0.89	28.5	12.3	15.7
pH at 25 Degrees C	Std. Units	6.6	6.6	6.6	6.7	6.9	7	6.8	6.7	6.5	6.9	6.6	6.7	--	6.6	7.4	6.8
Field Oxidation Potential	millivolts	174.7	56	8.6	43.3	44.2	70.9	15.1	-10.5	174.1	14.2	22.8	13.3	59.5	49.1	-0.5	49.7

Single Location

Name: IPL - Ottumwa Generating Station

Location ID: MW-307
Number of Sampling Dates: 15

Parameter Name	Units	1/19/2017	4/20/2017	6/21/2017	8/21/2017	11/8/2017	4/16/2018	5/30/2018	6/28/2018	7/18/2018	10/16/2018	4/8/2019	10/23/2019	12/11/2019	2/5/2020	4/14/2020
Boron	ug/L	207	205	197	197	214	200	--	210	--	195	240	200	190	200	240
Calcium	mg/L	230	241	229	221	227	220	--	239	--	222	240	230	230	210	240
Chloride	mg/L	210	201	213	219	217	224	--	--	223	293	220	220	200	220	230
Fluoride	mg/L	0.12	0.13	0.16	0.2	0.12	0.11	--	--	0.13	<0.19	0.28	<0.23	<0.23	--	<0.23
Field pH	Std. Units	6.7	6.51	6.82	6.4	6.61	7.04	6.44	6.87	6.62	6.54	6.76	6.68	6.37	6.67	6.76
Sulfate	mg/L	105	105	110	102	102	103	--	--	105	104	100	95	92	100	99
Total Dissolved Solids	mg/L	1050	1100	1070	1050	1030	--	1100	--	1070	1070	1000	1000	1000	970	980
Antimony	ug/L	0.1	<0.026	<0.026	<0.026	<0.026	<0.026	--	<0.15	--	<0.078	--	--	<0.53	--	<0.58
Arsenic	ug/L	1.1	0.96	0.62	0.52	0.54	0.41	--	0.86	--	0.66	--	--	<0.75	<0.88	<0.88
Barium	ug/L	127	139	132	128	131	126	--	147	--	145	--	--	140	130	140
Beryllium	ug/L	<0.08	0.029	0.016	<0.012	<0.012	<0.012	--	<0.12	--	<0.089	--	--	<0.27	--	<0.27
Cadmium	ug/L	<0.029	0.025	<0.018	<0.018	0.018	<0.018	--	<0.07	--	<0.033	--	--	<0.039	<0.039	<0.039
Chromium	ug/L	0.59	1.6	1	0.38	0.38	0.28	--	1.4	--	0.59	--	--	<0.98	<1.1	<1.1
Cobalt	ug/L	0.62	1.6	1.1	1.1	1.3	1.3	--	2.9	--	4.8	--	--	11	13	20
Lead	ug/L	<0.19	0.49	0.26	0.085	0.075	0.13	--	0.48	--	0.13	--	--	0.71	<0.27	0.31
Lithium	ug/L	10	9.4	11.2	15.2	12.9	9.3	--	13.2	--	11.6	--	--	12	9.1	13
Mercury	ug/L	<0.039	<0.046	<0.046	<0.046	<0.046	<0.09	--	<0.037	--	<0.09	--	--	<0.1	--	<0.1
Molybdenum	ug/L	0.5	0.56	0.31	0.31	0.37	0.3	--	0.39	--	<0.57	--	--	<1.1	--	<1.1
Selenium	ug/L	<0.18	0.12	0.11	0.11	0.13	<0.086	--	0.25	--	0.13	--	--	<1	--	<1
Thallium	ug/L	<0.5	<0.036	<0.036	<0.036	0.065	<0.036	--	<0.14	--	<0.099	--	--	<0.27	--	<0.26
Total Radium	pCi/L	2.66	2.77	2.83	3.07	2.88	2.96	--	2.47	--	3.1	--	--	2.46	2.23	2.06
Radium-226	pCi/L	1.55	1.72	1.87	1.69	1.76	1.31	--	1.84	--	2.11	--	--	1.65	1.51	1.5
Radium-228	pCi/L	1.11	1.05	0.96	1.38	1.12	1.65	--	0.629	--	0.991	--	--	0.81	0.718	0.562
Collected By		0	0	0	0	--	--	--	--	--	--	--	--	--	--	--
Field Specific Conductance	umhos/cm	1640	1648	1557	2193	1656	1674	1710	1686	1718	1697	1599	1684	1576	1681	1554
Field Temperature	deg C	12.9	12	12.7	13	13.2	11.6	12.7	13.4	12.9	14.3	12.47	13.38	11.5	11.65	10.6
Groundwater Elevation	feet	648.81	653.62	649.85	645.78	647.37	649.66	652.45	652.87	652.27	654.13	654.9	651.89 ft	649.59	649.88	650.66
Oxygen, Dissolved	mg/L	0.16	0.2	0.08	0.08	0.17	0.29	0.18	0.21	0.21	0.08	0.51	0.25	0.18	0.9	0.69
Turbidity	NTU	9.01	66.67	34.94	4.89	11.16	11.93	18.58	53.34	14.94	14.08	26	12.5	43.13	9.74	28.9
Collected Time		--	--	--	--	--	--	--	--	13	--	--	--	--	--	--
pH at 25 Degrees C	Std. Units	7	6.9	6.8	6.9	7	7.1	--	--	6.7	6.8	6.7	7.5	6.7	6.7	6.8
Field Oxidation Potential	millivolts	-42	-16	-23.1	23.7	176.7	-105.9	-45.8	-43.4	-416.3	-65.7	-3.7	-24.8	-45.8	-15.6	-52.9

Single Location

Name: IPL - Ottumwa Generating Station

Location ID: MW-308
Number of Sampling Dates: 15

Parameter Name	Units	1/19/2017	4/20/2017	6/21/2017	8/21/2017	11/8/2017	4/16/2018	5/30/2018	6/28/2018	7/18/2018	10/16/2018	4/8/2019	10/23/2019	12/11/2019	2/5/2020	4/14/2020
Boron	ug/L	218	146	182	214	240	210	--	153	--	162	190	220	160	220	210
Calcium	mg/L	212	222	209	218	212	229	--	215	--	209	240	240	220	210	240
Chloride	mg/L	151	149	146	151	156	153	--	--	158	158	160	160	150	160	170
Fluoride	mg/L	0.11	0.12	0.12	0.23	0.12	0.1	--	--	0.12	<0.19	<0.23	<0.23	<0.23	--	<0.23
Field pH	Std. Units	6.85	6.7	6.93	6.52	6.76	7.14	6.61	7.08	6.73	6.68	6.9	6.78	6.55	6.78	6.9
Sulfate	mg/L	296	283	303	294	297	305	--	--	310	311	300	300	280	300	290
Total Dissolved Solids	mg/L	1060	1100	1050	1020	1120	--	1090	--	1080	1110	1200	1100	1100	1100	1000
Antimony	ug/L	0.11	<0.026	0.039	<0.026	<0.026	<0.026	--	<0.15	--	<0.078	--	--	<0.53	--	<0.58
Arsenic	ug/L	0.44	0.34	0.14	0.32	0.32	0.29	--	0.39	--	0.44	--	--	<0.75	<0.88	<0.88
Barium	ug/L	118	118	125	132	133	123	--	134	--	143	--	--	130	130	140
Beryllium	ug/L	<0.08	<0.012	<0.012	<0.012	<0.012	<0.012	--	<0.12	--	<0.089	--	--	<0.27	--	<0.27
Cadmium	ug/L	<0.029	<0.018	<0.018	<0.018	<0.018	<0.018	--	<0.07	--	<0.033	--	--	<0.039	<0.039	<0.039
Chromium	ug/L	0.57	0.44	0.34	0.49	0.45	0.17	--	0.42	--	0.27	--	--	5.9	<1.1	<1.1
Cobalt	ug/L	0.52	0.43	0.25	0.26	0.23	0.18	--	0.19	--	0.15	--	--	0.26	0.14	0.14
Lead	ug/L	<0.19	0.066	<0.033	<0.033	<0.033	0.043	--	<0.12	--	<0.13	--	--	0.52	<0.27	<0.27
Lithium	ug/L	10.3	13.3	12.7	19.1	12.6	12.3	--	17.6	--	13.7	--	--	16	12	17
Mercury	ug/L	<0.039	<0.046	<0.046	<0.046	<0.046	<0.09	--	<0.037	--	<0.09	--	--	<0.1	--	<0.1
Molybdenum	ug/L	0.95	0.53	0.5	0.61	0.75	0.6	--	0.46	--	<0.57	--	--	<1.1	--	<1.1
Selenium	ug/L	<0.18	<0.086	<0.086	<0.086	<0.086	<0.086	--	<0.16	--	<0.085	--	--	<1	--	<1
Thallium	ug/L	<0.5	<0.036	<0.036	<0.036	<0.036	<0.036	--	<0.14	--	<0.099	--	--	<0.27	--	<0.26
Total Radium	pCi/L	1.45	0.496	3.3	2.17	1.47	1.63	--	1.88	--	2.85	--	--	2.73	2.13	1.69
Radium-226	pCi/L	0.282	-0.173	2	1.42	1.18	0.532	--	1.5	--	1.44	--	--	1.54	1.42	1.24
Radium-228	pCi/L	1.17	0.496	1.3	0.745	0.286	1.1	--	0.379	--	1.41	--	--	1.19	0.705	0.454
Collected By		0	0	0	0	--	--	--	--	--	--	--	--	--	--	--
Field Specific Conductance	umhos/cm	1559	1509	1467	2042	1577	1577	1611	1584	1628	1594	1539	1637	1532	1630	1502
Field Temperature	deg C	12.6	11.9	12.2	12.6	13	11.8	12.1	13.1	12.6	13.1	12.54	13.16	10.5	11.35	10.9
Groundwater Elevation	feet	647.42	651.09	648.26	643.12	644.99	647.91	651.05	651.43	650.67	--	653.7	651.31	647.39	650.12	650.09
Oxygen, Dissolved	mg/L	0.15	0.21	0.03	0.12	0.12	0.35	0.14	0.19	0.13	0.08	0.66	4.42	0.43	1.48	0.28
Turbidity	NTU	1.65	4.6	0.84	1.15	0.73	0.93	3.34	5.87	1.54	5.49	6.87	7.42	15.72	3.49	5.12
Collected Time		--	--	--	--	--	--	--	--	14	--	--	--	--	--	--
pH at 25 Degrees C	Std. Units	7.2	7.2	7	6.9	7	7.1	--	--	6.8	7	6.8	7.9	6.8	6.8	6.9
Field Oxidation Potential	millivolts	-44.4	1.7	-29.1	24.4	169.7	-47.2	-48.2	-60.3	-415.4	-80.8	-23	-38.7	-56.6	-35.9	-69.1

Single Location

Name: IPL - Ottumwa Generating Station

Location ID: MW-309
Number of Sampling Dates: 15

Parameter Name	Units	1/19/2017	4/20/2017	6/21/2017	8/21/2017	11/8/2017	4/16/2018	5/30/2018	6/28/2018	7/18/2018	10/16/2018	4/8/2019	10/23/2019	12/11/2019	2/5/2020	4/14/2020
Boron	ug/L	1300	1280	1250	1320	1360	1340	--	1360	--	1280	1500	1300	1100	1300	1400
Calcium	mg/L	134	152	136	135	135	150	--	181	--	139	160	150	150	130	150
Chloride	mg/L	73.1	73.7	75.5	78.4	78.1	78.9	--	--	76.4	80.6	72	74	66	68	69
Fluoride	mg/L	0.12	0.13	0.16	0.19	0.14	0.094	--	--	0.13	<0.19	0.27	<0.23	<0.23	--	0.36
Field pH	Std. Units	7.18	7.01	7.17	6.9	7.11	7.52	6.92	7.36	7.02	6.95	7.18	6.98	6.67	7.09	7.21
Sulfate	mg/L	406	393	415	395	402	373	--	--	417	453	410	400	370	370	390
Total Dissolved Solids	mg/L	1030	1030	1020	1010	1010	--	1050	--	1030	1040	1100	1100	980	990	1000
Antimony	ug/L	0.095	<0.026	0.041	0.029	<0.026	0.079	--	<0.15	--	<0.078	--	--	<0.53	--	<0.58
Arsenic	ug/L	0.66	1.1	0.52	0.44	0.45	0.62	--	2	--	0.74	--	--	1.1	<0.88	0.88
Barium	ug/L	48.7	62.4	48.7	46.1	46	53.7	--	82.1	--	54.5	--	--	54	46	50
Beryllium	ug/L	<0.08	0.073	0.025	<0.012	0.016	0.056	--	0.28	--	<0.089	--	--	<0.27	--	<0.27
Cadmium	ug/L	<0.029	0.042	0.033	0.018	<0.018	0.052	--	0.15	--	<0.033	--	--	0.09	<0.039	<0.039
Chromium	ug/L	1.4	3.2	1.8	1.2	1.2	2.7	--	5.4	--	1.6	--	--	1.7	<1.1	1.3
Cobalt	ug/L	2	3.1	2.4	2.1	2	2.4	--	4.7	--	2.7	--	--	3.7	2.3	3.2
Lead	ug/L	<0.19	1	0.5	0.096	0.057	0.95	--	3.1	--	0.46	--	--	2.8	0.63	1.6
Lithium	ug/L	5.8	9.3	7.3	9.4	6.9	8	--	16.2	--	8.8	--	--	8.2	6.3	9.6
Mercury	ug/L	<0.039	<0.046	<0.046	<0.046	<0.046	<0.09	--	<0.037	--	<0.09	--	--	<0.1	--	<0.1
Molybdenum	ug/L	0.57	0.32	0.28	0.28	0.37	0.29	--	0.33	--	<0.57	--	--	<1.1	--	<1.1
Selenium	ug/L	<0.18	0.22	<0.086	<0.086	<0.086	<0.086	--	1	--	0.24	--	--	<1	--	<1
Thallium	ug/L	<0.5	<0.036	<0.036	<0.036	<0.036	<0.036	--	<0.14	--	<0.099	--	--	<0.27	--	<0.26
Total Radium	pCi/L	0.606	2.23	1.63	1.65	1.11	1.59	--	2.36	--	2.2	--	--	1.77	1.02	0.957
Radium-226	pCi/L	0.143	0.968	1.37	0.783	0.284	0.974	--	1.83	--	1.09	--	--	1.08	0.771	0.868
Radium-228	pCi/L	0.463	1.26	0.259	0.866	0.825	0.614	--	0.534	--	1.11	--	--	0.683	0.251	0.0894
Collected By		0	0	0	0	--	--	--	--	--	--	--	--	--	--	--
Field Specific Conductance	umhos/cm	1426	1430	1363	1821	1431	1445	1484	1477	1501	1464	1396	1461	1350	1433	1322
Field Temperature	deg C	12.7	12.1	12.4	12.6	13.1	11.2	12.4	13.8	12.6	13.5	12.4	12.83	11.5	11.42	11.2
Groundwater Elevation	feet	646.66	650.16	647.6	641.82	644.2	647.65	650.98	651.47	650.69	651.61	653.55	651.28	647.24	648.34	649.19
Oxygen, Dissolved	mg/L	0.09	0.16	0.06	0.08	0.13	0.37	0.12	0.17	0.11	0.03	0.66	0.36	0.26	1.07	0.16
Turbidity	NTU	8.56	77.74	20.33	2.34	3.71	36.7	40.55	241.4	40.38	28.27	72.1	42.6	413.6	18.1	100.1
Collected Time		--	--	--	--	--	--	--	--	16	--	--	--	--	--	--
pH at 25 Degrees C	Std. Units	7.4	7.4	7.2	7.2	7.4	7.3	--	--	7.3	7.2	7.2	7.2	7.1	7.2	7.1
Field Oxidation Potential	millivolts	-42.1	0.2	-34.8	-5	149.7	-58.5	-38	-45.5	-432.6	-81.6	-3.3	-27.5	-37.8	-7.8	-51.5

Single Location

Name: IPL - Ottumwa Generating Station

Location ID: MW-310
Number of Sampling Dates: 4

Parameter Name	Units	10/24/2019	2/5/2020	3/12/2020	4/13/2020
Boron	ug/L	720	620	--	550
Calcium	mg/L	230	160	--	200
Chloride	mg/L	150	120	--	130
Fluoride	mg/L	0.31	0.85	--	1.1
Field pH	Std. Units	7.15	7.08	6.89	7
Sulfate	mg/L	610	530	--	590
Total Dissolved Solids	mg/L	260	1200	--	1300
Antimony	ug/L	<0.53	<0.58	--	<0.58
Arsenic	ug/L	0.78	<0.88	--	<0.88
Barium	ug/L	76	53	--	62
Beryllium	ug/L	<0.27	<0.27	--	<0.27
Cadmium	ug/L	0.22	0.12	--	0.16
Chromium	ug/L	<0.98	<1.1	--	<1.1
Cobalt	ug/L	0.57	0.32	0.32	0.24
Lead	ug/L	<0.27	<0.27	--	<0.27
Lithium	ug/L	35	42	46	48
Mercury	ug/L	<0.1	<0.1	--	<0.1
Molybdenum	ug/L	26	29	--	31
Selenium	ug/L	5	3.3	--	4.5
Thallium	ug/L	<0.27	<0.26	--	<0.26

Location ID: MW-310

Number of Sampling Dates: 4

Parameter Name	Units	10/24/2019	2/5/2020	3/12/2020	4/13/2020
Total Radium	pCi/L	0.411	0.0344	--	0.271
Radium-226	pCi/L	-0.0393	0.0344	--	0.0494
Radium-228	pCi/L	0.411	-0.137	--	0.222
Field Specific Conductance	umhos/cm	1906	1723	1902	1823
Field Temperature	deg C	13.74	12.49	12.8	10.3
Groundwater Elevation	feet	649.31 ft	644.71	645.45	645.91
Oxygen, Dissolved	mg/L	0.41	0.68	0.3	0.22
Turbidity	NTU	2.29	0.9	2.77	0.87
pH at 25 Degrees C	Std. Units	7.2	7.1	--	7
Field Oxidation Potential	millivolts	-9.3	42.2	252.2	179.4
Manganese	ug/L	--	--	260	--

Single Location

Name: IPL - Ottumwa Generating Station

Location ID: MW-310A

Number of Sampling Dates: 2

Parameter Name	Units	3/13/2020	4/14/2020
Boron	ug/L	1500	1600
Calcium	mg/L	82	87
Chloride	mg/L	140	130
Fluoride	mg/L	1.7	1.8
Field pH	Std. Units	7.73	7.85
Sulfate	mg/L	1200	1100
Total Dissolved Solids	mg/L	2300	2300
Antimony	ug/L	<0.58	<0.58
Arsenic	ug/L	<0.88	<0.88
Barium	ug/L	16	16
Beryllium	ug/L	<0.27	<0.27
Cadmium	ug/L	<0.039	<0.039
Chromium	ug/L	<1.1	<1.1

Location ID: MW-310A

Number of Sampling Dates: 2

Parameter Name	Units	3/13/2020	4/14/2020
Cobalt	ug/L	0.63	0.39
Lead	ug/L	<0.27	<0.27
Lithium	ug/L	250	290
Mercury	ug/L	<0.1	<0.1
Molybdenum	ug/L	2.6	2.7
Selenium	ug/L	<1	<1
Thallium	ug/L	<0.26	<0.26
Total Radium	pCi/L	3.43	3.9
Radium-226	pCi/L	3.27	3.48
Radium-228	pCi/L	0.157	0.418
Field Specific Conductance	umhos/cm	3160	2915
Field Temperature	deg C	12.5	8.8
Oxygen, Dissolved	mg/L	6.28	6.39
Turbidity	NTU	109	--
pH at 25 Degrees C	Std. Units	--	7.5
Field Oxidation Potential	millivolts	178.9	146.1
Iron	ug/L	99	--

Location ID: MW-310A

Number of Sampling Dates: 2

Parameter Name	Units	3/13/2020	4/14/2020
Manganese	ug/L	51	--

Single Location

Name: IPL - Ottumwa Generating Station

Location ID: MW-311

Number of Sampling Dates: 4

Parameter Name	Units	10/24/2019	2/5/2020	3/13/2020	4/13/2020
Boron	ug/L	<110	<100	--	<100
Calcium	mg/L	170	130	--	170
Chloride	mg/L	13	14	--	13
Fluoride	mg/L	<0.23	<0.23	--	<0.23
Field pH	Std. Units	6.95	6.72	7.11	6.86
Sulfate	mg/L	47	54	--	54
Total Dissolved Solids	mg/L	530	520	--	570
Antimony	ug/L	<0.53	<0.58	--	<0.58
Arsenic	ug/L	<0.75	<0.88	--	<0.88
Barium	ug/L	200	160	--	180
Beryllium	ug/L	<0.27	<0.27	--	<0.27
Cadmium	ug/L	0.04	<0.039	--	<0.039
Chromium	ug/L	<0.98	<1.1	--	<1.1
Cobalt	ug/L	0.78	0.11	<0.091	<0.091
Lead	ug/L	<0.27	<0.27	--	<0.27
Lithium	ug/L	4.7	2.9	4.7	6.2
Mercury	ug/L	<0.1	<0.1	--	<0.1
Molybdenum	ug/L	<1.1	<1.1	--	<1.1
Selenium	ug/L	<1	1.2	--	<1
Thallium	ug/L	<0.27	<0.26	--	<0.26

Location ID: MW-311

Number of Sampling Dates: 4

Parameter Name	Units	10/24/2019	2/5/2020	3/13/2020	4/13/2020
Total Radium	pCi/L	0.386	0.108	--	0.17
Radium-226	pCi/L	0.0831	0.0368	--	0.0742
Radium-228	pCi/L	0.303	0.0711	--	0.0963
Field Specific Conductance	umhos/cm	926	891	877	912
Field Temperature	deg C	13.88	10.21	10	8.8
Groundwater Elevation	feet	647.8	645	644.18	646.79
Oxygen, Dissolved	mg/L	0.29	2.11	0.23	0.29
Turbidity	NTU	3.88	1.89	3.44	0.44
pH at 25 Degrees C	Std. Units	7	7.1	--	6.9
Field Oxidation Potential	millivolts	-24.7	21	222.6	103.4
Iron	ug/L	--	--	<50	--
Manganese	ug/L	--	--	20	--

Single Location

Name: IPL - Ottumwa Generating Station

Location ID: MW-311A

Number of Sampling Dates: 3

Parameter Name	Units	3/13/2020	4/13/2020	6/30/2020
Boron	ug/L	1400	1500	--
Calcium	mg/L	44	48	--
Chloride	mg/L	130	140	--
Fluoride	mg/L	3.4	4.1	3.7
Field pH	Std. Units	7.85	8.4	7.64
Sulfate	mg/L	1200	1200	--
Total Dissolved Solids	mg/L	2300	2400	--
Antimony	ug/L	<0.58	<0.58	--
Arsenic	ug/L	<0.88	<0.88	--
Barium	ug/L	20	20	--
Beryllium	ug/L	<0.27	<0.27	--
Cadmium	ug/L	<0.039	<0.039	--
Chromium	ug/L	<1.1	<1.1	--
Cobalt	ug/L	0.19	0.13	--
Lead	ug/L	<0.27	<0.27	--
Lithium	ug/L	260	310	--

Location ID: MW-311A

Number of Sampling Dates: 3

Parameter Name	Units	3/13/2020	4/13/2020	6/30/2020
Mercury	ug/L	<0.1	<0.1	--
Molybdenum	ug/L	1.2	2.8	--
Selenium	ug/L	<1	<1	--
Thallium	ug/L	<0.26	<0.26	--
Total Radium	pCi/L	1.47	2.31	--
Radium-226	pCi/L	1.42	2.1	--
Radium-228	pCi/L	0.0555	0.214	--
Field Specific Conductance	umhos/cm	3336	3027	3391
Field Temperature	deg C	12.1	7.9	12.6
Groundwater Elevation	feet	--	--	647.73
Oxygen, Dissolved	mg/L	2.29	3.87	1.51
Turbidity	NTU	7.74	3.19	1.43
pH at 25 Degrees C	Std. Units	--	7.9	--
Field Oxidation Potential	millivolts	206	115.8	23.4
Iron	ug/L	<50	--	--
Manganese	ug/L	20	--	--

2019 Annual Groundwater Monitoring and Corrective Action Report

Ottumwa Generating Station – Ash Pond
Ottumwa, Iowa

Prepared for:

Alliant Energy

SCS ENGINEERS

25219072.00 | January 31, 2020

2830 Dairy Drive
Madison, WI 53718-6751
608-224-2830

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1.0 INTRODUCTION

This 2019 Annual Groundwater Monitoring and Corrective Action Report was prepared to support compliance with the groundwater monitoring requirements of the Coal Combustion Residuals (CCR) Rule [40 CFR 257.50-107]. Specifically, this report was prepared to fulfill the requirements of 40 CFR 257.90(e). The applicable sections of the Rule are provided below in *italics*, followed by applicable information relative to the 2019 Annual Groundwater Monitoring and Corrective Action Report for the CCR Units.

This report covers the period of groundwater monitoring from January 1, 2019, through December 31, 2019.

The groundwater monitoring system is designed to detect monitored constituents at the waste boundary of the Ottumwa Generating Station (OGS) Ash Pond (existing CCR surface impoundment), as required by 40 CFR 257.91(d). The groundwater monitoring system currently consists of 1 upgradient monitoring well, 5 downgradient monitoring wells at the waste boundaries, and 2 additional downgradient monitoring wells.

2.0 § 257.90(E) ANNUAL REPORT REQUIREMENTS

Annual groundwater monitoring and corrective action report. *For existing CCR landfills and existing CCR surface impoundments, no later than January 31, 2018, and annually thereafter, the owner or operator must prepare an annual groundwater monitoring and corrective action report. For new CCR landfills, new CCR surface impoundments, and all lateral expansions of CCR units, the owner or operator must prepare the initial annual groundwater monitoring and corrective action report no later than January 31 of the year following the calendar year a groundwater monitoring system has been established for such CCR unit as required by this subpart, and annually thereafter. For the preceding calendar year, the annual report must document the status of the groundwater monitoring and corrective action program for the CCR unit, summarize key actions completed, describe any problems encountered, discuss actions to resolve the problems, and project key activities for the upcoming year. For purposes of this section, the owner or operator has prepared the annual report when the report is placed in the facility's operating record as required by § 257.105(h)(1). At a minimum, the annual groundwater monitoring and corrective action report must contain the following information, to the extent available:*

2.1 §257.90(E)(1) SITE MAP

A map, aerial image, or diagram showing the CCR unit and all background (or upgradient) and downgradient monitoring wells, to include the well identification numbers, that are part of the groundwater monitoring program for the CCR unit;

A map of the site location is provided on **Figure 1**. A map with an aerial image showing the CCR unit and all background (or upgradient) and downgradient monitoring wells with identification numbers for the groundwater monitoring program is provided as **Figure 2**. The OGS Zero Liquid Discharge Pond CCR unit is also shown on **Figure 2**.

2.2 §257.90(E)(2) MONITORING SYSTEM CHANGES

Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a narrative description of why those actions were taken;

Two new monitoring wells, MW-310 and MW-311, were installed on August 27, 2019, to characterize site conditions in accordance with § 257.95(g)(1). The monitoring well logs and well construction forms were completed for the operating record on November 12, 2019.

2.3 §257.90(E)(3) SUMMARY OF SAMPLING EVENTS

In addition to all the monitoring data obtained under §§ 257.90 through 257.98, a summary including the number of groundwater samples that were collected for analysis for each background and downgradient well, the dates the samples were collected, and whether the sample was required by the detection monitoring or assessment monitoring programs;

Two groundwater sampling events were completed in 2019. The first round of semiannual assessment monitoring was completed in April 2019, and the second round was completed in October 2019. The two new wells were added to the monitoring program beginning with the October 2019 event.

Groundwater samples collected in the April and October 2019 events were analyzed for Appendix III and Appendix IV constituents. A summary including the number of groundwater samples that were collected for analysis for each background and downgradient well, the dates the samples were collected, and whether the sample was required by the detection monitoring or assessment monitoring programs is included in **Table 1**. The results of the analytical laboratory analyses are provided in the laboratory reports in **Appendix A**.

2.4 § 257.90(E)(4) MONITORING TRANSITION NARRATIVE

A narrative discussion of any transition between monitoring programs (e.g., the date and circumstances for transitioning from detection monitoring to assessment monitoring in addition to identifying the constituent(s) detected at a statistically significant increase over background levels);

An Assessment of Corrective Measures (ACM) was initiated for the OGS Ash Pond in April 2019 and completed in September 2019. The selection of remedy is in progress. The ACM was initiated in response to the detection of cobalt at a statistically significant level exceeding the Groundwater Protection Standards (GPS) in monitoring wells MW-305 and MW-306. Assessment monitoring continued during the ACM and will continue during the selection of remedy.

2.5 § 257.90(E)(5) OTHER REQUIREMENTS

Other information required to be included in the annual report as specified in §§ 257.90 through 257.98.

Additional potentially applicable requirements for the annual report, and the location of the requirement within the Rule, are provided in the following sections. For each cited section of the Rule, the portion referencing the annual report requirement is provided below in italics, followed by applicable information relative to the 2019 Annual Groundwater Monitoring and Corrective Action Report.

2.5.1 § 257.90(e) General Requirements

For the preceding calendar year, the annual report must document the status of the groundwater monitoring and corrective action program for the CCR unit, summarize key actions completed, describe any problems encountered, discuss actions to resolve the problems, and project key activities for the upcoming year.

Status of Groundwater Monitoring and Corrective Action Program. The groundwater monitoring and corrective action program is currently in the selection of remedy process, with assessment monitoring continuing.

Summary of Key Actions Completed.

- Statistical evaluation for the initial Assessment Monitoring samples collected in April, August, and October 2018, completed January 14, 2019.
- Statistical evaluation for the April 2019 monitoring event, completed July 15, 2019.
- Initiation of the ACM on April 15, 2019.
- Two semiannual assessment monitoring events (April and October 2019).
- Installation of two additional compliance groundwater monitoring wells (August 2019) to characterize the site conditions in accordance with §257.95(g)(1).
- Preparation of the ACM report, completed September 12, 2019.

Description of Any Problems Encountered.

- There were no problems encountered during 2019.

Discussion of Actions to Resolve the Problems.

- Not applicable.

Projection of Key Activities for the Upcoming Year (2020):

- Statistical evaluation and determination of any statistically significant levels exceeding the GPS for the October 2019 monitoring event (January 2020).
- Statistical evaluation and determination of any statistically significant levels exceeding the GPS for the April 2020 monitoring event (July 2020).
- Continued work on the selection of remedy in accordance with § 257.97.
- Installation of three additional monitoring wells to characterize site conditions for the selection of remedy (first quarter of 2020).
- Semiannual progress reports for the Selection of Remedy process (March and September 2020).
- Two semiannual assessment monitoring events (April and October 2020).

2.5.2 § 257.94(d) Alternative Detection Monitoring Frequency

The owner or operator must include the demonstration providing the basis for the alternative monitoring frequency and the certification by a qualified professional engineer in the annual groundwater monitoring and corrective action report required by § 257.90(e).

Not applicable. OGS is no longer in detection monitoring program.

2.5.3 § 257.94(e)(2) Alternative Source Demonstration for Detection Monitoring

The owner or operator must also include the demonstration in the annual groundwater monitoring and corrective action report required by § 257.90(e), in addition to the certification by a qualified professional engineer.

Not applicable. OGS is no longer in detection monitoring program.

2.5.4 § 257.95(c) Alternative Assessment Monitoring Frequency

The owner or operator must include the demonstration providing the basis for the alternative monitoring frequency and the certification by a qualified professional engineer in the annual groundwater monitoring and corrective action report required by § 257.90(e).

Not applicable. Assessment monitoring has been initiated at the site, but no alternative assessment monitoring frequency is proposed at this time.

2.5.5 § 257.95(d)(3) Assessment Monitoring Results and Standards

Include the recorded concentrations required by paragraph (d)(1) of this section, identify the background concentrations established under § 257.94(b), and identify the groundwater protection standards established under paragraph (d)(2) of this section in the annual groundwater monitoring and corrective action report required by § 257.90(e).

The recorded concentrations for the assessment monitoring events are in the laboratory reports in **Appendix A**. The background concentrations established under §257.94(b) were provided in Appendix A of the 2017 Annual Groundwater Monitoring and Corrective Action Report for OGS. The groundwater protection standards established for OGS are provided in **Table 2**.

2.5.6 § 257.95(g)(3)(ii) Alternative Source Demonstration for Assessment Monitoring

The owner or operator must also include the demonstration in the annual groundwater monitoring and corrective action report required by § 257.90(e), in addition to the certification by a qualified professional engineer.

Not applicable. No alternative source demonstration evaluation for assessment monitoring was completed in 2019.

2.5.7 § 257.96(a) Extension of Time for Corrective Measures Assessment

The assessment of corrective measures must be completed within 90 days, unless the owner or operator demonstrates the need for additional time to complete the assessment of corrective measure due to site-specific conditions or circumstances. The owner or operator must obtain a certification from a qualified professional engineer attesting that the demonstration is accurate. The 90-day deadline to complete the assessment of corrective measures may be extended for longer than 60 days. The owner or operator must also include the demonstration in the annual groundwater monitoring and corrective action report required by § 257.90(e), in addition to the certification by a qualified professional engineer.

The ACM was initiated on April 15, 2019. The July 10, 2019 certification demonstrating the need for a 90-day deadline extension is included in **Appendix B**. The ACM was completed on September 12, 2019.

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Tables

Table 1. CCR Rule Groundwater Samples Summary
Ottumwa Generating Station / SCS Engineers Project #25216072

Sample Dates	Downgradient Wells							Background Well
	MW-302	MW-303	MW-304	MW-305	MW-306	MW-310	MW-311	MW-301
4/8/2019	A	A	A	A	A	NI	NI	A
10/23-24/2019	A	A	A	A	A	A	A	A
Total Samples	2	2	2	2	2	1	1	2

Abbreviations:
A = Required by Assessment Monitoring Program
NI= Well not installed

Created by: NDK Date: 1/4/2019
Last revision by: LWJ Date: 12/24/2019
Checked by: NDK Date: 12/24/2019

I:\25219072.00\Deliverables\2019 Annual OGS AP\Tables\[Table 1_GW_Samples_Summary_Table_OGS.xlsx]GW Summary

Table 2. Groundwater Protection Standards - CCR Program - Assessment Monitoring
Ottumwa Generating Station Ash Pond / SCS Engineers Project #25219072.00

Parameter Name	GPS	Source
Antimony, ug/L	6	MCL
Arsenic, ug/L	10	MCL
Barium, ug/L	2000	MCL
Beryllium, ug/L	4	MCL
Cadmium, ug/L	5	MCL
Chromium, ug/L	100	MCL
Cobalt, ug/L	6	40 CFR 257.95(h)(2)
Fluoride, mg/L	4	MCL
Lead, ug/L	15	40 CFR 257.95(h)(2)
Lithium, ug/L	40	40 CFR 257.95(h)(2)
Mercury, ug/L	2	MCL
Molybdenum, ug/L	100	40 CFR 257.95(h)(2)
Selenium, ug/L	50	MCL
Thallium, ug/L	2	MCL
Radium 226/228 Combined, pCl/L	5	MCL

Abbreviations:
GPS = Groundwater Protection Standard
MCL = Maximum Contaminant Level established under 40 CFR 141.62 and 141.66

Created by:	NDK, 1/8/2019
Checked by:	MDB, 1/8/2019

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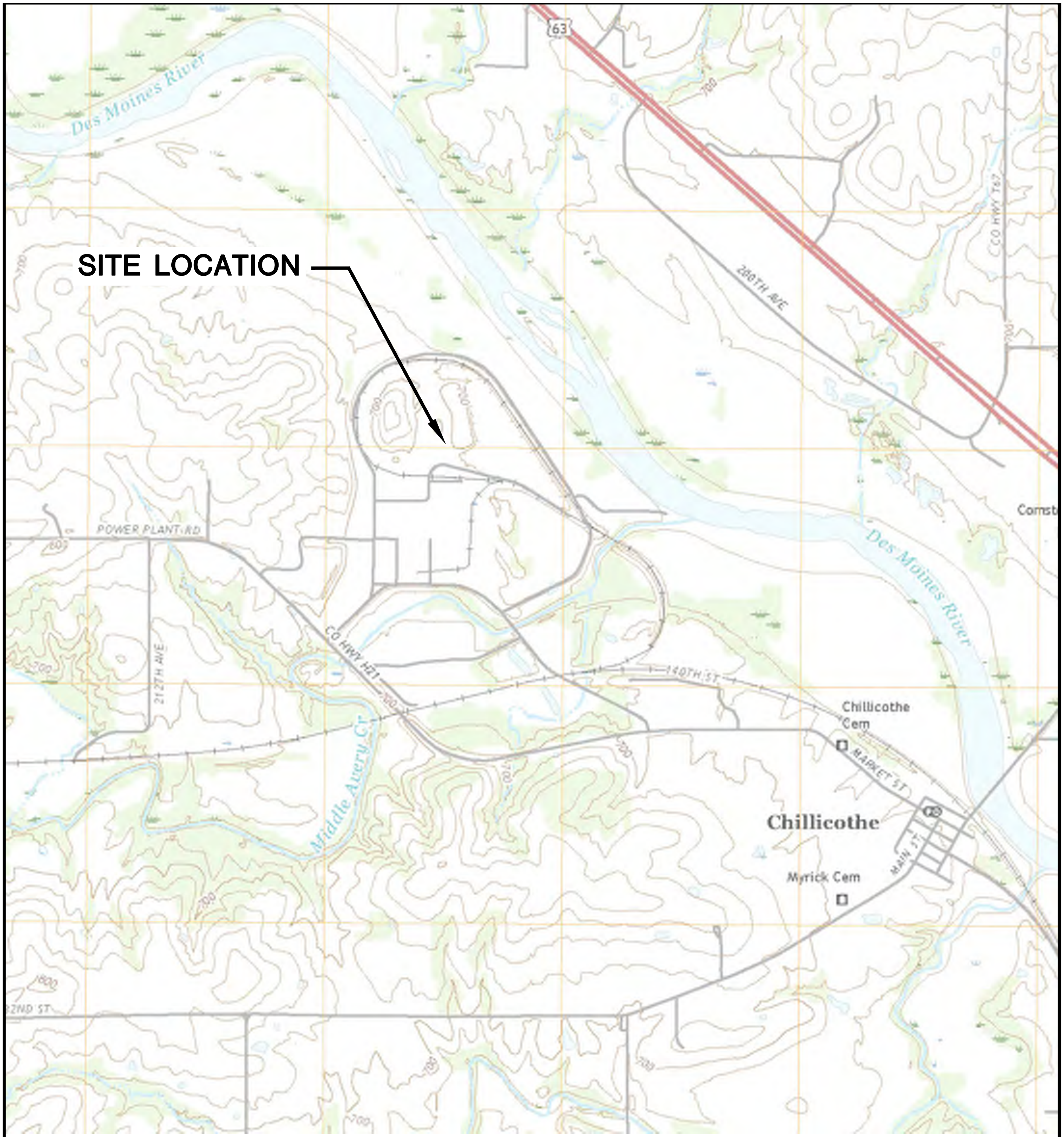
Figures



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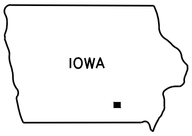
CHILLICOTHE QUADRANGLE
IOWA–WAPELLO CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
2018
SCALE: 1" = 2,000'



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

SITE
ALLIANT ENERGY
OTTUMWA GENERATING STATION
OTTUMWA, IOWA

SITE LOCATION MAP

PROJECT NO.	25219072.00	DRAWN BY:	BSS
DRAWN:	11/15/2019	CHECKED BY:	MDB
REVISED:	01/10/2020	APPROVED BY:	TK 01/30/2020

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

FIGURE
1

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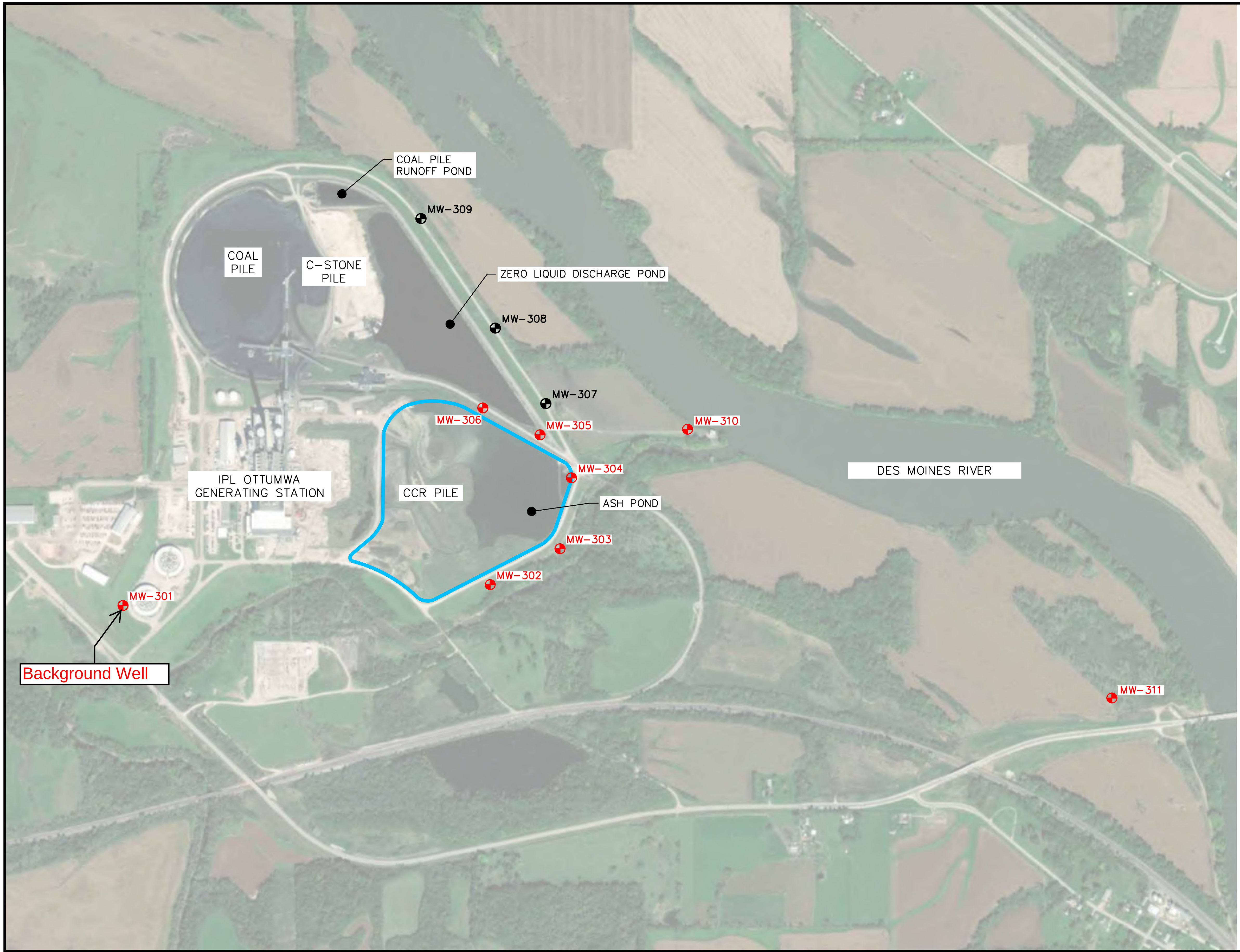

LEGEND

━	CCR UNIT
●	CCR MONITORING WELL
●	ADDITIONAL MONITORING WELL

NOTES:

1. 2014 AERIAL PHOTOGRAPH SOURCES: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA FSA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY.
2. CCR UNIT LIMITS ARE APPROXIMATE.
3. MONITORING WELLS MW-301, MW-302, AND MW-304, WERE INSTALLED BY CASCADE DRILLING, LLP. UNDER THE SUPERVISION OF SCS ENGINEERS FROM NOVEMBER 11-12, 2015.
4. MONITORING WELLS MW-303 AND MW-305 WERE INSTALLED BY CASCADE DRILLING LLP. UNDER THE SUPERVISION OF SCS ENGINEERS ON DECEMBER 7-8, 2015.
5. MONITORING WELLS MW-307, MW-308, AND MW-309 WERE INSTALLED BY CASCADE DRILLING, LLP. UNDER THE SUPERVISION OF SCS ENGINEERS FROM OCTOBER 25-27, 2016.
6. MONITORING WELLS MW-310 AND MW-311 WERE INSTALLED BY ROBERTS ENVIRONMENTAL DRILLING ON AUGUST 27, 2019.

N

800 0 800

SCALE: 1" = 800'

PROJECT NO.	25219072.00	DRAWN BY:	BSS
DRAWN:	11/15/2019	CHECKED BY:	MDB
REVISED:	01/13/2020	APPROVED BY:	TK 01/30/2020

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

ALLIANT ENERGY
OTTUMWA GENERATING STATION
OTTUMWA, IOWA

SITE PLAN AND MONITORING WELL LOCATIONS-ASH POND

FIGURE
2

I:\25219072.00\Drawings\ 2019 Annual Report\Site Plan and Monitoring Well Locations Settling Pond and ile.dwg, 1/ 0/2020 :5 :25 M

11/25/2020 - Classification: Internal - ECRM7804236

Appendix A

Analytical Laboratory Reports

A1 Assessment Monitoring Sampling, April 2019

eurofins | Environment Testing
TestAmerica

ANALYTICAL REPORT

Eurofins TestAmerica, Cedar Falls
3019 Venture Way
Cedar Falls, IA 50613
Tel: (319)277-2401

Laboratory Job ID: 310-152915-1
Laboratory Sample Delivery Group: 25219072
Client Project/Site: IPL Ottumwa Generating Station 25219072
Revision: 1

For:
SCS Engineers
2830 Dairy Drive
Madison, Wisconsin 53718

Attn: Meghan Blodgett

Sandie Fredrick

Authorized for release by:
7/11/2019 9:21:34 AM

Sandie Fredrick, Project Manager II
(920)261-1660
sandie.fredrick@testamericainc.com

Table of Contents

Case Narrative

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Job ID: 310-152915-1

Laboratory: Eurofins TestAmerica, Cedar Falls

Narrative

Job Narrative
310-152915-1

Comments

REVISION: Client requested split reports

Receipt

The samples were received on 4/9/2019 5:15 PM; the samples arrived in good condition, properly preserved and, where required, on ice. The temperatures of the 2 coolers at receipt time were 0.1º C and 0.8º C.

HPLC/IC

Method(s) 300.0, 9056A: The following samples were diluted due to the nature of the sample matrix: MW 301 (310-152915-1), MW 302 (310-152915-2), MW 303 (310-152915-3) and MW 306 (310-152915-6). Elevated reporting limits (RLs) are provided.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Metals

No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

General Chemistry

No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

Sample Summary

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-1
SDG: 25219072

Lab Sample ID	Client Sample ID	Matrix	Collected	Received	Asset ID
310-152915-1	MW 301	Ground Water	04/08/19 09:32	04/09/19 17:15	
310-152915-2	MW 302	Ground Water	04/08/19 10:36	04/09/19 17:15	
310-152915-3	MW 303	Ground Water	04/08/19 11:41	04/09/19 17:15	
310-152915-4	MW 304	Ground Water	04/08/19 12:53	04/09/19 17:15	
310-152915-5	MW 305	Ground Water	04/08/19 13:39	04/09/19 17:15	
310-152915-6	MW 306	Ground Water	04/08/19 14:25	04/09/19 17:15	
310-152915-7	Field Blank	Ground Water	04/08/19 14:30	04/09/19 17:15	

Detection Summary

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-1
SDG: 25219072

Client Sample ID: MW 301 — Lab Sample ID: 310-152915-1

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloride	50		5.0	1.5	mg/L	5		9056A	Total/NA
Fluoride	0.44	J	0.50	0.23	mg/L	5		9056A	Total/NA
Sulfate	81		5.0	1.8	mg/L	5		9056A	Total/NA
Barium	25		2.0	0.84	ug/L	1		6020A	Total/NA
Boron	380		200	110	ug/L	1		6020A	Total/NA
Calcium	43		0.50	0.10	mg/L	1		6020A	Total/NA
Cobalt	0.44	J	0.50	0.091	ug/L	1		6020A	Total/NA
Lithium	15		10	2.7	ug/L	1		6020A	Total/NA
Selenium	3.1	J	5.0	1.0	ug/L	1		6020A	Total/NA
Total Dissolved Solids	340		30	24	mg/L	1		SM 2540C	Total/NA
pH	7.1	HF	0.1	0.1	SU	1		SM 4500 H+ B	Total/NA
Field Conductivity	501				umhos/cm	1		Field Sampling	Total/NA
Field Dissolved Oxygen	8.32				mg/L	1		Field Sampling	Total/NA
Field pH	6.61				SU	1		Field Sampling	Total/NA
Field Temperature	7.27				Degrees C	1		Field Sampling	Total/NA
Field Turbidity	1.87				NTU	1		Field Sampling	Total/NA
Groundwater Elevation (ft MSL)	682.69				ft	1		Field Sampling	Total/NA
Oxidation Reduction Potential	37.6				millivolts	1		Field Sampling	Total/NA

Client Sample ID: MW 302 — Lab Sample ID: 310-152915-2

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloride	240		5.0	1.5	mg/L	5		9056A	Total/NA
Sulfate	840		50	18	mg/L	50		9056A	Total/NA
Barium	19		2.0	0.84	ug/L	1		6020A	Total/NA
Boron	1300		200	110	ug/L	1		6020A	Total/NA
Cadmium	0.21	J	0.50	0.077	ug/L	1		6020A	Total/NA
Calcium	200		0.50	0.10	mg/L	1		6020A	Total/NA
Cobalt	1.2		0.50	0.091	ug/L	1		6020A	Total/NA
Lithium	10		10	2.7	ug/L	1		6020A	Total/NA
Total Dissolved Solids	1600		30	24	mg/L	1		SM 2540C	Total/NA
pH	6.9	HF	0.1	0.1	SU	1		SM 4500 H+ B	Total/NA
Field Conductivity	2159				umhos/cm	1		Field Sampling	Total/NA
Field Dissolved Oxygen	0.86				mg/L	1		Field Sampling	Total/NA
Field pH	6.61				SU	1		Field Sampling	Total/NA
Field Temperature	12.27				Degrees C	1		Field Sampling	Total/NA
Field Turbidity	26.9				NTU	1		Field Sampling	Total/NA
Groundwater Elevation (ft MSL)	657.23				ft	1		Field Sampling	Total/NA
Oxidation Reduction Potential	68.3				millivolts	1		Field Sampling	Total/NA

Client Sample ID: MW 303 — Lab Sample ID: 310-152915-3

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloride	22		5.0	1.5	mg/L	5		9056A	Total/NA
Sulfate	260		20	7.0	mg/L	20		9056A	Total/NA
Barium	54		2.0	0.84	ug/L	1		6020A	Total/NA
Boron	290		200	110	ug/L	1		6020A	Total/NA
Cadmium	0.092	J	0.50	0.077	ug/L	1		6020A	Total/NA
Calcium	170		0.50	0.10	mg/L	1		6020A	Total/NA
Cobalt	0.42	J	0.50	0.091	ug/L	1		6020A	Total/NA
Molybdenum	7.5		2.0	1.1	ug/L	1		6020A	Total/NA
Selenium	2.1	J	5.0	1.0	ug/L	1		6020A	Total/NA

This Detection Summary does not include radiochemical test results.

Detection Summary

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-1
SDG: 25219072

Client Sample ID: MW 303 (Continued)

Lab Sample ID: 310-152915-3

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Total Dissolved Solids	890		30	24	mg/L	1		SM 2540C	Total/NA
pH	7.5	HF	0.1	0.1	SU	1		SM 4500 H+ B	Total/NA
Field Conductivity	1181				umhos/cm	1		Field Sampling	Total/NA
Field Dissolved Oxygen	2.29				mg/L	1		Field Sampling	Total/NA
Field pH	7.00				SU	1		Field Sampling	Total/NA
Field Temperature	8.51				Degrees C	1		Field Sampling	Total/NA
Field Turbidity	3.49				NTU	1		Field Sampling	Total/NA
Groundwater Elevation (ft MSL)	655.55				ft	1		Field Sampling	Total/NA
Oxidation Reduction Potential	51.7				millivolts	1		Field Sampling	Total/NA

Client Sample ID: MW 304

Lab Sample ID: 310-152915-4

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloride	320		20	5.8	mg/L	20		9056A	Total/NA
Fluoride	1.3		0.50	0.23	mg/L	5		9056A	Total/NA
Sulfate	180		5.0	1.8	mg/L	5		9056A	Total/NA
Barium	80		2.0	0.84	ug/L	1		6020A	Total/NA
Boron	1100		200	110	ug/L	1		6020A	Total/NA
Calcium	130		0.50	0.10	mg/L	1		6020A	Total/NA
Chromium	1.6	J	5.0	0.98	ug/L	1		6020A	Total/NA
Cobalt	0.40	J	0.50	0.091	ug/L	1		6020A	Total/NA
Lithium	3.3	J	10	2.7	ug/L	1		6020A	Total/NA
Molybdenum	1.5	J	2.0	1.1	ug/L	1		6020A	Total/NA
Total Dissolved Solids	1100		30	24	mg/L	1		SM 2540C	Total/NA
pH	7.5	HF	0.1	0.1	SU	1		SM 4500 H+ B	Total/NA
Field Conductivity	1876				umhos/cm	1		Field Sampling	Total/NA
Field Dissolved Oxygen	0.41				mg/L	1		Field Sampling	Total/NA
Field pH	7.17				SU	1		Field Sampling	Total/NA
Field Temperature	13.75				Degrees C	1		Field Sampling	Total/NA
Field Turbidity	57.9				NTU	1		Field Sampling	Total/NA
Groundwater Elevation (ft MSL)	659.33				ft	1		Field Sampling	Total/NA
Oxidation Reduction Potential	-58.3				millivolts	1		Field Sampling	Total/NA

Client Sample ID: MW 305

Lab Sample ID: 310-152915-5

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloride	250		5.0	1.5	mg/L	5		9056A	Total/NA
Fluoride	0.75		0.50	0.23	mg/L	5		9056A	Total/NA
Sulfate	110		5.0	1.8	mg/L	5		9056A	Total/NA
Barium	120		2.0	0.84	ug/L	1		6020A	Total/NA
Boron	1000		200	110	ug/L	1		6020A	Total/NA
Calcium	110		0.50	0.10	mg/L	1		6020A	Total/NA
Cobalt	17		0.50	0.091	ug/L	1		6020A	Total/NA
Molybdenum	7.2		2.0	1.1	ug/L	1		6020A	Total/NA
Thallium	0.33	J	1.0	0.27	ug/L	1		6020A	Total/NA
Total Dissolved Solids	1000		30	24	mg/L	1		SM 2540C	Total/NA
pH	7.0	HF	0.1		SU	1		SM 4500 H+ B	Total/NA
Field Conductivity	1728				umhos/cm	1		Field Sampling	Total/NA
Field Dissolved Oxygen	0.59				mg/L	1		Field Sampling	Total/NA
Field pH	7.06				SU	1		Field Sampling	Total/NA
Field Temperature	13.8				Degrees C	1		Field Sampling	Total/NA
Field Turbidity	21.7				NTU	1		Field Sampling	Total/NA

This Detection Summary does not include radiochemical test results.

Detection Summary

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-1
SDG: 25219072

Client Sample ID: MW 305 (Continued) — Lab Sample ID: 310-152915-5

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Groundwater Elevation (ft MSL)	664.01				ft	1		Field Sampling	Total/NA
Oxidation Reduction Potential	32.6				millivolts	1		Field Sampling	Total/NA

Client Sample ID: MW 306 — Lab Sample ID: 310-152915-6

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloride	98		5.0	1.5	mg/L	5		9056A	Total/NA
Fluoride	0.27	J	0.50	0.23	mg/L	5		9056A	Total/NA
Sulfate	270		10	3.5	mg/L	10		9056A	Total/NA
Barium	58		2.0	0.84	ug/L	1		6020A	Total/NA
Boron	1100		200	110	ug/L	1		6020A	Total/NA
Cadmium	1.1		0.50	0.077	ug/L	1		6020A	Total/NA
Calcium	95		0.50	0.10	mg/L	1		6020A	Total/NA
Cobalt	6.9		0.50	0.091	ug/L	1		6020A	Total/NA
Molybdenum	4.3		2.0	1.1	ug/L	1		6020A	Total/NA
Total Dissolved Solids	930		30	24	mg/L	1		SM 2540C	Total/NA
pH	6.6	HF	0.1		SU	1		SM 4500 H+ B	Total/NA
Field Conductivity	1350				umhos/cm	1		Field Sampling	Total/NA
Field Dissolved Oxygen	0.92				mg/L	1		Field Sampling	Total/NA
Field pH	6.66				SU	1		Field Sampling	Total/NA
Field Temperature	13.63				Degrees C	1		Field Sampling	Total/NA
Field Turbidity	28.5				NTU	1		Field Sampling	Total/NA
Groundwater Elevation (ft MSL)	670.96				ft	1		Field Sampling	Total/NA
Oxidation Reduction Potential	49.1				millivolts	1		Field Sampling	Total/NA

Client Sample ID: Field Blank — Lab Sample ID: 310-152915-7

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Total Dissolved Solids	26	J	30	24	mg/L	1		SM 2540C	Total/NA
pH	7.3	HF	0.1		SU	1		SM 4500 H+ B	Total/NA

This Detection Summary does not include radiochemical test results.

Client Sample Results

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-1
SDG: 25219072

Client Sample ID: MW 301

Date Collected: 04/08/19 09:32
Date Received: 04/09/19 17:15

Lab Sample ID: 310-152915-1

Matrix: Ground Water

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Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**50**		5.0	1.5	mg/L			04/10/19 19:13	5
Fluoride	**0.44**	**J**	0.50	0.23	mg/L			04/10/19 19:13	5
Sulfate	**81**		5.0	1.8	mg/L			04/10/19 19:13	5

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.53		1.0	0.53	ug/L		04/10/19 08:11	04/22/19 21:44	1
Arsenic	<0.75		2.0	0.75	ug/L		04/10/19 08:11	04/22/19 21:44	1
Barium	**25**		2.0	0.84	ug/L		04/10/19 08:11	04/22/19 21:44	1
Beryllium	<0.27		1.0	0.27	ug/L		04/10/19 08:11	04/22/19 21:44	1
Boron	**380**		200	110	ug/L		04/10/19 08:11	04/22/19 21:44	1
Cadmium	<0.077		0.50	0.077	ug/L		04/10/19 08:11	04/22/19 21:44	1
Calcium	**43**		0.50	0.10	mg/L		04/10/19 08:11	04/22/19 21:44	1
Chromium	<0.98		5.0	0.98	ug/L		04/10/19 08:11	04/22/19 21:44	1
Cobalt	**0.44**	**J**	0.50	0.091	ug/L		04/10/19 08:11	04/22/19 21:44	1
Lead	<0.27		0.50	0.27	ug/L		04/10/19 08:11	04/22/19 21:44	1
Lithium	**15**		10	2.7	ug/L		04/10/19 08:11	04/22/19 21:44	1
Molybdenum	<1.1		2.0	1.1	ug/L		04/10/19 08:11	04/22/19 21:44	1
Selenium	**3.1**	**J**	5.0	1.0	ug/L		04/10/19 08:11	04/22/19 21:44	1
Thallium	<0.27		1.0	0.27	ug/L		04/10/19 08:11	04/22/19 21:44	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.10		0.20	0.10	ug/L		04/09/19 10:07	04/10/19 14:28	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	**340**		30	24	mg/L			04/10/19 14:38	1
pH	**7.1**	**HF**	0.1	0.1	SU			04/09/19 23:56	1

Method: Field Sampling - Field Sampling

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Field Conductivity	**501**				umhos/cm			04/08/19 09:32	1
Field Dissolved Oxygen	**8.32**				mg/L			04/08/19 09:32	1
Field pH	**6.61**				SU			04/08/19 09:32	1
Field Temperature	**7.27**				Degrees C			04/08/19 09:32	1
Field Turbidity	**1.87**				NTU			04/08/19 09:32	1
Groundwater Elevation (ft MSL)	**682.69**				ft			04/08/19 09:32	1
Oxidation Reduction Potential	**37.6**				millivolts			04/08/19 09:32	1

Client Sample Results

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-1
SDG: 25219072

Client Sample ID: MW 302

Date Collected: 04/08/19 10:36
Date Received: 04/09/19 17:15

Lab Sample ID: 310-152915-2

Matrix: Ground Water

Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**240**		5.0	1.5	mg/L			04/10/19 19:28	5
Fluoride	<0.23		0.50	0.23	mg/L			04/10/19 19:28	5
Sulfate	**840**		50	18	mg/L			04/11/19 10:13	50

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.53		1.0	0.53	ug/L		04/10/19 08:11	04/22/19 22:11	1
Arsenic	<0.75		2.0	0.75	ug/L		04/10/19 08:11	04/22/19 22:11	1
Barium	**19**		2.0	0.84	ug/L		04/10/19 08:11	04/22/19 22:11	1
Beryllium	<0.27		1.0	0.27	ug/L		04/10/19 08:11	04/22/19 22:11	1
Boron	**1300**		200	110	ug/L		04/10/19 08:11	04/22/19 22:11	1
Cadmium	**0.21**	**J**	0.50	0.077	ug/L		04/10/19 08:11	04/22/19 22:11	1
Calcium	**200**		0.50	0.10	mg/L		04/10/19 08:11	04/22/19 22:11	1
Chromium	<0.98		5.0	0.98	ug/L		04/10/19 08:11	04/22/19 22:11	1
Cobalt	**1.2**		0.50	0.091	ug/L		04/10/19 08:11	04/22/19 22:11	1
Lead	<0.27		0.50	0.27	ug/L		04/10/19 08:11	04/22/19 22:11	1
Lithium	**10**		10	2.7	ug/L		04/10/19 08:11	04/22/19 22:11	1
Molybdenum	<1.1		2.0	1.1	ug/L		04/10/19 08:11	04/22/19 22:11	1
Selenium	<1.0		5.0	1.0	ug/L		04/10/19 08:11	04/22/19 22:11	1
Thallium	<0.27		1.0	0.27	ug/L		04/10/19 08:11	04/22/19 22:11	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.10		0.20	0.10	ug/L		04/09/19 10:07	04/10/19 14:30	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	**1600**		30	24	mg/L			04/10/19 14:38	1
pH	**6.9**	**HF**	0.1	0.1	SU			04/09/19 23:59	1

Method: Field Sampling - Field Sampling

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Field Conductivity	**2159**				umhos/cm			04/08/19 10:36	1
Field Dissolved Oxygen	**0.86**				mg/L			04/08/19 10:36	1
Field pH	**6.61**				SU			04/08/19 10:36	1
Field Temperature	**12.27**				Degrees C			04/08/19 10:36	1
Field Turbidity	**26.9**				NTU			04/08/19 10:36	1
Groundwater Elevation (ft MSL)	**657.23**				ft			04/08/19 10:36	1
Oxidation Reduction Potential	**68.3**				millivolts			04/08/19 10:36	1

Client Sample Results

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-1
SDG: 25219072

Client Sample ID: MW 303

Date Collected: 04/08/19 11:41
Date Received: 04/09/19 17:15

Lab Sample ID: 310-152915-3

Matrix: Ground Water

Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**22**		5.0	1.5	mg/L			04/10/19 19:44	5
Fluoride	<0.23		0.50	0.23	mg/L			04/10/19 19:44	5
Sulfate	**260**		20	7.0	mg/L			04/11/19 10:30	20

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.53		1.0	0.53	ug/L		04/10/19 08:11	04/22/19 22:15	1
Arsenic	<0.75		2.0	0.75	ug/L		04/10/19 08:11	04/22/19 22:15	1
Barium	**54**		2.0	0.84	ug/L		04/10/19 08:11	04/22/19 22:15	1
Beryllium	<0.27		1.0	0.27	ug/L		04/10/19 08:11	04/22/19 22:15	1
Boron	**290**		200	110	ug/L		04/10/19 08:11	04/22/19 22:15	1
Cadmium	**0.092**	**J**	0.50	0.077	ug/L		04/10/19 08:11	04/22/19 22:15	1
Calcium	**170**		0.50	0.10	mg/L		04/10/19 08:11	04/22/19 22:15	1
Chromium	<0.98		5.0	0.98	ug/L		04/10/19 08:11	04/22/19 22:15	1
Cobalt	**0.42**	**J**	0.50	0.091	ug/L		04/10/19 08:11	04/22/19 22:15	1
Lead	<0.27		0.50	0.27	ug/L		04/10/19 08:11	04/22/19 22:15	1
Lithium	<2.7		10	2.7	ug/L		04/10/19 08:11	04/22/19 22:15	1
Molybdenum	**7.5**		2.0	1.1	ug/L		04/10/19 08:11	04/22/19 22:15	1
Selenium	**2.1**	**J**	5.0	1.0	ug/L		04/10/19 08:11	04/22/19 22:15	1
Thallium	<0.27		1.0	0.27	ug/L		04/10/19 08:11	04/22/19 22:15	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.10		0.20	0.10	ug/L		04/09/19 13:18	04/10/19 14:37	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	**890**		30	24	mg/L			04/10/19 14:38	1
pH	**7.5**	**HF**	0.1	0.1	SU			04/10/19 00:04	1

Method: Field Sampling - Field Sampling

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Field Conductivity	**1181**				umhos/cm			04/08/19 11:41	1
Field Dissolved Oxygen	**2.29**				mg/L			04/08/19 11:41	1
Field pH	**7.00**				SU			04/08/19 11:41	1
Field Temperature	**8.51**				Degrees C			04/08/19 11:41	1
Field Turbidity	**3.49**				NTU			04/08/19 11:41	1
Groundwater Elevation (ft MSL)	**655.55**				ft			04/08/19 11:41	1
Oxidation Reduction Potential	**51.7**				millivolts			04/08/19 11:41	1

Client Sample ID: MW 304

Date Collected: 04/08/19 12:53
Date Received: 04/09/19 17:15

Lab Sample ID: 310-152915-4
Matrix: Ground Water

Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**320**		20	5.8	mg/L			04/11/19 10:49	20
Fluoride	**1.3**		0.50	0.23	mg/L			04/10/19 20:00	5
Sulfate	**180**		5.0	1.8	mg/L			04/10/19 20:00	5

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.53		1.0	0.53	ug/L		04/10/19 08:11	04/22/19 22:18	1
Arsenic	<0.75		2.0	0.75	ug/L		04/10/19 08:11	04/22/19 22:18	1
Barium	**80**		2.0	0.84	ug/L		04/10/19 08:11	04/22/19 22:18	1
Beryllium	<0.27		1.0	0.27	ug/L		04/10/19 08:11	04/22/19 22:18	1
Boron	**1100**		200	110	ug/L		04/10/19 08:11	04/22/19 22:18	1
Cadmium	<0.077		0.50	0.077	ug/L		04/10/19 08:11	04/22/19 22:18	1
Calcium	**130**		0.50	0.10	mg/L		04/10/19 08:11	04/22/19 22:18	1
Chromium	**1.6**	**J**	5.0	0.98	ug/L		04/10/19 08:11	04/22/19 22:18	1
Cobalt	**0.40**	**J**	0.50	0.091	ug/L		04/10/19 08:11	04/22/19 22:18	1
Lead	<0.27		0.50	0.27	ug/L		04/10/19 08:11	04/22/19 22:18	1
Lithium	**3.3**	**J**	10	2.7	ug/L		04/10/19 08:11	04/22/19 22:18	1
Molybdenum	**1.5**	**J**	2.0	1.1	ug/L		04/10/19 08:11	04/22/19 22:18	1
Selenium	<1.0		5.0	1.0	ug/L		04/10/19 08:11	04/22/19 22:18	1
Thallium	<0.27		1.0	0.27	ug/L		04/10/19 08:11	04/22/19 22:18	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.10		0.20	0.10	ug/L		04/09/19 13:18	04/10/19 14:39	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	**1100**		30	24	mg/L			04/10/19 14:38	1
pH	**7.5**	**HF**	0.1	0.1	SU			04/10/19 00:06	1

Method: Field Sampling - Field Sampling

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Field Conductivity	**1876**				umhos/cm			04/08/19 12:53	1
Field Dissolved Oxygen	**0.41**				mg/L			04/08/19 12:53	1
Field pH	**7.17**				SU			04/08/19 12:53	1
Field Temperature	**13.75**				Degrees C			04/08/19 12:53	1
Field Turbidity	**57.9**				NTU			04/08/19 12:53	1
Groundwater Elevation (ft MSL)	**659.33**				ft			04/08/19 12:53	1
Oxidation Reduction Potential	**-58.3**				millivolts			04/08/19 12:53	1

Client Sample Results

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-1
SDG: 25219072

Client Sample ID: MW 305

Date Collected: 04/08/19 13:39
Date Received: 04/09/19 17:15

Lab Sample ID: 310-152915-5

Matrix: Ground Water

Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**250**		5.0	1.5	mg/L			04/10/19 20:15	5
Fluoride	**0.75**		0.50	0.23	mg/L			04/10/19 20:15	5
Sulfate	**110**		5.0	1.8	mg/L			04/10/19 20:15	5

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.53		1.0	0.53	ug/L		04/10/19 08:11	04/22/19 22:21	1
Arsenic	<0.75		2.0	0.75	ug/L		04/10/19 08:11	04/22/19 22:21	1
Barium	**120**		2.0	0.84	ug/L		04/10/19 08:11	04/22/19 22:21	1
Beryllium	<0.27		1.0	0.27	ug/L		04/10/19 08:11	04/22/19 22:21	1
Boron	**1000**		200	110	ug/L		04/10/19 08:11	04/22/19 22:21	1
Cadmium	<0.077		0.50	0.077	ug/L		04/10/19 08:11	04/22/19 22:21	1
Calcium	**110**		0.50	0.10	mg/L		04/10/19 08:11	04/22/19 22:21	1
Chromium	<0.98		5.0	0.98	ug/L		04/10/19 08:11	04/22/19 22:21	1
Cobalt	**17**		0.50	0.091	ug/L		04/10/19 08:11	04/22/19 22:21	1
Lead	<0.27		0.50	0.27	ug/L		04/10/19 08:11	04/22/19 22:21	1
Lithium	<2.7		10	2.7	ug/L		04/10/19 08:11	04/22/19 22:21	1
Molybdenum	**7.2**		2.0	1.1	ug/L		04/10/19 08:11	04/22/19 22:21	1
Selenium	<1.0		5.0	1.0	ug/L		04/10/19 08:11	04/22/19 22:21	1
Thallium	**0.33**	**J**	1.0	0.27	ug/L		04/10/19 08:11	04/22/19 22:21	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.10		0.20	0.10	ug/L		04/09/19 13:18	04/10/19 14:41	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	**1000**		30	24	mg/L			04/10/19 14:38	1
pH	**7.0**	**HF**	0.1		SU			04/10/19 00:14	1

Method: Field Sampling - Field Sampling

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Field Conductivity	**1728**				umhos/cm			04/08/19 13:39	1
Field Dissolved Oxygen	**0.59**				mg/L			04/08/19 13:39	1
Field pH	**7.06**				SU			04/08/19 13:39	1
Field Temperature	**13.8**				Degrees C			04/08/19 13:39	1
Field Turbidity	**21.7**				NTU			04/08/19 13:39	1
Groundwater Elevation (ft MSL)	**664.01**				ft			04/08/19 13:39	1
Oxidation Reduction Potential	**32.6**				millivolts			04/08/19 13:39	1

Client Sample Results

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-1
SDG: 25219072

Client Sample ID: MW 306

Date Collected: 04/08/19 14:25
Date Received: 04/09/19 17:15

Lab Sample ID: 310-152915-6

Matrix: Ground Water

Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**98**		5.0	1.5	mg/L			04/10/19 20:31	5
Fluoride	**0.27**	**J**	0.50	0.23	mg/L			04/10/19 20:31	5
Sulfate	**270**		10	3.5	mg/L			04/11/19 11:04	10

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.53		1.0	0.53	ug/L		04/10/19 08:11	04/22/19 22:25	1
Arsenic	<0.75		2.0	0.75	ug/L		04/10/19 08:11	04/22/19 22:25	1
Barium	**58**		2.0	0.84	ug/L		04/10/19 08:11	04/22/19 22:25	1
Beryllium	<0.27		1.0	0.27	ug/L		04/10/19 08:11	04/22/19 22:25	1
Boron	**1100**		200	110	ug/L		04/10/19 08:11	04/22/19 22:25	1
Cadmium	**1.1**		0.50	0.077	ug/L		04/10/19 08:11	04/22/19 22:25	1
Calcium	**95**		0.50	0.10	mg/L		04/10/19 08:11	04/22/19 22:25	1
Chromium	<0.98		5.0	0.98	ug/L		04/10/19 08:11	04/22/19 22:25	1
Cobalt	**6.9**		0.50	0.091	ug/L		04/10/19 08:11	04/22/19 22:25	1
Lead	<0.27		0.50	0.27	ug/L		04/10/19 08:11	04/22/19 22:25	1
Lithium	<2.7		10	2.7	ug/L		04/10/19 08:11	04/22/19 22:25	1
Molybdenum	**4.3**		2.0	1.1	ug/L		04/10/19 08:11	04/22/19 22:25	1
Selenium	<1.0		5.0	1.0	ug/L		04/10/19 08:11	04/22/19 22:25	1
Thallium	<0.27		1.0	0.27	ug/L		04/10/19 08:11	04/22/19 22:25	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.10		0.20	0.10	ug/L		04/09/19 13:18	04/10/19 14:43	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	**930**		30	24	mg/L			04/10/19 14:38	1
pH	**6.6**	**HF**	0.1		SU			04/10/19 00:18	1

Method: Field Sampling - Field Sampling

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Field Conductivity	**1350**				umhos/cm			04/08/19 14:25	1
Field Dissolved Oxygen	**0.92**				mg/L			04/08/19 14:25	1
Field pH	**6.66**				SU			04/08/19 14:25	1
Field Temperature	**13.63**				Degrees C			04/08/19 14:25	1
Field Turbidity	**28.5**				NTU			04/08/19 14:25	1
Groundwater Elevation (ft MSL)	**670.96**				ft			04/08/19 14:25	1
Oxidation Reduction Potential	**49.1**				millivolts			04/08/19 14:25	1

Client Sample Results

Client Sample ID: Field Blank

Lab Sample ID: 310-152915-7

Date Collected: 04/08/19 14:30

Matrix: Ground Water

Date Received: 04/09/19 17:15

Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	<0.29		1.0	0.29	mg/L			04/10/19 20:46	1
Fluoride	<0.045		0.10	0.045	mg/L			04/10/19 20:46	1
Sulfate	<0.35		1.0	0.35	mg/L			04/10/19 20:46	1

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.53		1.0	0.53	ug/L		04/10/19 08:11	04/22/19 22:28	1
Arsenic	<0.75		2.0	0.75	ug/L		04/10/19 08:11	04/22/19 22:28	1
Barium	<0.84		2.0	0.84	ug/L		04/10/19 08:11	04/22/19 22:28	1
Beryllium	<0.27		1.0	0.27	ug/L		04/10/19 08:11	04/22/19 22:28	1
Boron	<110		200	110	ug/L		04/10/19 08:11	04/22/19 22:28	1
Cadmium	<0.077		0.50	0.077	ug/L		04/10/19 08:11	04/22/19 22:28	1
Calcium	<0.10		0.50	0.10	mg/L		04/10/19 08:11	04/22/19 22:28	1
Chromium	<0.98		5.0	0.98	ug/L		04/10/19 08:11	04/22/19 22:28	1
Cobalt	<0.091		0.50	0.091	ug/L		04/10/19 08:11	04/22/19 22:28	1
Lead	<0.27		0.50	0.27	ug/L		04/10/19 08:11	04/22/19 22:28	1
Lithium	<2.7		10	2.7	ug/L		04/10/19 08:11	04/22/19 22:28	1
Molybdenum	<1.1		2.0	1.1	ug/L		04/10/19 08:11	04/22/19 22:28	1
Selenium	<1.0		5.0	1.0	ug/L		04/10/19 08:11	04/22/19 22:28	1
Thallium	<0.27		1.0	0.27	ug/L		04/10/19 08:11	04/22/19 22:28	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.10		0.20	0.10	ug/L		04/09/19 13:18	04/10/19 14:45	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	**26**	**J**	30	24	mg/L			04/10/19 14:38	1
pH	**7.3**	**HF**	0.1		SU			04/10/19 00:21	1

Definitions/Glossary

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-1
SDG: 25219072

Qualifiers

HPLC/IC

Qualifier	Qualifier Description
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

Metals

Qualifier	Qualifier Description
4	MS, MSD: The analyte present in the original sample is greater than 4 times the matrix spike concentration; therefore, control limits are not applicable.
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

General Chemistry

Qualifier	Qualifier Description
HF	Field parameter with a holding time of 15 minutes. Test performed by laboratory at client's request.
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

QC Sample Results

Method: 9056A - Anions, Ion Chromatography

Lab Sample ID: MB 310-235649/3
Matrix: Water
Analysis Batch: 235649
Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	<0.29		1.0	0.29	mg/L			04/10/19 15:44	1
Fluoride	<0.045		0.10	0.045	mg/L			04/10/19 15:44	1
Sulfate	<0.35		1.0	0.35	mg/L			04/10/19 15:44	1

Lab Sample ID: LCS 310-235649/4
Matrix: Water
Analysis Batch: 235649
Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Chloride	7.50	7.26		mg/L		97	90 - 110
Fluoride	1.50	1.47		mg/L		98	90 - 110
Sulfate	7.50	7.49		mg/L		100	90 - 110

Method: 6020A - Metals (ICP/MS)

Lab Sample ID: MB 310-235260/1-A
Matrix: Water
Analysis Batch: 236802
Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 235260

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.53		1.0	0.53	ug/L		04/10/19 08:11	04/22/19 21:37	1
Arsenic	<0.75		2.0	0.75	ug/L		04/10/19 08:11	04/22/19 21:37	1
Barium	<0.84		2.0	0.84	ug/L		04/10/19 08:11	04/22/19 21:37	1
Beryllium	<0.27		1.0	0.27	ug/L		04/10/19 08:11	04/22/19 21:37	1
Boron	<110		200	110	ug/L		04/10/19 08:11	04/22/19 21:37	1
Cadmium	<0.077		0.50	0.077	ug/L		04/10/19 08:11	04/22/19 21:37	1
Calcium	<0.10		0.50	0.10	mg/L		04/10/19 08:11	04/22/19 21:37	1
Chromium	<0.98		5.0	0.98	ug/L		04/10/19 08:11	04/22/19 21:37	1
Cobalt	<0.091		0.50	0.091	ug/L		04/10/19 08:11	04/22/19 21:37	1
Lead	<0.27		0.50	0.27	ug/L		04/10/19 08:11	04/22/19 21:37	1
Lithium	<2.7		10	2.7	ug/L		04/10/19 08:11	04/22/19 21:37	1
Molybdenum	<1.1		2.0	1.1	ug/L		04/10/19 08:11	04/22/19 21:37	1
Selenium	<1.0		5.0	1.0	ug/L		04/10/19 08:11	04/22/19 21:37	1
Thallium	<0.27		1.0	0.27	ug/L		04/10/19 08:11	04/22/19 21:37	1

Lab Sample ID: LCS 310-235260/2-A
Matrix: Water
Analysis Batch: 236802
Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 235260

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Antimony	20.0	19.6		ug/L		98	80 - 120
Arsenic	40.0	43.4		ug/L		109	80 - 120
Barium	40.0	41.6		ug/L		104	80 - 120
Beryllium	20.0	20.0		ug/L		100	80 - 120
Boron	880	920		ug/L		105	80 - 120
Cadmium	20.0	20.4		ug/L		102	80 - 120
Calcium	2.00	1.97		mg/L		99	80 - 120
Chromium	40.0	40.2		ug/L		101	80 - 120
Cobalt	20.0	19.1		ug/L		96	80 - 120

QC Sample Results

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-1
SDG: 25219072

Method: 6020A - Metals (ICP/MS) (Continued)

Lab Sample ID: LCS 310-235260/2-A
Matrix: Water
Analysis Batch: 236802

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 235260

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Lead	20.0	20.7		ug/L		104	80 - 120
Lithium	100	110		ug/L		110	80 - 120
Molybdenum	40.0	40.0		ug/L		100	80 - 120
Selenium	40.0	39.3		ug/L		98	80 - 120
Thallium	16.0	15.9		ug/L		100	80 - 120

Lab Sample ID: 310-152915-1 MS
Matrix: Ground Water
Analysis Batch: 236802

Client Sample ID: MW 301
Prep Type: Total/NA
Prep Batch: 235260

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Antimony	<0.53		20.0	20.7		ug/L		103	75 - 125
Arsenic	<0.75		40.0	44.0		ug/L		110	75 - 125
Barium	25		40.0	67.7		ug/L		106	75 - 125
Beryllium	<0.27		20.0	20.0		ug/L		100	75 - 125
Boron	380		880	1370		ug/L		113	75 - 125
Cadmium	<0.077		20.0	21.1		ug/L		105	75 - 125
Calcium	43		2.00	49.0	4	mg/L		275	75 - 125
Chromium	<0.98		40.0	39.8		ug/L		99	75 - 125
Cobalt	0.44	J	20.0	19.9		ug/L		97	75 - 125
Lead	<0.27		20.0	20.8		ug/L		104	75 - 125
Lithium	15		100	121		ug/L		105	75 - 125
Molybdenum	<1.1		40.0	42.7		ug/L		107	75 - 125
Selenium	3.1	J	40.0	44.9		ug/L		105	75 - 125
Thallium	<0.27		16.0	16.0		ug/L		100	75 - 125

Lab Sample ID: 310-152915-1 MSD
Matrix: Ground Water
Analysis Batch: 236802

Client Sample ID: MW 301
Prep Type: Total/NA
Prep Batch: 235260

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Antimony	<0.53		20.0	19.8		ug/L		99	75 - 125	5	20
Arsenic	<0.75		40.0	41.8		ug/L		105	75 - 125	5	20
Barium	25		40.0	65.8		ug/L		101	75 - 125	3	20
Beryllium	<0.27		20.0	20.0		ug/L		100	75 - 125	0	20
Boron	380		880	1320		ug/L		108	75 - 125	3	20
Cadmium	<0.077		20.0	20.2		ug/L		101	75 - 125	4	20
Calcium	43		2.00	47.7	4	mg/L		211	75 - 125	3	20
Chromium	<0.98		40.0	38.0		ug/L		95	75 - 125	5	20
Cobalt	0.44	J	20.0	18.9		ug/L		92	75 - 125	5	20
Lead	<0.27		20.0	19.9		ug/L		100	75 - 125	4	20
Lithium	15		100	117		ug/L		101	75 - 125	3	20
Molybdenum	<1.1		40.0	40.6		ug/L		101	75 - 125	5	20
Selenium	3.1	J	40.0	42.6		ug/L		99	75 - 125	5	20
Thallium	<0.27		16.0	15.4		ug/L		96	75 - 125	4	20

QC Sample Results

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-1
SDG: 25219072

Method: 7470A - Mercury (CVAA)

Lab Sample ID: MB 310-235150/1-A
Matrix: Water
Analysis Batch: 235380

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 235150

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.10		0.20	0.10	ug/L		04/09/19 10:07	04/10/19 13:59	1

Lab Sample ID: LCS 310-235150/2-A
Matrix: Water
Analysis Batch: 235380

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 235150

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Mercury			1.67	1.85		ug/L		111	80 - 120		

Method: SM 2540C - Solids, Total Dissolved (TDS)

Lab Sample ID: MB 310-235365/1
Matrix: Water
Analysis Batch: 235365

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	<30.0		30.0		mg/L			04/10/19 14:38	1

Lab Sample ID: LCS 310-235365/2
Matrix: Water
Analysis Batch: 235365

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Total Dissolved Solids			1000	998.0		mg/L		100	90 - 110		

Lab Sample ID: 310-152915-6 DU
Matrix: Ground Water
Analysis Batch: 235365

Client Sample ID: MW 306
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier		DU Result	DU Qualifier	Unit	D			RPD	RPD Limit
Total Dissolved Solids	930			960.0		mg/L				3	24

Method: SM 4500 H+ B - pH

Lab Sample ID: LCS 310-235230/1
Matrix: Water
Analysis Batch: 235230

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
pH			7.00	7.0		SU		100	98 - 102		

Lab Sample ID: 310-152915-5 DU
Matrix: Ground Water
Analysis Batch: 235230

Client Sample ID: MW 305
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier		DU Result	DU Qualifier	Unit	D			RPD	RPD Limit
pH	7.0	HF		7.1		SU				0.4	20

QC Association Summary

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-1
SDG: 25219072

HPLC/IC

Analysis Batch: 235649

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-152915-1	MW 301	Total/NA	Ground Water	9056A	
310-152915-2	MW 302	Total/NA	Ground Water	9056A	
310-152915-2	MW 302	Total/NA	Ground Water	9056A	
310-152915-3	MW 303	Total/NA	Ground Water	9056A	
310-152915-3	MW 303	Total/NA	Ground Water	9056A	
310-152915-4	MW 304	Total/NA	Ground Water	9056A	
310-152915-4	MW 304	Total/NA	Ground Water	9056A	
310-152915-5	MW 305	Total/NA	Ground Water	9056A	
310-152915-6	MW 306	Total/NA	Ground Water	9056A	
310-152915-6	MW 306	Total/NA	Ground Water	9056A	
310-152915-7	Field Blank	Total/NA	Ground Water	9056A	
MB 310-235649/3	Method Blank	Total/NA	Water	9056A	
LCS 310-235649/4	Lab Control Sample	Total/NA	Water	9056A	

Metals

Prep Batch: 235150

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-152915-1	MW 301	Total/NA	Ground Water	7470A	
310-152915-2	MW 302	Total/NA	Ground Water	7470A	
310-152915-3	MW 303	Total/NA	Ground Water	7470A	
310-152915-4	MW 304	Total/NA	Ground Water	7470A	
310-152915-5	MW 305	Total/NA	Ground Water	7470A	
310-152915-6	MW 306	Total/NA	Ground Water	7470A	
310-152915-7	Field Blank	Total/NA	Ground Water	7470A	
MB 310-235150/1-A	Method Blank	Total/NA	Water	7470A	
LCS 310-235150/2-A	Lab Control Sample	Total/NA	Water	7470A	

Prep Batch: 235260

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-152915-1	MW 301	Total/NA	Ground Water	3010A	
310-152915-2	MW 302	Total/NA	Ground Water	3010A	
310-152915-3	MW 303	Total/NA	Ground Water	3010A	
310-152915-4	MW 304	Total/NA	Ground Water	3010A	
310-152915-5	MW 305	Total/NA	Ground Water	3010A	
310-152915-6	MW 306	Total/NA	Ground Water	3010A	
310-152915-7	Field Blank	Total/NA	Ground Water	3010A	
MB 310-235260/1-A	Method Blank	Total/NA	Water	3010A	
LCS 310-235260/2-A	Lab Control Sample	Total/NA	Water	3010A	
310-152915-1 MS	MW 301	Total/NA	Ground Water	3010A	
310-152915-1 MSD	MW 301	Total/NA	Ground Water	3010A	

Analysis Batch: 235380

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-152915-1	MW 301	Total/NA	Ground Water	7470A	235150
310-152915-2	MW 302	Total/NA	Ground Water	7470A	235150
310-152915-3	MW 303	Total/NA	Ground Water	7470A	235150
310-152915-4	MW 304	Total/NA	Ground Water	7470A	235150
310-152915-5	MW 305	Total/NA	Ground Water	7470A	235150
310-152915-6	MW 306	Total/NA	Ground Water	7470A	235150
310-152915-7	Field Blank	Total/NA	Ground Water	7470A	235150

QC Association Summary

Metals (Continued)

Analysis Batch: 235380 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
MB 310-235150/1-A	Method Blank	Total/NA	Water	7470A	235150
LCS 310-235150/2-A	Lab Control Sample	Total/NA	Water	7470A	235150

Analysis Batch: 236802

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-152915-1	MW 301	Total/NA	Ground Water	6020A	235260
310-152915-2	MW 302	Total/NA	Ground Water	6020A	235260
310-152915-3	MW 303	Total/NA	Ground Water	6020A	235260
310-152915-4	MW 304	Total/NA	Ground Water	6020A	235260
310-152915-5	MW 305	Total/NA	Ground Water	6020A	235260
310-152915-6	MW 306	Total/NA	Ground Water	6020A	235260
310-152915-7	Field Blank	Total/NA	Ground Water	6020A	235260
MB 310-235260/1-A	Method Blank	Total/NA	Water	6020A	235260
LCS 310-235260/2-A	Lab Control Sample	Total/NA	Water	6020A	235260
310-152915-1 MS	MW 301	Total/NA	Ground Water	6020A	235260
310-152915-1 MSD	MW 301	Total/NA	Ground Water	6020A	235260

General Chemistry

Analysis Batch: 235230

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-152915-1	MW 301	Total/NA	Ground Water	SM 4500 H+ B	
310-152915-2	MW 302	Total/NA	Ground Water	SM 4500 H+ B	
310-152915-3	MW 303	Total/NA	Ground Water	SM 4500 H+ B	
310-152915-4	MW 304	Total/NA	Ground Water	SM 4500 H+ B	
310-152915-5	MW 305	Total/NA	Ground Water	SM 4500 H+ B	
310-152915-6	MW 306	Total/NA	Ground Water	SM 4500 H+ B	
310-152915-7	Field Blank	Total/NA	Ground Water	SM 4500 H+ B	
LCS 310-235230/1	Lab Control Sample	Total/NA	Water	SM 4500 H+ B	
310-152915-5 DU	MW 305	Total/NA	Ground Water	SM 4500 H+ B	

Analysis Batch: 235365

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-152915-1	MW 301	Total/NA	Ground Water	SM 2540C	
310-152915-2	MW 302	Total/NA	Ground Water	SM 2540C	
310-152915-3	MW 303	Total/NA	Ground Water	SM 2540C	
310-152915-4	MW 304	Total/NA	Ground Water	SM 2540C	
310-152915-5	MW 305	Total/NA	Ground Water	SM 2540C	
310-152915-6	MW 306	Total/NA	Ground Water	SM 2540C	
310-152915-7	Field Blank	Total/NA	Ground Water	SM 2540C	
MB 310-235365/1	Method Blank	Total/NA	Water	SM 2540C	
LCS 310-235365/2	Lab Control Sample	Total/NA	Water	SM 2540C	
310-152915-6 DU	MW 306	Total/NA	Ground Water	SM 2540C	

Field Service / Mobile Lab

Analysis Batch: 236698

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-152915-1	MW 301	Total/NA	Ground Water	Field Sampling	
310-152915-2	MW 302	Total/NA	Ground Water	Field Sampling	
310-152915-3	MW 303	Total/NA	Ground Water	Field Sampling	
310-152915-4	MW 304	Total/NA	Ground Water	Field Sampling	

QC Association Summary

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-1
SDG: 25219072

Field Service / Mobile Lab (Continued)

Analysis Batch: 236698 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-152915-5	MW 305	Total/NA	Ground Water	Field Sampling	
310-152915-6	MW 306	Total/NA	Ground Water	Field Sampling	

Lab Chronicle

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-1
SDG: 25219072

Client Sample ID: MW 301

Date Collected: 04/08/19 09:32
Date Received: 04/09/19 17:15

Lab Sample ID: 310-152915-1
Matrix: Ground Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	9056A		5	235649	04/10/19 19:13	MLU	TAL CF
Total/NA	Prep	3010A			235260	04/10/19 08:11	HED	TAL CF
Total/NA	Analysis	6020A		1	236802	04/22/19 21:44	SAD	TAL CF
Total/NA	Prep	7470A			235150	04/09/19 10:07	JNR	TAL CF
Total/NA	Analysis	7470A		1	235380	04/10/19 14:28	JNR	TAL CF
Total/NA	Analysis	SM 2540C		1	235365	04/10/19 14:38	MDK	TAL CF
Total/NA	Analysis	SM 4500 H+ B		1	235230	04/09/19 23:56	JMH	TAL CF
Total/NA	Analysis	Field Sampling		1	236698	04/08/19 09:32	ANO	TAL CF

Client Sample ID: MW 302

Date Collected: 04/08/19 10:36
Date Received: 04/09/19 17:15

Lab Sample ID: 310-152915-2
Matrix: Ground Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	9056A		5	235649	04/10/19 19:28	MLU	TAL CF
Total/NA	Analysis	9056A		50	235649	04/11/19 10:13	MLU	TAL CF
Total/NA	Prep	3010A			235260	04/10/19 08:11	HED	TAL CF
Total/NA	Analysis	6020A		1	236802	04/22/19 22:11	SAD	TAL CF
Total/NA	Prep	7470A			235150	04/09/19 10:07	JNR	TAL CF
Total/NA	Analysis	7470A		1	235380	04/10/19 14:30	JNR	TAL CF
Total/NA	Analysis	SM 2540C		1	235365	04/10/19 14:38	MDK	TAL CF
Total/NA	Analysis	SM 4500 H+ B		1	235230	04/09/19 23:59	JMH	TAL CF
Total/NA	Analysis	Field Sampling		1	236698	04/08/19 10:36	ANO	TAL CF

Client Sample ID: MW 303

Date Collected: 04/08/19 11:41
Date Received: 04/09/19 17:15

Lab Sample ID: 310-152915-3
Matrix: Ground Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	9056A		5	235649	04/10/19 19:44	MLU	TAL CF
Total/NA	Analysis	9056A		20	235649	04/11/19 10:30	MLU	TAL CF
Total/NA	Prep	3010A			235260	04/10/19 08:11	HED	TAL CF
Total/NA	Analysis	6020A		1	236802	04/22/19 22:15	SAD	TAL CF
Total/NA	Prep	7470A			235150	04/09/19 13:18	JNR	TAL CF
Total/NA	Analysis	7470A		1	235380	04/10/19 14:37	JNR	TAL CF
Total/NA	Analysis	SM 2540C		1	235365	04/10/19 14:38	MDK	TAL CF
Total/NA	Analysis	SM 4500 H+ B		1	235230	04/10/19 00:04	JMH	TAL CF
Total/NA	Analysis	Field Sampling		1	236698	04/08/19 11:41	ANO	TAL CF

Lab Chronicle

Client Sample ID: MW 304

Lab Sample ID: 310-152915-4
Date Collected: 04/08/19 12:53
Matrix: Ground Water
Date Received: 04/09/19 17:15

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	9056A		5	235649	04/10/19 20:00	MLU	TAL CF
Total/NA	Analysis	9056A		20	235649	04/11/19 10:49	MLU	TAL CF
Total/NA	Prep	3010A			235260	04/10/19 08:11	HED	TAL CF
Total/NA	Analysis	6020A		1	236802	04/22/19 22:18	SAD	TAL CF
Total/NA	Prep	7470A			235150	04/09/19 13:18	JNR	TAL CF
Total/NA	Analysis	7470A		1	235380	04/10/19 14:39	JNR	TAL CF
Total/NA	Analysis	SM 2540C		1	235365	04/10/19 14:38	MDK	TAL CF
Total/NA	Analysis	SM 4500 H+ B		1	235230	04/10/19 00:06	JMH	TAL CF
Total/NA	Analysis	Field Sampling		1	236698	04/08/19 12:53	ANO	TAL CF

Client Sample ID: MW 305

Lab Sample ID: 310-152915-5
Date Collected: 04/08/19 13:39
Matrix: Ground Water
Date Received: 04/09/19 17:15

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	9056A		5	235649	04/10/19 20:15	MLU	TAL CF
Total/NA	Prep	3010A			235260	04/10/19 08:11	HED	TAL CF
Total/NA	Analysis	6020A		1	236802	04/22/19 22:21	SAD	TAL CF
Total/NA	Prep	7470A			235150	04/09/19 13:18	JNR	TAL CF
Total/NA	Analysis	7470A		1	235380	04/10/19 14:41	JNR	TAL CF
Total/NA	Analysis	SM 2540C		1	235365	04/10/19 14:38	MDK	TAL CF
Total/NA	Analysis	SM 4500 H+ B		1	235230	04/10/19 00:14	JMH	TAL CF
Total/NA	Analysis	Field Sampling		1	236698	04/08/19 13:39	ANO	TAL CF

Client Sample ID: MW 306

Lab Sample ID: 310-152915-6
Date Collected: 04/08/19 14:25
Matrix: Ground Water
Date Received: 04/09/19 17:15

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	9056A		5	235649	04/10/19 20:31	MLU	TAL CF
Total/NA	Analysis	9056A		10	235649	04/11/19 11:04	MLU	TAL CF
Total/NA	Prep	3010A			235260	04/10/19 08:11	HED	TAL CF
Total/NA	Analysis	6020A		1	236802	04/22/19 22:25	SAD	TAL CF
Total/NA	Prep	7470A			235150	04/09/19 13:18	JNR	TAL CF
Total/NA	Analysis	7470A		1	235380	04/10/19 14:43	JNR	TAL CF
Total/NA	Analysis	SM 2540C		1	235365	04/10/19 14:38	MDK	TAL CF
Total/NA	Analysis	SM 4500 H+ B		1	235230	04/10/19 00:18	JMH	TAL CF
Total/NA	Analysis	Field Sampling		1	236698	04/08/19 14:25	ANO	TAL CF

Lab Chronicle

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-1
SDG: 25219072

Client Sample ID: Field Blank

Date Collected: 04/08/19 14:30
Date Received: 04/09/19 17:15

Lab Sample ID: 310-152915-7

Matrix: Ground Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	9056A		1	235649	04/10/19 20:46	MLU	TAL CF
Total/NA	Prep	3010A			235260	04/10/19 08:11	HED	TAL CF
Total/NA	Analysis	6020A		1	236802	04/22/19 22:28	SAD	TAL CF
Total/NA	Prep	7470A			235150	04/09/19 13:18	JNR	TAL CF
Total/NA	Analysis	7470A		1	235380	04/10/19 14:45	JNR	TAL CF
Total/NA	Analysis	SM 2540C		1	235365	04/10/19 14:38	MDK	TAL CF
Total/NA	Analysis	SM 4500 H+ B		1	235230	04/10/19 00:21	JMH	TAL CF

Laboratory References:

TAL CF = Eurofins TestAmerica, Cedar Falls, 3019 Venture Way, Cedar Falls, IA 50613, TEL (319)277-2401

Accreditation/Certification Summary

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-1
SDG: 25219072

Laboratory: Eurofins TestAmerica, Cedar Falls

The accreditations/certifications listed below are applicable to this report.

Authority	Program	EPA Region	Identification Number	Expiration Date
Iowa	State Program	7	007	12-01-19

Method Summary

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-1
SDG: 25219072

Method	Method Description	Protocol	Laboratory
9056A	Anions, Ion Chromatography	SW846	TAL CF
6020A	Metals (ICP/MS)	SW846	TAL CF
7470A	Mercury (CVAA)	SW846	TAL CF
SM 2540C	Solids, Total Dissolved (TDS)	SM	TAL CF
SM 4500 H+ B	pH	SM	TAL CF
Field Sampling	Field Sampling	EPA	TAL CF
3010A	Preparation, Total Metals	SW846	TAL CF
7470A	Preparation, Mercury	SW846	TAL CF

Protocol References:

EPA = US Environmental Protection Agency

SM = "Standard Methods For The Examination Of Water And Wastewater"

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

TAL CF = Eurofins TestAmerica, Cedar Falls, 3019 Venture Way, Cedar Falls, IA 50613, TEL (319)277-2401

Fredrick, Sandie

From: Blodgett, Meghan <mblodgett@scsengineers.com>
Sent: Wednesday, April 10, 2019 9:01 AM
To: Fredrick, Sandie
Cc: Schemmel, Nick; Karwoski, Thomas; Kron, Nicole
Subject: RE: TestAmerica Sample Login Confirmation files from 310-152915 IPL Ottumwa Generating Station 25219072

-External Email-

Sandie,

A couple changes on this one:

-For reporting, please split MW-301 through MW-306 plus the field blank onto one report, and MW-307 through MW-309 on a second report.
-We do not need all the listed metals for MW-307 through MW-309. The only metals needed for those three wells are boron and calcium (full parameter list for these three is boron, calcium, chloride, fluoride, sulfate, TDS, and pH).

-Meg

Meghan Blodgett
608.216.7362 (o)
608.345.9221 (m)

From: Sandie Fredrick <sandie.fredrick@testamericainc.com>
Sent: Tuesday, April 9, 2019 9:21 PM
To: Blodgett, Meghan <mblodgett@scsengineers.com>; Schemmel, Nick <NSchemmel@scsengineers.com>; Karwoski, Thomas <TKarwoski@scsengineers.com>
Subject: TestAmerica Sample Login Confirmation files from 310-152915 IPL Ottumwa Generating Station 25219072

Hello Everyone,

Please send over field data when you can.
Thanks,
Sandie

Attached, please find the Sample Confirmation files for job 310-152915; IPL Ottumwa Generating Station 25219072

Please feel free to contact me if you have any questions.

Thank you.

Sandie Fredrick
Project Manager

TestAmerica Laboratories, Inc.
Phone: 920-261-1660

E-mail: sandie.fredrick@testamericainc.com
www.eurofinsus.com | www.testamericainc.com

Reference: [310-351154]
Attachments: 5

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

310-152915 Chain of Custody

Cooler/Sample Receipt and Temperature Log Form

Client Information

Client: SCS Engineers

City/State: CITY Clive STATE IA

Project: IPL - Ottumwa Generating Station

Receipt Information

Date/Time Received: DATE 4-9-19 TIME ~~15~~ 1715 4-9LAB

Received By: LAB

Delivery Type: ☐ UPS ☐ FedEx ☐ FedEx Ground ☐ US Mail ☐ Spee-Dee ☑ Lab Courier ☐ TA Field Services ☐ Client Drop-off ☐ Other:________

Condition of Cooler/Containers

Sample(s) received in Cooler? ☒ Yes ☐ No — *If yes:* Cooler ID:

Multiple Coolers? ☑ Yes ☐ No — *If yes:* Cooler # 1 of 2

Cooler Custody Seals Present? ☑ Yes ☐ No — *If yes:* Cooler custody seals intact? ☒ Yes ☐ No

Sample Custody Seals Present? ☐ Yes ☒ No — *If yes:* Sample custody seals intact? ☐ Yes ☐ No

Trip Blank Present? ☐ Yes ☒ No — *If yes:* Which VOA samples are in cooler? ↓

Temperature Record

Coolant: ☒ Wet ice ☐ Blue ice ☐ Dry ice ☐ Other:________ ☐ NONE

Thermometer ID: N

Correction Factor (°C): +0.0

• Temp Blank Temperature – If no temp blank, or temp blank temperature above criteria, proceed to Sample Container Temperature

Uncorrected Temp (°C): 0.1

Corrected Temp (°C): 0.1

• Sample Container Temperature

Container type(s) used: CONTAINER 1 CONTAINER 2

Uncorrected Temp (°C): TEMP 1 TEMP 2

Corrected Temp (°C): TEMP 1 TEMP 2

Exceptions Noted

1) If temperature exceeds criteria, was sample(s) received same day of sampling? ☐ Yes ☐ No

a) *If yes:* Is there evidence that the chilling process began? ☐ Yes ☐ No

2) If temperature is <0°C, are there obvious signs that the integrity of sample containers is compromised? (e.g., bulging septa, broken/cracked bottles, frozen solid?) ☐ Yes ☐ No

NOTE: If yes, contact PM before proceeding. If no, proceed with login

Additional Comments

Document: CF-LG-WI-002
Revision: 24
Date: 03/07/2019

TestAmerica Cedar Falls

General temperature criteria is 0 to 6°C
Bacteria temperature criteria is 0 to 10°C

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Place COC scanning label here
214

Cooler/Sample Receipt and Temperature Log Form

Client Information

Client: SCS Engineers

City/State: CITY Clive, STATE IA

Project: IPL - Ottumwa Generating Station

Receipt Information

Date/Time Received: DATE 4-9-19 TIME ~~15~~ 1715 4-9 LAB

Received By: LAB

Delivery Type: ☐ UPS ☐ FedEx ☐ FedEx Ground ☐ US Mail ☐ Spee-Dee
☒ Lab Courier ☐ TA Field Services ☐ Client Drop-off ☐ Other:______

Condition of Cooler/Containers

Sample(s) received in Cooler? ☒ Yes ☐ No — *If yes:* Cooler ID:

Multiple Coolers? ☒ Yes ☐ No — *If yes:* Cooler # 2 of 2

Cooler Custody Seals Present? ☒ Yes ☐ No — *If yes:* Cooler custody seals intact? ☒ Yes ☐ No

Sample Custody Seals Present? ☐ Yes ☒ No — *If yes:* Sample custody seals intact? ☐ Yes ☐ No

Trip Blank Present? ☐ Yes ☒ No — *If yes:* Which VOA samples are in cooler? ↓

Temperature Record

Coolant: ☒ Wet ice ☐ Blue ice ☐ Dry ice ☐ Other:______ ☐ NONE

Thermometer ID: N

Correction Factor (°C): +0.0

• Temp Blank Temperature – If no temp blank, or temp blank temperature above criteria, proceed to Sample Container Temperature

Uncorrected Temp (°C): 0.8

Corrected Temp (°C): 0.8

• Sample Container Temperature

Container type(s) used: CONTAINER 1 CONTAINER 2

Uncorrected Temp (°C): TEMP 1 TEMP 2

Corrected Temp (°C): TEMP 1 TEMP 2

Exceptions Noted

1) If temperature exceeds criteria, was sample(s) received same day of sampling? ☐ Yes ☐ No
   a) *If yes:* Is there evidence that the chilling process began? ☐ Yes ☐ No

2) If temperature is <0°C, are there obvious signs that the integrity of sample containers is compromised? (e.g., bulging septa, broken/cracked bottles, frozen solid?) ☐ Yes ☐ No

NOTE: If yes, contact PM before proceeding. If no, proceed with login

Additional Comments

Document: CF-LG-WI-002
Revision: 24
Date: 03/07/2019

TestAmerica-Cedar Falls

General temperature criteria is 0 to 6°C
Bacteria temperature criteria is 0 to 10°C

38727

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Cedar Falls Division
704 Enterprise Drive
Cedar Falls, IA 50613

Phone 319-277-2401 or 800-750-2401
Fax 319-277-2425

TestAmerica Des Moines SC
214

To assist us in using the proper analytical methods, is this work being conducted for regulatory purposes?
Compliance Monitoring ______

Client Name: SCS Engineers
Client #: ______
Address: 8450 Hickman Rd Suite 20
City/State/Zip Code: Clive IA 50325
Project Manager: Tom Karwoski
Email Address: ______
Telephone Number: 608-509-~~82~~ 8245
Fax: ______
Sampler Name: (Print Name) Nick Schremmel
Sampler Signature: ______

Project Name: IPL-Ottumwa Generating Station
Project #: 25219072
Site/Location ID: Ottumwa
State: IA
Report To: ______
Invoice To: ______
Quote #: ______
PO#: ______

TAT
___ Standard
___ Rush (surcharges may apply)

Date Needed: ______

Fax Results: Y N
Email Results: Y N

SAMPLE ID	Date Sampled	Time Sampled	G = Grab, C = Composite	Field Filtered	Matrix: SL - Sludge DW - Drinking Water GW - Groundwater S - Soil/Solid WW - Wastewater Specify, Other	Preservation & # of Containers: HNO_3	HCl	NaOH	H_2SO_4	Methanol	None	Other (Specify)	Analyze For: Metals	pH	~~T~~ TDS	Chloride/Fluoride/SO4	Radium 226 + 228					**QC Deliverables** / **REMARKS**
MW 301	4.8.19	0932	G		GW	3					1		X	X	X	X	X					
MW 302		1036				3					1		X	X	X	X	X					
MW 303		1141				3					1		X	X	X	X	X					
MW 304		1253				3					1		X	X	X	X	X					
MW 305		1339				3					1		X	X	X	X	X					
MW 306		1425				3					1		X	X	X	X	X					
Field Blank		1430				3					1		X	X	X	X	X					

QC Deliverables
___ None
___ Level 2
(Batch QC)
___ Level 3
___ Level 4
Other: ______

REMARKS

Special Instructions:

LABORATORY COMMENTS:

Relinquished By: Nick Schremmel	Date: 4.9.19	Time: 1000	Received By: Lindsay Bindert	Date: 4-9-19	Time: 1715
Relinquished By:	Date:	Time:	Received By:	Date:	Time:
Relinquished By:	Date:	Time:	Received By:	Date:	Time:

TAL-0033 (0708)

Page ______ of ______

4/9/2019

Login Container Summary Report

310-152915

Temperature readings: ____________________

Client Sample ID	Lab ID	Container Type	Container pH	Preservative Added (mls)	Lot #
MW 301	310-152915-A-1	Plastic 250ml - with Nitric Acid	<2		
MW 301	310-152915-C-1	Plastic 1 liter - Nitric Acid	<2		
MW 301	310-152915-D-1	Plastic 1 liter - Nitric Acid	<2		
MW 302	310-152915-A-2	Plastic 250ml - with Nitric Acid	<2		
MW 302	310-152915-C-2	Plastic 1 liter - Nitric Acid	<2		
MW 302	310-152915-D-2	Plastic 1 liter - Nitric Acid	<2		
MW 303	310-152915-A-3	Plastic 250ml - with Nitric Acid	<2		
MW 303	310-152915-C-3	Plastic 1 liter - Nitric Acid	<2		
MW 303	310-152915-D-3	Plastic 1 liter - Nitric Acid	<2		
MW 304	310-152915-A-4	Plastic 250ml - with Nitric Acid	<2		
MW 304	310-152915-C-4	Plastic 1 liter - Nitric Acid	<2		
MW 304	310-152915-D-4	Plastic 1 liter - Nitric Acid	<2		
MW 305	310-152915-A-5	Plastic 250ml - with Nitric Acid	<2		
MW 305	310-152915-C-5	Plastic 1 liter - Nitric Acid	<2		
MW 305	310-152915-D-5	Plastic 1 liter - Nitric Acid	<2		
MW 306	310-152915-A-6	Plastic 250ml - with Nitric Acid	<2		
MW 306	310-152915-C-6	Plastic 1 liter - Nitric Acid	<2		
MW 306	310-152915-D-6	Plastic 1 liter - Nitric Acid	<2		
Field Blank	310-152915-A-7	Plastic 250ml - with Nitric Acid	<2		
Field Blank	310-152915-C-7	Plastic 1 liter - Nitric Acid	<2		
Field Blank	310-152915-D-7	Plastic 1 liter - Nitric Acid	<2		
MW 307	310-152915-A-8	Plastic 250ml - with Nitric Acid	<2		
MW 308	310-152915-A-9	Plastic 250ml - with Nitric Acid	<2		
MW 309	310-152915-A-10	Plastic 250ml - with Nitric Acid	<2		

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Table 2. Groundwater Monitoring Results - Field Parameters
Ottumwa Generating Station / SCS Engineers Project No. 25219072
April 2019

Sample	Date/Sample Time	Groundwater Elevation (amsl)	Temperature (Deg. C)	pH (Std. Units)	Dissolved Oxygen (mg/L)	Specific Conductivity (µmhos/cm)	ORP (mV)	Turbidity
MW-301	4-8-2019/0932	682.69	7.27	6.61	8.32	501	37.6	1.87
MW-302	4-8-2019/1036	657.23	12.27	6.61	0.86	2159	68.3	26.9
MW-303	4-8-2019/1141	655.55	8.51	7.00	2.29	1181	51.7	3.49
MW-304	4-8-2019/1253	659.33	13.75	7.17	0.41	1876	-58.3	57.9
MW-305	4-8-2019/1339	664.01	13.8	7.06	0.59	1728	32.6	21.7
MW-306	4-8-2019/1425	670.96	13.63	6.66	0.92	1350	49.1	28.5

Abbreviations:

mg/L = milligrams per liter

amsl = above mean sea level

NA = Not Analyzed

Notes:
none

Created by:	KAK	Date: 5/1/2017
Last revision by:	JR	Date: 4/12/2019
Checked by:	MDB	Date: 4/12/2019

\\Mad-fs01\data\Projects\25219072.00\Data and Calculations\Tables\[OGS_CCR_Field_2019_April.xlsx]GW Field Parameters

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Login Sample Receipt Checklist

Client: SCS Engineers

Job Number: 310-152915-1
SDG Number: 25219072

Login Number: 152915
List Number: 1
Creator: Bindert, Lindsay A

List Source: Eurofins TestAmerica, Cedar Falls

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	N/A	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

Tracer/Carrier Summary

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-1
SDG: 25219072

Method: 903.0 - Radium-226 (GFPC)

Matrix: Ground Water **Prep Type: Total/NA**

Percent Yield (Acceptance Limits)

Lab Sample ID	Client Sample ID	Ba Carrier (40-110)
310-152915-1	MW 301	93.5
310-152915-2	MW 302	95.8
310-152915-3	MW 303	87.9
310-152915-4	MW 304	87.3
310-152915-5	MW 305	91.0
310-152915-6	MW 306	87.9
310-152915-7	Field Blank	99.4

Tracer/Carrier Legend

Ba Carrier = Ba Carrier

Method: 903.0 - Radium-226 (GFPC)

Matrix: Water **Prep Type: Total/NA**

Percent Yield (Acceptance Limits)

Lab Sample ID	Client Sample ID	Ba Carrier (40-110)
LCS 160-425538/1-A	Lab Control Sample	99.7
LCSD 160-425538/2-A	Lab Control Sample Dup	98.9
MB 160-425538/23-A	Method Blank	96.0

Tracer/Carrier Legend

Ba Carrier = Ba Carrier

Method: 904.0 - Radium-228 (GFPC)

Matrix: Ground Water **Prep Type: Total/NA**

Percent Yield (Acceptance Limits)

Lab Sample ID	Client Sample ID	Ba Carrier (40-110)	Y Carrier (40-110)
310-152915-1	MW 301	93.5	93.1
310-152915-2	MW 302	95.8	86.4
310-152915-3	MW 303	87.9	89.7
310-152915-4	MW 304	87.3	94.2
310-152915-5	MW 305	91.0	95.3
310-152915-6	MW 306	87.9	96.1
310-152915-7	Field Blank	99.4	95.3

Tracer/Carrier Legend

Ba Carrier = Ba Carrier
Y Carrier = Y Carrier

Method: 904.0 - Radium-228 (GFPC)

Matrix: Water **Prep Type: Total/NA**

Percent Yield (Acceptance Limits)

Lab Sample ID	Client Sample ID	Ba Carrier (40-110)	Y Carrier (40-110)
LCS 160-425541/1-A	Lab Control Sample	99.7	95.3
LCSD 160-425541/2-A	Lab Control Sample Dup	98.9	83.7
MB 160-425541/23-A	Method Blank	96.0	93.5

Tracer/Carrier Legend

Tracer/Carrier Summary

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-1
SDG: 25219072

Ba Carrier = Ba Carrier
Y Carrier = Y Carrier

eurofins

Environment Testing
TestAmerica

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ANALYTICAL REPORT

Eurofins TestAmerica, Cedar Falls
3019 Venture Way
Cedar Falls, IA 50613
Tel: (319)277-2401

Laboratory Job ID: 310-152915-2
Laboratory Sample Delivery Group: 25219072
Client Project/Site: IPL Ottumwa Generating Station 25219072

For:
SCS Engineers
2830 Dairy Drive
Madison, Wisconsin 53718

Attn: Meghan Blodgett

Sandie Fredrick

Authorized for release by:
7/11/2019 9:30:07 AM

Sandie Fredrick, Project Manager II
(920)261-1660
sandie.fredrick@testamericainc.com

Table of Contents

Case Narrative

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-2
SDG: 25219072

Job ID: 310-152915-2

Laboratory: Eurofins TestAmerica, Cedar Falls

Narrative

Job Narrative
310-152915-2

Comments
No additional comments.

Receipt
The samples were received on 4/9/2019 5:15 PM; the samples arrived in good condition, properly preserved and, where required, on ice. The temperatures of the 2 coolers at receipt time were 0.1° C and 0.8° C.

RAD
Method(s) 903.0, 9315: Ra-226 Prep Batch 160-425538
Any minimum detectable concentration (MDC), critical value (DLC), or Safe Drinking Water Act detection limit (SDWA DL) is sample-specific unless otherwise stated elsewhere in this narrative.

Radiochemistry sample results are reported with the count date/time applied as the Activity Reference Date.
MW 301 (310-152915-1), MW 302 (310-152915-2), MW 303 (310-152915-3), MW 304 (310-152915-4), MW 305 (310-152915-5), MW 306 (310-152915-6), Field Blank (310-152915-7), (LCS 160-425538/1-A), (LCSD 160-425538/2-A) and (MB 160-425538/23-A)

Method(s) 904.0, 9320: Ra-228 Prep Batch 160-425541
Any minimum detectable concentration (MDC), critical value (DLC), or Safe Drinking Water Act detection limit (SDWA DL) is sample-specific unless otherwise stated elsewhere in this narrative.

Radiochemistry sample results are reported with the count date/time applied as the Activity Reference Date.
MW 301 (310-152915-1), MW 302 (310-152915-2), MW 303 (310-152915-3), MW 304 (310-152915-4), MW 305 (310-152915-5), MW 306 (310-152915-6), Field Blank (310-152915-7), (LCS 160-425541/1-A), (LCSD 160-425541/2-A) and (MB 160-425541/23-A)

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Sample Summary

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-2
SDG: 25219072

Lab Sample ID	Client Sample ID	Matrix	Collected	Received	Asset ID
310-152915-1	MW 301	Ground Water	04/08/19 09:32	04/09/19 17:15	
310-152915-2	MW 302	Ground Water	04/08/19 10:36	04/09/19 17:15	
310-152915-3	MW 303	Ground Water	04/08/19 11:41	04/09/19 17:15	
310-152915-4	MW 304	Ground Water	04/08/19 12:53	04/09/19 17:15	
310-152915-5	MW 305	Ground Water	04/08/19 13:39	04/09/19 17:15	
310-152915-6	MW 306	Ground Water	04/08/19 14:25	04/09/19 17:15	
310-152915-7	Field Blank	Ground Water	04/08/19 14:30	04/09/19 17:15	

Detection Summary

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-2
SDG: 25219072

Client Sample ID: MW 301 — Lab Sample ID: 310-152915-1

No Detections.

Client Sample ID: MW 302 — Lab Sample ID: 310-152915-2

No Detections.

Client Sample ID: MW 303 — Lab Sample ID: 310-152915-3

No Detections.

Client Sample ID: MW 304 — Lab Sample ID: 310-152915-4

No Detections.

Client Sample ID: MW 305 — Lab Sample ID: 310-152915-5

No Detections.

Client Sample ID: MW 306 — Lab Sample ID: 310-152915-6

No Detections.

Client Sample ID: Field Blank — Lab Sample ID: 310-152915-7

No Detections.

This Detection Summary does not include radiochemical test results.

Client Sample Results

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-2
SDG: 25219072

Client Sample ID: MW 301
Date Collected: 04/08/19 09:32
Date Received: 04/09/19 17:15

Lab Sample ID: 310-152915-1
Matrix: Ground Water

Method: 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.0726	U	0.0694	0.0697	1.00	0.104	pCi/L	04/25/19 15:16	05/20/19 10:45	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*93.5*		*40 - 110*	*04/25/19 15:16*	*05/20/19 10:45*	*1*

Method: 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.0230	U	0.243	0.243	1.00	0.435	pCi/L	04/25/19 15:58	05/13/19 11:49	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*93.5*		*40 - 110*	*04/25/19 15:58*	*05/13/19 11:49*	*1*
Y Carrier	*93.1*		*40 - 110*	*04/25/19 15:58*	*05/13/19 11:49*	*1*

Method: Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	0.0956	U	0.253	0.253	5.00	0.435	pCi/L		05/30/19 09:15	1

Client Sample Results

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-2
SDG: 25219072

Client Sample ID: MW 302

Date Collected: 04/08/19 10:36
Date Received: 04/09/19 17:15

Lab Sample ID: 310-152915-2

Matrix: Ground Water

Method: 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	**0.116**		0.0759	0.0766	1.00	0.0952	pCi/L	04/25/19 15:16	05/20/19 10:45	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*95.8*		*40 - 110*	*04/25/19 15:16*	*05/20/19 10:45*	*1*

Method: 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	-0.0591	U	0.321	0.321	1.00	0.576	pCi/L	04/25/19 15:58	05/13/19 11:49	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*95.8*		*40 - 110*	*04/25/19 15:58*	*05/13/19 11:49*	*1*
Y Carrier	*86.4*		*40 - 110*	*04/25/19 15:58*	*05/13/19 11:49*	*1*

Method: Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	0.116	U	0.330	0.330	5.00	0.576	pCi/L		05/30/19 09:15	1

Client Sample Results

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-2
SDG: 25219072

Client Sample ID: MW 303
Date Collected: 04/08/19 11:41
Date Received: 04/09/19 17:15

Lab Sample ID: 310-152915-3
Matrix: Ground Water

Method: 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	**0.172**		0.0857	0.0871	1.00	0.0897	pCi/L	04/25/19 15:16	05/20/19 10:45	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*87.9*		*40 - 110*	*04/25/19 15:16*	*05/20/19 10:45*	*1*

Method: 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.220	U	0.312	0.313	1.00	0.522	pCi/L	04/25/19 15:58	05/13/19 11:49	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*87.9*		*40 - 110*	*04/25/19 15:58*	*05/13/19 11:49*	*1*
Y Carrier	*89.7*		*40 - 110*	*04/25/19 15:58*	*05/13/19 11:49*	*1*

Method: Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	0.391	U	0.324	0.325	5.00	0.522	pCi/L		05/30/19 09:15	1

Client Sample Results

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-2
SDG: 25219072

Client Sample ID: MW 304

Date Collected: 04/08/19 12:53
Date Received: 04/09/19 17:15

Lab Sample ID: 310-152915-4

Matrix: Ground Water

Method: 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	**1.23**		0.209	0.237	1.00	0.0952	pCi/L	04/25/19 15:16	05/20/19 10:45	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*87.3*		*40 - 110*	*04/25/19 15:16*	*05/20/19 10:45*	*1*

Method: 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	**1.19**		0.376	0.391	1.00	0.494	pCi/L	04/25/19 15:58	05/13/19 11:49	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*87.3*		*40 - 110*	*04/25/19 15:58*	*05/13/19 11:49*	*1*
Y Carrier	*94.2*		*40 - 110*	*04/25/19 15:58*	*05/13/19 11:49*	*1*

Method: Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	**2.42**		0.430	0.457	5.00	0.494	pCi/L		05/30/19 09:15	1

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Client Sample Results

Client Sample ID: MW 305
Date Collected: 04/08/19 13:39
Date Received: 04/09/19 17:15

Lab Sample ID: 310-152915-5
Matrix: Ground Water

Method: 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	**0.339**		0.114	0.118	1.00	0.103	pCi/L	04/25/19 15:16	05/20/19 18:37	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*91.0*		*40 - 110*	*04/25/19 15:16*	*05/20/19 18:37*	*1*

Method: 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.347	U	0.266	0.268	1.00	0.417	pCi/L	04/25/19 15:58	05/13/19 11:50	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*91.0*		*40 - 110*	*04/25/19 15:58*	*05/13/19 11:50*	*1*
Y Carrier	*95.3*		*40 - 110*	*04/25/19 15:58*	*05/13/19 11:50*	*1*

Method: Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	**0.685**		0.289	0.293	5.00	0.417	pCi/L		05/30/19 09:15	1

Client Sample Results

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-2
SDG: 25219072

Client Sample ID: MW 306

Date Collected: 04/08/19 14:25
Date Received: 04/09/19 17:15

Lab Sample ID: 310-152915-6

Matrix: Ground Water

Method: 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.0529	U	0.0713	0.0714	1.00	0.120	pCi/L	04/25/19 15:16	05/20/19 18:37	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*87.9*		*40 - 110*	*04/25/19 15:16*	*05/20/19 18:37*	*1*

Method: 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.102	U	0.301	0.302	1.00	0.520	pCi/L	04/25/19 15:58	05/13/19 11:50	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*87.9*		*40 - 110*	*04/25/19 15:58*	*05/13/19 11:50*	*1*
Y Carrier	*96.1*		*40 - 110*	*04/25/19 15:58*	*05/13/19 11:50*	*1*

Method: Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	0.155	U	0.309	0.310	5.00	0.520	pCi/L		05/30/19 09:15	1

Client Sample Results

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-2
SDG: 25219072

Client Sample ID: Field Blank

Date Collected: 04/08/19 14:30
Date Received: 04/09/19 17:15

Lab Sample ID: 310-152915-7

Matrix: Ground Water

Method: 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.0169	U	0.0506	0.0507	1.00	0.0968	pCi/L	04/25/19 15:16	05/20/19 18:37	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*99.4*		*40 - 110*	*04/25/19 15:16*	*05/20/19 18:37*	*1*

Method: 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.0163	U	0.226	0.226	1.00	0.404	pCi/L	04/25/19 15:58	05/13/19 11:50	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*99.4*		*40 - 110*	*04/25/19 15:58*	*05/13/19 11:50*	*1*
Y Carrier	*95.3*		*40 - 110*	*04/25/19 15:58*	*05/13/19 11:50*	*1*

Method: Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	0.0332	U	0.232	0.232	5.00	0.404	pCi/L		05/30/19 09:15	1

Definitions/Glossary

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-2
SDG: 25219072

Qualifiers

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Qualifier	Qualifier Description
U	Result is less than the sample detection limit.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

QC Sample Results

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-2
SDG: 25219072

Method: 903.0 - Radium-226 (GFPC)

Lab Sample ID: MB 160-425538/23-A
Matrix: Water
Analysis Batch: 429093

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 425538

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.07851	U	0.0617	0.0621	1.00	0.0866	pCi/L	04/25/19 15:16	05/20/19 20:01	1

Carrier	*MB %Yield*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*96.0*		*40 - 110*	*04/25/19 15:16*	*05/20/19 20:01*	*1*

Lab Sample ID: LCS 160-425538/1-A
Matrix: Water
Analysis Batch: 429839

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 425538

Analyte			Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits		
Radium-226			11.4	8.599		0.903	1.00	0.0811	pCi/L	76	75 - 125		

Carrier	*LCS %Yield*	*LCS Qualifier*	*Limits*
Ba Carrier	*99.7*		*40 - 110*

Lab Sample ID: LCSD 160-425538/2-A
Matrix: Water
Analysis Batch: 429095

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA
Prep Batch: 425538

Analyte			Spike Added	LCSD Result	LCSD Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits	RER	RER Limit
Radium-226			11.4	8.867		0.947	1.00	0.0808	pCi/L	78	75 - 125	0.14	1

Carrier	*LCSD %Yield*	*LCSD Qualifier*	*Limits*
Ba Carrier	*98.9*		*40 - 110*

Method: 904.0 - Radium-228 (GFPC)

Lab Sample ID: MB 160-425541/23-A
Matrix: Water
Analysis Batch: 428064

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 425541

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.08722	U	0.244	0.244	1.00	0.424	pCi/L	04/25/19 15:58	05/13/19 11:51	1

Carrier	*MB %Yield*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*96.0*		*40 - 110*	*04/25/19 15:58*	*05/13/19 11:51*	*1*
Y Carrier	*93.5*		*40 - 110*	*04/25/19 15:58*	*05/13/19 11:51*	*1*

QC Sample Results

Method: 904.0 - Radium-228 (GFPC) (Continued)

Lab Sample ID: LCS 160-425541/1-A
Matrix: Water
Analysis Batch: 428064

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 425541

Analyte			Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits		
Radium-228			9.21	8.180		0.997	1.00	0.405	pCi/L	89	75 - 125		

Carrier	*LCS %Yield*	*LCS Qualifier*	*Limits*
Ba Carrier	*99.7*		*40 - 110*
Y Carrier	*95.3*		*40 - 110*

Lab Sample ID: LCSD 160-425541/2-A
Matrix: Water
Analysis Batch: 428064

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA
Prep Batch: 425541

Analyte			Spike Added	LCSD Result	LCSD Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits	RER	RER Limit
Radium-228			9.21	9.446		1.15	1.00	0.473	pCi/L	103	75 - 125	0.59	1

Carrier	*LCSD %Yield*	*LCSD Qualifier*	*Limits*
Ba Carrier	*98.9*		*40 - 110*
Y Carrier	*83.7*		*40 - 110*

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QC Association Summary

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Prep Batch: 425538

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-152915-1	MW 301	Total/NA	Ground Water	PrecSep-21	
310-152915-2	MW 302	Total/NA	Ground Water	PrecSep-21	
310-152915-3	MW 303	Total/NA	Ground Water	PrecSep-21	
310-152915-4	MW 304	Total/NA	Ground Water	PrecSep-21	
310-152915-5	MW 305	Total/NA	Ground Water	PrecSep-21	
310-152915-6	MW 306	Total/NA	Ground Water	PrecSep-21	
310-152915-7	Field Blank	Total/NA	Ground Water	PrecSep-21	
MB 160-425538/23-A	Method Blank	Total/NA	Water	PrecSep-21	
LCS 160-425538/1-A	Lab Control Sample	Total/NA	Water	PrecSep-21	
LCSD 160-425538/2-A	Lab Control Sample Dup	Total/NA	Water	PrecSep-21	

Prep Batch: 425541

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-152915-1	MW 301	Total/NA	Ground Water	PrecSep_0	
310-152915-2	MW 302	Total/NA	Ground Water	PrecSep_0	
310-152915-3	MW 303	Total/NA	Ground Water	PrecSep_0	
310-152915-4	MW 304	Total/NA	Ground Water	PrecSep_0	
310-152915-5	MW 305	Total/NA	Ground Water	PrecSep_0	
310-152915-6	MW 306	Total/NA	Ground Water	PrecSep_0	
310-152915-7	Field Blank	Total/NA	Ground Water	PrecSep_0	
MB 160-425541/23-A	Method Blank	Total/NA	Water	PrecSep_0	
LCS 160-425541/1-A	Lab Control Sample	Total/NA	Water	PrecSep_0	
LCSD 160-425541/2-A	Lab Control Sample Dup	Total/NA	Water	PrecSep_0	

Lab Chronicle

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-2
SDG: 25219072

Client Sample ID: MW 301

Date Collected: 04/08/19 09:32
Date Received: 04/09/19 17:15

Lab Sample ID: 310-152915-1
Matrix: Ground Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	PrecSep-21			425538	04/25/19 15:16		TAL SL
Total/NA	Analysis	903.0		1	429095	05/20/19 10:45	CDR	TAL SL
Total/NA	Prep	PrecSep_0			425541	04/25/19 15:58		TAL SL
Total/NA	Analysis	904.0		1	428064	05/13/19 11:49	BLH	TAL SL
Total/NA	Analysis	Ra226_Ra228 Pos		1	430224	05/30/19 09:15	SMP	TAL SL

Client Sample ID: MW 302

Date Collected: 04/08/19 10:36
Date Received: 04/09/19 17:15

Lab Sample ID: 310-152915-2
Matrix: Ground Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	PrecSep-21			425538	04/25/19 15:16		TAL SL
Total/NA	Analysis	903.0		1	429095	05/20/19 10:45	CDR	TAL SL
Total/NA	Prep	PrecSep_0			425541	04/25/19 15:58		TAL SL
Total/NA	Analysis	904.0		1	428064	05/13/19 11:49	BLH	TAL SL
Total/NA	Analysis	Ra226_Ra228 Pos		1	430224	05/30/19 09:15	SMP	TAL SL

Client Sample ID: MW 303

Date Collected: 04/08/19 11:41
Date Received: 04/09/19 17:15

Lab Sample ID: 310-152915-3
Matrix: Ground Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	PrecSep-21			425538	04/25/19 15:16		TAL SL
Total/NA	Analysis	903.0		1	429095	05/20/19 10:45	CDR	TAL SL
Total/NA	Prep	PrecSep_0			425541	04/25/19 15:58		TAL SL
Total/NA	Analysis	904.0		1	428064	05/13/19 11:49	BLH	TAL SL
Total/NA	Analysis	Ra226_Ra228 Pos		1	430224	05/30/19 09:15	SMP	TAL SL

Client Sample ID: MW 304

Date Collected: 04/08/19 12:53
Date Received: 04/09/19 17:15

Lab Sample ID: 310-152915-4
Matrix: Ground Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	PrecSep-21			425538	04/25/19 15:16		TAL SL
Total/NA	Analysis	903.0		1	429095	05/20/19 10:45	CDR	TAL SL
Total/NA	Prep	PrecSep_0			425541	04/25/19 15:58		TAL SL
Total/NA	Analysis	904.0		1	428064	05/13/19 11:49	BLH	TAL SL
Total/NA	Analysis	Ra226_Ra228 Pos		1	430224	05/30/19 09:15	SMP	TAL SL

Lab Chronicle

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-2
SDG: 25219072

Client Sample ID: MW 305

Lab Sample ID: 310-152915-5

Date Collected: 04/08/19 13:39
Date Received: 04/09/19 17:15

Matrix: Ground Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	PrecSep-21			425538	04/25/19 15:16		TAL SL
Total/NA	Analysis	903.0		1	429092	05/20/19 18:37	CDR	TAL SL
Total/NA	Prep	PrecSep_0			425541	04/25/19 15:58		TAL SL
Total/NA	Analysis	904.0		1	428064	05/13/19 11:50	BLH	TAL SL
Total/NA	Analysis	Ra226_Ra228 Pos		1	430224	05/30/19 09:15	SMP	TAL SL

Client Sample ID: MW 306

Lab Sample ID: 310-152915-6

Date Collected: 04/08/19 14:25
Date Received: 04/09/19 17:15

Matrix: Ground Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	PrecSep-21			425538	04/25/19 15:16		TAL SL
Total/NA	Analysis	903.0		1	429092	05/20/19 18:37	CDR	TAL SL
Total/NA	Prep	PrecSep_0			425541	04/25/19 15:58		TAL SL
Total/NA	Analysis	904.0		1	428064	05/13/19 11:50	BLH	TAL SL
Total/NA	Analysis	Ra226_Ra228 Pos		1	430224	05/30/19 09:15	SMP	TAL SL

Client Sample ID: Field Blank

Lab Sample ID: 310-152915-7

Date Collected: 04/08/19 14:30
Date Received: 04/09/19 17:15

Matrix: Ground Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	PrecSep-21			425538	04/25/19 15:16		TAL SL
Total/NA	Analysis	903.0		1	429092	05/20/19 18:37	CDR	TAL SL
Total/NA	Prep	PrecSep_0			425541	04/25/19 15:58		TAL SL
Total/NA	Analysis	904.0		1	428064	05/13/19 11:50	BLH	TAL SL
Total/NA	Analysis	Ra226_Ra228 Pos		1	430224	05/30/19 09:15	SMP	TAL SL

Laboratory References:

TAL SL = Eurofins TestAmerica, St. Louis, 13715 Rider Trail North, Earth City, MO 63045, TEL (314)298-8566

Accreditation/Certification Summary

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-2
SDG: 25219072

Laboratory: Eurofins TestAmerica, Cedar Falls

The accreditations/certifications listed below are applicable to this report.

Authority	Program	EPA Region	Identification Number	Expiration Date
Iowa	State Program	7	007	12-01-19

Laboratory: Eurofins TestAmerica, St. Louis

The accreditations/certifications listed below are applicable to this report.

Authority	Program	EPA Region	Identification Number	Expiration Date
Iowa	State Program	7	373	12-01-20

Method Summary

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-2
SDG: 25219072

Method	Method Description	Protocol	Laboratory
903.0	Radium-226 (GFPC)	EPA	TAL SL
904.0	Radium-228 (GFPC)	EPA	TAL SL
Ra226_Ra228 Pos	Combined Radium-226 and Radium-228	TAL-STL	TAL SL
PrecSep_0	Preparation, Precipitate Separation	None	TAL SL
PrecSep-21	Preparation, Precipitate Separation (21-Day In-Growth)	None	TAL SL

Protocol References:

EPA = US Environmental Protection Agency

None = None

TAL-STL = TestAmerica Laboratories, St. Louis, Facility Standard Operating Procedure.

Laboratory References:

TAL SL = Eurofins TestAmerica, St. Louis, 13715 Rider Trail North, Earth City, MO 63045, TEL (314)298-8566

Fredrick, Sandie

From: Blodgett, Meghan <mblodgett@scsengineers.com>
Sent: Wednesday, April 10, 2019 9:01 AM
To: Fredrick, Sandie
Cc: Schemmel, Nick; Karwoski, Thomas; Kron, Nicole
Subject: RE: TestAmerica Sample Login Confirmation files from 310-152915 IPL Ottumwa Generating Station 25219072

-External Email-

Sandie,

A couple changes on this one:

-For reporting, please split MW-301 through MW-306 plus the field blank onto one report, and MW-307 through MW-309 on a second report.
-We do not need all the listed metals for MW-307 through MW-309. The only metals needed for those three wells are boron and calcium (full parameter list for these three is boron, calcium, chloride, fluoride, sulfate, TDS, and pH).

-Meg

Meghan Blodgett
608.216.7362 (o)
608.345.9221 (m)

From: Sandie Fredrick <sandie.fredrick@testamericainc.com>
Sent: Tuesday, April 9, 2019 9:21 PM
To: Blodgett, Meghan <mblodgett@scsengineers.com>; Schemmel, Nick <NSchemmel@scsengineers.com>; Karwoski, Thomas <TKarwoski@scsengineers.com>
Subject: TestAmerica Sample Login Confirmation files from 310-152915 IPL Ottumwa Generating Station 25219072

Hello Everyone,

Please send over field data when you can.
Thanks,
Sandie

Attached, please find the Sample Confirmation files for job 310-152915; IPL Ottumwa Generating Station 25219072

Please feel free to contact me if you have any questions.

Thank you.

Sandie Fredrick
Project Manager

TestAmerica Laboratories, Inc.
Phone: 920-261-1660

E-mail: sandie.fredrick@testamericainc.com
www.eurofinsus.com | www.testamericainc.com

Reference: [310-351154]
Attachments: 5

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

310-152915 Chain of Custody

Cooler/Sample Receipt and Temperature Log Form

Client Information

Client: SCS Engineers

City/State: CITY Clive STATE IA

Project: IPL-Ottumwa Generating Station

Receipt Information

Date/Time Received: DATE 4-9-19 TIME ~~15~~ 1715 4-9LAB

Received By: LAB

Delivery Type: ☐ UPS ☐ FedEx ☐ FedEx Ground ☐ US Mail ☐ Spee-Dee
☑ Lab Courier ☐ TA Field Services ☐ Client Drop-off ☐ Other:__________

Condition of Cooler/Containers

Sample(s) received in Cooler? ☒ Yes ☐ No *If yes:* Cooler ID:

Multiple Coolers? ☑ Yes ☐ No *If yes:* Cooler # 1 of 2

Cooler Custody Seals Present? ☑ Yes ☐ No *If yes:* Cooler custody seals intact? ☒ Yes ☐ No

Sample Custody Seals Present? ☐ Yes ☒ No *If yes:* Sample custody seals intact? ☐ Yes ☐ No

Trip Blank Present? ☐ Yes ☒ No *If yes:* Which VOA samples are in cooler? ↓

Temperature Record

Coolant: ☒ Wet ice ☐ Blue ice ☐ Dry ice ☐ Other:__________ ☐ NONE

Thermometer ID: N

Correction Factor (°C): +0.0

• Temp Blank Temperature – If no temp blank, or temp blank temperature above criteria, proceed to Sample Container Temperature

Uncorrected Temp (°C): 0.1

Corrected Temp (°C): 0.1

• Sample Container Temperature

Container type(s) used: CONTAINER 1 CONTAINER 2

Uncorrected Temp (°C): TEMP 1 TEMP 2

Corrected Temp (°C): TEMP 1 TEMP 2

Exceptions Noted

1) If temperature exceeds criteria, was sample(s) received same day of sampling? ☐ Yes ☐ No
   a) *If yes:* Is there evidence that the chilling process began? ☐ Yes ☐ No

2) If temperature is <0°C, are there obvious signs that the integrity of sample containers is compromised? (e.g., bulging septa, broken/cracked bottles, frozen solid?) ☐ Yes ☐ No

NOTE: If yes, contact PM before proceeding. If no, proceed with login

Additional Comments

Document: CF-LG-WI-002
Revision: 24
Date: 03/07/2019

General temperature criteria is 0 to 6°C
Bacteria temperature criteria is 0 to 10°C

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Place COC scanning label here
214

Cooler/Sample Receipt and Temperature Log Form

Client Information

Client: SCS Engineers

City/State: CITY Clive STATE IA | Project: IPL - Ottumwa Generating Station

Receipt Information

Date/Time Received: DATE 4-9-19 TIME ~~15~~ 1715 4-9LAB | Received By: LAB

Delivery Type: ☐ UPS ☐ FedEx ☐ FedEx Ground ☐ US Mail ☐ Spee-Dee
☒ Lab Courier ☐ TA Field Services ☐ Client Drop-off ☐ Other:

Condition of Cooler/Containers

Sample(s) received in Cooler?	☒ Yes	☐ No	*If yes:* Cooler ID:
Multiple Coolers?	☒ Yes	☐ No	*If yes:* Cooler # 2 of 2
Cooler Custody Seals Present?	☒ Yes	☐ No	*If yes:* Cooler custody seals intact? ☒ Yes ☐ No
Sample Custody Seals Present?	☐ Yes	☒ No	*If yes:* Sample custody seals intact? ☐ Yes ☐ No
Trip Blank Present?	☐ Yes	☒ No	*If yes:* Which VOA samples are in cooler? ↓

Temperature Record

Coolant: ☒ Wet ice ☐ Blue ice ☐ Dry ice ☐ Other: ☐ NONE

Thermometer ID: N | Correction Factor (°C): +0.0

• Temp Blank Temperature – If no temp blank, or temp blank temperature above criteria, proceed to Sample Container Temperature

Uncorrected Temp (°C): 0.8 | Corrected Temp (°C): 0.8

• Sample Container Temperature

Container type(s) used: CONTAINER 1 | CONTAINER 2

Uncorrected Temp (°C): TEMP 1 | TEMP 2 | Corrected Temp (°C): TEMP 1 | TEMP 2

Exceptions Noted

1) If temperature exceeds criteria, was sample(s) received same day of sampling? ☐ Yes ☐ No
a) *If yes:* Is there evidence that the chilling process began? ☐ Yes ☐ No

2) If temperature is <0°C, are there obvious signs that the integrity of sample containers is compromised? (e.g., bulging septa, broken/cracked bottles, frozen solid?) ☐ Yes ☐ No

NOTE: If yes, contact PM before proceeding. If no, proceed with login

Additional Comments

Document: CF-LG-WI-002
Revision: 24
Date: 03/07/2019

TestAmerica-Cedar Falls

General temperature criteria is 0 to 6°C
Bacteria temperature criteria is 0 to 10°C

\# 38727

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Cedar Falls Division
704 Enterprise Drive
Cedar Falls, IA 50613

Phone 319-277-2401 or 800-750-2401
Fax 319-277-2425

TestAmerica Des Moines SC
214

To assist us in using the proper analytical methods, is this work being conducted for regulatory purposes?
Compliance Monitoring

Client Name: SCS Engineers
Client #:
Address: 8450 Hickman Rd Suite 20
City/State/Zip Code: Clive IA 50325
Project Manager: Tom Karwoski
Email Address:
Telephone Number: 608-509-~~82~~ 8245
Fax:
Sampler Name: (Print Name) Nick Schemmel
Sampler Signature:

Project Name: IPL-Ottumwa Generating Station
Project #: 25219072
Site/Location ID: Ottumwa
State: IA
Report To:
Invoice To:
Quote #:
PO#:

TAT
___ Standard
___ Rush (surcharges may apply)

Date Needed:

Fax Results: Y N
Email Results: Y N

QC Deliverables
___ None
___ Level 2 (Batch QC)
___ Level 3
___ Level 4
Other:

SAMPLE ID	Date Sampled	Time Sampled	G = Grab, C = Composite	Field Filtered	Matrix: SL - Sludge DW - Drinking Water GW - Groundwater S - Soil/Solid WW - Wastewater Specify, Other	HNO₃	HCl	NaOH	H₂SO₄	Methanol	None	Other (Specify)	Metals	pH	TDS	Chloride/Fluoride/SO4	Radium 226 + 228					REMARKS
MW 301	4.8.19	0932	G		GW	3					1		x	x	x	x	x					
MW 302		1036				3					1		x	x	x	x	x					
MW 303		1141				3					1		x	x	x	x	x					
MW 304		1253				3					1		x	x	x	x	x					
MW 305		1339				3					1		x	x	x	x	x					
MW 306		1425				3					1		x	x	x	x	x					
Field Blank		1430				3					1		x	x	x	x	x					

Special Instructions:

LABORATORY COMMENTS:

Relinquished By: Nick Schemmel	Date: 4-9-19	Time: 1000	Received By: Lindsay Bindert	Date: 4-9-19	Time: 1715
Relinquished By:	Date:	Time:	Received By:	Date:	Time:
Relinquished By:	Date:	Time:	Received By:	Date:	Time:

TAL-0033 (0708)

Page ___ of ___

4/9/2019

Login Container Summary Report

310-152915

Temperature readings: ____________________

Client Sample ID	Lab ID	Container Type	Container pH	Preservative Added (mls)	Lot #
MW 301	310-152915-A-1	Plastic 250ml - with Nitric Acid	<2		
MW 301	310-152915-C-1	Plastic 1 liter - Nitric Acid	<2		
MW 301	310-152915-D-1	Plastic 1 liter - Nitric Acid	<2		
MW 302	310-152915-A-2	Plastic 250ml - with Nitric Acid	<2		
MW 302	310-152915-C-2	Plastic 1 liter - Nitric Acid	<2		
MW 302	310-152915-D-2	Plastic 1 liter - Nitric Acid	<2		
MW 303	310-152915-A-3	Plastic 250ml - with Nitric Acid	<2		
MW 303	310-152915-C-3	Plastic 1 liter - Nitric Acid	<2		
MW 303	310-152915-D-3	Plastic 1 liter - Nitric Acid	<2		
MW 304	310-152915-A-4	Plastic 250ml - with Nitric Acid	<2		
MW 304	310-152915-C-4	Plastic 1 liter - Nitric Acid	<2		
MW 304	310-152915-D-4	Plastic 1 liter - Nitric Acid	<2		
MW 305	310-152915-A-5	Plastic 250ml - with Nitric Acid	<2		
MW 305	310-152915-C-5	Plastic 1 liter - Nitric Acid	<2		
MW 305	310-152915-D-5	Plastic 1 liter - Nitric Acid	<2		
MW 306	310-152915-A-6	Plastic 250ml - with Nitric Acid	<2		
MW 306	310-152915-C-6	Plastic 1 liter - Nitric Acid	<2		
MW 306	310-152915-D-6	Plastic 1 liter - Nitric Acid	<2		
Field Blank	310-152915-A-7	Plastic 250ml - with Nitric Acid	<2		
Field Blank	310-152915-C-7	Plastic 1 liter - Nitric Acid	<2		
Field Blank	310-152915-D-7	Plastic 1 liter - Nitric Acid	<2		
MW 307	310-152915-A-8	Plastic 250ml - with Nitric Acid	<2		
MW 308	310-152915-A-9	Plastic 250ml - with Nitric Acid	<2		
MW 309	310-152915-A-10	Plastic 250ml - with Nitric Acid	<2		

Table 2. Groundwater Monitoring Results - Field Parameters
Ottumwa Generating Station / SCS Engineers Project No. 25219072
April 2019

Sample	Date/Sample Time	Groundwater Elevation (amsl)	Temperature (Deg. C)	pH (Std. Units)	Dissolved Oxygen (mg/L)	Specific Conductivity (µmhos/cm)	ORP (mV)	Turbidity
MW-301	4-8-2019/0932	682.69	7.27	6.61	8.32	501	37.6	1.87
MW-302	4-8-2019/1036	657.23	12.27	6.61	0.86	2159	68.3	26.9
MW-303	4-8-2019/1141	655.55	8.51	7.00	2.29	1181	51.7	3.49
MW-304	4-8-2019/1253	659.33	13.75	7.17	0.41	1876	-58.3	57.9
MW-305	4-8-2019/1339	664.01	13.8	7.06	0.59	1728	32.6	21.7
MW-306	4-8-2019/1425	670.96	13.63	6.66	0.92	1350	49.1	28.5

Abbreviations:
mg/L = milligrams per liter
amsl = above mean sea level
NA = Not Analyzed

Notes:
none

Created by:	KAK	Date: 5/1/2017
Last revision by:	JR	Date: 4/12/2019
Checked by:	MDB	Date: 4/12/2019

\\Mad-fs01\data\Projects\25219072.00\Data and Calculations\Tables\[OGS_CCR_Field_2019_April.xlsx]GW Field Parameters

Login Sample Receipt Checklist

Client: SCS Engineers

Job Number: 310-152915-2
SDG Number: 25219072

Login Number: 152915
List Number: 1
Creator: Bindert, Lindsay A

List Source: Eurofins TestAmerica, Cedar Falls

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	N/A	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

Login Sample Receipt Checklist

Client: SCS Engineers

Job Number: 310-152915-2
SDG Number: 25219072

Login Number: 152915
List Number: 2
Creator: Hellm, Michael

List Source: Eurofins TestAmerica, St. Louis
List Creation: 04/11/19 06:01 PM

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	N/A	
Sample custody seals, if present, are intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	N/A	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	18.0
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	N/A	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	N/A	
Multiphasic samples are not present.	N/A	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

Tracer/Carrier Summary

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-2
SDG: 25219072

Method: 903.0 - Radium-226 (GFPC)

Matrix: Ground Water

Prep Type: Total/NA

Percent Yield (Acceptance Limits)

Lab Sample ID	Client Sample ID	Ba Carrier (40-110)
310-152915-1	MW 301	93.5
310-152915-2	MW 302	95.8
310-152915-3	MW 303	87.9
310-152915-4	MW 304	87.3
310-152915-5	MW 305	91.0
310-152915-6	MW 306	87.9
310-152915-7	Field Blank	99.4

Tracer/Carrier Legend

Ba Carrier = Ba Carrier

Method: 903.0 - Radium-226 (GFPC)

Matrix: Water

Prep Type: Total/NA

Percent Yield (Acceptance Limits)

Lab Sample ID	Client Sample ID	Ba Carrier (40-110)
LCS 160-425538/1-A	Lab Control Sample	99.7
LCSD 160-425538/2-A	Lab Control Sample Dup	98.9
MB 160-425538/23-A	Method Blank	96.0

Tracer/Carrier Legend

Ba Carrier = Ba Carrier

Method: 904.0 - Radium-228 (GFPC)

Matrix: Ground Water

Prep Type: Total/NA

Percent Yield (Acceptance Limits)

Lab Sample ID	Client Sample ID	Ba Carrier (40-110)	Y Carrier (40-110)
310-152915-1	MW 301	93.5	93.1
310-152915-2	MW 302	95.8	86.4
310-152915-3	MW 303	87.9	89.7
310-152915-4	MW 304	87.3	94.2
310-152915-5	MW 305	91.0	95.3
310-152915-6	MW 306	87.9	96.1
310-152915-7	Field Blank	99.4	95.3

Tracer/Carrier Legend

Ba Carrier = Ba Carrier
Y Carrier = Y Carrier

Method: 904.0 - Radium-228 (GFPC)

Matrix: Water

Prep Type: Total/NA

Percent Yield (Acceptance Limits)

Lab Sample ID	Client Sample ID	Ba Carrier (40-110)	Y Carrier (40-110)
LCS 160-425541/1-A	Lab Control Sample	99.7	95.3
LCSD 160-425541/2-A	Lab Control Sample Dup	98.9	83.7
MB 160-425541/23-A	Method Blank	96.0	93.5

Tracer/Carrier Legend

Tracer/Carrier Summary

Ba Carrier = Ba Carrier
Y Carrier = Y Carrier

A2 Assessment Monitoring Sampling, October 2019

eurofins | Environment Testing
TestAmerica

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ANALYTICAL REPORT

Eurofins TestAmerica, Cedar Falls
3019 Venture Way
Cedar Falls, IA 50613
Tel: (319)277-2401

Laboratory Job ID: 310-168508-1
Client Project/Site: Ottumwa Generating Station 25219072
Revision: 1

For:
SCS Engineers
2830 Dairy Drive
Madison, Wisconsin 53718

Attn: Meghan Blodgett

Sandie Fredrick

Authorized for release by:
1/6/2020 3:25:33 PM

Sandie Fredrick, Project Manager II
(920)261-1660
sandie.fredrick@testamericainc.com

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

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Table of Contents

Case Narrative

Job ID: 310-168508-1

Laboratory: Eurofins TestAmerica, Cedar Falls

Narrative

Job Narrative
310-168508-1

Comments
REVISION: Client requested split report

Receipt
The samples were received on 10/25/2019 6:30 PM; the samples arrived in good condition, properly preserved and, where required, on ice. The temperatures of the 2 coolers at receipt time were 1.2º C and 4.3º C.

HPLC/IC
Method 9056A: The following samples were diluted due to the nature of the sample matrix: MW-301 (310-168508-1), MW-302 (310-168508-2), MW-303 (310-168508-3), MW-305 (310-168508-5), MW-306 (310-168508-6), MW-310 (310-168508-11) and MW-311 (310-168508-12). Elevated reporting limits (RLs) are provided.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Metals
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

General Chemistry
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

Sample Summary

Client: SCS Engineers
Project/Site: Ottumwa Generating Station 25219072

Job ID: 310-168508-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received	Asset ID
310-168508-1	MW-301	Water	10/24/19 09:00	10/25/19 18:30	
310-168508-2	MW-302	Water	10/24/19 10:20	10/25/19 18:30	
310-168508-3	MW-303	Water	10/24/19 12:00	10/25/19 18:30	
310-168508-4	MW-304	Water	10/23/19 14:27	10/25/19 18:30	
310-168508-5	MW-305	Water	10/23/19 16:15	10/25/19 18:30	
310-168508-6	MW-306	Water	10/23/19 17:00	10/25/19 18:30	
310-168508-7	FIELD BLANK	Water	10/23/19 23:59	10/25/19 18:30	
310-168508-11	MW-310	Water	10/24/19 12:50	10/25/19 18:30	
310-168508-12	MW-311	Water	10/24/19 13:45	10/25/19 18:30	

Detection Summary

Client: SCS Engineers
Project/Site: Ottumwa Generating Station 25219072

Job ID: 310-168508-1

Client Sample ID: MW-301 — Lab Sample ID: 310-168508-1

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloride	110		5.0	1.5	mg/L	5		9056A	Total/NA
Sulfate	130		5.0	1.8	mg/L	5		9056A	Total/NA
Barium	56		2.0	0.84	ug/L	1		6020A	Total/NA
Boron	680		200	110	ug/L	1		6020A	Total/NA
Cadmium	0.040	J	0.10	0.039	ug/L	1		6020A	Total/NA
Calcium	78		0.50	0.10	mg/L	1		6020A	Total/NA
Cobalt	0.60		0.50	0.091	ug/L	1		6020A	Total/NA
Lithium	24		10	2.7	ug/L	1		6020A	Total/NA
Molybdenum	1.1	J	2.0	1.1	ug/L	1		6020A	Total/NA
Selenium	6.2		5.0	1.0	ug/L	1		6020A	Total/NA
Total Dissolved Solids	510		30	24	mg/L	1		SM 2540C	Total/NA
pH	7.1	HF	0.1	0.1	SU	1		SM 4500 H+ B	Total/NA
Ground Water Elevation	683.07				ft	1		Field Sampling	Total/NA
Oxidation Reduction Potential	9.9				millivolts	1		Field Sampling	Total/NA
Oxygen, Dissolved, Client Supplied	4.94				mg/L	1		Field Sampling	Total/NA
pH, Field	6.33				SU	1		Field Sampling	Total/NA
Specific Conductance, Field	902				umhos/cm	1		Field Sampling	Total/NA
Temperature, Field	13.71				Degrees C	1		Field Sampling	Total/NA
Turbidity, Field	1.6				NTU	1		Field Sampling	Total/NA

Client Sample ID: MW-302 — Lab Sample ID: 310-168508-2

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloride	220		5.0	1.5	mg/L	5		9056A	Total/NA
Sulfate	810		20	7.0	mg/L	20		9056A	Total/NA
Barium	21		2.0	0.84	ug/L	1		6020A	Total/NA
Boron	1200		200	110	ug/L	1		6020A	Total/NA
Cadmium	0.20		0.10	0.039	ug/L	1		6020A	Total/NA
Calcium	180		0.50	0.10	mg/L	1		6020A	Total/NA
Cobalt	2.7		0.50	0.091	ug/L	1		6020A	Total/NA
Lead	0.29	J	0.50	0.27	ug/L	1		6020A	Total/NA
Lithium	10		10	2.7	ug/L	1		6020A	Total/NA
Total Dissolved Solids	1600		150	120	mg/L	1		SM 2540C	Total/NA
pH	7.2	HF	0.1	0.1	SU	1		SM 4500 H+ B	Total/NA
Ground Water Elevation	660.14				ft	1		Field Sampling	Total/NA
Oxidation Reduction Potential	-0.5				millivolts	1		Field Sampling	Total/NA
Oxygen, Dissolved, Client Supplied	0.35				mg/L	1		Field Sampling	Total/NA
pH, Field	6.55				SU	1		Field Sampling	Total/NA
Specific Conductance, Field	2184				umhos/cm	1		Field Sampling	Total/NA
Temperature, Field	12.91				Degrees C	1		Field Sampling	Total/NA
Turbidity, Field	11.9				NTU	1		Field Sampling	Total/NA

Client Sample ID: MW-303 — Lab Sample ID: 310-168508-3

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloride	35		5.0	1.5	mg/L	5		9056A	Total/NA
Sulfate	180		5.0	1.8	mg/L	5		9056A	Total/NA
Barium	77		2.0	0.84	ug/L	1		6020A	Total/NA
Boron	440		200	110	ug/L	1		6020A	Total/NA
Cadmium	0.21		0.10	0.039	ug/L	1		6020A	Total/NA
Calcium	170		0.50	0.10	mg/L	1		6020A	Total/NA
Cobalt	1.2		0.50	0.091	ug/L	1		6020A	Total/NA

This Detection Summary does not include radiochemical test results.

Detection Summary

Client Sample ID: MW-303 (Continued)

Lab Sample ID: 310-168508-3

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Molybdenum	5.2		2.0	1.1	ug/L	1		6020A	Total/NA
Total Dissolved Solids	810		30	24	mg/L	1		SM 2540C	Total/NA
pH	7.5	HF	0.1	0.1	SU	1		SM 4500 H+ B	Total/NA
Ground Water Elevation	653.86				ft	1		Field Sampling	Total/NA
Oxidation Reduction Potential	-5.1				millivolts	1		Field Sampling	Total/NA
Oxygen, Dissolved, Client Supplied	0.28				mg/L	1		Field Sampling	Total/NA
pH, Field	6.83				SU	1		Field Sampling	Total/NA
Specific Conductance, Field	1287				umhos/cm	1		Field Sampling	Total/NA
Temperature, Field	15.34				Degrees C	1		Field Sampling	Total/NA
Turbidity, Field	4.24				NTU	1		Field Sampling	Total/NA

Client Sample ID: MW-304

Lab Sample ID: 310-168508-4

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloride	280		10	2.9	mg/L	10		9056A	Total/NA
Fluoride	0.74		0.50	0.23	mg/L	5		9056A	Total/NA
Sulfate	190		5.0	1.8	mg/L	5		9056A	Total/NA
Arsenic	0.83	J	2.0	0.75	ug/L	1		6020A	Total/NA
Barium	80		2.0	0.84	ug/L	1		6020A	Total/NA
Boron	970		200	110	ug/L	1		6020A	Total/NA
Calcium	120		0.50	0.10	mg/L	1		6020A	Total/NA
Chromium	2.0	J	5.0	0.98	ug/L	1		6020A	Total/NA
Cobalt	0.50		0.50	0.091	ug/L	1		6020A	Total/NA
Lead	0.27	J	0.50	0.27	ug/L	1		6020A	Total/NA
Lithium	2.8	J	10	2.7	ug/L	1		6020A	Total/NA
Molybdenum	2.3		2.0	1.1	ug/L	1		6020A	Total/NA
Total Dissolved Solids	1100		30	24	mg/L	1		SM 2540C	Total/NA
pH	7.7	HF	0.1	0.1	SU	1		SM 4500 H+ B	Total/NA
Ground Water Elevation	657.71				ft	1		Field Sampling	Total/NA
Oxidation Reduction Potential	-57.5				millivolts	1		Field Sampling	Total/NA
Oxygen, Dissolved, Client Supplied	0.44				mg/L	1		Field Sampling	Total/NA
pH, Field	7.05				SU	1		Field Sampling	Total/NA
Specific Conductance, Field	1871				umhos/cm	1		Field Sampling	Total/NA
Temperature, Field	13.64				Degrees C	1		Field Sampling	Total/NA
Turbidity, Field	18.9				NTU	1		Field Sampling	Total/NA

Client Sample ID: MW-305

Lab Sample ID: 310-168508-5

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloride	280		10	2.9	mg/L	10		9056A	Total/NA
Sulfate	76		5.0	1.8	mg/L	5		9056A	Total/NA
Barium	110		2.0	0.84	ug/L	1		6020A	Total/NA
Boron	880		200	110	ug/L	1		6020A	Total/NA
Cadmium	0.087	J	0.10	0.039	ug/L	1		6020A	Total/NA
Calcium	100		0.50	0.10	mg/L	1		6020A	Total/NA
Cobalt	17		0.50	0.091	ug/L	1		6020A	Total/NA
Molybdenum	7.2		2.0	1.1	ug/L	1		6020A	Total/NA
Thallium	0.38	J	1.0	0.27	ug/L	1		6020A	Total/NA
Total Dissolved Solids	1000		30	24	mg/L	1		SM 2540C	Total/NA
pH	7.5	HF	0.1	0.1	SU	1		SM 4500 H+ B	Total/NA
Ground Water Elevation	663.21				ft	1		Field Sampling	Total/NA
Oxidation Reduction Potential	-6.7				millivolts	1		Field Sampling	Total/NA

This Detection Summary does not include radiochemical test results.

Detection Summary

Client: SCS Engineers　　Job ID: 310-168508-1

Project/Site: Ottumwa Generating Station 25219072

Client Sample ID: MW-305 (Continued)　　Lab Sample ID: 310-168508-5

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Oxygen, Dissolved, Client Supplied	0.42				mg/L	1		Field Sampling	Total/NA
pH, Field	6.91				SU	1		Field Sampling	Total/NA
Specific Conductance, Field	1794				umhos/cm	1		Field Sampling	Total/NA
Temperature, Field	13.2				Degrees C	1		Field Sampling	Total/NA
Turbidity, Field	6.21				NTU	1		Field Sampling	Total/NA

Client Sample ID: MW-306　　Lab Sample ID: 310-168508-6

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloride	47		5.0	1.5	mg/L	5		9056A	Total/NA
Sulfate	280		20	7.0	mg/L	20		9056A	Total/NA
Arsenic	0.78	J	2.0	0.75	ug/L	1		6020A	Total/NA
Barium	51		2.0	0.84	ug/L	1		6020A	Total/NA
Boron	980		200	110	ug/L	1		6020A	Total/NA
Cadmium	0.89		0.10	0.039	ug/L	1		6020A	Total/NA
Calcium	77		0.50	0.10	mg/L	1		6020A	Total/NA
Chromium	1.0	J	5.0	0.98	ug/L	1		6020A	Total/NA
Cobalt	6.2		0.50	0.091	ug/L	1		6020A	Total/NA
Lead	0.34	J	0.50	0.27	ug/L	1		6020A	Total/NA
Molybdenum	4.9		2.0	1.1	ug/L	1		6020A	Total/NA
Total Dissolved Solids	870		30	24	mg/L	1		SM 2540C	Total/NA
pH	7.4	HF	0.1	0.1	SU	1		SM 4500 H+ B	Total/NA
Ground Water Elevation	671.28				ft	1		Field Sampling	Total/NA
Oxidation Reduction Potential	-0.5				millivolts	1		Field Sampling	Total/NA
Oxygen, Dissolved, Client Supplied	0.29				mg/L	1		Field Sampling	Total/NA
pH, Field	6.74				SU	1		Field Sampling	Total/NA
Specific Conductance, Field	1266				umhos/cm	1		Field Sampling	Total/NA
Temperature, Field	13.12				Degrees C	1		Field Sampling	Total/NA
Turbidity, Field	12.3				NTU	1		Field Sampling	Total/NA

Client Sample ID: FIELD BLANK　　Lab Sample ID: 310-168508-7

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Total Dissolved Solids	74		30	24	mg/L	1		SM 2540C	Total/NA
pH	6.8	HF	0.1	0.1	SU	1		SM 4500 H+ B	Total/NA

Client Sample ID: MW-310　　Lab Sample ID: 310-168508-11

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloride	150		5.0	1.5	mg/L	5		9056A	Total/NA
Fluoride	0.31	J	0.50	0.23	mg/L	5		9056A	Total/NA
Sulfate	610		20	7.0	mg/L	20		9056A	Total/NA
Arsenic	0.78	J	2.0	0.75	ug/L	1		6020A	Total/NA
Barium	76		2.0	0.84	ug/L	1		6020A	Total/NA
Boron	720		200	110	ug/L	1		6020A	Total/NA
Cadmium	0.22		0.10	0.039	ug/L	1		6020A	Total/NA
Calcium	230		0.50	0.10	mg/L	1		6020A	Total/NA
Cobalt	0.57		0.50	0.091	ug/L	1		6020A	Total/NA
Lithium	35		10	2.7	ug/L	1		6020A	Total/NA
Molybdenum	26		2.0	1.1	ug/L	1		6020A	Total/NA
Selenium	5.0		5.0	1.0	ug/L	1		6020A	Total/NA
Total Dissolved Solids	260		30	24	mg/L	1		SM 2540C	Total/NA

This Detection Summary does not include radiochemical test results.

Detection Summary

Client: SCS Engineers Job ID: 310-168508-1
Project/Site: Ottumwa Generating Station 25219072

Client Sample ID: MW-310 (Continued) Lab Sample ID: 310-168508-11

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
pH	7.2	HF	0.1	0.1	SU	1		SM 4500 H+ B	Total/NA
Ground Water Elevation	649.31				ft	1		Field Sampling	Total/NA
Oxidation Reduction Potential	-9.3				millivolts	1		Field Sampling	Total/NA
Oxygen, Dissolved, Client Supplied	0.41				mg/L	1		Field Sampling	Total/NA
pH, Field	7.15				SU	1		Field Sampling	Total/NA
Specific Conductance, Field	1906				umhos/cm	1		Field Sampling	Total/NA
Temperature, Field	13.74				Degrees C	1		Field Sampling	Total/NA
Turbidity, Field	2.29				NTU	1		Field Sampling	Total/NA

Client Sample ID: MW-311 Lab Sample ID: 310-168508-12

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloride	13		5.0	1.5	mg/L	5		9056A	Total/NA
Sulfate	47		5.0	1.8	mg/L	5		9056A	Total/NA
Barium	200		2.0	0.84	ug/L	1		6020A	Total/NA
Cadmium	0.040	J	0.10	0.039	ug/L	1		6020A	Total/NA
Calcium	170		0.50	0.10	mg/L	1		6020A	Total/NA
Cobalt	0.78		0.50	0.091	ug/L	1		6020A	Total/NA
Lithium	4.7	J	10	2.7	ug/L	1		6020A	Total/NA
Total Dissolved Solids	530		30	24	mg/L	1		SM 2540C	Total/NA
pH	7.0	HF	0.1	0.1	SU	1		SM 4500 H+ B	Total/NA
Ground Water Elevation	647.80				ft	1		Field Sampling	Total/NA
Oxidation Reduction Potential	-24.7				millivolts	1		Field Sampling	Total/NA
Oxygen, Dissolved, Client Supplied	0.29				mg/L	1		Field Sampling	Total/NA
pH, Field	6.95				SU	1		Field Sampling	Total/NA
Specific Conductance, Field	926				umhos/cm	1		Field Sampling	Total/NA
Temperature, Field	13.88				Degrees C	1		Field Sampling	Total/NA
Turbidity, Field	3.88				NTU	1		Field Sampling	Total/NA

This Detection Summary does not include radiochemical test results.

Client Sample Results

Client: SCS Engineers | Job ID: 310-168508-1
Project/Site: Ottumwa Generating Station 25219072

Client Sample ID: MW-301 | Lab Sample ID: 310-168508-1

Date Collected: 10/24/19 09:00 | **Matrix: Water**
Date Received: 10/25/19 18:30

Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**110**		5.0	1.5	mg/L			10/31/19 11:59	5
Fluoride	<0.23		0.50	0.23	mg/L			10/31/19 11:59	5
Sulfate	**130**		5.0	1.8	mg/L			10/31/19 11:59	5

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.53		1.0	0.53	ug/L		10/29/19 08:00	10/29/19 21:22	1
Arsenic	<0.75		2.0	0.75	ug/L		10/29/19 08:00	10/29/19 21:22	1
Barium	**56**		2.0	0.84	ug/L		10/29/19 08:00	10/29/19 21:22	1
Beryllium	<0.27		1.0	0.27	ug/L		10/29/19 08:00	10/29/19 21:22	1
Boron	**680**		200	110	ug/L		10/29/19 08:00	10/29/19 21:22	1
Cadmium	**0.040**	**J**	0.10	0.039	ug/L		10/29/19 08:00	10/29/19 21:22	1
Calcium	**78**		0.50	0.10	mg/L		10/29/19 08:00	10/29/19 21:22	1
Chromium	<0.98		5.0	0.98	ug/L		10/29/19 08:00	10/29/19 21:22	1
Cobalt	**0.60**		0.50	0.091	ug/L		10/29/19 08:00	10/29/19 21:22	1
Lead	<0.27		0.50	0.27	ug/L		10/29/19 08:00	10/29/19 21:22	1
Lithium	**24**		10	2.7	ug/L		10/29/19 08:00	10/29/19 21:22	1
Molybdenum	**1.1**	**J**	2.0	1.1	ug/L		10/29/19 08:00	10/29/19 21:22	1
Selenium	**6.2**		5.0	1.0	ug/L		10/29/19 08:00	10/29/19 21:22	1
Thallium	<0.27		1.0	0.27	ug/L		10/29/19 08:00	10/29/19 21:22	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.10		0.20	0.10	ug/L		10/30/19 12:40	10/31/19 13:13	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	**510**		30	24	mg/L			10/31/19 14:13	1
pH	**7.1**	**HF**	0.1	0.1	SU			10/25/19 22:47	1

Method: Field Sampling - Field Sampling

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Ground Water Elevation	**683.07**				ft			10/24/19 09:00	1
Oxidation Reduction Potential	**9.9**				millivolts			10/24/19 09:00	1
Oxygen, Dissolved, Client Supplied	**4.94**				mg/L			10/24/19 09:00	1
pH, Field	**6.33**				SU			10/24/19 09:00	1
Specific Conductance, Field	**902**				umhos/cm			10/24/19 09:00	1
Temperature, Field	**13.71**				Degrees C			10/24/19 09:00	1
Turbidity, Field	**1.6**				NTU			10/24/19 09:00	1

Client Sample Results

Client: SCS Engineers
Project/Site: Ottumwa Generating Station 25219072

Job ID: 310-168508-1

Client Sample ID: MW-302

Date Collected: 10/24/19 10:20
Date Received: 10/25/19 18:30

Lab Sample ID: 310-168508-2
Matrix: Water

Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**220**		5.0	1.5	mg/L			10/31/19 12:15	5
Fluoride	<0.23		0.50	0.23	mg/L			10/31/19 12:15	5
Sulfate	**810**		20	7.0	mg/L			11/01/19 11:35	20

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.53		1.0	0.53	ug/L		10/29/19 08:00	10/29/19 21:36	1
Arsenic	<0.75		2.0	0.75	ug/L		10/29/19 08:00	10/29/19 21:36	1
Barium	**21**		2.0	0.84	ug/L		10/29/19 08:00	10/29/19 21:36	1
Beryllium	<0.27		1.0	0.27	ug/L		10/29/19 08:00	10/29/19 21:36	1
Boron	**1200**		200	110	ug/L		10/29/19 08:00	10/29/19 21:36	1
Cadmium	**0.20**		0.10	0.039	ug/L		10/29/19 08:00	10/29/19 21:36	1
Calcium	**180**		0.50	0.10	mg/L		10/29/19 08:00	10/29/19 21:36	1
Chromium	<0.98		5.0	0.98	ug/L		10/29/19 08:00	10/29/19 21:36	1
Cobalt	**2.7**		0.50	0.091	ug/L		10/29/19 08:00	10/29/19 21:36	1
Lead	**0.29**	**J**	0.50	0.27	ug/L		10/29/19 08:00	10/29/19 21:36	1
Lithium	**10**		10	2.7	ug/L		10/29/19 08:00	10/29/19 21:36	1
Molybdenum	<1.1		2.0	1.1	ug/L		10/29/19 08:00	10/29/19 21:36	1
Selenium	<1.0		5.0	1.0	ug/L		10/29/19 08:00	10/29/19 21:36	1
Thallium	<0.27		1.0	0.27	ug/L		10/29/19 08:00	10/29/19 21:36	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.10		0.20	0.10	ug/L		10/30/19 12:40	10/31/19 13:15	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	**1600**		150	120	mg/L			10/31/19 14:13	1
pH	**7.2**	**HF**	0.1	0.1	SU			10/25/19 22:50	1

Method: Field Sampling - Field Sampling

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Ground Water Elevation	**660.14**				ft			10/24/19 10:20	1
Oxidation Reduction Potential	**-0.5**				millivolts			10/24/19 10:20	1
Oxygen, Dissolved, Client Supplied	**0.35**				mg/L			10/24/19 10:20	1
pH, Field	**6.55**				SU			10/24/19 10:20	1
Specific Conductance, Field	**2184**				umhos/cm			10/24/19 10:20	1
Temperature, Field	**12.91**				Degrees C			10/24/19 10:20	1
Turbidity, Field	**11.9**				NTU			10/24/19 10:20	1

Client Sample Results

Client: SCS Engineers
Job ID: 310-168508-1
Project/Site: Ottumwa Generating Station 25219072

Client Sample ID: MW-303
Date Collected: 10/24/19 12:00
Date Received: 10/25/19 18:30

Lab Sample ID: 310-168508-3
Matrix: Water

Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**35**		5.0	1.5	mg/L			10/31/19 12:30	5
Fluoride	<0.23		0.50	0.23	mg/L			10/31/19 12:30	5
Sulfate	**180**		5.0	1.8	mg/L			10/31/19 12:30	5

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.53		1.0	0.53	ug/L		10/29/19 08:00	10/29/19 21:39	1
Arsenic	<0.75		2.0	0.75	ug/L		10/29/19 08:00	10/29/19 21:39	1
Barium	**77**		2.0	0.84	ug/L		10/29/19 08:00	10/29/19 21:39	1
Beryllium	<0.27		1.0	0.27	ug/L		10/29/19 08:00	10/29/19 21:39	1
Boron	**440**		200	110	ug/L		10/29/19 08:00	10/29/19 21:39	1
Cadmium	**0.21**		0.10	0.039	ug/L		10/29/19 08:00	10/29/19 21:39	1
Calcium	**170**		0.50	0.10	mg/L		10/29/19 08:00	10/29/19 21:39	1
Chromium	<0.98		5.0	0.98	ug/L		10/29/19 08:00	10/29/19 21:39	1
Cobalt	**1.2**		0.50	0.091	ug/L		10/29/19 08:00	10/29/19 21:39	1
Lead	<0.27		0.50	0.27	ug/L		10/29/19 08:00	10/29/19 21:39	1
Lithium	<2.7		10	2.7	ug/L		10/29/19 08:00	10/29/19 21:39	1
Molybdenum	**5.2**		2.0	1.1	ug/L		10/29/19 08:00	10/29/19 21:39	1
Selenium	<1.0		5.0	1.0	ug/L		10/29/19 08:00	10/29/19 21:39	1
Thallium	<0.27		1.0	0.27	ug/L		10/29/19 08:00	10/29/19 21:39	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.10		0.20	0.10	ug/L		10/30/19 12:40	10/31/19 13:21	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	**810**		30	24	mg/L			10/31/19 14:13	1
pH	**7.5**	**HF**	0.1	0.1	SU			10/25/19 22:52	1

Method: Field Sampling - Field Sampling

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Ground Water Elevation	**653.86**				ft			10/24/19 12:00	1
Oxidation Reduction Potential	**-5.1**				millivolts			10/24/19 12:00	1
Oxygen, Dissolved, Client Supplied	**0.28**				mg/L			10/24/19 12:00	1
pH, Field	**6.83**				SU			10/24/19 12:00	1
Specific Conductance, Field	**1287**				umhos/cm			10/24/19 12:00	1
Temperature, Field	**15.34**				Degrees C			10/24/19 12:00	1
Turbidity, Field	**4.24**				NTU			10/24/19 12:00	1

Client Sample Results

Client: SCS Engineers | Job ID: 310-168508-1

Project/Site: Ottumwa Generating Station 25219072

Client Sample ID: MW-304

Lab Sample ID: 310-168508-4

Date Collected: 10/23/19 14:27

Matrix: Water

Date Received: 10/25/19 18:30

Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**280**		10	2.9	mg/L			11/01/19 11:52	10
Fluoride	**0.74**		0.50	0.23	mg/L			10/31/19 12:46	5
Sulfate	**190**		5.0	1.8	mg/L			10/31/19 12:46	5

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.53		1.0	0.53	ug/L		10/29/19 08:00	10/29/19 21:42	1
Arsenic	**0.83**	**J**	2.0	0.75	ug/L		10/29/19 08:00	10/29/19 21:42	1
Barium	**80**		2.0	0.84	ug/L		10/29/19 08:00	10/29/19 21:42	1
Beryllium	<0.27		1.0	0.27	ug/L		10/29/19 08:00	10/29/19 21:42	1
Boron	**970**		200	110	ug/L		10/29/19 08:00	10/29/19 21:42	1
Cadmium	<0.039		0.10	0.039	ug/L		10/29/19 08:00	10/29/19 21:42	1
Calcium	**120**		0.50	0.10	mg/L		10/29/19 08:00	10/29/19 21:42	1
Chromium	**2.0**	**J**	5.0	0.98	ug/L		10/29/19 08:00	10/29/19 21:42	1
Cobalt	**0.50**		0.50	0.091	ug/L		10/29/19 08:00	10/29/19 21:42	1
Lead	**0.27**	**J**	0.50	0.27	ug/L		10/29/19 08:00	10/29/19 21:42	1
Lithium	**2.8**	**J**	10	2.7	ug/L		10/29/19 08:00	10/29/19 21:42	1
Molybdenum	**2.3**		2.0	1.1	ug/L		10/29/19 08:00	10/29/19 21:42	1
Selenium	<1.0		5.0	1.0	ug/L		10/29/19 08:00	10/29/19 21:42	1
Thallium	<0.27		1.0	0.27	ug/L		10/29/19 08:00	10/29/19 21:42	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.10		0.20	0.10	ug/L		10/30/19 12:40	10/31/19 13:36	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	**1100**		30	24	mg/L			10/29/19 13:03	1
pH	**7.7**	**HF**	0.1	0.1	SU			10/25/19 22:53	1

Method: Field Sampling - Field Sampling

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Ground Water Elevation	**657.71**				ft			10/23/19 14:27	1
Oxidation Reduction Potential	**-57.5**				millivolts			10/23/19 14:27	1
Oxygen, Dissolved, Client Supplied	**0.44**				mg/L			10/23/19 14:27	1
pH, Field	**7.05**				SU			10/23/19 14:27	1
Specific Conductance, Field	**1871**				umhos/cm			10/23/19 14:27	1
Temperature, Field	**13.64**				Degrees C			10/23/19 14:27	1
Turbidity, Field	**18.9**				NTU			10/23/19 14:27	1

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Client Sample Results

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Client Sample ID: MW-305

Date Collected: 10/23/19 16:15
Date Received: 10/25/19 18:30

Lab Sample ID: 310-168508-5
Matrix: Water

Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**280**		10	2.9	mg/L			11/01/19 12:08	10
Fluoride	<0.23		0.50	0.23	mg/L			10/31/19 13:01	5
Sulfate	**76**		5.0	1.8	mg/L			10/31/19 13:01	5

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.53		1.0	0.53	ug/L		10/29/19 08:00	10/29/19 21:46	1
Arsenic	<0.75		2.0	0.75	ug/L		10/29/19 08:00	10/29/19 21:46	1
Barium	**110**		2.0	0.84	ug/L		10/29/19 08:00	10/29/19 21:46	1
Beryllium	<0.27		1.0	0.27	ug/L		10/29/19 08:00	10/29/19 21:46	1
Boron	**880**		200	110	ug/L		10/29/19 08:00	10/29/19 21:46	1
Cadmium	**0.087**	**J**	0.10	0.039	ug/L		10/29/19 08:00	10/29/19 21:46	1
Calcium	**100**		0.50	0.10	mg/L		10/29/19 08:00	10/29/19 21:46	1
Chromium	<0.98		5.0	0.98	ug/L		10/29/19 08:00	10/29/19 21:46	1
Cobalt	**17**		0.50	0.091	ug/L		10/29/19 08:00	10/29/19 21:46	1
Lead	<0.27		0.50	0.27	ug/L		10/29/19 08:00	10/29/19 21:46	1
Lithium	<2.7		10	2.7	ug/L		10/29/19 08:00	10/29/19 21:46	1
Molybdenum	**7.2**		2.0	1.1	ug/L		10/29/19 08:00	10/29/19 21:46	1
Selenium	<1.0		5.0	1.0	ug/L		10/29/19 08:00	10/29/19 21:46	1
Thallium	**0.38**	**J**	1.0	0.27	ug/L		10/29/19 08:00	10/29/19 21:46	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.10		0.20	0.10	ug/L		10/30/19 12:40	10/31/19 13:38	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	**1000**		30	24	mg/L			10/29/19 13:03	1
pH	**7.5**	**HF**	0.1	0.1	SU			10/25/19 22:54	1

Method: Field Sampling - Field Sampling

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Ground Water Elevation	**663.21**				ft			10/23/19 16:15	1
Oxidation Reduction Potential	**-6.7**				millivolts			10/23/19 16:15	1
Oxygen, Dissolved, Client Supplied	**0.42**				mg/L			10/23/19 16:15	1
pH, Field	**6.91**				SU			10/23/19 16:15	1
Specific Conductance, Field	**1794**				umhos/cm			10/23/19 16:15	1
Temperature, Field	**13.2**				Degrees C			10/23/19 16:15	1
Turbidity, Field	**6.21**				NTU			10/23/19 16:15	1

Client Sample Results

Client Sample ID: MW-306

Date Collected: 10/23/19 17:00
Date Received: 10/25/19 18:30

Lab Sample ID: 310-168508-6
Matrix: Water

Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**47**		5.0	1.5	mg/L			10/31/19 13:17	5
Fluoride	<0.23		0.50	0.23	mg/L			10/31/19 13:17	5
Sulfate	**280**		20	7.0	mg/L			10/31/19 13:33	20

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.53		1.0	0.53	ug/L		10/29/19 08:00	10/29/19 21:49	1
Arsenic	**0.78**	**J**	2.0	0.75	ug/L		10/29/19 08:00	10/29/19 21:49	1
Barium	**51**		2.0	0.84	ug/L		10/29/19 08:00	10/29/19 21:49	1
Beryllium	<0.27		1.0	0.27	ug/L		10/29/19 08:00	10/29/19 21:49	1
Boron	**980**		200	110	ug/L		10/29/19 08:00	10/29/19 21:49	1
Cadmium	**0.89**		0.10	0.039	ug/L		10/29/19 08:00	10/29/19 21:49	1
Calcium	**77**		0.50	0.10	mg/L		10/29/19 08:00	10/29/19 21:49	1
Chromium	**1.0**	**J**	5.0	0.98	ug/L		10/29/19 08:00	10/29/19 21:49	1
Cobalt	**6.2**		0.50	0.091	ug/L		10/29/19 08:00	10/29/19 21:49	1
Lead	**0.34**	**J**	0.50	0.27	ug/L		10/29/19 08:00	10/29/19 21:49	1
Lithium	<2.7		10	2.7	ug/L		10/29/19 08:00	10/29/19 21:49	1
Molybdenum	**4.9**		2.0	1.1	ug/L		10/29/19 08:00	10/29/19 21:49	1
Selenium	<1.0		5.0	1.0	ug/L		10/29/19 08:00	10/29/19 21:49	1
Thallium	<0.27		1.0	0.27	ug/L		10/29/19 08:00	10/29/19 21:49	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.10		0.20	0.10	ug/L		10/30/19 12:40	10/31/19 13:29	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	**870**		30	24	mg/L			10/29/19 13:03	1
pH	**7.4**	**HF**	0.1	0.1	SU			10/25/19 22:55	1

Method: Field Sampling - Field Sampling

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Ground Water Elevation	**671.28**				ft			10/23/19 17:00	1
Oxidation Reduction Potential	**-0.5**				millivolts			10/23/19 17:00	1
Oxygen, Dissolved, Client Supplied	**0.29**				mg/L			10/23/19 17:00	1
pH, Field	**6.74**				SU			10/23/19 17:00	1
Specific Conductance, Field	**1266**				umhos/cm			10/23/19 17:00	1
Temperature, Field	**13.12**				Degrees C			10/23/19 17:00	1
Turbidity, Field	**12.3**				NTU			10/23/19 17:00	1

Client Sample Results

Client: SCS Engineers
Project/Site: Ottumwa Generating Station 25219072

Job ID: 310-168508-1

Client Sample ID: FIELD BLANK
Date Collected: 10/23/19 23:59
Date Received: 10/25/19 18:30

Lab Sample ID: 310-168508-7
Matrix: Water

Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	<0.29		1.0	0.29	mg/L			10/31/19 13:48	1
Fluoride	<0.045		0.10	0.045	mg/L			10/31/19 13:48	1
Sulfate	<0.35		1.0	0.35	mg/L			10/31/19 13:48	1

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.53		1.0	0.53	ug/L		10/29/19 08:00	10/29/19 22:03	1
Arsenic	<0.75		2.0	0.75	ug/L		10/29/19 08:00	10/29/19 22:03	1
Barium	<0.84		2.0	0.84	ug/L		10/29/19 08:00	10/29/19 22:03	1
Beryllium	<0.27		1.0	0.27	ug/L		10/29/19 08:00	10/29/19 22:03	1
Boron	<110		200	110	ug/L		10/29/19 08:00	10/29/19 22:03	1
Cadmium	<0.039		0.10	0.039	ug/L		10/29/19 08:00	10/29/19 22:03	1
Calcium	<0.10		0.50	0.10	mg/L		10/29/19 08:00	10/29/19 22:03	1
Chromium	<0.98		5.0	0.98	ug/L		10/29/19 08:00	10/29/19 22:03	1
Cobalt	<0.091		0.50	0.091	ug/L		10/29/19 08:00	10/29/19 22:03	1
Lead	<0.27		0.50	0.27	ug/L		10/29/19 08:00	10/29/19 22:03	1
Lithium	<2.7		10	2.7	ug/L		10/29/19 08:00	10/29/19 22:03	1
Molybdenum	<1.1		2.0	1.1	ug/L		10/29/19 08:00	10/29/19 22:03	1
Selenium	<1.0		5.0	1.0	ug/L		10/29/19 08:00	10/29/19 22:03	1
Thallium	<0.27		1.0	0.27	ug/L		10/29/19 08:00	10/29/19 22:03	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.10	F1	0.20	0.10	ug/L		10/31/19 12:56	11/01/19 12:06	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	**74**		30	24	mg/L			10/29/19 13:03	1
pH	**6.8**	**HF**	0.1	0.1	SU			10/25/19 23:00	1

Client Sample Results

Client: SCS Engineers
Project/Site: Ottumwa Generating Station 25219072

Job ID: 310-168508-1

Client Sample ID: MW-310

Date Collected: 10/24/19 12:50
Date Received: 10/25/19 18:30

Lab Sample ID: 310-168508-11

Matrix: Water

Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**150**		5.0	1.5	mg/L			10/31/19 15:22	5
Fluoride	**0.31**	**J**	0.50	0.23	mg/L			10/31/19 15:22	5
Sulfate	**610**		20	7.0	mg/L			11/01/19 12:57	20

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.53		1.0	0.53	ug/L		10/29/19 08:00	10/29/19 22:16	1
Arsenic	**0.78**	**J**	2.0	0.75	ug/L		10/29/19 08:00	10/29/19 22:16	1
Barium	**76**		2.0	0.84	ug/L		10/29/19 08:00	10/29/19 22:16	1
Beryllium	<0.27		1.0	0.27	ug/L		10/29/19 08:00	10/29/19 22:16	1
Boron	**720**		200	110	ug/L		10/29/19 08:00	10/29/19 22:16	1
Cadmium	**0.22**		0.10	0.039	ug/L		10/29/19 08:00	10/29/19 22:16	1
Calcium	**230**		0.50	0.10	mg/L		10/29/19 08:00	10/29/19 22:16	1
Chromium	<0.98		5.0	0.98	ug/L		10/29/19 08:00	10/29/19 22:16	1
Cobalt	**0.57**		0.50	0.091	ug/L		10/29/19 08:00	10/29/19 22:16	1
Lead	<0.27		0.50	0.27	ug/L		10/29/19 08:00	10/29/19 22:16	1
Lithium	**35**		10	2.7	ug/L		10/29/19 08:00	10/29/19 22:16	1
Molybdenum	**26**		2.0	1.1	ug/L		10/29/19 08:00	10/29/19 22:16	1
Selenium	**5.0**		5.0	1.0	ug/L		10/29/19 08:00	10/29/19 22:16	1
Thallium	<0.27		1.0	0.27	ug/L		10/29/19 08:00	10/29/19 22:16	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.10		0.20	0.10	ug/L		10/31/19 12:56	11/01/19 12:13	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	**260**		30	24	mg/L			10/31/19 14:13	1
pH	**7.2**	**HF**	0.1	0.1	SU			10/25/19 23:39	1

Method: Field Sampling - Field Sampling

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Ground Water Elevation	**649.31**				ft			10/24/19 12:50	1
Oxidation Reduction Potential	**-9.3**				millivolts			10/24/19 12:50	1
Oxygen, Dissolved, Client Supplied	**0.41**				mg/L			10/24/19 12:50	1
pH, Field	**7.15**				SU			10/24/19 12:50	1
Specific Conductance, Field	**1906**				umhos/cm			10/24/19 12:50	1
Temperature, Field	**13.74**				Degrees C			10/24/19 12:50	1
Turbidity, Field	**2.29**				NTU			10/24/19 12:50	1

Client Sample Results

Client Sample ID: MW-311

Date Collected: 10/24/19 13:45
Date Received: 10/25/19 18:30

Lab Sample ID: 310-168508-12
Matrix: Water

Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**13**		5.0	1.5	mg/L			10/31/19 15:37	5
Fluoride	<0.23		0.50	0.23	mg/L			10/31/19 15:37	5
Sulfate	**47**		5.0	1.8	mg/L			10/31/19 15:37	5

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.53		1.0	0.53	ug/L		10/29/19 08:00	10/29/19 22:23	1
Arsenic	<0.75		2.0	0.75	ug/L		10/29/19 08:00	10/29/19 22:23	1
Barium	**200**		2.0	0.84	ug/L		10/29/19 08:00	10/29/19 22:23	1
Beryllium	<0.27		1.0	0.27	ug/L		10/29/19 08:00	10/29/19 22:23	1
Boron	<110		200	110	ug/L		10/29/19 08:00	10/29/19 22:23	1
Cadmium	**0.040**	**J**	0.10	0.039	ug/L		10/29/19 08:00	10/29/19 22:23	1
Calcium	**170**		0.50	0.10	mg/L		10/29/19 08:00	10/29/19 22:23	1
Chromium	<0.98		5.0	0.98	ug/L		10/29/19 08:00	10/29/19 22:23	1
Cobalt	**0.78**		0.50	0.091	ug/L		10/29/19 08:00	10/29/19 22:23	1
Lead	<0.27		0.50	0.27	ug/L		10/29/19 08:00	10/29/19 22:23	1
Lithium	**4.7**	**J**	10	2.7	ug/L		10/29/19 08:00	10/29/19 22:23	1
Molybdenum	<1.1		2.0	1.1	ug/L		10/29/19 08:00	10/29/19 22:23	1
Selenium	<1.0		5.0	1.0	ug/L		10/29/19 08:00	10/29/19 22:23	1
Thallium	<0.27		1.0	0.27	ug/L		10/29/19 08:00	10/29/19 22:23	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.10	F1	0.20	0.10	ug/L		10/31/19 13:00	11/01/19 13:17	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	**530**		30	24	mg/L			10/31/19 14:13	1
pH	**7.0**	**HF**	0.1	0.1	SU			10/25/19 23:40	1

Method: Field Sampling - Field Sampling

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Ground Water Elevation	**647.80**				ft			10/24/19 13:45	1
Oxidation Reduction Potential	**-24.7**				millivolts			10/24/19 13:45	1
Oxygen, Dissolved, Client Supplied	**0.29**				mg/L			10/24/19 13:45	1
pH, Field	**6.95**				SU			10/24/19 13:45	1
Specific Conductance, Field	**926**				umhos/cm			10/24/19 13:45	1
Temperature, Field	**13.88**				Degrees C			10/24/19 13:45	1
Turbidity, Field	**3.88**				NTU			10/24/19 13:45	1

Definitions/Glossary

Client: SCS Engineers
Job ID: 310-168508-1
Project/Site: Ottumwa Generating Station 25219072

Qualifiers

HPLC/IC

Qualifier	Qualifier Description
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

Metals

Qualifier	Qualifier Description
4	MS, MSD: The analyte present in the original sample is greater than 4 times the matrix spike concentration; therefore, control limits are not applicable.
F1	MS and/or MSD Recovery is outside acceptance limits.
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

General Chemistry

Qualifier	Qualifier Description
HF	Field parameter with a holding time of 15 minutes. Test performed by laboratory at client's request.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

QC Sample Results

Client: SCS Engineers
Project/Site: Ottumwa Generating Station 25219072

Job ID: 310-168508-1

Method: 9056A - Anions, Ion Chromatography

Lab Sample ID: MB 310-259370/3
Matrix: Water
Analysis Batch: 259370

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	<0.29		1.0	0.29	mg/L			10/31/19 08:19	1
Fluoride	<0.045		0.10	0.045	mg/L			10/31/19 08:19	1
Sulfate	<0.35		1.0	0.35	mg/L			10/31/19 08:19	1

Lab Sample ID: LCS 310-259370/4
Matrix: Water
Analysis Batch: 259370

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Chloride	10.0	10.1		mg/L		101	90 - 110
Fluoride	2.00	2.07		mg/L		104	90 - 110
Sulfate	10.0	10.3		mg/L		103	90 - 110

Method: 6020A - Metals (ICP/MS)

Lab Sample ID: MB 310-258560/1-A
Matrix: Water
Analysis Batch: 258765

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 258560

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.53		1.0	0.53	ug/L		10/29/19 08:00	10/29/19 21:05	1
Arsenic	<0.75		2.0	0.75	ug/L		10/29/19 08:00	10/29/19 21:05	1
Barium	<0.84		2.0	0.84	ug/L		10/29/19 08:00	10/29/19 21:05	1
Beryllium	<0.27		1.0	0.27	ug/L		10/29/19 08:00	10/29/19 21:05	1
Boron	<110		200	110	ug/L		10/29/19 08:00	10/29/19 21:05	1
Cadmium	<0.039		0.10	0.039	ug/L		10/29/19 08:00	10/29/19 21:05	1
Calcium	<0.10		0.50	0.10	mg/L		10/29/19 08:00	10/29/19 21:05	1
Chromium	<0.98		5.0	0.98	ug/L		10/29/19 08:00	10/29/19 21:05	1
Cobalt	<0.091		0.50	0.091	ug/L		10/29/19 08:00	10/29/19 21:05	1
Lead	<0.27		0.50	0.27	ug/L		10/29/19 08:00	10/29/19 21:05	1
Lithium	<2.7		10	2.7	ug/L		10/29/19 08:00	10/29/19 21:05	1
Molybdenum	<1.1		2.0	1.1	ug/L		10/29/19 08:00	10/29/19 21:05	1
Selenium	<1.0		5.0	1.0	ug/L		10/29/19 08:00	10/29/19 21:05	1
Thallium	<0.27		1.0	0.27	ug/L		10/29/19 08:00	10/29/19 21:05	1

Lab Sample ID: LCS 310-258560/2-A
Matrix: Water
Analysis Batch: 258765

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 258560

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Antimony	40.0	33.5		ug/L		84	80 - 120
Arsenic	80.0	75.4		ug/L		94	80 - 120
Barium	80.0	78.9		ug/L		99	80 - 120
Beryllium	40.0	37.8		ug/L		94	80 - 120
Boron	1760	1680		ug/L		95	80 - 120
Cadmium	40.0	40.2		ug/L		100	80 - 120
Calcium	4.00	4.04		mg/L		101	80 - 120
Chromium	80.0	78.0		ug/L		98	80 - 120
Cobalt	40.0	39.2		ug/L		98	80 - 120

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Method: 6020A - Metals (ICP/MS) (Continued)

Lab Sample ID: LCS 310-258560/2-A
Matrix: Water
Analysis Batch: 258765

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 258560

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Lead	40.0	39.3		ug/L		98	80 - 120
Lithium	200	174		ug/L		87	80 - 120
Molybdenum	80.0	68.8		ug/L		86	80 - 120
Selenium	80.0	75.6		ug/L		95	80 - 120
Thallium	32.0	30.8		ug/L		96	80 - 120

Lab Sample ID: 310-168508-1 MS
Matrix: Water
Analysis Batch: 258765

Client Sample ID: MW-301
Prep Type: Total/NA
Prep Batch: 258560

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Antimony	<0.53		40.0	40.3		ug/L		101	75 - 125
Arsenic	<0.75		80.0	85.7		ug/L		107	75 - 125
Barium	56		80.0	139		ug/L		104	75 - 125
Beryllium	<0.27		40.0	43.9		ug/L		110	75 - 125
Boron	680		1760	2480		ug/L		102	75 - 125
Cadmium	0.040	J	40.0	43.1		ug/L		108	75 - 125
Calcium	78		4.00	81.9	4	mg/L		98	75 - 125
Chromium	<0.98		80.0	86.8		ug/L		108	75 - 125
Cobalt	0.60		40.0	43.0		ug/L		106	75 - 125
Lead	<0.27		40.0	43.4		ug/L		108	75 - 125
Lithium	24		200	215		ug/L		96	75 - 125
Molybdenum	1.1	J	80.0	83.7		ug/L		105	75 - 125
Selenium	6.2		80.0	86.0		ug/L		100	75 - 125
Thallium	<0.27		32.0	34.5		ug/L		108	75 - 125

Lab Sample ID: 310-168508-1 MSD
Matrix: Water
Analysis Batch: 258765

Client Sample ID: MW-301
Prep Type: Total/NA
Prep Batch: 258560

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Antimony	<0.53		40.0	39.4		ug/L		99	75 - 125	2	20
Arsenic	<0.75		80.0	85.0		ug/L		106	75 - 125	1	20
Barium	56		80.0	139		ug/L		103	75 - 125	0	20
Beryllium	<0.27		40.0	43.4		ug/L		108	75 - 125	1	20
Boron	680		1760	2500		ug/L		104	75 - 125	1	20
Cadmium	0.040	J	40.0	42.9		ug/L		107	75 - 125	0	20
Calcium	78		4.00	82.4	4	mg/L		111	75 - 125	1	20
Chromium	<0.98		80.0	84.5		ug/L		106	75 - 125	3	20
Cobalt	0.60		40.0	42.2		ug/L		104	75 - 125	2	20
Lead	<0.27		40.0	42.5		ug/L		106	75 - 125	2	20
Lithium	24		200	209		ug/L		93	75 - 125	3	20
Molybdenum	1.1	J	80.0	82.5		ug/L		103	75 - 125	1	20
Selenium	6.2		80.0	87.1		ug/L		101	75 - 125	1	20
Thallium	<0.27		32.0	33.7		ug/L		105	75 - 125	2	20

QC Sample Results

Client: SCS Engineers
Job ID: 310-168508-1
Project/Site: Ottumwa Generating Station 25219072

Method: 6020A - Metals (ICP/MS) (Continued)

Lab Sample ID: 310-168508-11 DU
Client Sample ID: MW-310
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 258765
Prep Batch: 258560

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Antimony	<0.53		<0.53		ug/L		NC	20
Arsenic	0.78	J	0.797	J	ug/L		2	20
Barium	76		78.2		ug/L		2	20
Beryllium	<0.27		<0.27		ug/L		NC	20
Boron	720		739		ug/L		3	20
Cadmium	0.22		0.262		ug/L		17	20
Calcium	230		227		mg/L		0.4	20
Chromium	<0.98		<0.98		ug/L		NC	20
Cobalt	0.57		0.705		ug/L		20	20
Lead	<0.27		<0.27		ug/L		NC	20
Lithium	35		36.7		ug/L		4	20
Molybdenum	26		26.8		ug/L		1	20
Selenium	5.0		5.40		ug/L		7	20
Thallium	<0.27		<0.27		ug/L		NC	20

Method: 7470A - Mercury (CVAA)

Lab Sample ID: MB 310-258836/1-A
Client Sample ID: Method Blank
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 259013
Prep Batch: 258836

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.10		0.20	0.10	ug/L		10/30/19 12:40	10/31/19 12:34	1

Lab Sample ID: LCS 310-258836/2-A
Client Sample ID: Lab Control Sample
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 259013
Prep Batch: 258836

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Mercury	1.67	1.55		ug/L		93	80 - 120

Lab Sample ID: MB 310-258991/1-A
Client Sample ID: Method Blank
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 259222
Prep Batch: 258991

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.10		0.20	0.10	ug/L		10/31/19 12:56	11/01/19 12:02	1

Lab Sample ID: LCS 310-258991/2-A
Client Sample ID: Lab Control Sample
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 259222
Prep Batch: 258991

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Mercury	1.67	1.52		ug/L		91	80 - 120

QC Sample Results

Method: 7470A - Mercury (CVAA) (Continued)

Lab Sample ID: 310-168508-7 MS
Matrix: Water
Analysis Batch: 259222

Client Sample ID: FIELD BLANK
Prep Type: Total/NA
Prep Batch: 258991

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Mercury	<0.10	F1	1.67	1.32	F1	ug/L		79	80 - 120

Lab Sample ID: 310-168508-7 MSD
Matrix: Water
Analysis Batch: 259222

Client Sample ID: FIELD BLANK
Prep Type: Total/NA
Prep Batch: 258991

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Mercury	<0.10	F1	1.67	1.42		ug/L		85	80 - 120	7	20

Lab Sample ID: MB 310-258993/1-A
Matrix: Water
Analysis Batch: 259222

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 258993

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.10		0.20	0.10	ug/L		10/31/19 13:00	11/01/19 13:13	1

Lab Sample ID: LCS 310-258993/2-A
Matrix: Water
Analysis Batch: 259222

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 258993

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Mercury	1.67	1.44		ug/L		86	80 - 120

Lab Sample ID: 310-168508-12 MS
Matrix: Water
Analysis Batch: 259222

Client Sample ID: MW-311
Prep Type: Total/NA
Prep Batch: 258993

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Mercury	<0.10	F1	1.67	1.37		ug/L		82	80 - 120

Lab Sample ID: 310-168508-12 MSD
Matrix: Water
Analysis Batch: 259222

Client Sample ID: MW-311
Prep Type: Total/NA
Prep Batch: 258993

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Mercury	<0.10	F1	1.67	1.28	F1	ug/L		77	80 - 120	6	20

Method: SM 2540C - Solids, Total Dissolved (TDS)

Lab Sample ID: 310-168508-7 DU
Matrix: Water
Analysis Batch: 258685

Client Sample ID: FIELD BLANK
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Total Dissolved Solids	74		76.0		mg/L		3	24

QC Sample Results

Client: SCS Engineers
Job ID: 310-168508-1
Project/Site: Ottumwa Generating Station 25219072

Method: SM 2540C - Solids, Total Dissolved (TDS) (Continued)

Lab Sample ID: MB 310-259015/1
Client Sample ID: Method Blank
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 259015

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	<24		30	24	mg/L			10/31/19 14:13	1

Lab Sample ID: LCS 310-259015/2
Client Sample ID: Lab Control Sample
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 259015

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Total Dissolved Solids			1000	966		mg/L		97	90 - 110		

Method: SM 4500 H+ B - pH

Lab Sample ID: LCS 310-258389/1
Client Sample ID: Lab Control Sample
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 258389

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
pH			7.00	7.0		SU		100	98 - 102		

Lab Sample ID: 310-168508-1 DU
Client Sample ID: MW-301
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 258389

Analyte	Sample Result	Sample Qualifier		DU Result	DU Qualifier	Unit	D			RPD	RPD Limit
pH	7.1	HF		7.1		SU				0.3	20

QC Association Summary

Client: SCS Engineers
Project/Site: Ottumwa Generating Station 25219072

Job ID: 310-168508-1

HPLC/IC

Analysis Batch: 259370

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-168508-1	MW-301	Total/NA	Water	9056A	
310-168508-2	MW-302	Total/NA	Water	9056A	
310-168508-2	MW-302	Total/NA	Water	9056A	
310-168508-3	MW-303	Total/NA	Water	9056A	
310-168508-4	MW-304	Total/NA	Water	9056A	
310-168508-4	MW-304	Total/NA	Water	9056A	
310-168508-5	MW-305	Total/NA	Water	9056A	
310-168508-5	MW-305	Total/NA	Water	9056A	
310-168508-6	MW-306	Total/NA	Water	9056A	
310-168508-6	MW-306	Total/NA	Water	9056A	
310-168508-7	FIELD BLANK	Total/NA	Water	9056A	
310-168508-11	MW-310	Total/NA	Water	9056A	
310-168508-11	MW-310	Total/NA	Water	9056A	
310-168508-12	MW-311	Total/NA	Water	9056A	
MB 310-259370/3	Method Blank	Total/NA	Water	9056A	
LCS 310-259370/4	Lab Control Sample	Total/NA	Water	9056A	

Metals

Prep Batch: 258560

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-168508-1	MW-301	Total/NA	Water	3010A	
310-168508-2	MW-302	Total/NA	Water	3010A	
310-168508-3	MW-303	Total/NA	Water	3010A	
310-168508-4	MW-304	Total/NA	Water	3010A	
310-168508-5	MW-305	Total/NA	Water	3010A	
310-168508-6	MW-306	Total/NA	Water	3010A	
310-168508-7	FIELD BLANK	Total/NA	Water	3010A	
310-168508-11	MW-310	Total/NA	Water	3010A	
310-168508-12	MW-311	Total/NA	Water	3010A	
MB 310-258560/1-A	Method Blank	Total/NA	Water	3010A	
LCS 310-258560/2-A	Lab Control Sample	Total/NA	Water	3010A	
310-168508-1 MS	MW-301	Total/NA	Water	3010A	
310-168508-1 MSD	MW-301	Total/NA	Water	3010A	
310-168508-11 DU	MW-310	Total/NA	Water	3010A	

Analysis Batch: 258765

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-168508-1	MW-301	Total/NA	Water	6020A	258560
310-168508-2	MW-302	Total/NA	Water	6020A	258560
310-168508-3	MW-303	Total/NA	Water	6020A	258560
310-168508-4	MW-304	Total/NA	Water	6020A	258560
310-168508-5	MW-305	Total/NA	Water	6020A	258560
310-168508-6	MW-306	Total/NA	Water	6020A	258560
310-168508-7	FIELD BLANK	Total/NA	Water	6020A	258560
310-168508-11	MW-310	Total/NA	Water	6020A	258560
310-168508-12	MW-311	Total/NA	Water	6020A	258560
MB 310-258560/1-A	Method Blank	Total/NA	Water	6020A	258560
LCS 310-258560/2-A	Lab Control Sample	Total/NA	Water	6020A	258560
310-168508-1 MS	MW-301	Total/NA	Water	6020A	258560
310-168508-1 MSD	MW-301	Total/NA	Water	6020A	258560

QC Association Summary

Metals (Continued)

Analysis Batch: 258765 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-168508-11 DU	MW-310	Total/NA	Water	6020A	258560

Prep Batch: 258836

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-168508-1	MW-301	Total/NA	Water	7470A	
310-168508-2	MW-302	Total/NA	Water	7470A	
310-168508-3	MW-303	Total/NA	Water	7470A	
310-168508-4	MW-304	Total/NA	Water	7470A	
310-168508-5	MW-305	Total/NA	Water	7470A	
310-168508-6	MW-306	Total/NA	Water	7470A	
MB 310-258836/1-A	Method Blank	Total/NA	Water	7470A	
LCS 310-258836/2-A	Lab Control Sample	Total/NA	Water	7470A	

Prep Batch: 258991

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-168508-7	FIELD BLANK	Total/NA	Water	7470A	
310-168508-11	MW-310	Total/NA	Water	7470A	
MB 310-258991/1-A	Method Blank	Total/NA	Water	7470A	
LCS 310-258991/2-A	Lab Control Sample	Total/NA	Water	7470A	
310-168508-7 MS	FIELD BLANK	Total/NA	Water	7470A	
310-168508-7 MSD	FIELD BLANK	Total/NA	Water	7470A	

Prep Batch: 258993

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-168508-12	MW-311	Total/NA	Water	7470A	
MB 310-258993/1-A	Method Blank	Total/NA	Water	7470A	
LCS 310-258993/2-A	Lab Control Sample	Total/NA	Water	7470A	
310-168508-12 MS	MW-311	Total/NA	Water	7470A	
310-168508-12 MSD	MW-311	Total/NA	Water	7470A	

Analysis Batch: 259013

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-168508-1	MW-301	Total/NA	Water	7470A	258836
310-168508-2	MW-302	Total/NA	Water	7470A	258836
310-168508-3	MW-303	Total/NA	Water	7470A	258836
310-168508-4	MW-304	Total/NA	Water	7470A	258836
310-168508-5	MW-305	Total/NA	Water	7470A	258836
310-168508-6	MW-306	Total/NA	Water	7470A	258836
MB 310-258836/1-A	Method Blank	Total/NA	Water	7470A	258836
LCS 310-258836/2-A	Lab Control Sample	Total/NA	Water	7470A	258836

Analysis Batch: 259222

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-168508-7	FIELD BLANK	Total/NA	Water	7470A	258991
310-168508-11	MW-310	Total/NA	Water	7470A	258991
310-168508-12	MW-311	Total/NA	Water	7470A	258993
MB 310-258991/1-A	Method Blank	Total/NA	Water	7470A	258991
MB 310-258993/1-A	Method Blank	Total/NA	Water	7470A	258993
LCS 310-258991/2-A	Lab Control Sample	Total/NA	Water	7470A	258991
LCS 310-258993/2-A	Lab Control Sample	Total/NA	Water	7470A	258993
310-168508-7 MS	FIELD BLANK	Total/NA	Water	7470A	258991

QC Association Summary

Metals (Continued)

Analysis Batch: 259222 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-168508-7 MSD	FIELD BLANK	Total/NA	Water	7470A	258991
310-168508-12 MS	MW-311	Total/NA	Water	7470A	258993
310-168508-12 MSD	MW-311	Total/NA	Water	7470A	258993

General Chemistry

Analysis Batch: 258389

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-168508-1	MW-301	Total/NA	Water	SM 4500 H+ B	
310-168508-2	MW-302	Total/NA	Water	SM 4500 H+ B	
310-168508-3	MW-303	Total/NA	Water	SM 4500 H+ B	
310-168508-4	MW-304	Total/NA	Water	SM 4500 H+ B	
310-168508-5	MW-305	Total/NA	Water	SM 4500 H+ B	
310-168508-6	MW-306	Total/NA	Water	SM 4500 H+ B	
310-168508-7	FIELD BLANK	Total/NA	Water	SM 4500 H+ B	
310-168508-11	MW-310	Total/NA	Water	SM 4500 H+ B	
310-168508-12	MW-311	Total/NA	Water	SM 4500 H+ B	
LCS 310-258389/1	Lab Control Sample	Total/NA	Water	SM 4500 H+ B	
310-168508-1 DU	MW-301	Total/NA	Water	SM 4500 H+ B	

Analysis Batch: 258685

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-168508-4	MW-304	Total/NA	Water	SM 2540C	
310-168508-5	MW-305	Total/NA	Water	SM 2540C	
310-168508-6	MW-306	Total/NA	Water	SM 2540C	
310-168508-7	FIELD BLANK	Total/NA	Water	SM 2540C	
310-168508-7 DU	FIELD BLANK	Total/NA	Water	SM 2540C	

Analysis Batch: 259015

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-168508-1	MW-301	Total/NA	Water	SM 2540C	
310-168508-2	MW-302	Total/NA	Water	SM 2540C	
310-168508-3	MW-303	Total/NA	Water	SM 2540C	
310-168508-11	MW-310	Total/NA	Water	SM 2540C	
310-168508-12	MW-311	Total/NA	Water	SM 2540C	
MB 310-259015/1	Method Blank	Total/NA	Water	SM 2540C	
LCS 310-259015/2	Lab Control Sample	Total/NA	Water	SM 2540C	

Field Service / Mobile Lab

Analysis Batch: 259232

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-168508-1	MW-301	Total/NA	Water	Field Sampling	
310-168508-2	MW-302	Total/NA	Water	Field Sampling	
310-168508-3	MW-303	Total/NA	Water	Field Sampling	
310-168508-4	MW-304	Total/NA	Water	Field Sampling	
310-168508-5	MW-305	Total/NA	Water	Field Sampling	
310-168508-6	MW-306	Total/NA	Water	Field Sampling	
310-168508-11	MW-310	Total/NA	Water	Field Sampling	
310-168508-12	MW-311	Total/NA	Water	Field Sampling	

Lab Chronicle

Client: SCS Engineers
Job ID: 310-168508-1
Project/Site: Ottumwa Generating Station 25219072

Client Sample ID: MW-301
Lab Sample ID: 310-168508-1
Date Collected: 10/24/19 09:00
Matrix: Water
Date Received: 10/25/19 18:30

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	9056A		5	259370	10/31/19 11:59	CJT	TAL CF
Total/NA	Prep	3010A			258560	10/29/19 08:00	HED	TAL CF
Total/NA	Analysis	6020A		1	258765	10/29/19 21:22	SAD	TAL CF
Total/NA	Prep	7470A			258836	10/30/19 12:40	HIS	TAL CF
Total/NA	Analysis	7470A		1	259013	10/31/19 13:13	HIS	TAL CF
Total/NA	Analysis	SM 2540C		1	259015	10/31/19 14:13	SAS	TAL CF
Total/NA	Analysis	SM 4500 H+ B		1	258389	10/25/19 22:47	JMH	TAL CF
Total/NA	Analysis	Field Sampling		1	259232	10/24/19 09:00	EAR	TAL CF

Client Sample ID: MW-302
Lab Sample ID: 310-168508-2
Date Collected: 10/24/19 10:20
Matrix: Water
Date Received: 10/25/19 18:30

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	9056A		5	259370	10/31/19 12:15	CJT	TAL CF
Total/NA	Analysis	9056A		20	259370	11/01/19 11:35	CJT	TAL CF
Total/NA	Prep	3010A			258560	10/29/19 08:00	HED	TAL CF
Total/NA	Analysis	6020A		1	258765	10/29/19 21:36	SAD	TAL CF
Total/NA	Prep	7470A			258836	10/30/19 12:40	HIS	TAL CF
Total/NA	Analysis	7470A		1	259013	10/31/19 13:15	HIS	TAL CF
Total/NA	Analysis	SM 2540C		1	259015	10/31/19 14:13	SAS	TAL CF
Total/NA	Analysis	SM 4500 H+ B		1	258389	10/25/19 22:50	JMH	TAL CF
Total/NA	Analysis	Field Sampling		1	259232	10/24/19 10:20	EAR	TAL CF

Client Sample ID: MW-303
Lab Sample ID: 310-168508-3
Date Collected: 10/24/19 12:00
Matrix: Water
Date Received: 10/25/19 18:30

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	9056A		5	259370	10/31/19 12:30	CJT	TAL CF
Total/NA	Prep	3010A			258560	10/29/19 08:00	HED	TAL CF
Total/NA	Analysis	6020A		1	258765	10/29/19 21:39	SAD	TAL CF
Total/NA	Prep	7470A			258836	10/30/19 12:40	HIS	TAL CF
Total/NA	Analysis	7470A		1	259013	10/31/19 13:21	HIS	TAL CF
Total/NA	Analysis	SM 2540C		1	259015	10/31/19 14:13	SAS	TAL CF
Total/NA	Analysis	SM 4500 H+ B		1	258389	10/25/19 22:52	JMH	TAL CF
Total/NA	Analysis	Field Sampling		1	259232	10/24/19 12:00	EAR	TAL CF

Client Sample ID: MW-304
Lab Sample ID: 310-168508-4
Date Collected: 10/23/19 14:27
Matrix: Water
Date Received: 10/25/19 18:30

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	9056A		5	259370	10/31/19 12:46	CJT	TAL CF

Lab Chronicle

Client: SCS Engineers
Job ID: 310-168508-1
Project/Site: Ottumwa Generating Station 25219072

Client Sample ID: MW-304
Lab Sample ID: 310-168508-4
Date Collected: 10/23/19 14:27
Matrix: Water
Date Received: 10/25/19 18:30

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	9056A		10	259370	11/01/19 11:52	CJT	TAL CF
Total/NA	Prep	3010A			258560	10/29/19 08:00	HED	TAL CF
Total/NA	Analysis	6020A		1	258765	10/29/19 21:42	SAD	TAL CF
Total/NA	Prep	7470A			258836	10/30/19 12:40	HIS	TAL CF
Total/NA	Analysis	7470A		1	259013	10/31/19 13:36	HIS	TAL CF
Total/NA	Analysis	SM 2540C		1	258685	10/29/19 13:03	MDK	TAL CF
Total/NA	Analysis	SM 4500 H+ B		1	258389	10/25/19 22:53	JMH	TAL CF
Total/NA	Analysis	Field Sampling		1	259232	10/23/19 14:27	EAR	TAL CF

Client Sample ID: MW-305
Lab Sample ID: 310-168508-5
Date Collected: 10/23/19 16:15
Matrix: Water
Date Received: 10/25/19 18:30

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	9056A		5	259370	10/31/19 13:01	CJT	TAL CF
Total/NA	Analysis	9056A		10	259370	11/01/19 12:08	CJT	TAL CF
Total/NA	Prep	3010A			258560	10/29/19 08:00	HED	TAL CF
Total/NA	Analysis	6020A		1	258765	10/29/19 21:46	SAD	TAL CF
Total/NA	Prep	7470A			258836	10/30/19 12:40	HIS	TAL CF
Total/NA	Analysis	7470A		1	259013	10/31/19 13:38	HIS	TAL CF
Total/NA	Analysis	SM 2540C		1	258685	10/29/19 13:03	MDK	TAL CF
Total/NA	Analysis	SM 4500 H+ B		1	258389	10/25/19 22:54	JMH	TAL CF
Total/NA	Analysis	Field Sampling		1	259232	10/23/19 16:15	EAR	TAL CF

Client Sample ID: MW-306
Lab Sample ID: 310-168508-6
Date Collected: 10/23/19 17:00
Matrix: Water
Date Received: 10/25/19 18:30

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	9056A		5	259370	10/31/19 13:17	CJT	TAL CF
Total/NA	Analysis	9056A		20	259370	10/31/19 13:33	CJT	TAL CF
Total/NA	Prep	3010A			258560	10/29/19 08:00	HED	TAL CF
Total/NA	Analysis	6020A		1	258765	10/29/19 21:49	SAD	TAL CF
Total/NA	Prep	7470A			258836	10/30/19 12:40	HIS	TAL CF
Total/NA	Analysis	7470A		1	259013	10/31/19 13:29	HIS	TAL CF
Total/NA	Analysis	SM 2540C		1	258685	10/29/19 13:03	MDK	TAL CF
Total/NA	Analysis	SM 4500 H+ B		1	258389	10/25/19 22:55	JMH	TAL CF
Total/NA	Analysis	Field Sampling		1	259232	10/23/19 17:00	EAR	TAL CF

Lab Chronicle

Client: SCS Engineers
Project/Site: Ottumwa Generating Station 25219072

Job ID: 310-168508-1

Client Sample ID: FIELD BLANK

Lab Sample ID: 310-168508-7

Date Collected: 10/23/19 23:59

Matrix: Water

Date Received: 10/25/19 18:30

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	9056A		1	259370	10/31/19 13:48	CJT	TAL CF
Total/NA	Prep	3010A			258560	10/29/19 08:00	HED	TAL CF
Total/NA	Analysis	6020A		1	258765	10/29/19 22:03	SAD	TAL CF
Total/NA	Prep	7470A			258991	10/31/19 12:56	HIS	TAL CF
Total/NA	Analysis	7470A		1	259222	11/01/19 12:06	HIS	TAL CF
Total/NA	Analysis	SM 2540C		1	258685	10/29/19 13:03	MDK	TAL CF
Total/NA	Analysis	SM 4500 H+ B		1	258389	10/25/19 23:00	JMH	TAL CF

Client Sample ID: MW-310

Lab Sample ID: 310-168508-11

Date Collected: 10/24/19 12:50

Matrix: Water

Date Received: 10/25/19 18:30

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	9056A		5	259370	10/31/19 15:22	CJT	TAL CF
Total/NA	Analysis	9056A		20	259370	11/01/19 12:57	CJT	TAL CF
Total/NA	Prep	3010A			258560	10/29/19 08:00	HED	TAL CF
Total/NA	Analysis	6020A		1	258765	10/29/19 22:16	SAD	TAL CF
Total/NA	Prep	7470A			258991	10/31/19 12:56	HIS	TAL CF
Total/NA	Analysis	7470A		1	259222	11/01/19 12:13	HIS	TAL CF
Total/NA	Analysis	SM 2540C		1	259015	10/31/19 14:13	SAS	TAL CF
Total/NA	Analysis	SM 4500 H+ B		1	258389	10/25/19 23:39	JMH	TAL CF
Total/NA	Analysis	Field Sampling		1	259232	10/24/19 12:50	EAR	TAL CF

Client Sample ID: MW-311

Lab Sample ID: 310-168508-12

Date Collected: 10/24/19 13:45

Matrix: Water

Date Received: 10/25/19 18:30

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	9056A		5	259370	10/31/19 15:37	CJT	TAL CF
Total/NA	Prep	3010A			258560	10/29/19 08:00	HED	TAL CF
Total/NA	Analysis	6020A		1	258765	10/29/19 22:23	SAD	TAL CF
Total/NA	Prep	7470A			258993	10/31/19 13:00	HIS	TAL CF
Total/NA	Analysis	7470A		1	259222	11/01/19 13:17	HIS	TAL CF
Total/NA	Analysis	SM 2540C		1	259015	10/31/19 14:13	SAS	TAL CF
Total/NA	Analysis	SM 4500 H+ B		1	258389	10/25/19 23:40	JMH	TAL CF
Total/NA	Analysis	Field Sampling		1	259232	10/24/19 13:45	EAR	TAL CF

Laboratory References:

TAL CF = Eurofins TestAmerica, Cedar Falls, 3019 Venture Way, Cedar Falls, IA 50613, TEL (319)277-2401

Accreditation/Certification Summary

Client: SCS Engineers
Project/Site: Ottumwa Generating Station 25219072
Job ID: 310-168508-1

Laboratory: Eurofins TestAmerica, Cedar Falls

The accreditations/certifications listed below are applicable to this report.

Authority	Program	Identification Number	Expiration Date
Iowa	State Program	007	12-01-19 *

* Accreditation/Certification renewal pending - accreditation/certification considered valid.

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Method Summary

Client: SCS Engineers
Project/Site: Ottumwa Generating Station 25219072

Job ID: 310-168508-1

Method	Method Description	Protocol	Laboratory
9056A	Anions, Ion Chromatography	SW846	TAL CF
6020A	Metals (ICP/MS)	SW846	TAL CF
7470A	Mercury (CVAA)	SW846	TAL CF
SM 2540C	Solids, Total Dissolved (TDS)	SM	TAL CF
SM 4500 H+ B	pH	SM	TAL CF
Field Sampling	Field Sampling	EPA	TAL CF
3010A	Preparation, Total Metals	SW846	TAL CF
7470A	Preparation, Mercury	SW846	TAL CF

Protocol References:

EPA = US Environmental Protection Agency
SM = "Standard Methods For The Examination Of Water And Wastewater"
SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

TAL CF = Eurofins TestAmerica, Cedar Falls, 3019 Venture Way, Cedar Falls, IA 50613, TEL (319)277-2401

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TestAmerica

310-168508 Chain of Custody

Cooler/Sample Receipt and Temperature Log Form

Client Information

Client: SCS Engineers

City/State: CITY Clive STATE IA

Project: Ottumwa Generating Station

Receipt Information

Date/Time Received: DATE 10-25-19 TIME 1830

Received By: LAB

Delivery Type: ☐ UPS ☐ FedEx ☐ FedEx Ground ☐ US Mail ☐ Spee-Dee
☒ Lab Courier ☐ Lab Field Services ☐ Client Drop-off ☐ Other:

Condition of Cooler/Containers

Sample(s) received in Cooler? ☒ Yes ☐ No *If yes:* Cooler ID:

Multiple Coolers? ☒ Yes ☐ No *If yes:* Cooler # 1 of 2

Cooler Custody Seals Present? ☐ Yes ☒ No *If yes:* Cooler custody seals intact? ☐ Yes ☐ No

Sample Custody Seals Present? ☐ Yes ☒ No *If yes:* Sample custody seals intact? ☐ Yes ☐ No

Trip Blank Present? ☐ Yes ☒ No *If yes:* Which VOA samples are in cooler? ↓

Temperature Record

Coolant: ☒ Wet ice ☐ Blue ice ☐ Dry ice ☐ Other: ☐ NONE

Thermometer ID: N

Correction Factor (°C): +0.0

• Temp Blank Temperature – If no temp blank, or temp blank temperature above criteria, proceed to Sample Container Temperature

Uncorrected Temp (°C): 1.2

Corrected Temp (°C): 1.2

• Sample Container Temperature

Container(s) used:	CONTAINER 1	CONTAINER 2
Uncorrected Temp (°C):		
Corrected Temp (°C):		

Exceptions Noted

1) If temperature exceeds criteria, was sample(s) received same day of sampling? ☐ Yes ☐ No
   a) *If yes:* Is there evidence that the chilling process began? ☐ Yes ☐ No

2) If temperature is <0°C, are there obvious signs that the integrity of sample containers is compromised? (e.g., bulging septa, broken/cracked bottles, frozen solid?) ☐ Yes ☐ No

NOTE: If yes, contact PM before proceeding. If no, proceed with login

Additional Comments

Document: CF-LG-WI-002
Revision: 25
Date: 06/17/2019

Eurofins TestAmerica, Cedar Falls

General temperature criteria is 0 to 6°C
Bacteria temperature criteria is 0 to 10°C

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

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TestAmerica

Place COC scanning label here
214

Cooler/Sample Receipt and Temperature Log Form

Client Information

Client: SCS engineers

City/State: CITY Clive STATE IA

Project: Ottumwa Generating Station

Receipt Information

Date/Time Received: DATE 10-25-19 TIME 1830

Received By: LAB

Delivery Type: ☐ UPS ☐ FedEx ☐ FedEx Ground ☐ US Mail ☐ Spee-Dee
☒ Lab Courier ☐ Lab Field Services ☐ Client Drop-off ☐ Other:

Condition of Cooler/Containers

Sample(s) received in Cooler? ☒ Yes ☐ No *If yes:* Cooler ID:

Multiple Coolers? ☒ Yes ☐ No *If yes:* Cooler # 2 of 2

Cooler Custody Seals Present? ☐ Yes ☒ No *If yes:* Cooler custody seals intact? ☐ Yes ☐ No

Sample Custody Seals Present? ☐ Yes ☒ No *If yes:* Sample custody seals intact? ☐ Yes ☐ No

Trip Blank Present? ☐ Yes ☒ No *If yes:* Which VOA samples are in cooler? ↓

Temperature Record

Coolant: ☒ Wet ice ☐ Blue ice ☐ Dry ice ☐ Other: ☐ NONE

Thermometer ID: N

Correction Factor (°C): +0.0

• Temp Blank Temperature – If no temp blank, or temp blank temperature above criteria, proceed to Sample Container Temperature

Uncorrected Temp (°C): 4.3

Corrected Temp (°C): 4.3

• Sample Container Temperature

	CONTAINER 1	CONTAINER 2
Container(s) used:		
Uncorrected Temp (°C):		
Corrected Temp (°C):		

Exceptions Noted

1) If temperature exceeds criteria, was sample(s) received same day of sampling? ☐ Yes ☐ No
a) *If yes:* Is there evidence that the chilling process began? ☐ Yes ☐ No

2) If temperature is <0°C, are there obvious signs that the integrity of sample containers is compromised? (e.g., bulging septa, broken/cracked bottles, frozen solid?) ☐ Yes ☐ No

NOTE: If yes, contact PM before proceeding. If no, proceed with login

Additional Comments

Document: CF-LG-WI-002
Revision: 25
Date: 06/17/2019

Eurofins TestAmerica, Cedar Falls

General temperature criteria is 0 to 6°C
Bacteria temperature criteria is 0 to 10°C

14167

Eurofins TestAmerica, Cedar Falls
3019 Venture Way
Cedar Falls, IA 50613
Phone (319) 277-2401 Fax (319) 277-2425

Chain of Custody Record

TestAmerica Des Moines SC
214

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Client Information	Sampler: Louise Jennings	Lab PM: Fredrick, Sandie	Carrier Tracking No(s):	COC No: 310-44167-12671.1
Client Contact: Louise Jennings	Phone: 608 509 8245	E-Mail: sandie.fredrick@testamericainc.com		Page: Page 1 of 2
Company: SCS Engineers		**Analysis Requested**		Job #:
Address: 8450 Hickman Road Suite 20	Due Date Requested:			**Preservation Codes:**
City: Clive	TAT Requested (days): Standard			
State, Zip: IA, 50325				
Phone:	PO #: 25219072			
Email: ljennings@scsengineers.com	WO #:			
Project Name: Ottumwa Generating Station 25219072	Project #: 31011020			
Site:	SSOW#:			Other:

Preservation Codes:

A - HCL	M - Hexane
B - NaOH	N - None
C - Zn Acetate	O - AsNaO2
D - Nitric Acid	P - Na2O4S
E - NaHSO4	Q - Na2SO3
F - MeOH	R - Na2S2O3
G - Amchlor	S - H2SO4
H - Ascorbic Acid	T - TSP Dodecahydrate
I - Ice	U - Acetone
J - DI Water	V - MCAA
K - EDTA	W - pH 4-5
L - EDA	Z - other (specify)

Sample Identification	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	903.0, 904.0	6020A, 7470A	2540C_Calcd, 9056A_ORGFM_28D, SM4500_H+	Total Number of containers	Special Instructions/Note:
			Preservation Code:		☒	☒	D	D	N	☒	
MW-301	10.24.19	0900	G	Water			X	X	X		
MW-302	10.24.19	1020		Water							
MW-303	10.24.19	1200		Water							
MW-304	10.23.19	1427		Water							
MW-305	10.23.19	1615		Water							
MW-306	10.23.19	1700		Water							
FIELD BLANK	10.23.19	2359	—	Water							
MW-307	10.23.19	1315	G	Water							
MW-308	10.23.19	1156		Water							
MW-309	10.23.19	1032		Water							
~~FIELD BLANK~~				~~Water~~							

Possible Hazard Identification
☐ *Non-Hazard* ☐ *Flammable* ☐ *Skin Irritant* ☐ *Poison B* ☐ *Unknown* ☐ *Radiological*

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ *Return To Client* ☐ *Disposal By Lab* ☐ *Archive For* ______ *Months*

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements:

Empty Kit Relinquished by:	Date:	Time:	Method of Shipment:	
Relinquished by: Jennings	Date/Time: 10.24.19 1800	Company: SCS	Received by: Lindsay Binder	Date/Time: 10-25-19 1830	Company: ETA
Relinquished by:	Date/Time:	Company:	Received by:	Date/Time:	Company:
Relinquished by:	Date/Time:	Company:	Received by:	Date/Time:	Company:

Custody Seals Intact: Δ Yes Δ No

Custody Seal No.:

Cooler Temperature(s) °C and Other Remarks

Ver: 01/16/2019

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

14167

Eurofins TestAmerica, Cedar Falls
3019 Venture Way
Cedar Falls, IA 50613
Phone (319) 277-2401 Fax (319) 277-2425

Chain of Custody Record

TestAmerica Des Moines SC
214

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Client Information	Sampler: Louise Jennings	Lab PM: Fredrick, Sandie	Carrier Tracking No(s):	COC No: 310-44167-12871.2
Client Contact: Louise Jennings	Phone: 608 509 8245	E-Mail: sandie.fredrick@testamericainc.com		Page: Page 2 of 2
Company: SCS Engineers		**Analysis Requested**		Job #:

Address: 8450 Hickman Road Suite 20
City: Clive
State, Zip: IA, 50325
Phone:
Email: ljennings@scsengineers.com
Project Name: Ottumwa Generating Station 25219072
Site:

Due Date Requested:
TAT Requested (days): Standard
PO #: 25219072
WO #:
Project #: 31011020
SSOW#:

Preservation Codes:

A - HCL	M - Hexane
B - NaOH	N - None
C - Zn Acetate	O - AsNaO2
D - Nitric Acid	P - Na2O4S
E - NaHSO4	Q - Na2SO3
F - MeOH	R - Na2S2O3
G - Amchlor	S - H2SO4
H - Ascorbic Acid	T - TSP Dodecahydrate
I - Ice	U - Acetone
J - DI Water	V - MCAA
K - EDTA	W - pH 4-5
L - EDA	Z - other (specify)

Other:

Sample Identification	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	903.0, 904.0	6020A, 7470A	2540C_Calcd, 9056A_ORGFM_28D, SM4500_H+	Total Number of containers	Special Instructions/Note:
			Preservation Code:				D	D	N		
MW-310	10.24.19	1250	G	Water			X	X	X		
MW-311	10.24.19	1345	G	Water			X	X	X		

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☐ Disposal By Lab ☐ Archive For ________ Months

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements:

Empty Kit Relinquished by: | Date: | Time: | Method of Shipment:

Relinquished by:	Date/Time: 10.24.19 1600	Company: SCS	Received by: Lindsay Binder	Date/Time: 10-25-19 1830	Company: ETA
Relinquished by:	Date/Time:	Company:	Received by:	Date/Time:	Company:
Relinquished by:	Date/Time:	Company:	Received by:	Date/Time:	Company:

Custody Seals Intact: Δ Yes Δ No | Custody Seal No.: | Cooler Temperature(s) °C and Other Remarks:

Ver: 01/16/2019

10/28/2019

Login Container Summary Report

310-168508

Temperature readings: ______________________________

Client Sample ID	Lab ID	Container Type	Container pH	Preservative Added (mls)	Lot #
MW-301	310-168508-A-1	Plastic 250ml - with Nitric Acid	<2		
MW-301	310-168508-C-1	Plastic 1 liter - Nitric Acid	<2		
MW-301	310-168508-D-1	Plastic 1 liter - Nitric Acid	<2		
MW-302	310-168508-A-2	Plastic 250ml - with Nitric Acid	<2		
MW-302	310-168508-C-2	Plastic 1 liter - Nitric Acid	<2		
MW-302	310-168508-D-2	Plastic 1 liter - Nitric Acid	<2		
MW-303	310-168508-A-3	Plastic 250ml - with Nitric Acid	<2		
MW-303	310-168508-C-3	Plastic 1 liter - Nitric Acid	<2		
MW-303	310-168508-D-3	Plastic 1 liter - Nitric Acid	<2		
MW-304	310-168508-A-4	Plastic 250ml - with Nitric Acid	<2		
MW-304	310-168508-C-4	Plastic 1 liter - Nitric Acid	<2		
MW-304	310-168508-D-4	Plastic 1 liter - Nitric Acid	<2		
MW-305	310-168508-A-5	Plastic 250ml - with Nitric Acid	<2		
MW-305	310-168508-C-5	Plastic 1 liter - Nitric Acid	<2		
MW-305	310-168508-D-5	Plastic 1 liter - Nitric Acid	<2		
MW-306	310-168508-A-6	Plastic 250ml - with Nitric Acid	<2		
MW-306	310-168508-C-6	Plastic 1 liter - Nitric Acid	<2		
MW-306	310-168508-D-6	Plastic 1 liter - Nitric Acid	<2		
FIELD BLANK	310-168508-A-7	Plastic 250ml - with Nitric Acid	<2		
FIELD BLANK	310-168508-C-7	Plastic 1 liter - Nitric Acid	<2		
FIELD BLANK	310-168508-D-7	Plastic 1 liter - Nitric Acid	<2		
MW-307	310-168508-A-8	Plastic 250ml - with Nitric Acid	<2		
MW-308	310-168508-A-9	Plastic 250ml - with Nitric Acid	<2		
MW-309	310-168508-A-10	Plastic 250ml - with Nitric Acid	<2		
MW-310	310-168508-A-11	Plastic 250ml - with Nitric Acid	<2		
MW-310	310-168508-C-11	Plastic 1 liter - Nitric Acid	<2		
MW-310	310-168508-D-11	Plastic 1 liter - Nitric Acid	<2		
MW-311	310-168508-A-12	Plastic 250ml - with Nitric Acid	<2		
MW-311	310-168508-C-12	Plastic 1 liter - Nitric Acid	<2		
MW-311	310-168508-D-12	Plastic 1 liter - Nitric Acid	<2		

Table 1. Sampling Points and Parameters - CCR Rule Sampling Program
Groundwater Monitoring - Ottumwa Generating Station / SCS Engineers Project #25219072

		COC #1		COC #2							COC #3			
	Parameter	MW-301	Field Blank	MW-302	MW-303	MW-304	MW-305	MW-306	MW-310	MW-311	MW-307	MW-308	MW-309	TOTAL
Appendix III Parameters	Boron	x	x	x	x	x	x	x	x	x	x	x	x	12
	Calcium	x	x	x	x	x	x	x	x	x	x	x	x	12
	Chloride	x	x	x	x	x	x	x	x	x	x	x	x	12
	Fluoride	x	x	x	x	x	x	x	x	x	x	x	x	12
	pH	x	x	x	x	x	x	x	x	x	x	x	x	12
	Sulfate	x	x	x	x	x	x	x	x	x	x	x	x	12
	TDS	x	x	x	x	x	x	x	x	x	x	x	x	12
Appendix IV Parameters	Antimony	x	x	x	x	x	x	x	x	x				9
	Arsenic	x	x	x	x	x	x	x	x	x				9
	Barium	x	x	x	x	x	x	x	x	x				9
	Beryllium	x	x	x	x	x	x	x	x	x				9
	Cadmium	x	x	x	x	x	x	x	x	x				9
	Chromium	x	x	x	x	x	x	x	x	x				9
	Cobalt	x	x	x	x	x	x	x	x	x				9
	Fluoride	x	x	x	x	x	x	x	x	x				9
	Lead	x	x	x	x	x	x	x	x	x				9
	Lithium	x	x	x	x	x	x	x	x	x				9
	Mercury	x	x	x	x	x	x	x	x	x				9
	Molybdenum	x	x	x	x	x	x	x	x	x				9
	Selenium	x	x	x	x	x	x	x	x	x				9
	Thallium	x	x	x	x	x	x	x	x	x				9
	Radium	x	x	x	x	x	x	x	x	x				9
Field Parameters	Groundwater Elevation	x		x	x	x	x	x	x	x	x	x	x	11
	Well Depth	x		x	x	x	x	x	x	x	x	x	x	11
	pH (field)	x		x	x	x	x	x	x	x	x	x	x	11
	Specific Conductance	x		x	x	x	x	x	x	x	x	x	x	11
	Dissolved Oxygen	x		x	x	x	x	x	x	x	x	x	x	11
	ORP	x		x	x	x	x	x	x	x	x	x	x	11
	Temperature	x		x	x	x	x	x	x	x	x	x	x	11
	Turbidity	x		x	x	x	x	x	x	x	x	x	x	11
	Color	x		x	x	x	x	x	x	x	x	x	x	11
	Odor	x		x	x	x	x	x	x	x	x	x	x	11

Notes: All samples are unfiltered (total).

C:\Users\fredricks\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.Outlook\232OUB0Y\[OGS_CCR_Rule_Sampling_2019_O

Login Sample Receipt Checklist

Client: SCS Engineers

Job Number: 310-168508-1

Login Number: 168508
List Number: 1
Creator: Bovy, Lorrainna L

List Source: Eurofins TestAmerica, Cedar Falls

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	N/A	
The cooler's custody seal, if present, is intact.	N/A	
Sample custody seals, if present, are intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	True	

Table 2. Groundwater Monitoring Results - Field Parameters
Ottumwa Generating Station - ZLDP / SCS Engineers Project No. 25219072
October 2019

Sample	Date/Sample Time	Groundwater Elevation (amsl)	Temperature (Deg. C)	pH (Std. Units)	Dissolved Oxygen (mg/L)	Specific Conductivity (µmhos/cm)	ORP (mV)	Turbidity
MW-307	10.23.19/1315	651.89	13.38	6.68	0.25	1684	-24.8	12.5
MW-308	10.23.19/1156	651.31	13.16	6.78	4.42	1637	-38.7	7.42
MW-309	10.23.19/1032	651.28	12.83	6.98	0.36	1461	-27.5	42.6

Abbreviations:

mg/L = milligrams per liter	amsl = above mean sea level	NA = Not Analyzed

Notes:
none

Created by:	KAK	Date: 5/1/2017
Last revision by:	NDK	Date: 11/1/2019
Checked by:	MDB	Date: 11/1/2019

I:\25219072.00\Data and Calculations\Tables\Field Data\[OGS_CCR_Field_2019 Oct-ZLDP.xlsx]GW Field Parameters

Table 2. Groundwater Monitoring Results - Field Parameters
Ottumwa Generating Station - Primary Pond / SCS Engineers Project No. 25219072
October 2019

Sample	Date/Sample Time	Groundwater Elevation (amsl)	Temperature (Deg. C)	pH (Std. Units)	Dissolved Oxygen (mg/L)	Specific Conductivity (µmhos/cm)	ORP (mV)	Turbidity
MW-301	10.24.19/0900	683.07	13.71	6.33	4.94	902	9.9	1.6
MW-302	10.24.19/1020	660.14	12.91	6.55	0.35	2184	-0.5	11.9
MW-303	10.24.19/1200	653.86	15.34	6.83	0.28	1287	-5.1	4.24
MW-304	10.23.19/1427	657.71	13.64	7.05	0.44	1871	-57.5	18.9
MW-305	10.23.19/1615	663.21	13.2	6.91	0.42	1794	-6.7	6.21
MW-306	10.23.19/1700	671.28	13.12	6.74	0.29	1266	-0.5	12.3
MW-310	10.24.19/1250	649.31	13.74	7.15	0.41	1906	-9.3	2.29
MW-311	10.24.19/1345	647.80	13.88	6.95	0.29	926	-24.7	3.88

Abbreviations:
mg/L = milligrams per liter
amsl = above mean sea level
NA = Not Analyzed

Notes:
none

Created by: KAK Date: 5/1/2017
Last revision by: LWJ Date: 10/31/2019
Checked by: JSN Date: 11/1/2019
Scientist QA/QC: NDK Date: 11/1/2019

I:\25219072.00\Data and Calculations\Tables\[OGS_CCR_Field_2019_October1.xlsx]GW Field Parameters

15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

eurofins
Environment Testing
TestAmerica

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ANALYTICAL REPORT

Eurofins TestAmerica, Cedar Falls
3019 Venture Way
Cedar Falls, IA 50613
Tel: (319)277-2401

Laboratory Job ID: 310-168508-2
Client Project/Site: Ottumwa Generating Station 25219072

For:
SCS Engineers
2830 Dairy Drive
Madison, Wisconsin 53718

Attn: Meghan Blodgett

Therese Hargraves

Authorized for release by:
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Designee for

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LINKS

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This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

Table of Contents

Case Narrative

Job ID: 310-168508-2

Laboratory: Eurofins TestAmerica, Cedar Falls

Narrative

Job Narrative
310-168508-2

Comments
No additional comments.

Receipt
The samples were received on 10/25/2019 6:30 PM; the samples arrived in good condition, properly preserved and, where required, on ice. The temperatures of the 2 coolers at receipt time were 1.2º C and 4.3º C.

RAD
Methods 903.0, 9315: Radium-226 Prep Batch 160-448344

Any minimum detectable concentration (MDC), critical value (DLC), or Safe Drinking Water Act detection limit (SDWA DL) is sample-specific unless otherwise stated elsewhere in this narrative.

Radiochemistry sample results are reported with the count date/time applied as the Activity Reference Date.
MW-301 (310-168508-1), MW-302 (310-168508-2), MW-303 (310-168508-3), MW-304 (310-168508-4), MW-305 (310-168508-5), MW-306 (310-168508-6), FIELD BLANK (310-168508-7), MW-310 (310-168508-11), MW-311 (310-168508-12), (LCS 160-448344/1-A), (LCSD 160-448344/2-A) and (MB 160-448344/21-A)

Methods 904.0, 9320: Radium-228 Prep Batch 160-448411

The following batch has a LCS (139%) that is above the upper limit (75-125%). The LCSD was within limits and all samples met the client requested limit (RL). The data has been reported with this narrative.

MW-301 (310-168508-1), MW-302 (310-168508-2), MW-303 (310-168508-3), MW-304 (310-168508-4), MW-305 (310-168508-5), MW-306 (310-168508-6), FIELD BLANK (310-168508-7), MW-310 (310-168508-11), MW-311 (310-168508-12), (LCS 160-448411/1-A), (LCSD 160-448411/2-A) and (MB 160-448411/21-A)

Methods 904.0, 9320: Radium-228 Prep Batch 160-448411

Any minimum detectable concentration (MDC), critical value (DLC), or Safe Drinking Water Act detection limit (SDWA DL) is sample-specific unless otherwise stated elsewhere in this narrative.

Radiochemistry sample results are reported with the count date/time applied as the Activity Reference Date.
MW-301 (310-168508-1), MW-302 (310-168508-2), MW-303 (310-168508-3), MW-304 (310-168508-4), MW-305 (310-168508-5), MW-306 (310-168508-6), FIELD BLANK (310-168508-7), MW-310 (310-168508-11), MW-311 (310-168508-12), (LCS 160-448411/1-A), (LCSD 160-448411/2-A) and (MB 160-448411/21-A)

Method PrecSep_0: Radium 228 Prep Batch 160-448411:

Insufficient sample volume was available to perform a sample duplicate for the following samples: MW-301 (310-168508-1), MW-302 (310-168508-2), MW-303 (310-168508-3), MW-304 (310-168508-4), MW-305 (310-168508-5), MW-306 (310-168508-6), FIELD BLANK (310-168508-7), MW-310 (310-168508-11) and MW-311 (310-168508-12). A laboratory control sample/ laboratory control sample duplicate (LCS/LCSD) were prepared instead to demonstrate batch precision.

Method PrecSep-21: Radium 226 Prep batch 160-448344:

Insufficient sample volume was available to perform a sample duplicate for the following samples: MW-301 (310-168508-1), MW-302 (310-168508-2), MW-303 (310-168508-3), MW-304 (310-168508-4), MW-305 (310-168508-5), MW-306 (310-168508-6), FIELD BLANK (310-168508-7), MW-310 (310-168508-11) and MW-311 (310-168508-12). A laboratory control sample/ laboratory control sample duplicate (LCS/LCSD) were prepared instead to demonstrate batch precision.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Sample Summary

Client: SCS Engineers
Project/Site: Ottumwa Generating Station 25219072

Job ID: 310-168508-2

Lab Sample ID	Client Sample ID	Matrix	Collected	Received	Asset ID
310-168508-1	MW-301	Water	10/24/19 09:00	10/25/19 18:30	
310-168508-2	MW-302	Water	10/24/19 10:20	10/25/19 18:30	
310-168508-3	MW-303	Water	10/24/19 12:00	10/25/19 18:30	
310-168508-4	MW-304	Water	10/23/19 14:27	10/25/19 18:30	
310-168508-5	MW-305	Water	10/23/19 16:15	10/25/19 18:30	
310-168508-6	MW-306	Water	10/23/19 17:00	10/25/19 18:30	
310-168508-7	FIELD BLANK	Water	10/23/19 23:59	10/25/19 18:30	
310-168508-11	MW-310	Water	10/24/19 12:50	10/25/19 18:30	
310-168508-12	MW-311	Water	10/24/19 13:45	10/25/19 18:30	

Client Sample Results

Client: SCS Engineers
Project/Site: Ottumwa Generating Station 25219072

Job ID: 310-168508-2

Client Sample ID: MW-301

Date Collected: 10/24/19 09:00
Date Received: 10/25/19 18:30

Lab Sample ID: 310-168508-1

Matrix: Water

Method: 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	**0.203**		0.101	0.103	1.00	0.119	pCi/L	10/30/19 11:17	11/21/19 08:40	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*94.9*		*40 - 110*	*10/30/19 11:17*	*11/21/19 08:40*	*1*

Method: 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	**0.753**	*	0.308	0.315	1.00	0.443	pCi/L	10/31/19 06:24	11/08/19 09:02	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*94.9*		*40 - 110*	*10/31/19 06:24*	*11/08/19 09:02*	*1*
Y Carrier	*86.7*		*40 - 110*	*10/31/19 06:24*	*11/08/19 09:02*	*1*

Method: Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	**0.956**		0.324	0.331	5.00	0.443	pCi/L		11/22/19 07:47	1

Client Sample Results

Client Sample ID: MW-302

Lab Sample ID: 310-168508-2

Date Collected: 10/24/19 10:20

Matrix: Water

Date Received: 10/25/19 18:30

Method: 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	**0.171**		0.112	0.113	1.00	0.156	pCi/L	10/30/19 11:17	11/21/19 08:40	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*82.6*		*40 - 110*	*10/30/19 11:17*	*11/21/19 08:40*	*1*

Method: 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	**0.619**	*****	0.295	0.301	1.00	0.427	pCi/L	10/31/19 06:24	11/08/19 09:06	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*82.6*		*40 - 110*	*10/31/19 06:24*	*11/08/19 09:06*	*1*
Y Carrier	*81.9*		*40 - 110*	*10/31/19 06:24*	*11/08/19 09:06*	*1*

Method: Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	**0.790**		0.316	0.322	5.00	0.427	pCi/L		11/22/19 07:47	1

Client Sample Results

Client: SCS Engineers
Project/Site: Ottumwa Generating Station 25219072

Job ID: 310-168508-2

Client Sample ID: MW-303

Date Collected: 10/24/19 12:00
Date Received: 10/25/19 18:30

Lab Sample ID: 310-168508-3
Matrix: Water

Method: 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.0705	U	0.105	0.106	1.00	0.180	pCi/L	10/30/19 11:17	11/21/19 08:40	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*74.8*		*40 - 110*	*10/30/19 11:17*	*11/21/19 08:40*	*1*

Method: 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.265	U *	0.279	0.280	1.00	0.455	pCi/L	10/31/19 06:24	11/08/19 09:06	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*74.8*		*40 - 110*	*10/31/19 06:24*	*11/08/19 09:06*	*1*
Y Carrier	*80.7*		*40 - 110*	*10/31/19 06:24*	*11/08/19 09:06*	*1*

Method: Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	0.336	U	0.298	0.299	5.00	0.455	pCi/L		11/22/19 07:47	1

Client Sample Results

Client: SCS Engineers
Project/Site: Ottumwa Generating Station 25219072

Job ID: 310-168508-2

Client Sample ID: MW-304

Date Collected: 10/23/19 14:27
Date Received: 10/25/19 18:30

Lab Sample ID: 310-168508-4

Matrix: Water

Method: 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	**1.52**		0.272	0.304	1.00	0.196	pCi/L	10/30/19 11:17	11/21/19 08:40	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*88.0*		*40 - 110*	*10/30/19 11:17*	*11/21/19 08:40*	*1*

Method: 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	**1.50**	*	0.336	0.364	1.00	0.369	pCi/L	10/31/19 06:24	11/08/19 09:06	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*88.0*		*40 - 110*	*10/31/19 06:24*	*11/08/19 09:06*	*1*
Y Carrier	*81.9*		*40 - 110*	*10/31/19 06:24*	*11/08/19 09:06*	*1*

Method: Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	**3.03**		0.432	0.474	5.00	0.369	pCi/L		11/22/19 07:47	1

Client Sample Results

1 2 3 4 5 6 7 8 9 10 11 12 13 14

Client Sample ID: MW-305

Lab Sample ID: 310-168508-5

Date Collected: 10/23/19 16:15

Matrix: Water

Date Received: 10/25/19 18:30

Method: 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	**0.263**		0.137	0.139	1.00	0.183	pCi/L	10/30/19 11:17	11/21/19 08:40	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*88.9*		*40 - 110*	*10/30/19 11:17*	*11/21/19 08:40*	*1*

Method: 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.197	U *	0.253	0.253	1.00	0.420	pCi/L	10/31/19 06:24	11/08/19 09:06	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*88.9*		*40 - 110*	*10/31/19 06:24*	*11/08/19 09:06*	*1*
Y Carrier	*86.4*		*40 - 110*	*10/31/19 06:24*	*11/08/19 09:06*	*1*

Method: Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	**0.460**		0.288	0.289	5.00	0.420	pCi/L		11/22/19 07:47	1

Client Sample Results

Client Sample ID: MW-306

Lab Sample ID: 310-168508-6

Date Collected: 10/23/19 17:00

Matrix: Water

Date Received: 10/25/19 18:30

Method: 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	-0.00587	U	0.0963	0.0963	1.00	0.190	pCi/L	10/30/19 11:17	11/21/19 08:41	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*90.1*		*40 - 110*	*10/30/19 11:17*	*11/21/19 08:41*	*1*

Method: 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	**0.624**	*****	0.260	0.266	1.00	0.359	pCi/L	10/31/19 06:24	11/08/19 09:06	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*90.1*		*40 - 110*	*10/31/19 06:24*	*11/08/19 09:06*	*1*
Y Carrier	*83.7*		*40 - 110*	*10/31/19 06:24*	*11/08/19 09:06*	*1*

Method: Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	**0.624**		0.277	0.283	5.00	0.359	pCi/L		11/22/19 07:47	1

Client Sample Results

Client: SCS Engineers

Job ID: 310-168508-2

Project/Site: Ottumwa Generating Station 25219072

Client Sample ID: FIELD BLANK

Lab Sample ID: 310-168508-7

Date Collected: 10/23/19 23:59

Matrix: Water

Date Received: 10/25/19 18:30

Method: 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	-0.0866	U	0.0593	0.0598	1.00	0.164	pCi/L	10/30/19 11:17	11/21/19 08:41	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*94.9*		*40 - 110*	*10/30/19 11:17*	*11/21/19 08:41*	*1*

Method: 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	**0.413**	*****	0.232	0.235	1.00	0.344	pCi/L	10/31/19 06:24	11/08/19 09:06	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*94.9*		*40 - 110*	*10/31/19 06:24*	*11/08/19 09:06*	*1*
Y Carrier	*86.7*		*40 - 110*	*10/31/19 06:24*	*11/08/19 09:06*	*1*

Method: Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	**0.413**		0.239	0.242	5.00	0.344	pCi/L		11/22/19 07:47	1

Client Sample Results

Client Sample ID: MW-310

Date Collected: 10/24/19 12:50
Date Received: 10/25/19 18:30

Lab Sample ID: 310-168508-11
Matrix: Water

Method: 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	-0.0487	U	0.0720	0.0721	1.00	0.164	pCi/L	10/30/19 11:17	11/21/19 10:26	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*81.4*		*40 - 110*	*10/30/19 11:17*	*11/21/19 10:26*	*1*

Method: 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	**0.411**	*****	0.268	0.270	1.00	0.408	pCi/L	10/31/19 06:24	11/08/19 09:06	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*81.4*		*40 - 110*	*10/31/19 06:24*	*11/08/19 09:06*	*1*
Y Carrier	*82.6*		*40 - 110*	*10/31/19 06:24*	*11/08/19 09:06*	*1*

Method: Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	**0.411**		0.278	0.279	5.00	0.408	pCi/L		11/22/19 07:47	1

Client Sample Results

Client: SCS Engineers
Job ID: 310-168508-2
Project/Site: Ottumwa Generating Station 25219072

Client Sample ID: MW-311
Lab Sample ID: 310-168508-12
Date Collected: 10/24/19 13:45
Matrix: Water
Date Received: 10/25/19 18:30

Method: 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.108	U	0.0981	0.0986	1.00	0.153	pCi/L	10/30/19 11:17	11/21/19 10:26	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*103*		*40 - 110*	*10/30/19 11:17*	*11/21/19 10:26*	*1*

Method: 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.303	U *	0.240	0.242	1.00	0.382	pCi/L	10/31/19 06:24	11/08/19 09:07	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*103*		*40 - 110*	*10/31/19 06:24*	*11/08/19 09:07*	*1*
Y Carrier	*85.2*		*40 - 110*	*10/31/19 06:24*	*11/08/19 09:07*	*1*

Method: Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	**0.411**		0.259	0.261	5.00	0.382	pCi/L		11/22/19 07:47	1

Definitions/Glossary

Qualifiers

Rad

Qualifier	Qualifier Description
*	LCS or LCSD is outside acceptance limits.
U	Result is less than the sample detection limit.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

QC Sample Results

Client: SCS Engineers
Job ID: 310-168508-2
Project/Site: Ottumwa Generating Station 25219072

Method: 903.0 - Radium-226 (GFPC)

Lab Sample ID: MB 160-448344/21-A
Matrix: Water
Analysis Batch: 451498

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 448344

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.01229	U	0.0607	0.0607	1.00	0.120	pCi/L	10/30/19 11:17	11/21/19 10:26	1

Carrier	*MB %Yield*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*93.1*		*40 - 110*	*10/30/19 11:17*	*11/21/19 10:26*	*1*

Lab Sample ID: LCS 160-448344/1-A
Matrix: Water
Analysis Batch: 451498

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 448344

Analyte			Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits		
Radium-226			11.4	12.16		1.29	1.00	0.175	pCi/L	107	75 - 125		

Carrier	*LCS %Yield*	*LCS Qualifier*	*Limits*
Ba Carrier	*74.8*		*40 - 110*

Lab Sample ID: LCSD 160-448344/2-A
Matrix: Water
Analysis Batch: 451498

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA
Prep Batch: 448344

Analyte			Spike Added	LCSD Result	LCSD Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits	RER	RER Limit
Radium-226			11.4	12.62		1.31	1.00	0.163	pCi/L	111	75 - 125	0.17	1

Carrier	*LCSD %Yield*	*LCSD Qualifier*	*Limits*
Ba Carrier	*94.0*		*40 - 110*

Method: 904.0 - Radium-228 (GFPC)

Lab Sample ID: MB 160-448411/21-A
Matrix: Water
Analysis Batch: 449621

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 448411

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.4561		0.249	0.252	1.00	0.369	pCi/L	10/31/19 06:24	11/08/19 09:07	1

Carrier	*MB %Yield*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*93.1*		*40 - 110*	*10/31/19 06:24*	*11/08/19 09:07*	*1*
Y Carrier	*83.7*		*40 - 110*	*10/31/19 06:24*	*11/08/19 09:07*	*1*

Method: 904.0 - Radium-228 (GFPC) (Continued)

Lab Sample ID: LCS 160-448411/1-A
Matrix: Water
Analysis Batch: 449588

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 448411

Analyte			Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits		
Radium-228			9.42	13.06	*	1.51	1.00	0.513	pCi/L	139	75 - 125		

Carrier	*LCS %Yield*	*LCS Qualifier*	*Limits*
Ba Carrier	*74.8*		*40 - 110*
Y Carrier	*82.2*		*40 - 110*

Lab Sample ID: LCSD 160-448411/2-A
Matrix: Water
Analysis Batch: 449588

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA
Prep Batch: 448411

Analyte			Spike Added	LCSD Result	LCSD Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits	RER	RER Limit
Radium-228			9.42	10.72		1.23	1.00	0.430	pCi/L	114	75 - 125	0.85	1

Carrier	*LCSD %Yield*	*LCSD Qualifier*	*Limits*
Ba Carrier	*94.0*		*40 - 110*
Y Carrier	*81.5*		*40 - 110*

QC Association Summary

Client: SCS Engineers
Job ID: 310-168508-2
Project/Site: Ottumwa Generating Station 25219072

Rad

Prep Batch: 448344

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-168508-1	MW-301	Total/NA	Water	PrecSep-21	
310-168508-2	MW-302	Total/NA	Water	PrecSep-21	
310-168508-3	MW-303	Total/NA	Water	PrecSep-21	
310-168508-4	MW-304	Total/NA	Water	PrecSep-21	
310-168508-5	MW-305	Total/NA	Water	PrecSep-21	
310-168508-6	MW-306	Total/NA	Water	PrecSep-21	
310-168508-7	FIELD BLANK	Total/NA	Water	PrecSep-21	
310-168508-11	MW-310	Total/NA	Water	PrecSep-21	
310-168508-12	MW-311	Total/NA	Water	PrecSep-21	
MB 160-448344/21-A	Method Blank	Total/NA	Water	PrecSep-21	
LCS 160-448344/1-A	Lab Control Sample	Total/NA	Water	PrecSep-21	
LCSD 160-448344/2-A	Lab Control Sample Dup	Total/NA	Water	PrecSep-21	

Prep Batch: 448411

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-168508-1	MW-301	Total/NA	Water	PrecSep_0	
310-168508-2	MW-302	Total/NA	Water	PrecSep_0	
310-168508-3	MW-303	Total/NA	Water	PrecSep_0	
310-168508-4	MW-304	Total/NA	Water	PrecSep_0	
310-168508-5	MW-305	Total/NA	Water	PrecSep_0	
310-168508-6	MW-306	Total/NA	Water	PrecSep_0	
310-168508-7	FIELD BLANK	Total/NA	Water	PrecSep_0	
310-168508-11	MW-310	Total/NA	Water	PrecSep_0	
310-168508-12	MW-311	Total/NA	Water	PrecSep_0	
MB 160-448411/21-A	Method Blank	Total/NA	Water	PrecSep_0	
LCS 160-448411/1-A	Lab Control Sample	Total/NA	Water	PrecSep_0	
LCSD 160-448411/2-A	Lab Control Sample Dup	Total/NA	Water	PrecSep_0	

Lab Chronicle

Client: SCS Engineers
Project/Site: Ottumwa Generating Station 25219072

Job ID: 310-168508-2

Client Sample ID: MW-301

Date Collected: 10/24/19 09:00
Date Received: 10/25/19 18:30

Lab Sample ID: 310-168508-1
Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	PrecSep-21			448344	10/30/19 11:17	MNH	TAL SL
Total/NA	Analysis	903.0		1	451498	11/21/19 08:40	CJQ	TAL SL
Total/NA	Prep	PrecSep_0			448411	10/31/19 06:24	MNH	TAL SL
Total/NA	Analysis	904.0		1	449588	11/08/19 09:02	AJD	TAL SL
Total/NA	Analysis	Ra226_Ra228 Pos		1	451575	11/22/19 07:47	SMP	TAL SL

Client Sample ID: MW-302

Date Collected: 10/24/19 10:20
Date Received: 10/25/19 18:30

Lab Sample ID: 310-168508-2
Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	PrecSep-21			448344	10/30/19 11:17	MNH	TAL SL
Total/NA	Analysis	903.0		1	451498	11/21/19 08:40	CJQ	TAL SL
Total/NA	Prep	PrecSep_0			448411	10/31/19 06:24	MNH	TAL SL
Total/NA	Analysis	904.0		1	449621	11/08/19 09:06	AJD	TAL SL
Total/NA	Analysis	Ra226_Ra228 Pos		1	451575	11/22/19 07:47	SMP	TAL SL

Client Sample ID: MW-303

Date Collected: 10/24/19 12:00
Date Received: 10/25/19 18:30

Lab Sample ID: 310-168508-3
Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	PrecSep-21			448344	10/30/19 11:17	MNH	TAL SL
Total/NA	Analysis	903.0		1	451498	11/21/19 08:40	CJQ	TAL SL
Total/NA	Prep	PrecSep_0			448411	10/31/19 06:24	MNH	TAL SL
Total/NA	Analysis	904.0		1	449621	11/08/19 09:06	AJD	TAL SL
Total/NA	Analysis	Ra226_Ra228 Pos		1	451575	11/22/19 07:47	SMP	TAL SL

Client Sample ID: MW-304

Date Collected: 10/23/19 14:27
Date Received: 10/25/19 18:30

Lab Sample ID: 310-168508-4
Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	PrecSep-21			448344	10/30/19 11:17	MNH	TAL SL
Total/NA	Analysis	903.0		1	451498	11/21/19 08:40	CJQ	TAL SL
Total/NA	Prep	PrecSep_0			448411	10/31/19 06:24	MNH	TAL SL
Total/NA	Analysis	904.0		1	449621	11/08/19 09:06	AJD	TAL SL
Total/NA	Analysis	Ra226_Ra228 Pos		1	451575	11/22/19 07:47	SMP	TAL SL

Lab Chronicle

Client: SCS Engineers
Job ID: 310-168508-2
Project/Site: Ottumwa Generating Station 25219072

Client Sample ID: MW-305

Lab Sample ID: 310-168508-5
Date Collected: 10/23/19 16:15
Matrix: Water
Date Received: 10/25/19 18:30

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	PrecSep-21			448344	10/30/19 11:17	MNH	TAL SL
Total/NA	Analysis	903.0		1	451498	11/21/19 08:40	CJQ	TAL SL
Total/NA	Prep	PrecSep_0			448411	10/31/19 06:24	MNH	TAL SL
Total/NA	Analysis	904.0		1	449621	11/08/19 09:06	AJD	TAL SL
Total/NA	Analysis	Ra226_Ra228 Pos		1	451575	11/22/19 07:47	SMP	TAL SL

Client Sample ID: MW-306

Lab Sample ID: 310-168508-6
Date Collected: 10/23/19 17:00
Matrix: Water
Date Received: 10/25/19 18:30

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	PrecSep-21			448344	10/30/19 11:17	MNH	TAL SL
Total/NA	Analysis	903.0		1	451498	11/21/19 08:41	CJQ	TAL SL
Total/NA	Prep	PrecSep_0			448411	10/31/19 06:24	MNH	TAL SL
Total/NA	Analysis	904.0		1	449621	11/08/19 09:06	AJD	TAL SL
Total/NA	Analysis	Ra226_Ra228 Pos		1	451575	11/22/19 07:47	SMP	TAL SL

Client Sample ID: FIELD BLANK

Lab Sample ID: 310-168508-7
Date Collected: 10/23/19 23:59
Matrix: Water
Date Received: 10/25/19 18:30

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	PrecSep-21			448344	10/30/19 11:17	MNH	TAL SL
Total/NA	Analysis	903.0		1	451498	11/21/19 08:41	CJQ	TAL SL
Total/NA	Prep	PrecSep_0			448411	10/31/19 06:24	MNH	TAL SL
Total/NA	Analysis	904.0		1	449621	11/08/19 09:06	AJD	TAL SL
Total/NA	Analysis	Ra226_Ra228 Pos		1	451575	11/22/19 07:47	SMP	TAL SL

Client Sample ID: MW-310

Lab Sample ID: 310-168508-11
Date Collected: 10/24/19 12:50
Matrix: Water
Date Received: 10/25/19 18:30

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	PrecSep-21			448344	10/30/19 11:17	MNH	TAL SL
Total/NA	Analysis	903.0		1	451498	11/21/19 10:26	CJQ	TAL SL
Total/NA	Prep	PrecSep_0			448411	10/31/19 06:24	MNH	TAL SL
Total/NA	Analysis	904.0		1	449621	11/08/19 09:06	AJD	TAL SL
Total/NA	Analysis	Ra226_Ra228 Pos		1	451575	11/22/19 07:47	SMP	TAL SL

Client Sample ID: MW-311
Lab Sample ID: 310-168508-12
Date Collected: 10/24/19 13:45
Matrix: Water
Date Received: 10/25/19 18:30

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	PrecSep-21			448344	10/30/19 11:17	MNH	TAL SL
Total/NA	Analysis	903.0		1	451498	11/21/19 10:26	CJQ	TAL SL
Total/NA	Prep	PrecSep_0			448411	10/31/19 06:24	MNH	TAL SL
Total/NA	Analysis	904.0		1	449621	11/08/19 09:07	AJD	TAL SL
Total/NA	Analysis	Ra226_Ra228 Pos		1	451575	11/22/19 07:47	SMP	TAL SL

Laboratory References:

TAL SL = Eurofins TestAmerica, St. Louis, 13715 Rider Trail North, Earth City, MO 63045, TEL (314)298-8566

Accreditation/Certification Summary

Client: SCS Engineers
Project/Site: Ottumwa Generating Station 25219072

Job ID: 310-168508-2

Laboratory: Eurofins TestAmerica, Cedar Falls

The accreditations/certifications listed below are applicable to this report.

Authority	Program	Identification Number	Expiration Date
Iowa	State Program	007	12-01-19

Laboratory: Eurofins TestAmerica, St. Louis

All accreditations/certifications held by this laboratory are listed. Not all accreditations/certifications are applicable to this report.

Authority	Program	Identification Number	Expiration Date
ANAB	Dept. of Defense ELAP	L2305	04-06-22
ANAB	Dept. of Energy	L2305.01	04-06-22
ANAB	ISO/IEC 17025	L2305	04-06-22
Arizona	State	AZ0813	12-08-19
California	Los Angeles County Sanitation Districts	10259	06-30-20
California	State	2886	06-30-20
Connecticut	State	PH-0241	03-31-21
Florida	NELAP	E87689	06-30-20
HI - RadChem Recognition	State	n/a	06-30-20
Illinois	NELAP	004553	11-30-19
Iowa	State	373	09-17-20
Kansas	NELAP	E-10236	10-31-20
Kentucky (DW)	State	KY90125	12-31-19
Louisiana	NELAP	04080	06-30-20
Louisiana (DW)	State	LA011	12-31-19
Maryland	State	310	09-30-20
MI - RadChem Recognition	State	9005	06-30-20
Missouri	State	780	06-30-22
Nevada	State	MO000542020-1	07-31-20
New Jersey	NELAP	MO002	06-30-20
New York	NELAP	11616	04-01-20
North Dakota	State	R-207	06-30-20
NRC	NRC	24-24817-01	12-31-22
Oklahoma	State	9997	08-31-20
Pennsylvania	NELAP	68-00540	02-28-20
South Carolina	State	85002001	06-30-20
Texas	NELAP	T104704193-19-13	07-31-20
US Fish & Wildlife	US Federal Programs	058448	07-31-20
USDA	US Federal Programs	P330-17-00028	02-02-20
Utah	NELAP	MO000542019-11	07-31-20
Virginia	NELAP	10310	06-14-20
Washington	State	C592	08-30-20
West Virginia DEP	State	381	12-01-19

Method Summary

Client: SCS Engineers
Project/Site: Ottumwa Generating Station 25219072

Job ID: 310-168508-2

Method	Method Description	Protocol	Laboratory
903.0	Radium-226 (GFPC)	EPA	TAL SL
904.0	Radium-228 (GFPC)	EPA	TAL SL
Ra226_Ra228 Pos	Combined Radium-226 and Radium-228	TAL-STL	TAL SL
PrecSep_0	Preparation, Precipitate Separation	None	TAL SL
PrecSep-21	Preparation, Precipitate Separation (21-Day In-Growth)	None	TAL SL

Protocol References:

EPA = US Environmental Protection Agency
None = None
TAL-STL = TestAmerica Laboratories, St. Louis, Facility Standard Operating Procedure.

Laboratory References:

TAL SL = Eurofins TestAmerica, St. Louis, 13715 Rider Trail North, Earth City, MO 63045, TEL (314)298-8566

eurofins | Environment Testing
TestAmerica

310-168508 Chain of Custody

Cooler/Sample Receipt and Temperature Log Form

Client Information

Client: SCS Engineers

City/State: CITY Clive STATE IA

Project: Ottumwa Generating Station

Receipt Information

Date/Time Received: DATE 10-25-19 TIME 1830

Received By: LAB

Delivery Type: ☐ UPS ☐ FedEx ☐ FedEx Ground ☐ US Mail ☐ Spee-Dee
☒ Lab Courier ☐ Lab Field Services ☐ Client Drop-off ☐ Other:__________

Condition of Cooler/Containers

Sample(s) received in Cooler? ☒ Yes ☐ No *If yes:* Cooler ID:

Multiple Coolers? ☒ Yes ☐ No *If yes:* Cooler # 1 of 2

Cooler Custody Seals Present? ☐ Yes ☒ No *If yes:* Cooler custody seals intact? ☐ Yes ☐ No

Sample Custody Seals Present? ☐ Yes ☒ No *If yes:* Sample custody seals intact? ☐ Yes ☐ No

Trip Blank Present? ☐ Yes ☒ No *If yes:* Which VOA samples are in cooler? ↓

Temperature Record

Coolant: ☒ Wet ice ☐ Blue ice ☐ Dry ice ☐ Other:__________ ☐ NONE

Thermometer ID: N

Correction Factor (°C): +0.0

• Temp Blank Temperature – If no temp blank, or temp blank temperature above criteria, proceed to Sample Container Temperature

Uncorrected Temp (°C): 1.2

Corrected Temp (°C): 1.2

• Sample Container Temperature

Container(s) used:	CONTAINER 1	CONTAINER 2
Uncorrected Temp (°C):		
Corrected Temp (°C):		

Exceptions Noted

1) If temperature exceeds criteria, was sample(s) received same day of sampling? ☐ Yes ☐ No
   a) *If yes:* Is there evidence that the chilling process began? ☐ Yes ☐ No

2) If temperature is <0°C, are there obvious signs that the integrity of sample containers is compromised? (e.g., bulging septa, broken/cracked bottles, frozen solid?) ☐ Yes ☐ No

NOTE: If yes, contact PM before proceeding. If no, proceed with login

Additional Comments

Document: CF-LG-WI-002
Revision: 25
Date: 06/17/2019

General temperature criteria is 0 to 6°C
Bacteria temperature criteria is 0 to 10°C

eurofins | Environment Testing
TestAmerica

Place COC scanning label here
214

Cooler/Sample Receipt and Temperature Log Form

Client Information

Client: SCS engineers

City/State: CITY Clive STATE IA | Project: Ottumwa Generating Station

Receipt Information

Date/Time Received: DATE 10-25-19 TIME 1830 | Received By: LAB

Delivery Type: ☐ UPS ☐ FedEx ☐ FedEx Ground ☐ US Mail ☐ Spee-Dee
☒ Lab Courier ☐ Lab Field Services ☐ Client Drop-off ☐ Other:______

Condition of Cooler/Containers

Sample(s) received in Cooler? ☒ Yes ☐ No *If yes:* Cooler ID:

Multiple Coolers? ☒ Yes ☐ No *If yes:* Cooler # 2 of 2

Cooler Custody Seals Present? ☐ Yes ☒ No *If yes:* Cooler custody seals intact? ☐ Yes ☐ No

Sample Custody Seals Present? ☐ Yes ☒ No *If yes:* Sample custody seals intact? ☐ Yes ☐ No

Trip Blank Present? ☐ Yes ☒ No *If yes:* Which VOA samples are in cooler? ↓

Temperature Record

Coolant: ☒ Wet ice ☐ Blue ice ☐ Dry ice ☐ Other:______ ☐ NONE

Thermometer ID: N | Correction Factor (°C): +0.0

• Temp Blank Temperature – If no temp blank, or temp blank temperature above criteria, proceed to Sample Container Temperature

Uncorrected Temp (°C): 4.3 | Corrected Temp (°C): 4.3

• Sample Container Temperature

	CONTAINER 1	CONTAINER 2
Container(s) used:		
Uncorrected Temp (°C):		
Corrected Temp (°C):		

Exceptions Noted

1) If temperature exceeds criteria, was sample(s) received same day of sampling? ☐ Yes ☐ No
a) *If yes:* Is there evidence that the chilling process began? ☐ Yes ☐ No

2) If temperature is <0°C, are there obvious signs that the integrity of sample containers is compromised? (e.g., bulging septa, broken/cracked bottles, frozen solid?) ☐ Yes ☐ No

NOTE: If yes, contact PM before proceeding. If no, proceed with login

Additional Comments

Document: CF-LG-WI-002
Revision: 25
Date: 06/17/2019

Eurofins TestAmerica, Cedar Falls

General temperature criteria is 0 to 6°C
Bacteria temperature criteria is 0 to 10°C

14167

Eurofins TestAmerica, Cedar Falls
3019 Venture Way
Cedar Falls, IA 50613
Phone (319) 277-2401 Fax (319) 277-2425

Chain of Custody Record

TestAmerica Des Moines SC
214

eurofins
Environment Testing
TestAmerica

Client Information	Sampler: Louise Jennings	Lab PM: Fredrick, Sandie	Carrier Tracking No(s):
Client Contact: Louise Jennings	Phone: 608 509 8245	E-Mail: sandie.fredrick@testamericainc.com	COC No: 310-44167-12671.1
Company: SCS Engineers		**Analysis Requested**	Page: Page 1 of 2
Address: 8450 Hickman Road Suite 20	Due Date Requested:		Job #:
City: Clive	TAT Requested (days): Standard		
State, Zip: IA, 50325			
Phone:	PO #: 25219072		
Email: jennings@scsengineers.com	WO #:		
Project Name: Ottumwa Generating Station 25219072	Project #: 31011020		
Site:	SSOW#:		

Preservation Codes:
A - HCL
B - NaOH
C - Zn Acetate
D - Nitric Acid
E - NaHSO4
F - MeOH
G - Amchlor
H - Ascorbic Acid
I - Ice
J - DI Water
K - EDTA
L - EDA
M - Hexane
N - None
O - AsNaO2
P - Na2O4S
Q - Na2SO3
R - Na2S2O3
S - H2SO4
T - TSP Dodecahydrate
U - Acetone
V - MCAA
W - pH 4-5
Z - other (specify)
Other:

Sample Identification	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	903.0, 904.0	9020A, 7470A	2540C_Calcd, 9056A_ORGFM_28D, SM4500_H+	Total Number of containers	Special Instructions/Note:
			Preservation Code:				D	D	N		
MW-301	10.24.19	0900	G	Water			X	X	X		
MW-302	10.24.19	1020		Water							
MW-303	10.24.19	1200		Water							
MW-304	10.23.19	1427		Water							
MW-305	10.23.19	1615		Water							
MW-306	10.23.19	1700		Water							
FIELD BLANK	10.23.19	2359		Water							
MW-307	10.23.19	1315	G	Water							
MW-308	10.23.19	1156		Water							
MW-309	10.23.19	1032		Water							
~~FIELD BLANK~~				~~Water~~							

Possible Hazard Identification
☐ *Non-Hazard* ☐ *Flammable* ☐ *Skin Irritant* ☐ *Poison B* ☐ *Unknown* ☐ *Radiological*

Deliverable Requested: I, II, III, IV, Other (specify)

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ *Return To Client* ☐ *Disposal By Lab* ☐ *Archive For* ____ *Months*

Special Instructions/QC Requirements:

Empty Kit Relinquished by:	Date:	Time:	Method of Shipment:

Relinquished by: Jennings	Date/Time: 10.24.19 1600	Company: SCS	Received by: Lindsay Binder	Date/Time: 10.25.19 1830	Company: ETA
Relinquished by:	Date/Time:	Company:	Received by:	Date/Time:	Company:
Relinquished by:	Date/Time:	Company:	Received by:	Date/Time:	Company:

Custody Seals Intact: Δ Yes Δ No	Custody Seal No.:	Cooler Temperature(s) °C and Other Remarks:

Ver: 01/16/2019

14167

Eurofins TestAmerica, Cedar Falls
3019 Venture Way
Cedar Falls, IA 50613
Phone (319) 277-2401 Fax (319) 277-2425

Chain of Custody Record

TestAmerica Des Moines SC
214

eurofins Environment Testing TestAmerica

Client Information	Sampler: Louise Jennings	Lab PM: Fredrick, Sandie	Carrier Tracking No(s):	COC No: 310-44167-12871.2
Client Contact: Louise Jennings	Phone: 608 509 8245	E-Mail: sandie.fredrick@testamericainc.com		Page: Page 2 of 2
Company: SCS Engineers				Job #:

Address: 8450 Hickman Road Suite 20
City: Clive
State, Zip: IA, 50325
Phone:
Email: ljennings@scsengineers.com
Project Name: Ottumwa Generating Station 25219072
Site:

Due Date Requested:
TAT Requested (days): Standard
PO #: 25219072
WO #:
Project #: 31011020
SSOW#:

Analysis Requested

Preservation Codes:
A - HCL
B - NaOH
C - Zn Acetate
D - Nitric Acid
E - NaHSO4
F - MeOH
G - Amchlor
H - Ascorbic Acid
I - Ice
J - DI Water
K - EDTA
L - EDA
M - Hexane
N - None
O - AsNaO2
P - Na2O4S
Q - Na2SO3
R - Na2S2O3
S - H2SO4
T - TSP Dodecahydrate
U - Acetone
V - MCAA
W - pH 4-5
Z - other (specify)
Other:

Sample Identification	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	903.0, 904.0	6020A, 7470A	2540C_Calcd, 9056A_ORGFM_28D, SM4500_H+	Total Number of containers	Special Instructions/Note:
				Preservation Code:			D	D	N		
MW-310	10.24.19	1250	G	Water			X	X	X		
MW-311	10.24.19	1345	G	Water			X	X	X		

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☐ Disposal By Lab ☐ Archive For ________ Months

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements:

Empty Kit Relinquished by: Date: Time: Method of Shipment:

Relinquished by:	Date/Time: 10.24.19 1600	Company: SCS	Received by: Lindsay Binder	Date/Time: 10-25-19 1830	Company: ETA
Relinquished by:	Date/Time:	Company:	Received by:	Date/Time:	Company:
Relinquished by:	Date/Time:	Company:	Received by:	Date/Time:	Company:

Custody Seals Intact: Δ Yes Δ No	Custody Seal No.:	Cooler Temperature(s) °C and Other Remarks:

Ver: 01/16/2019

10/28/2019

Login Container Summary Report

310-168508

Temperature readings: ______________________________

Client Sample ID	Lab ID	Container Type	Container pH	Preservative Added (mls)	Lot #
MW-301	310-168508-A-1	Plastic 250ml - with Nitric Acid	<2		
MW-301	310-168508-C-1	Plastic 1 liter - Nitric Acid	<2		
MW-301	310-168508-D-1	Plastic 1 liter - Nitric Acid	<2		
MW-302	310-168508-A-2	Plastic 250ml - with Nitric Acid	<2		
MW-302	310-168508-C-2	Plastic 1 liter - Nitric Acid	<2		
MW-302	310-168508-D-2	Plastic 1 liter - Nitric Acid	<2		
MW-303	310-168508-A-3	Plastic 250ml - with Nitric Acid	<2		
MW-303	310-168508-C-3	Plastic 1 liter - Nitric Acid	<2		
MW-303	310-168508-D-3	Plastic 1 liter - Nitric Acid	<2		
MW-304	310-168508-A-4	Plastic 250ml - with Nitric Acid	<2		
MW-304	310-168508-C-4	Plastic 1 liter - Nitric Acid	<2		
MW-304	310-168508-D-4	Plastic 1 liter - Nitric Acid	<2		
MW-305	310-168508-A-5	Plastic 250ml - with Nitric Acid	<2		
MW-305	310-168508-C-5	Plastic 1 liter - Nitric Acid	<2		
MW-305	310-168508-D-5	Plastic 1 liter - Nitric Acid	<2		
MW-306	310-168508-A-6	Plastic 250ml - with Nitric Acid	<2		
MW-306	310-168508-C-6	Plastic 1 liter - Nitric Acid	<2		
MW-306	310-168508-D-6	Plastic 1 liter - Nitric Acid	<2		
FIELD BLANK	310-168508-A-7	Plastic 250ml - with Nitric Acid	<2		
FIELD BLANK	310-168508-C-7	Plastic 1 liter - Nitric Acid	<2		
FIELD BLANK	310-168508-D-7	Plastic 1 liter - Nitric Acid	<2		
MW-307	310-168508-A-8	Plastic 250ml - with Nitric Acid	<2		
MW-308	310-168508-A-9	Plastic 250ml - with Nitric Acid	<2		
MW-309	310-168508-A-10	Plastic 250ml - with Nitric Acid	<2		
MW-310	310-168508-A-11	Plastic 250ml - with Nitric Acid	<2		
MW-310	310-168508-C-11	Plastic 1 liter - Nitric Acid	<2		
MW-310	310-168508-D-11	Plastic 1 liter - Nitric Acid	<2		
MW-311	310-168508-A-12	Plastic 250ml - with Nitric Acid	<2		
MW-311	310-168508-C-12	Plastic 1 liter - Nitric Acid	<2		
MW-311	310-168508-D-12	Plastic 1 liter - Nitric Acid	<2		

1 2 3 4 5 6 7 8 9 10 11 12 13 14

Login Sample Receipt Checklist

Client: SCS Engineers

Job Number: 310-168508-2

Login Number: 168508
List Number: 1
Creator: Bovy, Lorrainna L

List Source: Eurofins TestAmerica, Cedar Falls

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	N/A	
The cooler's custody seal, if present, is intact.	N/A	
Sample custody seals, if present, are intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	True	

1
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Login Sample Receipt Checklist

Client: SCS Engineers

Job Number: 310-168508-2

Login Number: 168508
List Number: 2
Creator: Hellm, Michael

List Source: Eurofins TestAmerica, St. Louis
List Creation: 10/29/19 01:05 PM

Question	**Answer**	**Comment**
Radioactivity wasn't checked or is </= background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	N/A	
Sample custody seals, if present, are intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	N/A	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	22.0
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	N/A	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	N/A	
Multiphasic samples are not present.	N/A	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

Tracer/Carrier Summary

Client: SCS Engineers　　Job ID: 310-168508-2
Project/Site: Ottumwa Generating Station 25219072

Method: 903.0 - Radium-226 (GFPC)

Matrix: Water　　**Prep Type: Total/NA**

Percent Yield (Acceptance Limits)

Lab Sample ID	Client Sample ID	Ba Carrier (40-110)
310-168508-1	MW-301	94.9
310-168508-2	MW-302	82.6
310-168508-3	MW-303	74.8
310-168508-4	MW-304	88.0
310-168508-5	MW-305	88.9
310-168508-6	MW-306	90.1
310-168508-7	FIELD BLANK	94.9
310-168508-11	MW-310	81.4
310-168508-12	MW-311	103
LCS 160-448344/1-A	Lab Control Sample	74.8
LCSD 160-448344/2-A	Lab Control Sample Dup	94.0
MB 160-448344/21-A	Method Blank	93.1

Tracer/Carrier Legend

Ba Carrier = Ba Carrier

Method: 904.0 - Radium-228 (GFPC)

Matrix: Water　　**Prep Type: Total/NA**

Percent Yield (Acceptance Limits)

Lab Sample ID	Client Sample ID	Ba Carrier (40-110)	Y Carrier (40-110)
310-168508-1	MW-301	94.9	86.7
310-168508-2	MW-302	82.6	81.9
310-168508-3	MW-303	74.8	80.7
310-168508-4	MW-304	88.0	81.9
310-168508-5	MW-305	88.9	86.4
310-168508-6	MW-306	90.1	83.7
310-168508-7	FIELD BLANK	94.9	86.7
310-168508-11	MW-310	81.4	82.6
310-168508-12	MW-311	103	85.2
LCS 160-448411/1-A	Lab Control Sample	74.8	82.2
LCSD 160-448411/2-A	Lab Control Sample Dup	94.0	81.5
MB 160-448411/21-A	Method Blank	93.1	83.7

Tracer/Carrier Legend

Ba Carrier = Ba Carrier
Y Carrier = Y Carrier

Appendix B

Demonstration of Need for ACM Deadline Extension

SCS ENGINEERS Environmental Consultants & Contractors

July 10, 2019
File No. 25218202.00

Mr. Rob Saunders
Alliant Energy
20775 Power Plant Rd
Ottumwa, IA 52501

Subject: Demonstration of Need for Deadline Extension
Assessment of Corrective Measures
Ottumwa Generating Station, Ottumwa, Iowa

Dear Mr. Saunders:

In accordance with 40 CFR 257.96(a), Interstate Power and Light Company (IPL) has initiated an Assessment of Corrective Measures (ACM) for the Ottumwa Generating Station. The ACM was initiated on April 15, 2019, in response to detections of constituents in Appendix IV to 40 CFR Part 257 at statistically significant levels above the groundwater protection standards (GPS) established under 40 CFR 257.95(h). As allowed under 40 CFR 257.96(a), this letter provides a demonstration that additional time beyond the 90-day deadline is needed to complete the ACM, and that the deadline may be extended by 60 days. Therefore, the ACM must be completed by September 13, 2019.

Demonstration of Need for Additional Time

Additional time is needed to complete the ACM in order to investigate the nature and extent of downgradient groundwater impacts and consider that information in preparing the ACM. The additional information obtained through further investigation of site conditions is important to the selection of suitable corrective measures and the evaluation of those corrective measures in meeting the requirements and objectives outlined in 40 CFR 257.96(c). Specifically, additional data about the nature and extent of groundwater impacts is needed to determine the current level of risk, evaluate the reduction of risk provided, and evaluate the implementation of potential corrective measures.

In January 2019, prior to initiating an ACM in April 2019, IPL began the process of designing, permitting, installing, and sampling additional groundwater monitoring wells to investigate the nature and extent of these constituents in groundwater, in accordance with 40 CFR 257.95(g)(1).

The following factors contributed to delays in the installation and sampling of the new wells, which in turn created the need for the extension of the ACM deadline by up to 60 days as allowed under 40 CFR 257.96(a):

- Permitting for the new wells included Federal, state, and local permit reviews related to floodplains, wetlands, and sovereign lands, which significantly delayed well installation.

- Extensive flooding in the area of the Ottumwa Generating Station significantly delayed well installation. The wells have not been installed as of the date of this letter due to continued flooding.

Additional information regarding the nature and extent of groundwater impacts will provide further understanding of existing risks associated with the groundwater impacts identified at the Ottumwa Generating Station, which provides the basis for evaluating potential corrective measures as required under 40 CFR 257.96. While evaluation of the nature and extent of impacts may continue in parallel with the ACM and selection of remedy, extending the ACM deadline as allowed under the coal combustion residuals (CCR) rule will allow for the consideration of additional information and provide for a more complete ACM. Thus, the 60-day extension is needed.

As required by 40 CFR 257.96(a), a professional engineer's certification of the accuracy of this demonstration is enclosed.

PE Certification

ERIC J. NELSON 23136	As required by 40 CFR 257.96, I, Eric J. Nelson, hereby certify that this demonstration of need for the 60-day extension of the deadline for completing an Assessment of Corrective Measures is accurate. I am a duly licensed Professional Engineer under the laws of the State of Iowa. 7/10/2019
	(signature) (date) Eric J. Nelson
	(printed or typed name) License number 23136 My license renewal date is December 31, 2020. Pages or sheets covered by this seal: ACM - Demonstration of Need for Deadline Extension
	Ottumwa Generating Station

Sincerely,

Eric J. Nelson, PE Project Director SCS Engineers	Thomas J. Karwoski Senior Project Manager SCS Engineers

EJN/AJR/SC

cc: Matt Hanson, Interstate Power and Light Company
Jeff Maxted, Alliant Energy

I:\25218202.00\Correspondence\Client\ACM Extension\190710_Saunders_OGS_ACM Ext_PE_Certification_Letter.docx

2019 Annual Groundwater Monitoring and Corrective Action Report

Zero Liquid Discharge Pond
Ottumwa Generating Station
20775 Power Plant Road
Ottumwa, Iowa

Prepared for:

Alliant Energy

Interstate Power and Light Company
4902 N. Biltmore Lane
Madison, Wisconsin 53718

SCS ENGINEERS

25220072.00 | August 3, 2020

2830 Dairy Drive
Madison, WI 53718-6751
608-224-2830

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Appendices

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1.0 INTRODUCTION

This 2019 Annual Groundwater Monitoring and Corrective Action Report was prepared to support compliance with the groundwater monitoring requirements of the "Coal Combustion Residuals (CCR) Final Rule" published by the U.S. Environmental Protection Agency (USEPA) in the *Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities;* Final Rule, dated April 17, 2015 (USEPA, 2015) and subsequent amendments. Specifically, this report was prepared to fulfill the requirements of 40 CFR.100 and 40 CFR 257.90(e) for inactive CCR surface impoundments. The applicable sections of the Rule are provided below in *italics*, followed by applicable information relative to the 2018 Annual Groundwater Monitoring and Corrective Action Report for the CCR unit.

This report covers the period of groundwater monitoring from January 1, 2019, through December 31, 2019.

The groundwater monitoring system for the Zero Liquid Discharge Pond (ZLDP) at the Ottumwa Generating Station (OGS) monitors a single inactive CCR unit:

- OGS ZLDP (inactive CCR surface impoundment)

The system is designed to detect monitored constituents at the waste boundary of the OGS ZLDP as required by 40 CFR 257.91(d). The groundwater monitoring system consists of one upgradient and three downgradient monitoring wells.

The OGS Ash Pond is a separate CCR unit at the OGS facility. The annual groundwater monitoring and corrective action report for this existing CCR unit is submitted separately on January 31 of each year in accordance with 40 CFR 257.90(e).

2.0 §257.100(E)(5) GROUNDWATER MONITORING AND CORRECTIVE ACTION FOR INACTIVE CCR SURFACE IMPOUNDMENTS

The owner or operator of the inactive CCR surface impoundment must: (i) No later than April 17, 2019, comply with groundwater monitoring requirements set forth in §§ 257.90(b) and 257.94(b); and (ii) No later than August 1, 2019, prepare the initial groundwater monitoring and corrective action report as set forth in § 257.90(e).

This report is submitted to fulfill the report requirement.

3.0 §257.90(E) ANNUAL REPORT REQUIREMENTS

Annual groundwater monitoring and corrective action report. . . . For the preceding calendar year, the annual report must document the status of the groundwater monitoring and corrective action program for the CCR unit, summarize key actions completed, describe any problems encountered, discuss actions to resolve the problems, and project key activities for the upcoming year. For purposes of this section, the owner or operator has prepared the annual report when the report is placed in the facility's operating record as required by § 257.105(h)(1). At a minimum, the annual groundwater monitoring and corrective action report must contain the following information, to the extent available:

3.1 §257.90(E)(1) SITE MAP

A map, aerial image, or diagram showing the CCR unit and all background (or upgradient) and downgradient monitoring wells, to include the well identification numbers, that are part of the groundwater monitoring program for the CCR unit;

A map showing the site location of the OGS site is provided as **Figure 1**. A map showing the site layout and all background (or upgradient) and downgradient monitoring wells with identification numbers for the groundwater monitoring program is provided as **Figure 2.** The location of the OGS ash pond CCR unit is also shown on **Figure 2.**

3.2 §257.90(E)(2) MONITORING SYSTEM CHANGES

Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a narrative description of why those actions were taken;

No new monitoring wells were installed and no wells were decommissioned as part of the groundwater monitoring program for the OGS ZLDP in 2019.

3.3 §257.90(E)(3) SUMMARY OF SAMPLING EVENTS

In addition to all the monitoring data obtained under §§ 257.90 through 257.98, a summary including the number of groundwater samples that were collected for analysis for each background and downgradient well, the dates the samples were collected, and whether the sample was required by the detection monitoring or assessment monitoring programs;

Three groundwater sampling events were completed for the inactive OGS ZLDP CCR unit in 2019. The semiannual sampling program for the site was established and sampling occurred in April 2019 and October 2019. As described in **Section 3.4** and **Section 3.5**, the site transitioned to an assessment monitoring program in 2019. The first round of assessment monitoring sampling was completed in December 2019.

Groundwater samples collected in April and October 2019 were analyzed for Appendix III constituents. The groundwater samples collected in December 2019 were analyzed for both Appendix III and Appendix IV constituents. A summary including the number of groundwater samples that were collected, and whether the sample was required by the detection monitoring or assessment monitoring program is included in **Table 1.** The results of the analytical laboratory analyses are provided in the laboratory reports in **Appendix A1** through **Appendix A3.**

3.4 §257.90(E)(4) MONITORING TRANSITION NARRATIVE

A narrative discussion of any transition between monitoring programs (e.g., the date and circumstances for transitioning from detection monitoring to assessment monitoring in addition to identifying the constituent(s) detected at a statistically significant increase over background levels);

Detection monitoring at the OGS ZLDP was initiated in April 2019. The statistical evaluation of the April 2019 detection monitoring results completed on July 15, 2019, identified statistically significant increases (SSIs) in detection monitoring constituents at the downgradient wells. SSIs were identified for boron, calcium, chloride, pH, sulfate and total dissolved solids (TDS) at one or more wells based on the April 2019 detection monitoring event. Interstate Power and Light Company (IPL) collected the first round of assessment monitoring samples in December 2019 and established an assessment monitoring program on January 13, 2020, in accordance with §257.95(b).

3.5 §257.90(E)(5) OTHER REQUIREMENTS

Other information required to be included in the annual report as specified in §§ 257.90 through 257.98.

Additional potentially applicable requirements for the annual report, and the location of the requirement within the Rule, are provided in the following sections. For each cited section of the Rule, the portion referencing the annual report requirement is provided below in *italics*, followed by applicable information relative to the 2019 Annual Groundwater Monitoring and Corrective Action Report for the CCR Units.

3.5.1 §257.90(e) General Requirements

For the preceding calendar year, the annual report must document the status of the groundwater monitoring and corrective action program for the CCR unit, summarize key actions completed, describe any problems encountered, discuss actions to resolve the problems, and project key activities for the upcoming year.

Status of Groundwater Monitoring and Corrective Action Program. The groundwater monitoring and corrective action program transitioned from detection monitoring to assessment monitoring in 2019.

Summary of Key Actions Completed.

- Statistical evaluation and determination of SSIs for the April 2019 monitoring event completed July 15, 2019.
- First annual groundwater monitoring and corrective action report completed on August 1, 2019.
- Two semiannual detection monitoring sampling and analysis events (April and October 2019).
- First assessment monitoring sampling and analysis event (December 2019).

Description of Any Problems Encountered: No problems were encountered in 2019.

Discussion of Actions to Resolve the Problems: Not Applicable.

Projection of Key Activities for the Upcoming Year (2020):

- Transmittal if results for the October 2019 detection monitoring event and notification of the initial round of assessment monitoring sampling in December 2019 (January 13, 2020).
- Establishment of assessment monitoring program (January 13, 2020).
- Establishment of groundwater protection standards (April 2020). Statistical evaluation and determination of any statistically significant levels exceeding the GPS for the December 2019, February 2020, and April 2020 monitoring events (July 2020).

- If one or more Appendix IV constituents is detected at a statistically significant level about the GPS, then within 30 days WPL will prepare a notification in accordance with §257.95(g) and within 90 days complete an alternative source demonstration or initiate an assessment of corrective measures (§257.95(g)(3)). WPL will also characterize the release (§257.95(g)(1)) and notify property owners (§257.95(g)(2)).

- Two semiannual groundwater sampling and analysis events (April and October 2020).

3.5.2 §257.94(d) Alternative Detection Monitoring Frequency

The owner or operator must include the demonstration providing the basis for the alternative monitoring frequency and the certification by a qualified professional engineer in the annual groundwater monitoring and corrective action report required by § 257.90(e).

Not applicable. No alternative frequency proposed.

3.5.3 §257.94(e)(2) Alternative Source Demonstration for Detection Monitoring

The owner or operator must also include the demonstration in the annual groundwater monitoring and corrective action report required by § 257.90(e), in addition to the certification by a qualified professional engineer.

Not applicable. No alternative source demonstration was completed in 2019.

3.5.4 §257.95(c) Alternative Assessment Monitoring Frequency

The owner or operator must include the demonstration providing the basis for the alternative monitoring frequency and the certification by a qualified professional engineer in the annual groundwater monitoring and corrective action report required by § 257.90(e).

Not applicable. No alternative assessment monitoring frequency has been proposed.

3.5.5 §257.95(d)(3) Assessment Monitoring Results and Standards

Include the recorded concentrations required by paragraph (d)(1) of this section, identify the background concentrations established under § 257.94(b), and identify the groundwater protection standards established under paragraph (d)(2) of this section in the annual groundwater monitoring and corrective action report required by § 257.90(e).

Not applicable. Although the first round of assessment monitoring samples was collected in December 2019, the complete results were received and the assessment monitoring program was established in January 2020. The requirements of §257.95(d)(1)-(2) must be met by April 15, 2020, and included in the 2020 annual groundwater monitoring and corrective action report.

3.5.6 §257.95(g)(3)(ii) Alternative Source Demonstration for Assessment Monitoring

The owner or operator must also include the demonstration in the annual groundwater monitoring and corrective action report required by § 257.90(e), in addition to the certification by a qualified professional engineer.

Not applicable. No alternative source demonstration for assessment monitoring was completed in 2019.

3.5.7 §257.96(a) Extension of Time for Corrective Measures Assessment

The assessment of corrective measures must be completed within 90 days, unless the owner or operator demonstrates the need for additional time to complete the assessment of corrective measure due to site-specific conditions or circumstances. The owner or operator must obtain a certification from a qualified professional engineer attesting that the demonstration is accurate. The 90-day deadline to complete the assessment of corrective measures may be extended for longer than 60 days. The owner or operator must also include the demonstration in the annual groundwater monitoring and corrective action report required by § 257.90(e), in addition to the certification by a qualified professional engineer.

Not applicable. Corrective measures assessment has not been initiated.

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Table 1

CCR Rule Groundwater Samples Summary

Table 1. CCR Rule Groundwater Samples Summary
Ottumwa Generating Station ZLDP / SCS Engineers Project #25220072.00

Sample Dates	Downgradient Wells			Background Well
	MW-307	MW-308	MW-309	MW-301
4/8/2019	D	D	D	D
10/23-24/2019	D	D	D	D
12/11/2019	A	A	A	A
Total Samples	3	3	3	3

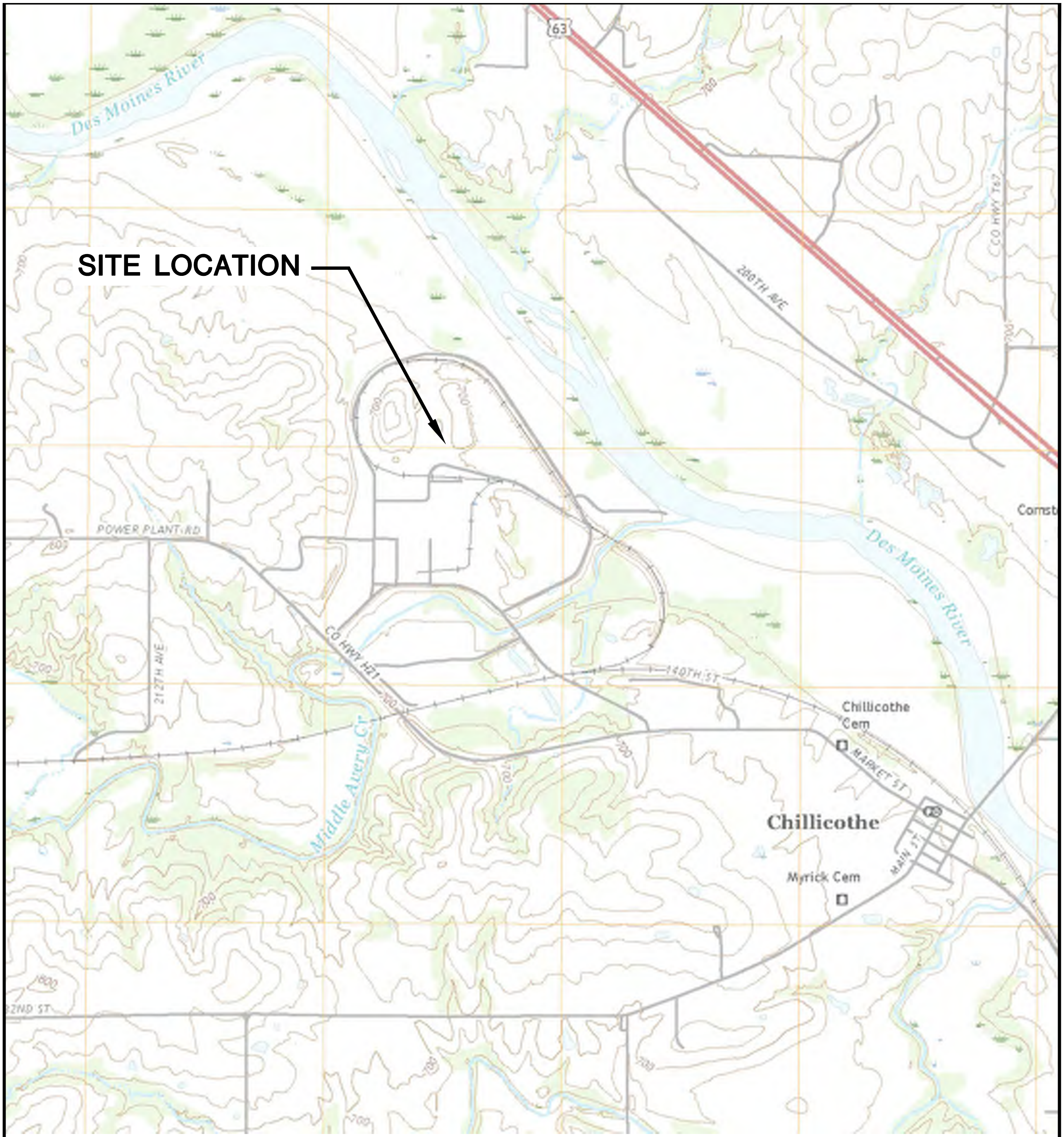
Abbreviations:
D = Detection Monitoring
A = Assessment Monitoring

Notes:
Note: MW-301 is a shared background well with another CCR unit. This well was sampled for assessment monitoring parameters in April and October 2019 as part of the assessment monitoring for the Ash Pond CCR Unit.

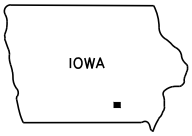
Created by:	JR	Date:	6/5/2019
Last revision by:	LWJ	Date:	6/29/2020
Checked by:	NDK	Date:	6/29/2020

I:\25220072.00\Deliverables\2019 Federal Annual Report - OGS ZLDP\Tables\[Table 1_GW_Samples_Summary_Table_ZLDP.xlsx]GW Summary

Figures



CHILLICOTHE QUADRANGLE
IOWA–WAPELLO CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
2018
SCALE: 1" = 2,000'



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

SITE
ALLIANT ENERGY
OTTUMWA GENERATING STATION
OTTUMWA, IOWA

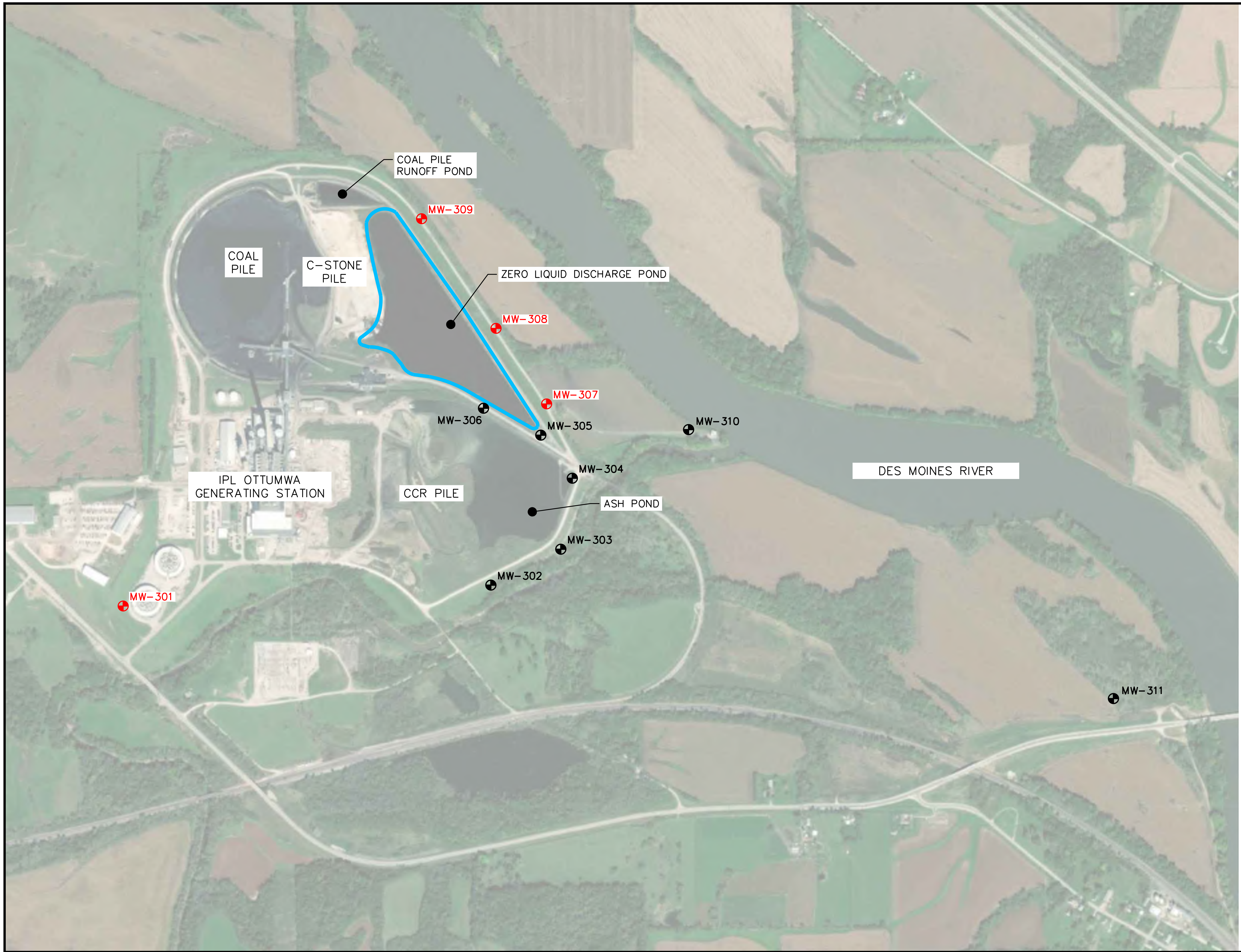
SITE LOCATION MAP

PROJECT NO.	25219072.00	DRAWN BY:	BSS
DRAWN:	11/15/2019	CHECKED BY:	MDB
REVISED:	01/10/2020	APPROVED BY:	

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

FIGURE
1

I:\25219072.00\Drawings\□□□ 2019 Annua□□e□ort\Site Location Ma□.dwg, 1/15/2020 6:15:□7 □M



LEGEND

▬	ZERO LIQUID DISCHARGE POND (ZLDP)
⊕	ZLDP MONITORING WELL
⊕	ADDITIONAL MONITORING WELL

NOTES:

1. 2014 AERIAL PHOTOGRAPH SOURCES: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA FSA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY.
2. CCR UNIT LIMITS ARE APPROXIMATE.
3. MONITORING WELLS MW-301, MW-302, AND MW-304, WERE INSTALLED BY CASCADE DRILLING, LLP. UNDER THE SUPERVISION OF SCS ENGINEERS FROM NOVEMBER 11-12, 2015.
4. MONITORING WELLS MW-303 AND MW-305 WERE INSTALLED BY CASCADE DRILLING LLP. UNDER THE SUPERVISION OF SCS ENGINEERS ON DECEMBER 7-8, 2015.
5. MONITORING WELLS MW-307, MW-308, AND MW-309 WERE INSTALLED BY CASCADE DRILLING, LLP. UNDER THE SUPERVISION OF SCS ENGINEERS FROM OCTOBER 25-27, 2016.
6. MONITORING WELLS MW-310 AND MW-311 WERE INSTALLED BY ROBERTS ENVIRONMENTAL DRILLING ON AUGUST 27, 2019.

N

800 0 800

SCALE: 1" = 800'

PROJECT NO.	25219072.00	DRAWN BY:	BSS
DRAWN:	11/15/2019	CHECKED BY:	MDB
REVISED:	01/13/2020	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

ALLIANT ENERGY
OTTUMWA GENERATING STATION
OTTUMWA, IOWA

SITE PLAN AND MONITORING WELL
LOCATIONS-ZERO LIQUID DISCHARGE POND

FIGURE
2

I:\25219072.00\Drawings\ 2019 Annua e ort\Site an and Monitoring e Locations LD .dwg, 1/15/2020 6:16:16 M

Appendix A

Analytical Laboratory Reports

A1 Round 1 Detection Sampling, Analytical Laboratory Reports

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eurofins | Environment Testing
TestAmerica

ANALYTICAL REPORT

Eurofins TestAmerica, Cedar Falls
704 Enterprise Drive
Cedar Falls, IA 50613
Tel: (319)277-2401

Laboratory Job ID: 310-152915-3
Laboratory Sample Delivery Group: 25219072
Client Project/Site: IPL Ottumwa Generating Station 25219072
Revision: 2

For:
SCS Engineers
2830 Dairy Drive
Madison, Wisconsin 53718

Attn: Meghan Blodgett

Sandie Fredrick

Authorized for release by:
5/23/2019 1:49:24 PM

Sandie Fredrick, Project Manager II
(920)261-1660
sandie.fredrick@testamericainc.com

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

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Table of Contents

Case Narrative

Job ID: 310-152915-3

Laboratory: Eurofins TestAmerica, Cedar Falls

Narrative

Job Narrative
310-152915-3

Comments
REVISION: Client updated formatter.
REVISION: Client updated metals units to ug/L for all but Calcium

Receipt
The samples were received on 4/9/2019 5:15 PM; the samples arrived in good condition, properly preserved and, where required, on ice. The temperatures of the 2 coolers at receipt time were 0.1° C and 0.8° C.

HPLC/IC
Method(s) 300.0, 9056A: The following samples were diluted due to the nature of the sample matrix: MW 307 (310-152915-8), MW 308 (310-152915-9) and MW 309 (310-152915-10). Elevated reporting limits (RLs) are provided.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Metals
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

General Chemistry
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

Sample Summary

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-3
SDG: 25219072

Lab Sample ID	Client Sample ID	Matrix	Collected	Received	Assest ID
310-152915-8	MW 307	Ground Water	04/08/19 15:15	04/09/19 17:15	
310-152915-9	MW 308	Ground Water	04/08/19 15:59	04/09/19 17:15	
310-152915-10	MW 309	Ground Water	04/08/19 16:37	04/09/19 17:15	

Detection Summary

Client: SCS Engineers
Job ID: 310-152915-3
Project/Site: IPL Ottumwa Generating Station 25219072
SDG: 25219072

Client Sample ID: MW 307
Lab Sample ID: 310-152915-8

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloride	220		5.0	1.5	mg/L	5		9056A	Total/NA
Fluoride	0.28	J	0.50	0.23	mg/L	5		9056A	Total/NA
Sulfate	100		5.0	1.8	mg/L	5		9056A	Total/NA
Boron	240		200	110	ug/L	1		6020A	Total/NA
Calcium	240		0.50	0.10	mg/L	1		6020A	Total/NA
Total Dissolved Solids	1000		30	24	mg/L	1		SM 2540C	Total/NA
pH	6.7	HF	0.1		SU	1		SM 4500 H+ B	Total/NA
Field Conductivity	1599				umhos/cm	1		Field Sampling	Total/NA
Field Dissolved Oxygen	0.51				mg/L	1		Field Sampling	Total/NA
Field pH	6.76				SU	1		Field Sampling	Total/NA
Field Temperature	12.47				Degrees C	1		Field Sampling	Total/NA
Field Turbidity	26.0				NTU	1		Field Sampling	Total/NA
Groundwater Elevation (ft MSL)	654.90				ft	1		Field Sampling	Total/NA
Oxidation Reduction Potential	-3.7				millivolts	1		Field Sampling	Total/NA

Client Sample ID: MW 308
Lab Sample ID: 310-152915-9

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloride	160		5.0	1.5	mg/L	5		9056A	Total/NA
Sulfate	300		20	7.0	mg/L	20		9056A	Total/NA
Boron	190	J	200	110	ug/L	1		6020A	Total/NA
Calcium	240		0.50	0.10	mg/L	1		6020A	Total/NA
Total Dissolved Solids	1200		30	24	mg/L	1		SM 2540C	Total/NA
pH	6.8	HF	0.1		SU	1		SM 4500 H+ B	Total/NA
Field Conductivity	1539				umhos/cm	1		Field Sampling	Total/NA
Field Dissolved Oxygen	0.66				mg/L	1		Field Sampling	Total/NA
Field pH	6.90				SU	1		Field Sampling	Total/NA
Field Temperature	12.54				Degrees C	1		Field Sampling	Total/NA
Field Turbidity	6.87				NTU	1		Field Sampling	Total/NA
Groundwater Elevation (ft MSL)	653.70				ft	1		Field Sampling	Total/NA
Oxidation Reduction Potential	-23				millivolts	1		Field Sampling	Total/NA

Client Sample ID: MW 309
Lab Sample ID: 310-152915-10

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloride	72		5.0	1.5	mg/L	5		9056A	Total/NA
Fluoride	0.27	J	0.50	0.23	mg/L	5		9056A	Total/NA
Sulfate	410		20	7.0	mg/L	20		9056A	Total/NA
Boron	1500		200	110	ug/L	1		6020A	Total/NA
Calcium	160		0.50	0.10	mg/L	1		6020A	Total/NA
Total Dissolved Solids	1100		30	24	mg/L	1		SM 2540C	Total/NA
pH	7.2	HF	0.1		SU	1		SM 4500 H+ B	Total/NA
Field Conductivity	1396				umhos/cm	1		Field Sampling	Total/NA
Field Dissolved Oxygen	0.66				mg/L	1		Field Sampling	Total/NA
Field pH	7.18				SU	1		Field Sampling	Total/NA
Field Temperature	12.40				Degrees C	1		Field Sampling	Total/NA
Field Turbidity	72.1				NTU	1		Field Sampling	Total/NA
Groundwater Elevation (ft MSL)	653.55				ft	1		Field Sampling	Total/NA
Oxidation Reduction Potential	-3.3				millivolts	1		Field Sampling	Total/NA

This Detection Summary does not include radiochemical test results.

Client Sample Results

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-3
SDG: 25219072

Client Sample ID: MW 307

Date Collected: 04/08/19 15:15
Date Received: 04/09/19 17:15

Lab Sample ID: 310-152915-8
Matrix: Ground Water

Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	220		5.0	1.5	mg/L			04/10/19 21:02	5
Fluoride	0.28	J	0.50	0.23	mg/L			04/10/19 21:02	5
Sulfate	100		5.0	1.8	mg/L			04/10/19 21:02	5

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron	240		200	110	ug/L		04/10/19 08:11	04/22/19 22:42	1
Calcium	240		0.50	0.10	mg/L		04/10/19 08:11	04/22/19 22:42	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	1000		30	24	mg/L			04/12/19 09:34	1
pH	6.7	HF	0.1		SU			04/10/19 00:23	1

Method: Field Sampling - Field Sampling

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Field Conductivity	1599				umhos/cm			04/08/19 15:15	1
Field Dissolved Oxygen	0.51				mg/L			04/08/19 15:15	1
Field pH	6.76				SU			04/08/19 15:15	1
Field Temperature	12.47				Degrees C			04/08/19 15:15	1
Field Turbidity	26.0				NTU			04/08/19 15:15	1
Groundwater Elevation (ft MSL)	654.90				ft			04/08/19 15:15	1
Oxidation Reduction Potential	-3.7				millivolts			04/08/19 15:15	1

Client Sample Results

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-3
SDG: 25219072

Client Sample ID: MW 308

Date Collected: 04/08/19 15:59
Date Received: 04/09/19 17:15

Lab Sample ID: 310-152915-9
Matrix: Ground Water

Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**160**		5.0	1.5	mg/L			04/10/19 21:17	5
Fluoride	<0.23		0.50	0.23	mg/L			04/10/19 21:17	5
Sulfate	**300**		20	7.0	mg/L			04/11/19 11:19	20

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron	**190**	**J**	200	110	ug/L		04/10/19 08:11	04/22/19 22:45	1
Calcium	**240**		0.50	0.10	mg/L		04/10/19 08:11	04/22/19 22:45	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	**1200**		30	24	mg/L			04/12/19 09:34	1
pH	**6.8**	**HF**	0.1		SU			04/10/19 00:25	1

Method: Field Sampling - Field Sampling

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Field Conductivity	**1539**				umhos/cm			04/08/19 15:59	1
Field Dissolved Oxygen	**0.66**				mg/L			04/08/19 15:59	1
Field pH	**6.90**				SU			04/08/19 15:59	1
Field Temperature	**12.54**				Degrees C			04/08/19 15:59	1
Field Turbidity	**6.87**				NTU			04/08/19 15:59	1
Groundwater Elevation (ft MSL)	**653.70**				ft			04/08/19 15:59	1
Oxidation Reduction Potential	**-23**				millivolts			04/08/19 15:59	1

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Client Sample Results

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-3
SDG: 25219072

Client Sample ID: MW 309
Date Collected: 04/08/19 16:37
Date Received: 04/09/19 17:15

Lab Sample ID: 310-152915-10
Matrix: Ground Water

Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	72		5.0	1.5	mg/L			04/10/19 22:04	5
Fluoride	0.27	J	0.50	0.23	mg/L			04/10/19 22:04	5
Sulfate	410		20	7.0	mg/L			04/11/19 11:35	20

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron	1500		200	110	ug/L		04/10/19 08:11	04/22/19 22:48	1
Calcium	160		0.50	0.10	mg/L		04/10/19 08:11	04/22/19 22:48	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	1100		30	24	mg/L			04/12/19 09:34	1
pH	7.2	HF	0.1		SU			04/10/19 00:29	1

Method: Field Sampling - Field Sampling

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Field Conductivity	1396				umhos/cm			04/08/19 16:37	1
Field Dissolved Oxygen	0.66				mg/L			04/08/19 16:37	1
Field pH	7.18				SU			04/08/19 16:37	1
Field Temperature	12.40				Degrees C			04/08/19 16:37	1
Field Turbidity	72.1				NTU			04/08/19 16:37	1
Groundwater Elevation (ft MSL)	653.55				ft			04/08/19 16:37	1
Oxidation Reduction Potential	-3.3				millivolts			04/08/19 16:37	1

Definitions/Glossary

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-3
SDG: 25219072

Qualifiers

HPLC/IC

Qualifier	Qualifier Description
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

Metals

Qualifier	Qualifier Description
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

General Chemistry

Qualifier	Qualifier Description
HF	Field parameter with a holding time of 15 minutes. Test performed by laboratory at client's request.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

QC Sample Results

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-3
SDG: 25219072

Method: 9056A - Anions, Ion Chromatography

Lab Sample ID: MB 310-235649/3
Matrix: Water
Analysis Batch: 235649

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	<0.29		1.0	0.29	mg/L			04/10/19 15:44	1
Fluoride	<0.045		0.10	0.045	mg/L			04/10/19 15:44	1
Sulfate	<0.35		1.0	0.35	mg/L			04/10/19 15:44	1

Lab Sample ID: LCS 310-235649/4
Matrix: Water
Analysis Batch: 235649

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Chloride			7.50	7.26		mg/L		97	90 - 110		
Fluoride			1.50	1.47		mg/L		98	90 - 110		
Sulfate			7.50	7.49		mg/L		100	90 - 110		

Method: 6020A - Metals (ICP/MS)

Lab Sample ID: MB 310-235260/1-A
Matrix: Water
Analysis Batch: 236802

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 235260

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron	<110		200	110	ug/L		04/10/19 08:11	04/22/19 21:37	1
Calcium	<0.10		0.50	0.10	mg/L		04/10/19 08:11	04/22/19 21:37	1

Lab Sample ID: LCS 310-235260/2-A
Matrix: Water
Analysis Batch: 236802

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 235260

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Boron			880	920		ug/L		105	80 - 120		
Calcium			2.00	1.97		mg/L		99	80 - 120		

Method: SM 2540C - Solids, Total Dissolved (TDS)

Lab Sample ID: MB 310-235607/1
Matrix: Water
Analysis Batch: 235607

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	<30.0		30.0		mg/L			04/12/19 09:34	1

Lab Sample ID: LCS 310-235607/2
Matrix: Water
Analysis Batch: 235607

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Total Dissolved Solids			1000	1018		mg/L		102	90 - 110		

QC Sample Results

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-3
SDG: 25219072

Method: SM 4500 H+ B - pH

Lab Sample ID: LCS 310-235230/1
Matrix: Water
Analysis Batch: 235230

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
pH	7.00	7.0		SU		100	98 - 102

QC Association Summary

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-3
SDG: 25219072

HPLC/IC

Analysis Batch: 235649

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-152915-8	MW 307	Total/NA	Ground Water	9056A	
310-152915-9	MW 308	Total/NA	Ground Water	9056A	
310-152915-9	MW 308	Total/NA	Ground Water	9056A	
310-152915-10	MW 309	Total/NA	Ground Water	9056A	
310-152915-10	MW 309	Total/NA	Ground Water	9056A	
MB 310-235649/3	Method Blank	Total/NA	Water	9056A	
LCS 310-235649/4	Lab Control Sample	Total/NA	Water	9056A	

Metals

Prep Batch: 235260

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-152915-8	MW 307	Total/NA	Ground Water	3010A	
310-152915-9	MW 308	Total/NA	Ground Water	3010A	
310-152915-10	MW 309	Total/NA	Ground Water	3010A	
MB 310-235260/1-A	Method Blank	Total/NA	Water	3010A	
LCS 310-235260/2-A	Lab Control Sample	Total/NA	Water	3010A	

Analysis Batch: 236802

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-152915-8	MW 307	Total/NA	Ground Water	6020A	235260
310-152915-9	MW 308	Total/NA	Ground Water	6020A	235260
310-152915-10	MW 309	Total/NA	Ground Water	6020A	235260
MB 310-235260/1-A	Method Blank	Total/NA	Water	6020A	235260
LCS 310-235260/2-A	Lab Control Sample	Total/NA	Water	6020A	235260

General Chemistry

Analysis Batch: 235230

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-152915-8	MW 307	Total/NA	Ground Water	SM 4500 H+ B	
310-152915-9	MW 308	Total/NA	Ground Water	SM 4500 H+ B	
310-152915-10	MW 309	Total/NA	Ground Water	SM 4500 H+ B	
LCS 310-235230/1	Lab Control Sample	Total/NA	Water	SM 4500 H+ B	

Analysis Batch: 235607

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-152915-8	MW 307	Total/NA	Ground Water	SM 2540C	
310-152915-9	MW 308	Total/NA	Ground Water	SM 2540C	
310-152915-10	MW 309	Total/NA	Ground Water	SM 2540C	
MB 310-235607/1	Method Blank	Total/NA	Water	SM 2540C	
LCS 310-235607/2	Lab Control Sample	Total/NA	Water	SM 2540C	

Field Service / Mobile Lab

Analysis Batch: 236698

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-152915-8	MW 307	Total/NA	Ground Water	Field Sampling	
310-152915-9	MW 308	Total/NA	Ground Water	Field Sampling	
310-152915-10	MW 309	Total/NA	Ground Water	Field Sampling	

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Lab Chronicle

Client Sample ID: MW 307

Lab Sample ID: 310-152915-8
Date Collected: 04/08/19 15:15
Matrix: Ground Water
Date Received: 04/09/19 17:15

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	9056A		5	235649	04/10/19 21:02	MLU	TAL CF
Total/NA	Prep	3010A			235260	04/10/19 08:11	HED	TAL CF
Total/NA	Analysis	6020A		1	236802	04/22/19 22:42	SAD	TAL CF
Total/NA	Analysis	SM 2540C		1	235607	04/12/19 09:34	MDK	TAL CF
Total/NA	Analysis	SM 4500 H+ B		1	235230	04/10/19 00:23	JMH	TAL CF
Total/NA	Analysis	Field Sampling		1	236698	04/08/19 15:15	ANO	TAL CF

Client Sample ID: MW 308

Lab Sample ID: 310-152915-9
Date Collected: 04/08/19 15:59
Matrix: Ground Water
Date Received: 04/09/19 17:15

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	9056A		5	235649	04/10/19 21:17	MLU	TAL CF
Total/NA	Analysis	9056A		20	235649	04/11/19 11:19	MLU	TAL CF
Total/NA	Prep	3010A			235260	04/10/19 08:11	HED	TAL CF
Total/NA	Analysis	6020A		1	236802	04/22/19 22:45	SAD	TAL CF
Total/NA	Analysis	SM 2540C		1	235607	04/12/19 09:34	MDK	TAL CF
Total/NA	Analysis	SM 4500 H+ B		1	235230	04/10/19 00:25	JMH	TAL CF
Total/NA	Analysis	Field Sampling		1	236698	04/08/19 15:59	ANO	TAL CF

Client Sample ID: MW 309

Lab Sample ID: 310-152915-10
Date Collected: 04/08/19 16:37
Matrix: Ground Water
Date Received: 04/09/19 17:15

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	9056A		5	235649	04/10/19 22:04	MLU	TAL CF
Total/NA	Analysis	9056A		20	235649	04/11/19 11:35	MLU	TAL CF
Total/NA	Prep	3010A			235260	04/10/19 08:11	HED	TAL CF
Total/NA	Analysis	6020A		1	236802	04/22/19 22:48	SAD	TAL CF
Total/NA	Analysis	SM 2540C		1	235607	04/12/19 09:34	MDK	TAL CF
Total/NA	Analysis	SM 4500 H+ B		1	235230	04/10/19 00:29	JMH	TAL CF
Total/NA	Analysis	Field Sampling		1	236698	04/08/19 16:37	ANO	TAL CF

Laboratory References:

TAL CF = Eurofins TestAmerica, Cedar Falls, 704 Enterprise Drive, Cedar Falls, IA 50613, TEL (319)277-2401

Accreditation/Certification Summary

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-3
SDG: 25219072

Laboratory: Eurofins TestAmerica, Cedar Falls

The accreditations/certifications listed below are applicable to this report.

Authority	Program	EPA Region	Identification Number	Expiration Date
Iowa	State Program	7	007	12-01-19

Method Summary

Client: SCS Engineers
Project/Site: IPL Ottumwa Generating Station 25219072

Job ID: 310-152915-3
SDG: 25219072

Method	Method Description	Protocol	Laboratory
9056A	Anions, Ion Chromatography	SW846	TAL CF
6020A	Metals (ICP/MS)	SW846	TAL CF
SM 2540C	Solids, Total Dissolved (TDS)	SM	TAL CF
SM 4500 H+ B	pH	SM	TAL CF
Field Sampling	Field Sampling	EPA	TAL CF
3010A	Preparation, Total Metals	SW846	TAL CF

Protocol References:

EPA = US Environmental Protection Agency

SM = "Standard Methods For The Examination Of Water And Wastewater"

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

TAL CF = Eurofins TestAmerica, Cedar Falls, 704 Enterprise Drive, Cedar Falls, IA 50613, TEL (319)277-2401

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

310-152915 Chain of Custody

Cooler/Sample Receipt and Temperature Log Form

Client Information

Client: SCS Engineers

City/State: CITY Clive STATE IA

Project: IPL-Ottumwa Generating Station

Receipt Information

Date/Time Received: DATE 4-9-19 TIME ~~15~~ 1715 4-9LAB

Received By: LAB

Delivery Type: ☐ UPS ☐ FedEx ☐ FedEx Ground ☐ US Mail ☐ Spee-Dee
☑ Lab Courier ☐ TA Field Services ☐ Client Drop-off ☐ Other:__________

Condition of Cooler/Containers

Sample(s) received in Cooler? ☒ Yes ☐ No — *If yes:* Cooler ID:

Multiple Coolers? ☑ Yes ☐ No — *If yes:* Cooler # 1 of 2

Cooler Custody Seals Present? ☑ Yes ☐ No — *If yes:* Cooler custody seals intact? ☒ Yes ☐ No

Sample Custody Seals Present? ☐ Yes ☒ No — *If yes:* Sample custody seals intact? ☐ Yes ☐ No

Trip Blank Present? ☐ Yes ☒ No — *If yes:* Which VOA samples are in cooler? ↓

Temperature Record

Coolant: ☒ Wet ice ☐ Blue ice ☐ Dry ice ☐ Other:__________ ☐ NONE

Thermometer ID: N

Correction Factor (°C): +0.0

• **Temp Blank Temperature** – If no temp blank, or temp blank temperature above criteria, proceed to Sample Container Temperature

Uncorrected Temp (°C): 0.1

Corrected Temp (°C): 0.1

• **Sample Container Temperature**

Container type(s) used: CONTAINER 1 CONTAINER 2

Uncorrected Temp (°C): TEMP 1 TEMP 2

Corrected Temp (°C): TEMP 1 TEMP 2

Exceptions Noted

1) If temperature exceeds criteria, was sample(s) received same day of sampling? ☐ Yes ☐ No
   a) *If yes:* Is there evidence that the chilling process began? ☐ Yes ☐ No

2) If temperature is <0°C, are there obvious signs that the integrity of sample containers is compromised? (e.g., bulging septa, broken/cracked bottles, frozen solid?) ☐ Yes ☐ No

NOTE: If yes, contact PM before proceeding. If no, proceed with login

Additional Comments

Document: CF-LG-WI-002
Revision: 24
Date: 03/07/2019

TestAmerica Cedar Falls

General temperature criteria is 0 to 6°C
Bacteria temperature criteria is 0 to 10°C

1 2 3 4 5 6 7 8 9 10 11 12 13 14

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Place COC scanning label here
214

Cooler/Sample Receipt and Temperature Log Form

Client Information

Client: SCS Engineers

City/State: CITY Clive STATE IA | Project: IPL-Ottumwa Generating Station

Receipt Information

Date/Time Received: DATE 4-9-19 TIME ~~15~~ 1715 4-9 LAB | Received By: LAB

Delivery Type: ☐ UPS ☐ FedEx ☐ FedEx Ground ☐ US Mail ☐ Spee-Dee
☒ Lab Courier ☐ TA Field Services ☐ Client Drop-off ☐ Other:

Condition of Cooler/Containers

Sample(s) received in Cooler?	☒ Yes	☐ No	*If yes:* Cooler ID:
Multiple Coolers?	☒ Yes	☐ No	*If yes:* Cooler # 2 of 2
Cooler Custody Seals Present?	☒ Yes	☐ No	*If yes:* Cooler custody seals intact? ☒ Yes ☐ No
Sample Custody Seals Present?	☐ Yes	☒ No	*If yes:* Sample custody seals intact? ☐ Yes ☐ No
Trip Blank Present?	☐ Yes	☒ No	*If yes:* Which VOA samples are in cooler? ↓

Temperature Record

Coolant: ☒ Wet ice ☐ Blue ice ☐ Dry ice ☐ Other: ☐ NONE

Thermometer ID: N | Correction Factor (°C): +0.0

• Temp Blank Temperature – If no temp blank, or temp blank temperature above criteria, proceed to Sample Container Temperature

Uncorrected Temp (°C): 0.8 | Corrected Temp (°C): 0.8

• Sample Container Temperature

Container type(s) used: CONTAINER 1 | CONTAINER 2

Uncorrected Temp (°C): TEMP 1 | TEMP 2 | Corrected Temp (°C): TEMP 1 | TEMP 2

Exceptions Noted

1) If temperature exceeds criteria, was sample(s) received same day of sampling? ☐ Yes ☐ No
   a) *If yes:* Is there evidence that the chilling process began? ☐ Yes ☐ No

2) If temperature is <0°C, are there obvious signs that the integrity of sample containers is compromised? (e.g., bulging septa, broken/cracked bottles, frozen solid?) ☐ Yes ☐ No

NOTE: If yes, contact PM before proceeding. If no, proceed with login

Additional Comments

Document: CF-LG-WI-002
Revision: 24
Date: 03/07/2019

TestAmerica-Cedar Falls

General temperature criteria is 0 to 6°C
Bacteria temperature criteria is 0 to 10°C

#38727

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Cedar Falls Division
704 Enterprise Drive
Cedar Falls, IA 50613

Phone 319-277-2401 or 800-750-2401
Fax 319-277-2425

To assist us in using the proper analytical methods, is this work being conducted for regulatory purposes?
Compliance Monitoring ____

Client Name: SCS Engineers
Client #: TestAmerica Des Moines SC 214
Address: 8420 Hickman Rd Suite 20
Project Name: IPL Ottumwa Generating Station
City/State/Zip Code: Clive IA 50325
Project #: 25219072
Project Manager: Tom Karwoski
Site/Location ID: Ottumwa
State: IA
Email Address:
Report To:
Telephone Number: 608-509-8245
Fax:
Invoice To:
Sampler Name: (Print Name) Nick Schemmel
Quote #:
PO#:
Sampler Signature:

TAT
___ Standard
___ Rush (surcharges may apply)

Date Needed: ____

Fax Results: Y N

Email Results: Y N

QC Deliverables
___ None
___ Level 2 (Batch QC)
___ Level 3
___ Level 4
Other: ____

					Matrix	Preservation & # of Containers							Analyze For:										
SAMPLE ID	Date Sampled	Time Sampled	G = Grab, C = Composite	Field Filtered	SL - Sludge DW - Drinking Water GW - Groundwater S - Soil/Solid WW - Wastewater Specify, Other	HNO_3	HCl	NaOH	H_2SO_4	Methanol	None	Other (Specify)	Metals	pH	TDS	Chloride/Fluoride/SO_4							REMARKS
MW 307	4.8.19	1515	G		GW	3					1		x	x	x	x							
MW 308	↓	1559	↓		↓	3					1		x	x	x	x							
MW 309	↓	1637	↓		↓	3					1		x	x	x	x							

Special Instructions:

LABORATORY COMMENTS:

Relinquished By: Nick Schemmel	Date: 4.9.19	Time: 1000	Received By: Lindsay Bindert	Date: 4-9-19	Time: 1715
Relinquished By:	Date:	Time:	Received By:	Date:	Time:
Relinquished By:	Date:	Time:	Received By:	Date:	Time:

TAL-0033 (0708)

Page ____ of ____

4/9/2019

Login Container Summary Report

310-152915

Temperature readings: ____________________

Client Sample ID	Lab ID	Container Type	Container pH	Preservative Added (mls)	Lot #
MW 301	310-152915-A-1	Plastic 250ml - with Nitric Acid	<2		
MW 301	310-152915-C-1	Plastic 1 liter - Nitric Acid	<2		
MW 301	310-152915-D-1	Plastic 1 liter - Nitric Acid	<2		
MW 302	310-152915-A-2	Plastic 250ml - with Nitric Acid	<2		
MW 302	310-152915-C-2	Plastic 1 liter - Nitric Acid	<2		
MW 302	310-152915-D-2	Plastic 1 liter - Nitric Acid	<2		
MW 303	310-152915-A-3	Plastic 250ml - with Nitric Acid	<2		
MW 303	310-152915-C-3	Plastic 1 liter - Nitric Acid	<2		
MW 303	310-152915-D-3	Plastic 1 liter - Nitric Acid	<2		
MW 304	310-152915-A-4	Plastic 250ml - with Nitric Acid	<2		
MW 304	310-152915-C-4	Plastic 1 liter - Nitric Acid	<2		
MW 304	310-152915-D-4	Plastic 1 liter - Nitric Acid	<2		
MW 305	310-152915-A-5	Plastic 250ml - with Nitric Acid	<2		
MW 305	310-152915-C-5	Plastic 1 liter - Nitric Acid	<2		
MW 305	310-152915-D-5	Plastic 1 liter - Nitric Acid	<2		
MW 306	310-152915-A-6	Plastic 250ml - with Nitric Acid	<2		
MW 306	310-152915-C-6	Plastic 1 liter - Nitric Acid	<2		
MW 306	310-152915-D-6	Plastic 1 liter - Nitric Acid	<2		
Field Blank	310-152915-A-7	Plastic 250ml - with Nitric Acid	<2		
Field Blank	310-152915-C-7	Plastic 1 liter - Nitric Acid	<2		
Field Blank	310-152915-D-7	Plastic 1 liter - Nitric Acid	<2		
MW 307	310-152915-A-8	Plastic 250ml - with Nitric Acid	<2		
MW 308	310-152915-A-9	Plastic 250ml - with Nitric Acid	<2		
MW 309	310-152915-A-10	Plastic 250ml - with Nitric Acid	<2		

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Fredrick, Sandie

From: Blodgett, Meghan <mblodgett@scsengineers.com>
Sent: Wednesday, April 10, 2019 9:01 AM
To: Fredrick, Sandie
Cc: Schemmel, Nick; Karwoski, Thomas; Kron, Nicole
Subject: RE: TestAmerica Sample Login Confirmation files from 310-152915 IPL Ottumwa Generating Station 25219072

-External Email-

Sandie,

A couple changes on this one:

-For reporting, please split MW-301 through MW-306 plus the field blank onto one report, and MW-307 through MW-309 on a second report.
-We do not need all the listed metals for MW-307 through MW-309. The only metals needed for those three wells are boron and calcium (full parameter list for these three is boron, calcium, chloride, fluoride, sulfate, TDS, and pH).

-Meg

Meghan Blodgett
608.216.7362 (o)
608.345.9221 (m)

From: Sandie Fredrick <sandie.fredrick@testamericainc.com>
Sent: Tuesday, April 9, 2019 9:21 PM
To: Blodgett, Meghan <mblodgett@scsengineers.com>; Schemmel, Nick <NSchemmel@scsengineers.com>; Karwoski, Thomas <TKarwoski@scsengineers.com>
Subject: TestAmerica Sample Login Confirmation files from 310-152915 IPL Ottumwa Generating Station 25219072

Hello Everyone,

Please send over field data when you can.
Thanks,
Sandie

Attached, please find the Sample Confirmation files for job 310-152915; IPL Ottumwa Generating Station 25219072

Please feel free to contact me if you have any questions.

Thank you.

Sandie Fredrick
Project Manager

TestAmerica Laboratories, Inc.
Phone: 920-261-1660

E-mail: sandie.fredrick@testamericainc.com
www.eurofinsus.com | www.testamericainc.com

Reference: [310-351154]
Attachments: 5

Table 2. Groundwater Monitoring Results - Field Parameters
Ottumwa Generating Station - ZDP / SCS Engineers Project No. 25219072
April 2019

Sample	Date/Sample Time	Groundwater Elevation (amsl)	Temperature (Deg. C)	pH (Std. Units)	Dissolved Oxygen (mg/L)	Specific Conductivity (µmhos/cm)	ORP (mV)	Turbidity
MW-307	4-8-2019/1515	654.90	12.47	6.76	0.51	1599	-3.7	26.0
MW-308	4-8-2019/1559	653.70	12.54	6.90	0.66	1539	-23	6.87
MW-309	4-8-2019/1637	653.55	12.40	7.18	0.66	1396	-3.3	72.1

Abbreviations:
mg/L = milligrams per liter
amsl = above mean sea level
NA = Not Analyzed

Notes:
none

Created by:	KAK	Date:	5/1/2017
Last revision by:	JR	Date:	4/12/2019
Checked by:	MDB	Date:	4/12/2019

\\Mad-fs01\data\Projects\25219072.00\Data and Calculations\Tables\[OGS_CCR_Field_2019 April-ZDP.xlsx]GW Field Parameters

14 13 12 11 10 9 8 7 6 5 4 3 2 1

Login Sample Receipt Checklist

Client: SCS Engineers

Job Number: 310-152915-3
SDG Number: 25219072

Login Number: 152915
List Number: 1
Creator: Bindert, Lindsay A

List Source: Eurofins TestAmerica, Cedar Falls

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	N/A	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

A2 Round 2 Detection Sampling, Analytical Laboratory Report

eurofins | Environment Testing
TestAmerica

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ANALYTICAL REPORT

Eurofins TestAmerica, Cedar Falls
3019 Venture Way
Cedar Falls, IA 50613
Tel: (319)277-2401

Laboratory Job ID: 310-168508-3
Client Project/Site: Ottumwa Generating Station 25219072

For:
SCS Engineers
2830 Dairy Drive
Madison, Wisconsin 53718

Attn: Meghan Blodgett

Sandie Fredrick

Authorized for release by:
1/6/2020 3:19:05 PM

Sandie Fredrick, Project Manager II
(920)261-1660
sandie.fredrick@testamericainc.com

LINKS

Review your project results through
TotalAccess

Have a Question?
Ask The Expert

Visit us at:
www.testamericainc.com

Table of Contents

Case Narrative

Client: SCS Engineers
Project/Site: Ottumwa Generating Station 25219072

Job ID: 310-168508-3

Job ID: 310-168508-3

Laboratory: Eurofins TestAmerica, Cedar Falls

Narrative

Job Narrative
310-168508-3

Comments
No additional comments.

Receipt
The samples were received on 10/25/2019 6:30 PM; the samples arrived in good condition, properly preserved and, where required, on ice. The temperatures of the 2 coolers at receipt time were 1.2º C and 4.3º C.

HPLC/IC
Method 9056A: The following samples were diluted due to the nature of the sample matrix: MW-307 (310-168508-8), MW-308 (310-168508-9) and MW-309 (310-168508-10). Elevated reporting limits (RLs) are provided.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Metals
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

General Chemistry
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

Sample Summary

Client: SCS Engineers
Job ID: 310-168508-3
Project/Site: Ottumwa Generating Station 25219072

Lab Sample ID	Client Sample ID	Matrix	Collected	Received	Asset ID
310-168508-8	MW-307	Water	10/23/19 13:15	10/25/19 18:30	
310-168508-9	MW-308	Water	10/23/19 11:56	10/25/19 18:30	
310-168508-10	MW-309	Water	10/23/19 10:32	10/25/19 18:30	

Detection Summary

Client: SCS Engineers
Project/Site: Ottumwa Generating Station 25219072

Job ID: 310-168508-3

Client Sample ID: MW-307

Lab Sample ID: 310-168508-8

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloride	220		5.0	1.5	mg/L	5		9056A	Total/NA
Sulfate	95		5.0	1.8	mg/L	5		9056A	Total/NA
Boron	200		200	110	ug/L	1		6020A	Total/NA
Calcium	230		0.50	0.10	mg/L	1		6020A	Total/NA
Total Dissolved Solids	1000		30	24	mg/L	1		SM 2540C	Total/NA
pH	7.5	HF	0.1	0.1	SU	1		SM 4500 H+ B	Total/NA
Ground Water Elevation	651.89				ft	1		Field Sampling	Total/NA
Oxidation Reduction Potential	-24.8				millivolts	1		Field Sampling	Total/NA
Oxygen, Dissolved, Client Supplied	0.25				mg/L	1		Field Sampling	Total/NA
pH, Field	6.68				SU	1		Field Sampling	Total/NA
Specific Conductance, Field	1684				umhos/cm	1		Field Sampling	Total/NA
Temperature, Field	13.38				Degrees C	1		Field Sampling	Total/NA
Turbidity, Field	12.5				NTU	1		Field Sampling	Total/NA

Client Sample ID: MW-308

Lab Sample ID: 310-168508-9

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloride	160		5.0	1.5	mg/L	5		9056A	Total/NA
Sulfate	300		10	3.5	mg/L	10		9056A	Total/NA
Boron	220		200	110	ug/L	1		6020A	Total/NA
Calcium	240		0.50	0.10	mg/L	1		6020A	Total/NA
Total Dissolved Solids	1100		30	24	mg/L	1		SM 2540C	Total/NA
pH	7.9	HF	0.1	0.1	SU	1		SM 4500 H+ B	Total/NA
Ground Water Elevation	651.31				ft	1		Field Sampling	Total/NA
Oxidation Reduction Potential	-38.7				millivolts	1		Field Sampling	Total/NA
Oxygen, Dissolved, Client Supplied	4.42				mg/L	1		Field Sampling	Total/NA
pH, Field	6.78				SU	1		Field Sampling	Total/NA
Specific Conductance, Field	1637				umhos/cm	1		Field Sampling	Total/NA
Temperature, Field	13.16				Degrees C	1		Field Sampling	Total/NA
Turbidity, Field	7.42				NTU	1		Field Sampling	Total/NA

Client Sample ID: MW-309

Lab Sample ID: 310-168508-10

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloride	74		5.0	1.5	mg/L	5		9056A	Total/NA
Sulfate	400		10	3.5	mg/L	10		9056A	Total/NA
Boron	1300		200	110	ug/L	1		6020A	Total/NA
Calcium	150		0.50	0.10	mg/L	1		6020A	Total/NA
Total Dissolved Solids	1100		30	24	mg/L	1		SM 2540C	Total/NA
pH	7.2	HF	0.1	0.1	SU	1		SM 4500 H+ B	Total/NA
Ground Water Elevation	651.28				ft	1		Field Sampling	Total/NA
Oxidation Reduction Potential	-27.5				millivolts	1		Field Sampling	Total/NA
Oxygen, Dissolved, Client Supplied	0.36				mg/L	1		Field Sampling	Total/NA
pH, Field	6.98				SU	1		Field Sampling	Total/NA
Specific Conductance, Field	1461				umhos/cm	1		Field Sampling	Total/NA
Temperature, Field	12.83				Degrees C	1		Field Sampling	Total/NA
Turbidity, Field	42.6				NTU	1		Field Sampling	Total/NA

This Detection Summary does not include radiochemical test results.

Client Sample Results

Client: SCS Engineers
Job ID: 310-168508-3
Project/Site: Ottumwa Generating Station 25219072

Client Sample ID: MW-307

Lab Sample ID: 310-168508-8
Date Collected: 10/23/19 13:15
Matrix: Water
Date Received: 10/25/19 18:30

Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**220**		5.0	1.5	mg/L			10/31/19 14:35	5
Fluoride	<0.23		0.50	0.23	mg/L			10/31/19 14:35	5
Sulfate	**95**		5.0	1.8	mg/L			10/31/19 14:35	5

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron	**200**		200	110	ug/L		10/29/19 08:00	10/29/19 22:06	1
Calcium	**230**		0.50	0.10	mg/L		10/29/19 08:00	10/29/19 22:06	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	**1000**		30	24	mg/L			10/29/19 13:03	1
pH	**7.5**	**HF**	0.1	0.1	SU			10/25/19 23:02	1

Method: Field Sampling - Field Sampling

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Ground Water Elevation	**651.89**				ft			10/23/19 13:15	1
Oxidation Reduction Potential	**-24.8**				millivolts			10/23/19 13:15	1
Oxygen, Dissolved, Client Supplied	**0.25**				mg/L			10/23/19 13:15	1
pH, Field	**6.68**				SU			10/23/19 13:15	1
Specific Conductance, Field	**1684**				umhos/cm			10/23/19 13:15	1
Temperature, Field	**13.38**				Degrees C			10/23/19 13:15	1
Turbidity, Field	**12.5**				NTU			10/23/19 13:15	1

Client Sample Results

Client: SCS Engineers
Job ID: 310-168508-3
Project/Site: Ottumwa Generating Station 25219072

Client Sample ID: MW-308

Lab Sample ID: 310-168508-9
Date Collected: 10/23/19 11:56
Matrix: Water
Date Received: 10/25/19 18:30

Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**160**		5.0	1.5	mg/L			10/31/19 14:50	5
Fluoride	<0.23		0.50	0.23	mg/L			10/31/19 14:50	5
Sulfate	**300**		10	3.5	mg/L			11/01/19 12:24	10

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron	**220**		200	110	ug/L		10/29/19 08:00	10/29/19 22:09	1
Calcium	**240**		0.50	0.10	mg/L		10/29/19 08:00	10/29/19 22:09	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	**1100**		30	24	mg/L			10/29/19 13:03	1
pH	**7.9**	**HF**	0.1	0.1	SU			10/25/19 23:03	1

Method: Field Sampling - Field Sampling

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Ground Water Elevation	**651.31**				ft			10/23/19 11:56	1
Oxidation Reduction Potential	**-38.7**				millivolts			10/23/19 11:56	1
Oxygen, Dissolved, Client Supplied	**4.42**				mg/L			10/23/19 11:56	1
pH, Field	**6.78**				SU			10/23/19 11:56	1
Specific Conductance, Field	**1637**				umhos/cm			10/23/19 11:56	1
Temperature, Field	**13.16**				Degrees C			10/23/19 11:56	1
Turbidity, Field	**7.42**				NTU			10/23/19 11:56	1

Client Sample Results

Client: SCS Engineers
Job ID: 310-168508-3
Project/Site: Ottumwa Generating Station 25219072

Client Sample ID: MW-309

Lab Sample ID: 310-168508-10
Date Collected: 10/23/19 10:32
Matrix: Water
Date Received: 10/25/19 18:30

Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**74**		5.0	1.5	mg/L			10/31/19 15:06	5
Fluoride	<0.23		0.50	0.23	mg/L			10/31/19 15:06	5
Sulfate	**400**		10	3.5	mg/L			11/01/19 12:41	10

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron	**1300**		200	110	ug/L		10/29/19 08:00	10/29/19 22:13	1
Calcium	**150**		0.50	0.10	mg/L		10/29/19 08:00	10/29/19 22:13	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	**1100**		30	24	mg/L			10/29/19 13:03	1
pH	**7.2**	**HF**	0.1	0.1	SU			10/25/19 23:35	1

Method: Field Sampling - Field Sampling

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Ground Water Elevation	**651.28**				ft			10/23/19 10:32	1
Oxidation Reduction Potential	**-27.5**				millivolts			10/23/19 10:32	1
Oxygen, Dissolved, Client Supplied	**0.36**				mg/L			10/23/19 10:32	1
pH, Field	**6.98**				SU			10/23/19 10:32	1
Specific Conductance, Field	**1461**				umhos/cm			10/23/19 10:32	1
Temperature, Field	**12.83**				Degrees C			10/23/19 10:32	1
Turbidity, Field	**42.6**				NTU			10/23/19 10:32	1

Definitions/Glossary

Client: SCS Engineers
Project/Site: Ottumwa Generating Station 25219072

Job ID: 310-168508-3

Qualifiers

General Chemistry

Qualifier	Qualifier Description
HF	Field parameter with a holding time of 15 minutes. Test performed by laboratory at client's request.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

QC Sample Results

Client: SCS Engineers
Project/Site: Ottumwa Generating Station 25219072

Job ID: 310-168508-3

Method: 9056A - Anions, Ion Chromatography

Lab Sample ID: MB 310-259370/3
Matrix: Water
Analysis Batch: 259370

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	<0.29		1.0	0.29	mg/L			10/31/19 08:19	1
Fluoride	<0.045		0.10	0.045	mg/L			10/31/19 08:19	1
Sulfate	<0.35		1.0	0.35	mg/L			10/31/19 08:19	1

Lab Sample ID: LCS 310-259370/4
Matrix: Water
Analysis Batch: 259370

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Chloride	10.0	10.1		mg/L		101	90 - 110
Fluoride	2.00	2.07		mg/L		104	90 - 110
Sulfate	10.0	10.3		mg/L		103	90 - 110

Method: 6020A - Metals (ICP/MS)

Lab Sample ID: MB 310-258560/1-A
Matrix: Water
Analysis Batch: 258765

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 258560

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron	<110		200	110	ug/L		10/29/19 08:00	10/29/19 21:05	1
Calcium	<0.10		0.50	0.10	mg/L		10/29/19 08:00	10/29/19 21:05	1

Lab Sample ID: LCS 310-258560/2-A
Matrix: Water
Analysis Batch: 258765

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 258560

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Boron	1760	1680		ug/L		95	80 - 120
Calcium	4.00	4.04		mg/L		101	80 - 120

Method: SM 2540C - Solids, Total Dissolved (TDS)

Lab Sample ID: MB 310-258685/1
Matrix: Water
Analysis Batch: 258685

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	<24		30	24	mg/L			10/29/19 13:03	1

Lab Sample ID: LCS 310-258685/2
Matrix: Water
Analysis Batch: 258685

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Total Dissolved Solids	1000	1030		mg/L		103	90 - 110

QC Sample Results

Client: SCS Engineers
Project/Site: Ottumwa Generating Station 25219072
Job ID: 310-168508-3

Method: SM 4500 H+ B - pH

Lab Sample ID: LCS 310-258389/1
Matrix: Water
Analysis Batch: 258389
Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
pH			7.00	7.0		SU		100	98 - 102		

Lab Sample ID: 310-168508-10 DU
Matrix: Water
Analysis Batch: 258389
Client Sample ID: MW-309
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier		DU Result	DU Qualifier	Unit	D			RPD	RPD Limit
pH	7.2	HF		7.2		SU				0.1	20

QC Association Summary

HPLC/IC

Analysis Batch: 259370

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-168508-8	MW-307	Total/NA	Water	9056A	
310-168508-9	MW-308	Total/NA	Water	9056A	
310-168508-9	MW-308	Total/NA	Water	9056A	
310-168508-10	MW-309	Total/NA	Water	9056A	
310-168508-10	MW-309	Total/NA	Water	9056A	
MB 310-259370/3	Method Blank	Total/NA	Water	9056A	
LCS 310-259370/4	Lab Control Sample	Total/NA	Water	9056A	

Metals

Prep Batch: 258560

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-168508-8	MW-307	Total/NA	Water	3010A	
310-168508-9	MW-308	Total/NA	Water	3010A	
310-168508-10	MW-309	Total/NA	Water	3010A	
MB 310-258560/1-A	Method Blank	Total/NA	Water	3010A	
LCS 310-258560/2-A	Lab Control Sample	Total/NA	Water	3010A	

Analysis Batch: 258765

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-168508-8	MW-307	Total/NA	Water	6020A	258560
310-168508-9	MW-308	Total/NA	Water	6020A	258560
310-168508-10	MW-309	Total/NA	Water	6020A	258560
MB 310-258560/1-A	Method Blank	Total/NA	Water	6020A	258560
LCS 310-258560/2-A	Lab Control Sample	Total/NA	Water	6020A	258560

General Chemistry

Analysis Batch: 258389

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-168508-8	MW-307	Total/NA	Water	SM 4500 H+ B	
310-168508-9	MW-308	Total/NA	Water	SM 4500 H+ B	
310-168508-10	MW-309	Total/NA	Water	SM 4500 H+ B	
LCS 310-258389/1	Lab Control Sample	Total/NA	Water	SM 4500 H+ B	
310-168508-10 DU	MW-309	Total/NA	Water	SM 4500 H+ B	

Analysis Batch: 258685

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-168508-8	MW-307	Total/NA	Water	SM 2540C	
310-168508-9	MW-308	Total/NA	Water	SM 2540C	
310-168508-10	MW-309	Total/NA	Water	SM 2540C	
MB 310-258685/1	Method Blank	Total/NA	Water	SM 2540C	
LCS 310-258685/2	Lab Control Sample	Total/NA	Water	SM 2540C	

Field Service / Mobile Lab

Analysis Batch: 259232

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-168508-8	MW-307	Total/NA	Water	Field Sampling	
310-168508-9	MW-308	Total/NA	Water	Field Sampling	
310-168508-10	MW-309	Total/NA	Water	Field Sampling	

Lab Chronicle

Client: SCS Engineers | Job ID: 310-168508-3
Project/Site: Ottumwa Generating Station 25219072

1 2 3 4 5 6 7 8 9 10 11 12 13 14

Client Sample ID: MW-307 | Lab Sample ID: 310-168508-8

Date Collected: 10/23/19 13:15 | **Matrix: Water**
Date Received: 10/25/19 18:30

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	9056A		5	259370	10/31/19 14:35	CJT	TAL CF
Total/NA	Prep	3010A			258560	10/29/19 08:00	HED	TAL CF
Total/NA	Analysis	6020A		1	258765	10/29/19 22:06	SAD	TAL CF
Total/NA	Analysis	SM 2540C		1	258685	10/29/19 13:03	MDK	TAL CF
Total/NA	Analysis	SM 4500 H+ B		1	258389	10/25/19 23:02	JMH	TAL CF
Total/NA	Analysis	Field Sampling		1	259232	10/23/19 13:15	EAR	TAL CF

Client Sample ID: MW-308 | Lab Sample ID: 310-168508-9

Date Collected: 10/23/19 11:56 | **Matrix: Water**
Date Received: 10/25/19 18:30

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	9056A		5	259370	10/31/19 14:50	CJT	TAL CF
Total/NA	Analysis	9056A		10	259370	11/01/19 12:24	CJT	TAL CF
Total/NA	Prep	3010A			258560	10/29/19 08:00	HED	TAL CF
Total/NA	Analysis	6020A		1	258765	10/29/19 22:09	SAD	TAL CF
Total/NA	Analysis	SM 2540C		1	258685	10/29/19 13:03	MDK	TAL CF
Total/NA	Analysis	SM 4500 H+ B		1	258389	10/25/19 23:03	JMH	TAL CF
Total/NA	Analysis	Field Sampling		1	259232	10/23/19 11:56	EAR	TAL CF

Client Sample ID: MW-309 | Lab Sample ID: 310-168508-10

Date Collected: 10/23/19 10:32 | **Matrix: Water**
Date Received: 10/25/19 18:30

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	9056A		5	259370	10/31/19 15:06	CJT	TAL CF
Total/NA	Analysis	9056A		10	259370	11/01/19 12:41	CJT	TAL CF
Total/NA	Prep	3010A			258560	10/29/19 08:00	HED	TAL CF
Total/NA	Analysis	6020A		1	258765	10/29/19 22:13	SAD	TAL CF
Total/NA	Analysis	SM 2540C		1	258685	10/29/19 13:03	MDK	TAL CF
Total/NA	Analysis	SM 4500 H+ B		1	258389	10/25/19 23:35	JMH	TAL CF
Total/NA	Analysis	Field Sampling		1	259232	10/23/19 10:32	EAR	TAL CF

Laboratory References:

TAL CF = Eurofins TestAmerica, Cedar Falls, 3019 Venture Way, Cedar Falls, IA 50613, TEL (319)277-2401

Accreditation/Certification Summary

Client: SCS Engineers
Job ID: 310-168508-3
Project/Site: Ottumwa Generating Station 25219072

Laboratory: Eurofins TestAmerica, Cedar Falls

The accreditations/certifications listed below are applicable to this report.

Authority	Program	Identification Number	Expiration Date
Iowa	State Program	007	12-01-19 *

* Accreditation/Certification renewal pending - accreditation/certification considered valid.

Method Summary

Method	Method Description	Protocol	Laboratory
9056A	Anions, Ion Chromatography	SW846	TAL CF
6020A	Metals (ICP/MS)	SW846	TAL CF
SM 2540C	Solids, Total Dissolved (TDS)	SM	TAL CF
SM 4500 H+ B	pH	SM	TAL CF
Field Sampling	Field Sampling	EPA	TAL CF
3010A	Preparation, Total Metals	SW846	TAL CF

Protocol References:

EPA = US Environmental Protection Agency
SM = "Standard Methods For The Examination Of Water And Wastewater"
SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

TAL CF = Eurofins TestAmerica, Cedar Falls, 3019 Venture Way, Cedar Falls, IA 50613, TEL (319)277-2401

eurofins | Environment Testing
TestAmerica

310-168508 Chain of Custody

Cooler/Sample Receipt and Temperature Log Form

Client Information

Client: SCS Engineers

City/State: CITY clive STATE IA

Project: Ottumwa Generating Station

Receipt Information

Date/Time Received: DATE 10-25-19 TIME 1830

Received By: LAB

Delivery Type: ☐ UPS ☐ FedEx ☐ FedEx Ground ☐ US Mail ☐ Spee-Dee
☒ Lab Courier ☐ Lab Field Services ☐ Client Drop-off ☐ Other:________

Condition of Cooler/Containers

Sample(s) received in Cooler? ☒ Yes ☐ No *If yes:* Cooler ID:

Multiple Coolers? ☒ Yes ☐ No *If yes:* Cooler # 1 of 2

Cooler Custody Seals Present? ☐ Yes ☒ No *If yes:* Cooler custody seals intact? ☐ Yes ☐ No

Sample Custody Seals Present? ☐ Yes ☒ No *If yes:* Sample custody seals intact? ☐ Yes ☐ No

Trip Blank Present? ☐ Yes ☒ No *If yes:* Which VOA samples are in cooler? ↓

Temperature Record

Coolant: ☒ Wet ice ☐ Blue ice ☐ Dry ice ☐ Other:________ ☐ NONE

Thermometer ID: N

Correction Factor (°C): +0.0

• Temp Blank Temperature – If no temp blank, or temp blank temperature above criteria, proceed to Sample Container Temperature

Uncorrected Temp (°C): 1.2

Corrected Temp (°C): 1.2

• Sample Container Temperature

Container(s) used:	CONTAINER 1	CONTAINER 2
Uncorrected Temp (°C):		
Corrected Temp (°C):		

Exceptions Noted

1) If temperature exceeds criteria, was sample(s) received same day of sampling? ☐ Yes ☐ No
   a) *If yes:* Is there evidence that the chilling process began? ☐ Yes ☐ No

2) If temperature is <0°C, are there obvious signs that the integrity of sample containers is compromised? (e.g., bulging septa, broken/cracked bottles, frozen solid?) ☐ Yes ☐ No

NOTE: If yes, contact PM before proceeding. If no, proceed with login

Additional Comments

Document: CF-LG-WI-002
Revision: 25
Date: 06/17/2019

General temperature criteria is 0 to 6°C
Bacteria temperature criteria is 0 to 10°C

eurofins | Environment Testing
TestAmerica

Place COC scanning label here
214

Cooler/Sample Receipt and Temperature Log Form

Client Information

Client: SCS engineers

City/State: CITY Clive STATE IA | Project: Ottumwa Generating Station

Receipt Information

Date/Time Received: DATE 10-25-19 TIME 1830 | Received By: LAB

Delivery Type: ☐ UPS ☐ FedEx ☐ FedEx Ground ☐ US Mail ☐ Spee-Dee
☒ Lab Courier ☐ Lab Field Services ☐ Client Drop-off ☐ Other:________

Condition of Cooler/Containers

Sample(s) received in Cooler? ☒ Yes ☐ No *If yes:* Cooler ID:

Multiple Coolers? ☒ Yes ☐ No *If yes:* Cooler # 2 of 2

Cooler Custody Seals Present? ☐ Yes ☒ No *If yes:* Cooler custody seals intact? ☐ Yes ☐ No

Sample Custody Seals Present? ☐ Yes ☒ No *If yes:* Sample custody seals intact? ☐ Yes ☐ No

Trip Blank Present? ☐ Yes ☒ No *If yes:* Which VOA samples are in cooler? ↓

Temperature Record

Coolant: ☒ Wet ice ☐ Blue ice ☐ Dry ice ☐ Other:________ ☐ NONE

Thermometer ID: N | Correction Factor (°C): +0.0

• Temp Blank Temperature – If no temp blank, or temp blank temperature above criteria, proceed to Sample Container Temperature

Uncorrected Temp (°C): 4.3 | Corrected Temp (°C): 4.3

• Sample Container Temperature

Container(s) used:	CONTAINER 1	CONTAINER 2
Uncorrected Temp (°C):		
Corrected Temp (°C):		

Exceptions Noted

1) If temperature exceeds criteria, was sample(s) received same day of sampling? ☐ Yes ☐ No
   a) *If yes:* Is there evidence that the chilling process began? ☐ Yes ☐ No

2) If temperature is <0°C, are there obvious signs that the integrity of sample containers is compromised? (e.g., bulging septa, broken/cracked bottles, frozen solid?) ☐ Yes ☐ No

NOTE: If yes, contact PM before proceeding. If no, proceed with login

Additional Comments

Document: CF-LG-WI-002
Revision: 25
Date: 06/17/2019

General temperature criteria is 0 to 6°C
Bacteria temperature criteria is 0 to 10°C

14167

Eurofins TestAmerica, Cedar Falls
3019 Venture Way
Cedar Falls, IA 50613
Phone (319) 277-2401 Fax (319) 277-2425

Chain of Custody Record

TestAmerica Des Moines SC
214

eurofins Environment Testing TestAmerica

Client Information	Sampler: Louise Jennings	Lab PM: Fredrick, Sandie	Carrier Tracking No(s):	COC No: 310-44167-12671.1
Client Contact: Louise Jennings	Phone: 608 509 8245	E-Mail: sandie.fredrick@testamericainc.com		Page: Page 1 of 2
Company: SCS Engineers		**Analysis Requested**		Job #:
Address: 8450 Hickman Road Suite 20	Due Date Requested:			**Preservation Codes:**
City: Clive	TAT Requested (days): Standard			
State, Zip: IA, 50325				
Phone:	PO #: 25219072			
Email: ljennings@scsengineers.com	WO #:			
Project Name: Ottumwa Generating Station 25219072	Project #: 31011020			
Site:	SSOW#:			Other:

Preservation Codes:
- A - HCL
- B - NaOH
- C - Zn Acetate
- D - Nitric Acid
- E - NaHSO4
- F - MeOH
- G - Amchlor
- H - Ascorbic Acid
- I - Ice
- J - DI Water
- K - EDTA
- L - EDA
- M - Hexane
- N - None
- O - AsNaO2
- P - Na2O4S
- Q - Na2SO3
- R - Na2S2O3
- S - H2SO4
- T - TSP Dodecahydrate
- U - Acetone
- V - MCAA
- W - pH 4-5
- Z - other (specify)

Sample Identification	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	903.0, 904.0	6020A, 7470A	2540C_Calcd, 9056A_ORGFM_28D, SM4500_H+	Total Number of containers	Special Instructions/Note:
			Preservation Code:				D	D	N		
MW-301	10.24.19	0900	G	Water			X	X	X		
MW-302	10.24.19	1030		Water							
MW-303	10.24.19	1200		Water							
MW-304	10.23.19	1427		Water							
MW-305	10.23.19	1615		Water							
MW-306	10.23.19	1700		Water							
FIELD BLANK	10.23.19	2359	—	Water							
MW-307	10.23.19	1315	G	Water							
MW-308	10.23.19	1156		Water							
MW-309	10.23.19	1032		Water							
~~FIELD BLANK~~				~~Water~~							

Possible Hazard Identification
☐ *Non-Hazard* ☐ *Flammable* ☐ *Skin Irritant* ☐ *Poison B* ☐ *Unknown* ☐ *Radiological*

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ *Return To Client* ☐ *Disposal By Lab* ☐ *Archive For* ______ *Months*

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements:

Empty Kit Relinquished by:	Date:	Time:	Method of Shipment:

Relinquished by: Jennings	Date/Time: 10.24.19 1600	Company: SCS	Received by: Lindsay Binder	Date/Time: 10-25-19 1830	Company: ETA
Relinquished by:	Date/Time:	Company:	Received by:	Date/Time:	Company:
Relinquished by:	Date/Time:	Company:	Received by:	Date/Time:	Company:

Custody Seals Intact: Δ Yes Δ No	Custody Seal No.:	Cooler Temperature(s) °C and Other Remarks:

Ver: 01/16/2019

1 2 3 4 5 6 7 8 9 10 11 12 13 14

14167

Eurofins TestAmerica, Cedar Falls
3019 Venture Way
Cedar Falls, IA 50613
Phone (319) 277-2401 Fax (319) 277-2425

Chain of Custody Record

TestAmerica Des Moines SC
214

eurofins Environment Testing TestAmerica

Client Information	Sampler: Louise Jennings	Lab PM: Fredrick, Sandie	Carrier Tracking No(s):	COC No: 310-44167-12871.2
Client Contact: Louise Jennings	Phone: 608 509 8245	E-Mail: sandie.fredrick@testamericainc.com		Page: Page 2 of 2
Company: SCS Engineers		Analysis Requested		Job #:
Address: 8450 Hickman Road Suite 20	Due Date Requested:			
City: Clive	TAT Requested (days): Standard			
State, Zip: IA, 50325				
Phone:	PO #: 25219072			
Email: ljennings@scsengineers.com	WO #:			
Project Name: Ottumwa Generating Station 25219072	Project #: 31011020			
Site:	SSOW#:			

Preservation Codes:
A - HCL
B - NaOH
C - Zn Acetate
D - Nitric Acid
E - NaHSO4
F - MeOH
G - Amchlor
H - Ascorbic Acid
I - Ice
J - DI Water
K - EDTA
L - EDA
M - Hexane
N - None
O - AsNaO2
P - Na2O4S
Q - Na2SO3
R - Na2S2O3
S - H2SO4
T - TSP Dodecahydrate
U - Acetone
V - MCAA
W - pH 4-5
Z - other (specify)
Other:

Sample Identification	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	903.0, 904.0	6020A, 7470A	2540C_Calcd, 9056A_ORGFM_28D, SM4500_H+	Total Number of containers	Special Instructions/Note:
			Preservation Code:				D	D	N		
MW-310	10.24.19	1250	G	Water			X	X	X		
MW-311	10.24.19	1345	G	Water			X	X	X		

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☐ Disposal By Lab ☐ Archive For ______ Months

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements:

Empty Kit Relinquished by: Date: Time: Method of Shipment:

Relinquished by: L. Jennings	Date/Time: 10.24.19 1600	Company: SCS	Received by: Lindsay Binder	Date/Time: 10-25-19 830	Company: ETA
Relinquished by:	Date/Time:	Company:	Received by:	Date/Time:	Company:
Relinquished by:	Date/Time:	Company:	Received by:	Date/Time:	Company:

Custody Seals Intact: Δ Yes Δ No

Custody Seal No.:

Cooler Temperature(s) °C and Other Remarks:

Ver: 01/16/2019

1 2 3 4 5 6 7 8 9 10 11 12 13 14

10/28/2019

Login Container Summary Report

310-168508

Temperature readings: ______________________________

Client Sample ID	Lab ID	Container Type	Container pH	Preservative Added (mls)	Lot #
MW-301	310-168508-A-1	Plastic 250ml - with Nitric Acid	<2		
MW-301	310-168508-C-1	Plastic 1 liter - Nitric Acid	<2		
MW-301	310-168508-D-1	Plastic 1 liter - Nitric Acid	<2		
MW-302	310-168508-A-2	Plastic 250ml - with Nitric Acid	<2		
MW-302	310-168508-C-2	Plastic 1 liter - Nitric Acid	<2		
MW-302	310-168508-D-2	Plastic 1 liter - Nitric Acid	<2		
MW-303	310-168508-A-3	Plastic 250ml - with Nitric Acid	<2		
MW-303	310-168508-C-3	Plastic 1 liter - Nitric Acid	<2		
MW-303	310-168508-D-3	Plastic 1 liter - Nitric Acid	<2		
MW-304	310-168508-A-4	Plastic 250ml - with Nitric Acid	<2		
MW-304	310-168508-C-4	Plastic 1 liter - Nitric Acid	<2		
MW-304	310-168508-D-4	Plastic 1 liter - Nitric Acid	<2		
MW-305	310-168508-A-5	Plastic 250ml - with Nitric Acid	<2		
MW-305	310-168508-C-5	Plastic 1 liter - Nitric Acid	<2		
MW-305	310-168508-D-5	Plastic 1 liter - Nitric Acid	<2		
MW-306	310-168508-A-6	Plastic 250ml - with Nitric Acid	<2		
MW-306	310-168508-C-6	Plastic 1 liter - Nitric Acid	<2		
MW-306	310-168508-D-6	Plastic 1 liter - Nitric Acid	<2		
FIELD BLANK	310-168508-A-7	Plastic 250ml - with Nitric Acid	<2		
FIELD BLANK	310-168508-C-7	Plastic 1 liter - Nitric Acid	<2		
FIELD BLANK	310-168508-D-7	Plastic 1 liter - Nitric Acid	<2		
MW-307	310-168508-A-8	Plastic 250ml - with Nitric Acid	<2		
MW-308	310-168508-A-9	Plastic 250ml - with Nitric Acid	<2		
MW-309	310-168508-A-10	Plastic 250ml - with Nitric Acid	<2		
MW-310	310-168508-A-11	Plastic 250ml - with Nitric Acid	<2		
MW-310	310-168508-C-11	Plastic 1 liter - Nitric Acid	<2		
MW-310	310-168508-D-11	Plastic 1 liter - Nitric Acid	<2		
MW-311	310-168508-A-12	Plastic 250ml - with Nitric Acid	<2		
MW-311	310-168508-C-12	Plastic 1 liter - Nitric Acid	<2		
MW-311	310-168508-D-12	Plastic 1 liter - Nitric Acid	<2		

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Table 1. Sampling Points and Parameters - CCR Rule Sampling Program
Groundwater Monitoring - Ottumwa Generating Station / SCS Engineers Project #25219072

		COC #1		COC #2							COC #3			
	Parameter	MW-301	Field Blank	MW-302	MW-303	MW-304	MW-305	MW-306	MW-310	MW-311	MW-307	MW-308	MW-309	TOTAL
Appendix III Parameters	Boron	x	x	x	x	x	x	x	x	x	x	x	x	12
	Calcium	x	x	x	x	x	x	x	x	x	x	x	x	12
	Chloride	x	x	x	x	x	x	x	x	x	x	x	x	12
	Fluoride	x	x	x	x	x	x	x	x	x	x	x	x	12
	pH	x	x	x	x	x	x	x	x	x	x	x	x	12
	Sulfate	x	x	x	x	x	x	x	x	x	x	x	x	12
	TDS	x	x	x	x	x	x	x	x	x	x	x	x	12
Appendix IV Parameters	Antimony	x	x	x	x	x	x	x	x	x				9
	Arsenic	x	x	x	x	x	x	x	x	x				9
	Barium	x	x	x	x	x	x	x	x	x				9
	Beryllium	x	x	x	x	x	x	x	x	x				9
	Cadmium	x	x	x	x	x	x	x	x	x				9
	Chromium	x	x	x	x	x	x	x	x	x				9
	Cobalt	x	x	x	x	x	x	x	x	x				9
	Fluoride	x	x	x	x	x	x	x	x	x				9
	Lead	x	x	x	x	x	x	x	x	x				9
	Lithium	x	x	x	x	x	x	x	x	x				9
	Mercury	x	x	x	x	x	x	x	x	x				9
	Molybdenum	x	x	x	x	x	x	x	x	x				9
	Selenium	x	x	x	x	x	x	x	x	x				9
	Thallium	x	x	x	x	x	x	x	x	x				9
	Radium	x	x	x	x	x	x	x	x	x				9
Field Parameters	Groundwater Elevation	x		x	x	x	x	x	x	x	x	x	x	11
	Well Depth	x		x	x	x	x	x	x	x	x	x	x	11
	pH (field)	x		x	x	x	x	x	x	x	x	x	x	11
	Specific Conductance	x		x	x	x	x	x	x	x	x	x	x	11
	Dissolved Oxygen	x		x	x	x	x	x	x	x	x	x	x	11
	ORP	x		x	x	x	x	x	x	x	x	x	x	11
	Temperature	x		x	x	x	x	x	x	x	x	x	x	11
	Turbidity	x		x	x	x	x	x	x	x	x	x	x	11
	Color	x		x	x	x	x	x	x	x	x	x	x	11
	Odor	x		x	x	x	x	x	x	x	x	x	x	11

Notes: All samples are unfiltered (total).

C:\Users\fredricks\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.Outlook\232OUB0Y\[OGS_CCR_Rule_Sampling_2019_O

Login Sample Receipt Checklist

Client: SCS Engineers	Job Number: 310-168508-3

Login Number: 168508 **List Source: Eurofins TestAmerica, Cedar Falls**
List Number: 1
Creator: Bovy, Lorrainna L

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	N/A	
The cooler's custody seal, if present, is intact.	N/A	
Sample custody seals, if present, are intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	True	

A3 Round 1 of Assessment Sampling, Analytical Laboratory Report

eurofins

Environment Testing
TestAmerica

ANALYTICAL REPORT

Eurofins TestAmerica, Cedar Falls
3019 Venture Way
Cedar Falls, IA 50613
Tel: (319)277-2401

Laboratory Job ID: 310-171907-1
Client Project/Site: Ottumwa Generating Station 25219072

For:
SCS Engineers
2830 Dairy Drive
Madison, Wisconsin 53718

Attn: Meghan Blodgett

Sandie Fredrick

Authorized for release by:
12/23/2019 3:38:09 PM

Sandie Fredrick, Project Manager II
(920)261-1660
sandie.fredrick@testamericainc.com

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

Table of Contents

Case Narrative

Job ID: 310-171907-1

Laboratory: Eurofins TestAmerica, Cedar Falls

Narrative

Job Narrative
310-171907-1

Comments
No additional comments.

Receipt
The samples were received on 12/11/2019 5:25 PM; the samples arrived in good condition, properly preserved and, where required, on ice. The temperature of the cooler at receipt was -0.2° C.

HPLC/IC
Methods 300.0, 9056A: The following samples were diluted due to the nature of the sample matrix: MW-307 (310-171907-1), MW-308 (310-171907-2) and MW-309 (310-171907-3). Elevated reporting limits (RLs) are provided.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Metals
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

General Chemistry
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

Sample Summary

Client: SCS Engineers
Project/Site: Ottumwa Generating Station 25219072

Job ID: 310-171907-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received	Asset ID
310-171907-1	MW-307	Water	12/11/19 08:55	12/11/19 17:25	
310-171907-2	MW-308	Water	12/11/19 09:50	12/11/19 17:25	
310-171907-3	MW-309	Water	12/11/19 10:50	12/11/19 17:25	
310-171907-4	Field Blank	Water	12/11/19 08:40	12/11/19 17:25	

Detection Summary

Client: SCS Engineers
Project/Site: Ottumwa Generating Station 25219072

Job ID: 310-171907-1

Client Sample ID: MW-307

Lab Sample ID: 310-171907-1

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloride	200		5.0	1.5	mg/L	5		9056A	Total/NA
Sulfate	92		5.0	1.8	mg/L	5		9056A	Total/NA
Barium	140		2.0	0.84	ug/L	1		6020A	Total/NA
Boron	190	J	200	110	ug/L	1		6020A	Total/NA
Calcium	230		0.50	0.10	mg/L	1		6020A	Total/NA
Cobalt	11		0.50	0.091	ug/L	1		6020A	Total/NA
Lead	0.71		0.50	0.27	ug/L	1		6020A	Total/NA
Lithium	12		10	2.7	ug/L	1		6020A	Total/NA
Total Dissolved Solids	1000		30	24	mg/L	1		SM 2540C	Total/NA
pH	6.7	HF	0.1	0.1	SU	1		SM 4500 H+ B	Total/NA
Ground Water Elevation	649.59				ft	1		Field Sampling	Total/NA
Oxidation Reduction Potential	-45.8				millivolts	1		Field Sampling	Total/NA
Oxygen, Dissolved, Client Supplied	0.18				mg/L	1		Field Sampling	Total/NA
pH, Field	6.37				SU	1		Field Sampling	Total/NA
Specific Conductance, Field	1576				umhos/cm	1		Field Sampling	Total/NA
Temperature, Field	11.50				Degrees C	1		Field Sampling	Total/NA
Turbidity, Field	43.13				NTU	1		Field Sampling	Total/NA

Client Sample ID: MW-308

Lab Sample ID: 310-171907-2

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloride	150		5.0	1.5	mg/L	5		9056A	Total/NA
Sulfate	280		10	3.5	mg/L	10		9056A	Total/NA
Barium	130		2.0	0.84	ug/L	1		6020A	Total/NA
Boron	160	J	200	110	ug/L	1		6020A	Total/NA
Calcium	220		0.50	0.10	mg/L	1		6020A	Total/NA
Chromium	5.9		5.0	0.98	ug/L	1		6020A	Total/NA
Cobalt	0.26	J	0.50	0.091	ug/L	1		6020A	Total/NA
Lead	0.52		0.50	0.27	ug/L	1		6020A	Total/NA
Lithium	16		10	2.7	ug/L	1		6020A	Total/NA
Total Dissolved Solids	1100		30	24	mg/L	1		SM 2540C	Total/NA
pH	6.8	HF	0.1	0.1	SU	1		SM 4500 H+ B	Total/NA
Ground Water Elevation	647.39				ft	1		Field Sampling	Total/NA
Oxidation Reduction Potential	-56.6				millivolts	1		Field Sampling	Total/NA
Oxygen, Dissolved, Client Supplied	0.43				mg/L	1		Field Sampling	Total/NA
pH, Field	6.55				SU	1		Field Sampling	Total/NA
Specific Conductance, Field	1532				umhos/cm	1		Field Sampling	Total/NA
Temperature, Field	10.50				Degrees C	1		Field Sampling	Total/NA
Turbidity, Field	15.72				NTU	1		Field Sampling	Total/NA

Client Sample ID: MW-309

Lab Sample ID: 310-171907-3

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloride	66		5.0	1.5	mg/L	5		9056A	Total/NA
Sulfate	370		10	3.5	mg/L	10		9056A	Total/NA
Arsenic	1.1	J	2.0	0.75	ug/L	1		6020A	Total/NA
Barium	54		2.0	0.84	ug/L	1		6020A	Total/NA
Boron	1100		200	110	ug/L	1		6020A	Total/NA
Cadmium	0.090	J	0.10	0.039	ug/L	1		6020A	Total/NA
Calcium	150		0.50	0.10	mg/L	1		6020A	Total/NA
Chromium	1.7	J	5.0	0.98	ug/L	1		6020A	Total/NA
Cobalt	3.7		0.50	0.091	ug/L	1		6020A	Total/NA

This Detection Summary does not include radiochemical test results.

Detection Summary

Client Sample ID: MW-309 (Continued)

Lab Sample ID: 310-171907-3

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Lead	2.8		0.50	0.27	ug/L	1		6020A	Total/NA
Lithium	8.2	J	10	2.7	ug/L	1		6020A	Total/NA
Total Dissolved Solids	980		30	24	mg/L	1		SM 2540C	Total/NA
pH	7.1	HF	0.1	0.1	SU	1		SM 4500 H+ B	Total/NA
Ground Water Elevation	647.24				ft	1		Field Sampling	Total/NA
Oxidation Reduction Potential	-37.8				millivolts	1		Field Sampling	Total/NA
Oxygen, Dissolved, Client Supplied	0.26				mg/L	1		Field Sampling	Total/NA
pH, Field	6.67				SU	1		Field Sampling	Total/NA
Specific Conductance, Field	1350				umhos/cm	1		Field Sampling	Total/NA
Temperature, Field	11.5				Degrees C	1		Field Sampling	Total/NA
Turbidity, Field	413.6				NTU	1		Field Sampling	Total/NA

Client Sample ID: Field Blank

Lab Sample ID: 310-171907-4

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Calcium	0.19	J	0.50	0.10	mg/L	1		6020A	Total/NA
pH	7.2	HF	0.1	0.1	SU	1		SM 4500 H+ B	Total/NA

This Detection Summary does not include radiochemical test results.

Client Sample Results

Client Sample ID: MW-307

Lab Sample ID: 310-171907-1

Date Collected: 12/11/19 08:55

Matrix: Water

Date Received: 12/11/19 17:25

Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**200**		5.0	1.5	mg/L			12/12/19 15:56	5
Fluoride	<0.23		0.50	0.23	mg/L			12/13/19 10:26	5
Sulfate	**92**		5.0	1.8	mg/L			12/12/19 15:56	5

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.53		1.0	0.53	ug/L		12/13/19 07:50	12/19/19 11:36	1
Arsenic	<0.75		2.0	0.75	ug/L		12/13/19 07:50	12/17/19 19:49	1
Barium	**140**		2.0	0.84	ug/L		12/13/19 07:50	12/17/19 19:49	1
Beryllium	<0.27		1.0	0.27	ug/L		12/13/19 07:50	12/17/19 19:49	1
Boron	**190**	**J**	200	110	ug/L		12/13/19 07:50	12/17/19 19:49	1
Cadmium	<0.039		0.10	0.039	ug/L		12/13/19 07:50	12/17/19 19:49	1
Calcium	**230**		0.50	0.10	mg/L		12/13/19 07:50	12/17/19 19:49	1
Chromium	<0.98		5.0	0.98	ug/L		12/13/19 07:50	12/17/19 19:49	1
Cobalt	**11**		0.50	0.091	ug/L		12/13/19 07:50	12/17/19 19:49	1
Lead	**0.71**		0.50	0.27	ug/L		12/13/19 07:50	12/17/19 19:49	1
Lithium	**12**		10	2.7	ug/L		12/13/19 07:50	12/19/19 11:36	1
Molybdenum	<1.1		2.0	1.1	ug/L		12/13/19 07:50	12/19/19 11:36	1
Selenium	<1.0		5.0	1.0	ug/L		12/13/19 07:50	12/17/19 19:49	1
Thallium	<0.27		1.0	0.27	ug/L		12/13/19 07:50	12/17/19 19:49	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.10		0.20	0.10	ug/L		12/13/19 11:22	12/16/19 13:34	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	**1000**		30	24	mg/L			12/13/19 11:40	1
pH	**6.7**	**HF**	0.1	0.1	SU			12/11/19 22:51	1

Method: Field Sampling - Field Sampling

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Ground Water Elevation	**649.59**				ft			12/11/19 08:55	1
Oxidation Reduction Potential	**-45.8**				millivolts			12/11/19 08:55	1
Oxygen, Dissolved, Client Supplied	**0.18**				mg/L			12/11/19 08:55	1
pH, Field	**6.37**				SU			12/11/19 08:55	1
Specific Conductance, Field	**1576**				umhos/cm			12/11/19 08:55	1
Temperature, Field	**11.50**				Degrees C			12/11/19 08:55	1
Turbidity, Field	**43.13**				NTU			12/11/19 08:55	1

Client Sample Results

Client: SCS Engineers
Job ID: 310-171907-1
Project/Site: Ottumwa Generating Station 25219072

Client Sample ID: MW-308

Lab Sample ID: 310-171907-2
Date Collected: 12/11/19 09:50
Matrix: Water
Date Received: 12/11/19 17:25

Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**150**		5.0	1.5	mg/L			12/12/19 16:43	5
Fluoride	<0.23		0.50	0.23	mg/L			12/13/19 10:41	5
Sulfate	**280**		10	3.5	mg/L			12/13/19 10:57	10

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.53		1.0	0.53	ug/L		12/13/19 07:50	12/19/19 11:43	1
Arsenic	<0.75		2.0	0.75	ug/L		12/13/19 07:50	12/17/19 20:00	1
Barium	**130**		2.0	0.84	ug/L		12/13/19 07:50	12/17/19 20:00	1
Beryllium	<0.27		1.0	0.27	ug/L		12/13/19 07:50	12/17/19 20:00	1
Boron	**160**	**J**	200	110	ug/L		12/13/19 07:50	12/17/19 20:00	1
Cadmium	<0.039		0.10	0.039	ug/L		12/13/19 07:50	12/17/19 20:00	1
Calcium	**220**		0.50	0.10	mg/L		12/13/19 07:50	12/17/19 20:00	1
Chromium	**5.9**		5.0	0.98	ug/L		12/13/19 07:50	12/17/19 20:00	1
Cobalt	**0.26**	**J**	0.50	0.091	ug/L		12/13/19 07:50	12/17/19 20:00	1
Lead	**0.52**		0.50	0.27	ug/L		12/13/19 07:50	12/17/19 20:00	1
Lithium	**16**		10	2.7	ug/L		12/13/19 07:50	12/19/19 11:43	1
Molybdenum	<1.1		2.0	1.1	ug/L		12/13/19 07:50	12/19/19 11:43	1
Selenium	<1.0		5.0	1.0	ug/L		12/13/19 07:50	12/17/19 20:00	1
Thallium	<0.27		1.0	0.27	ug/L		12/13/19 07:50	12/17/19 20:00	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.10		0.20	0.10	ug/L		12/13/19 11:22	12/16/19 13:32	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	**1100**		30	24	mg/L			12/13/19 11:40	1
pH	**6.8**	**HF**	0.1	0.1	SU			12/11/19 22:52	1

Method: Field Sampling - Field Sampling

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Ground Water Elevation	**647.39**				ft			12/11/19 09:50	1
Oxidation Reduction Potential	**-56.6**				millivolts			12/11/19 09:50	1
Oxygen, Dissolved, Client Supplied	**0.43**				mg/L			12/11/19 09:50	1
pH, Field	**6.55**				SU			12/11/19 09:50	1
Specific Conductance, Field	**1532**				umhos/cm			12/11/19 09:50	1
Temperature, Field	**10.50**				Degrees C			12/11/19 09:50	1
Turbidity, Field	**15.72**				NTU			12/11/19 09:50	1

Client Sample Results

Client: SCS Engineers
Job ID: 310-171907-1
Project/Site: Ottumwa Generating Station 25219072

Client Sample ID: MW-309
Lab Sample ID: 310-171907-3
Date Collected: 12/11/19 10:50
Matrix: Water
Date Received: 12/11/19 17:25

Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**66**		5.0	1.5	mg/L			12/12/19 16:58	5
Fluoride	<0.23		0.50	0.23	mg/L			12/13/19 11:13	5
Sulfate	**370**		10	3.5	mg/L			12/13/19 11:28	10

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.53		1.0	0.53	ug/L		12/13/19 07:50	12/19/19 11:46	1
Arsenic	**1.1**	**J**	2.0	0.75	ug/L		12/13/19 07:50	12/17/19 20:02	1
Barium	**54**		2.0	0.84	ug/L		12/13/19 07:50	12/17/19 20:02	1
Beryllium	<0.27		1.0	0.27	ug/L		12/13/19 07:50	12/17/19 20:02	1
Boron	**1100**		200	110	ug/L		12/13/19 07:50	12/17/19 20:02	1
Cadmium	**0.090**	**J**	0.10	0.039	ug/L		12/13/19 07:50	12/17/19 20:02	1
Calcium	**150**		0.50	0.10	mg/L		12/13/19 07:50	12/17/19 20:02	1
Chromium	**1.7**	**J**	5.0	0.98	ug/L		12/13/19 07:50	12/17/19 20:02	1
Cobalt	**3.7**		0.50	0.091	ug/L		12/13/19 07:50	12/17/19 20:02	1
Lead	**2.8**		0.50	0.27	ug/L		12/13/19 07:50	12/17/19 20:02	1
Lithium	**8.2**	**J**	10	2.7	ug/L		12/13/19 07:50	12/19/19 11:46	1
Molybdenum	<1.1		2.0	1.1	ug/L		12/13/19 07:50	12/19/19 11:46	1
Selenium	<1.0		5.0	1.0	ug/L		12/13/19 07:50	12/17/19 20:02	1
Thallium	<0.27		1.0	0.27	ug/L		12/13/19 07:50	12/17/19 20:02	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.10		0.20	0.10	ug/L		12/13/19 11:22	12/16/19 13:26	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	**980**		30	24	mg/L			12/13/19 11:40	1
pH	**7.1**	**HF**	0.1	0.1	SU			12/11/19 22:53	1

Method: Field Sampling - Field Sampling

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Ground Water Elevation	**647.24**				ft			12/11/19 10:50	1
Oxidation Reduction Potential	**-37.8**				millivolts			12/11/19 10:50	1
Oxygen, Dissolved, Client Supplied	**0.26**				mg/L			12/11/19 10:50	1
pH, Field	**6.67**				SU			12/11/19 10:50	1
Specific Conductance, Field	**1350**				umhos/cm			12/11/19 10:50	1
Temperature, Field	**11.5**				Degrees C			12/11/19 10:50	1
Turbidity, Field	**413.6**				NTU			12/11/19 10:50	1

Client Sample Results

Client: SCS Engineers
Project/Site: Ottumwa Generating Station 25219072

Job ID: 310-171907-1

Client Sample ID: Field Blank

Date Collected: 12/11/19 08:40
Date Received: 12/11/19 17:25

Lab Sample ID: 310-171907-4
Matrix: Water

Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	<0.29		1.0	0.29	mg/L			12/12/19 17:14	1
Fluoride	<0.045		0.10	0.045	mg/L			12/13/19 11:44	1
Sulfate	<0.35		1.0	0.35	mg/L			12/12/19 17:14	1

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.53		1.0	0.53	ug/L		12/13/19 07:50	12/19/19 11:48	1
Arsenic	<0.75		2.0	0.75	ug/L		12/13/19 07:50	12/17/19 20:05	1
Barium	<0.84		2.0	0.84	ug/L		12/13/19 07:50	12/17/19 20:05	1
Beryllium	<0.27		1.0	0.27	ug/L		12/13/19 07:50	12/17/19 20:05	1
Boron	<110		200	110	ug/L		12/13/19 07:50	12/17/19 20:05	1
Cadmium	<0.039		0.10	0.039	ug/L		12/13/19 07:50	12/17/19 20:05	1
Calcium	**0.19**	**J**	0.50	0.10	mg/L		12/13/19 07:50	12/17/19 20:05	1
Chromium	<0.98		5.0	0.98	ug/L		12/13/19 07:50	12/17/19 20:05	1
Cobalt	<0.091		0.50	0.091	ug/L		12/13/19 07:50	12/17/19 20:05	1
Lead	<0.27		0.50	0.27	ug/L		12/13/19 07:50	12/17/19 20:05	1
Lithium	<2.7		10	2.7	ug/L		12/13/19 07:50	12/19/19 11:48	1
Molybdenum	<1.1		2.0	1.1	ug/L		12/13/19 07:50	12/19/19 11:48	1
Selenium	<1.0		5.0	1.0	ug/L		12/13/19 07:50	12/17/19 20:05	1
Thallium	<0.27		1.0	0.27	ug/L		12/13/19 07:50	12/17/19 20:05	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.10		0.20	0.10	ug/L		12/13/19 11:22	12/16/19 13:24	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	<24		30	24	mg/L			12/13/19 11:40	1
pH	**7.2**	**HF**	0.1	0.1	SU			12/11/19 22:56	1

Definitions/Glossary

Client: SCS Engineers
Project/Site: Ottumwa Generating Station 25219072

Job ID: 310-171907-1

Qualifiers

Metals

Qualifier	Qualifier Description
4	MS, MSD: The analyte present in the original sample is greater than 4 times the matrix spike concentration; therefore, control limits are not applicable.
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

General Chemistry

Qualifier	Qualifier Description
HF	Field parameter with a holding time of 15 minutes. Test performed by laboratory at client's request.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

QC Sample Results

Method: 9056A - Anions, Ion Chromatography

Lab Sample ID: MB 310-264765/3
Matrix: Water
Analysis Batch: 264765

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	<0.29		1.0	0.29	mg/L			12/12/19 14:07	1
Sulfate	<0.35		1.0	0.35	mg/L			12/12/19 14:07	1

Lab Sample ID: MB 310-264765/60
Matrix: Water
Analysis Batch: 264765

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Fluoride	<0.045		0.10	0.045	mg/L			12/13/19 16:40	1

Lab Sample ID: LCS 310-264765/4
Matrix: Water
Analysis Batch: 264765

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Chloride	10.0	9.69		mg/L		97	90 - 110
Sulfate	10.0	10.1		mg/L		101	90 - 110

Lab Sample ID: LCS 310-264765/61
Matrix: Water
Analysis Batch: 264765

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Fluoride	2.00	1.98		mg/L		99	90 - 110

Method: 6020A - Metals (ICP/MS)

Lab Sample ID: MB 310-264522/1-A
Matrix: Water
Analysis Batch: 265032

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 264522

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	<0.75		2.0	0.75	ug/L		12/13/19 07:50	12/17/19 19:44	1
Barium	<0.84		2.0	0.84	ug/L		12/13/19 07:50	12/17/19 19:44	1
Beryllium	<0.27		1.0	0.27	ug/L		12/13/19 07:50	12/17/19 19:44	1
Boron	<110		200	110	ug/L		12/13/19 07:50	12/17/19 19:44	1
Cadmium	<0.039		0.10	0.039	ug/L		12/13/19 07:50	12/17/19 19:44	1
Calcium	<0.10		0.50	0.10	mg/L		12/13/19 07:50	12/17/19 19:44	1
Chromium	<0.98		5.0	0.98	ug/L		12/13/19 07:50	12/17/19 19:44	1
Cobalt	<0.091		0.50	0.091	ug/L		12/13/19 07:50	12/17/19 19:44	1
Lead	<0.27		0.50	0.27	ug/L		12/13/19 07:50	12/17/19 19:44	1
Molybdenum	<1.1		2.0	1.1	ug/L		12/13/19 07:50	12/17/19 19:44	1
Selenium	<1.0		5.0	1.0	ug/L		12/13/19 07:50	12/17/19 19:44	1
Thallium	<0.27		1.0	0.27	ug/L		12/13/19 07:50	12/17/19 19:44	1

QC Sample Results

Client: SCS Engineers
Project/Site: Ottumwa Generating Station 25219072

Job ID: 310-171907-1

Method: 6020A - Metals (ICP/MS) (Continued)

Lab Sample ID: MB 310-264522/1-A
Matrix: Water
Analysis Batch: 265426

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 264522

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.53		1.0	0.53	ug/L		12/13/19 07:50	12/19/19 11:23	1
Lithium	<2.7		10	2.7	ug/L		12/13/19 07:50	12/19/19 11:23	1

Lab Sample ID: LCS 310-264522/2-A
Matrix: Water
Analysis Batch: 265032

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 264522

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Arsenic			80.0	68.5		ug/L		86	80 - 120		
Barium			80.0	76.1		ug/L		95	80 - 120		
Beryllium			40.0	41.2		ug/L		103	80 - 120		
Boron			1760	1520		ug/L		86	80 - 120		
Cadmium			40.0	39.0		ug/L		98	80 - 120		
Calcium			4.00	3.84		mg/L		96	80 - 120		
Chromium			80.0	80.2		ug/L		100	80 - 120		
Cobalt			40.0	41.3		ug/L		103	80 - 120		
Lead			40.0	39.3		ug/L		98	80 - 120		
Selenium			80.0	69.7		ug/L		87	80 - 120		
Thallium			32.0	29.8		ug/L		93	80 - 120		

Lab Sample ID: LCS 310-264522/2-A
Matrix: Water
Analysis Batch: 265426

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 264522

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Lithium			200	198		ug/L		99	80 - 120		

Lab Sample ID: LCS 310-264522/2-A
Matrix: Water
Analysis Batch: 265741

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 264522

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Antimony			40.0	38.9		ug/L		97	80 - 120		
Molybdenum			80.0	83.2		ug/L		104	80 - 120		

Lab Sample ID: 310-171907-1 MS
Matrix: Water
Analysis Batch: 265032

Client Sample ID: MW-307
Prep Type: Total/NA
Prep Batch: 264522

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits		
Arsenic	<0.75		80.0	72.4		ug/L		91	75 - 125		
Barium	140		80.0	207		ug/L		89	75 - 125		
Beryllium	<0.27		40.0	41.4		ug/L		103	75 - 125		
Boron	190	J	1760	1660		ug/L		84	75 - 125		
Cadmium	<0.039		40.0	36.6		ug/L		91	75 - 125		
Calcium	230		4.00	230	4	mg/L		64	75 - 125		
Chromium	<0.98		80.0	78.2		ug/L		98	75 - 125		
Cobalt	11		40.0	49.9		ug/L		96	75 - 125		
Lead	0.71		40.0	40.6		ug/L		100	75 - 125		

QC Sample Results

Method: 6020A - Metals (ICP/MS) (Continued)

Lab Sample ID: 310-171907-1 MS
Matrix: Water
Analysis Batch: 265032

Client Sample ID: MW-307
Prep Type: Total/NA
Prep Batch: 264522

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Molybdenum	<1.1		80.0	80.0		ug/L		100	75 - 125
Selenium	<1.0		80.0	69.2		ug/L		87	75 - 125
Thallium	<0.27		32.0	30.7		ug/L		96	75 - 125

Lab Sample ID: 310-171907-1 MS
Matrix: Water
Analysis Batch: 265426

Client Sample ID: MW-307
Prep Type: Total/NA
Prep Batch: 264522

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Antimony	<0.53		40.0	37.3		ug/L		93	75 - 125
Lithium	12		200	201		ug/L		94	75 - 125

Lab Sample ID: 310-171907-1 MSD
Matrix: Water
Analysis Batch: 265032

Client Sample ID: MW-307
Prep Type: Total/NA
Prep Batch: 264522

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Arsenic	<0.75		80.0	71.8		ug/L		90	75 - 125	1	20
Barium	140		80.0	204		ug/L		85	75 - 125	2	20
Beryllium	<0.27		40.0	41.1		ug/L		103	75 - 125	1	20
Boron	190	J	1760	1660		ug/L		84	75 - 125	0	20
Cadmium	<0.039		40.0	36.6		ug/L		91	75 - 125	0	20
Calcium	230		4.00	227	4	mg/L		-11	75 - 125	1	20
Chromium	<0.98		80.0	77.7		ug/L		97	75 - 125	1	20
Cobalt	11		40.0	49.8		ug/L		96	75 - 125	0	20
Lead	0.71		40.0	40.2		ug/L		99	75 - 125	1	20
Molybdenum	<1.1		80.0	81.1		ug/L		101	75 - 125	1	20
Selenium	<1.0		80.0	69.1		ug/L		86	75 - 125	0	20
Thallium	<0.27		32.0	30.4		ug/L		95	75 - 125	1	20

Lab Sample ID: 310-171907-1 MSD
Matrix: Water
Analysis Batch: 265426

Client Sample ID: MW-307
Prep Type: Total/NA
Prep Batch: 264522

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Antimony	<0.53		40.0	37.1		ug/L		93	75 - 125	0	20
Lithium	12		200	200		ug/L		94	75 - 125	0	20

Method: 7470A - Mercury (CVAA)

Lab Sample ID: MB 310-264564/1-A
Matrix: Water
Analysis Batch: 264800

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 264564

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.10		0.20	0.10	ug/L		12/13/19 11:22	12/16/19 12:54	1

QC Sample Results

Method: 7470A - Mercury (CVAA) (Continued)

Lab Sample ID: LCS 310-264564/2-A
Client Sample ID: Lab Control Sample
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 264800
Prep Batch: 264564

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Mercury	1.67	1.71		ug/L		102	80 - 120

Method: SM 2540C - Solids, Total Dissolved (TDS)

Lab Sample ID: MB 310-264588/1
Client Sample ID: Method Blank
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 264588

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	<24		30	24	mg/L			12/13/19 11:40	1

Lab Sample ID: LCS 310-264588/2
Client Sample ID: Lab Control Sample
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 264588

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Total Dissolved Solids	1000	954		mg/L		95	90 - 110

Method: SM 4500 H+ B - pH

Lab Sample ID: LCS 310-264318/1
Client Sample ID: Lab Control Sample
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 264318

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
pH	7.00	7.0		SU		100	98 - 102

QC Association Summary

Client: SCS Engineers
Project/Site: Ottumwa Generating Station 25219072

Job ID: 310-171907-1

HPLC/IC

Analysis Batch: 264765

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-171907-1	MW-307	Total/NA	Water	9056A	
310-171907-1	MW-307	Total/NA	Water	9056A	
310-171907-2	MW-308	Total/NA	Water	9056A	
310-171907-2	MW-308	Total/NA	Water	9056A	
310-171907-2	MW-308	Total/NA	Water	9056A	
310-171907-3	MW-309	Total/NA	Water	9056A	
310-171907-3	MW-309	Total/NA	Water	9056A	
310-171907-3	MW-309	Total/NA	Water	9056A	
310-171907-4	Field Blank	Total/NA	Water	9056A	
310-171907-4	Field Blank	Total/NA	Water	9056A	
MB 310-264765/3	Method Blank	Total/NA	Water	9056A	
MB 310-264765/60	Method Blank	Total/NA	Water	9056A	
LCS 310-264765/4	Lab Control Sample	Total/NA	Water	9056A	
LCS 310-264765/61	Lab Control Sample	Total/NA	Water	9056A	

Metals

Prep Batch: 264522

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-171907-1	MW-307	Total/NA	Water	3010A	
310-171907-2	MW-308	Total/NA	Water	3010A	
310-171907-3	MW-309	Total/NA	Water	3010A	
310-171907-4	Field Blank	Total/NA	Water	3010A	
MB 310-264522/1-A	Method Blank	Total/NA	Water	3010A	
LCS 310-264522/2-A	Lab Control Sample	Total/NA	Water	3010A	
310-171907-1 MS	MW-307	Total/NA	Water	3010A	
310-171907-1 MSD	MW-307	Total/NA	Water	3010A	

Prep Batch: 264564

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-171907-1	MW-307	Total/NA	Water	7470A	
310-171907-2	MW-308	Total/NA	Water	7470A	
310-171907-3	MW-309	Total/NA	Water	7470A	
310-171907-4	Field Blank	Total/NA	Water	7470A	
MB 310-264564/1-A	Method Blank	Total/NA	Water	7470A	
LCS 310-264564/2-A	Lab Control Sample	Total/NA	Water	7470A	

Analysis Batch: 264800

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-171907-1	MW-307	Total/NA	Water	7470A	264564
310-171907-2	MW-308	Total/NA	Water	7470A	264564
310-171907-3	MW-309	Total/NA	Water	7470A	264564
310-171907-4	Field Blank	Total/NA	Water	7470A	264564
MB 310-264564/1-A	Method Blank	Total/NA	Water	7470A	264564
LCS 310-264564/2-A	Lab Control Sample	Total/NA	Water	7470A	264564

Analysis Batch: 265032

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-171907-1	MW-307	Total/NA	Water	6020A	264522
310-171907-2	MW-308	Total/NA	Water	6020A	264522
310-171907-3	MW-309	Total/NA	Water	6020A	264522

QC Association Summary

Client: SCS Engineers
Project/Site: Ottumwa Generating Station 25219072

Job ID: 310-171907-1

Metals (Continued)

Analysis Batch: 265032 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-171907-4	Field Blank	Total/NA	Water	6020A	264522
MB 310-264522/1-A	Method Blank	Total/NA	Water	6020A	264522
LCS 310-264522/2-A	Lab Control Sample	Total/NA	Water	6020A	264522
310-171907-1 MS	MW-307	Total/NA	Water	6020A	264522
310-171907-1 MSD	MW-307	Total/NA	Water	6020A	264522

Analysis Batch: 265426

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-171907-1	MW-307	Total/NA	Water	6020A	264522
310-171907-2	MW-308	Total/NA	Water	6020A	264522
310-171907-3	MW-309	Total/NA	Water	6020A	264522
310-171907-4	Field Blank	Total/NA	Water	6020A	264522
MB 310-264522/1-A	Method Blank	Total/NA	Water	6020A	264522
LCS 310-264522/2-A	Lab Control Sample	Total/NA	Water	6020A	264522
310-171907-1 MS	MW-307	Total/NA	Water	6020A	264522
310-171907-1 MSD	MW-307	Total/NA	Water	6020A	264522

Analysis Batch: 265741

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
LCS 310-264522/2-A	Lab Control Sample	Total/NA	Water	6020A	264522

General Chemistry

Analysis Batch: 264318

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-171907-1	MW-307	Total/NA	Water	SM 4500 H+ B	
310-171907-2	MW-308	Total/NA	Water	SM 4500 H+ B	
310-171907-3	MW-309	Total/NA	Water	SM 4500 H+ B	
310-171907-4	Field Blank	Total/NA	Water	SM 4500 H+ B	
LCS 310-264318/1	Lab Control Sample	Total/NA	Water	SM 4500 H+ B	

Analysis Batch: 264588

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-171907-1	MW-307	Total/NA	Water	SM 2540C	
310-171907-2	MW-308	Total/NA	Water	SM 2540C	
310-171907-3	MW-309	Total/NA	Water	SM 2540C	
310-171907-4	Field Blank	Total/NA	Water	SM 2540C	
MB 310-264588/1	Method Blank	Total/NA	Water	SM 2540C	
LCS 310-264588/2	Lab Control Sample	Total/NA	Water	SM 2540C	

Field Service / Mobile Lab

Analysis Batch: 265262

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-171907-1	MW-307	Total/NA	Water	Field Sampling	
310-171907-2	MW-308	Total/NA	Water	Field Sampling	
310-171907-3	MW-309	Total/NA	Water	Field Sampling	

Lab Chronicle

Client: SCS Engineers
Job ID: 310-171907-1
Project/Site: Ottumwa Generating Station 25219072

Client Sample ID: MW-307

Lab Sample ID: 310-171907-1

Date Collected: 12/11/19 08:55

Matrix: Water

Date Received: 12/11/19 17:25

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	9056A		5	264765	12/12/19 15:56	ACJ	TAL CF
Total/NA	Analysis	9056A		5	264765	12/13/19 10:26	ACJ	TAL CF
Total/NA	Prep	3010A			264522	12/13/19 07:50	HED	TAL CF
Total/NA	Analysis	6020A		1	265032	12/17/19 19:49	SAD	TAL CF
Total/NA	Prep	3010A			264522	12/13/19 07:50	HED	TAL CF
Total/NA	Analysis	6020A		1	265426	12/19/19 11:36	SAD	TAL CF
Total/NA	Prep	7470A			264564	12/13/19 11:22	HIS	TAL CF
Total/NA	Analysis	7470A		1	264800	12/16/19 13:34	HIS	TAL CF
Total/NA	Analysis	SM 2540C		1	264588	12/13/19 11:40	SAS	TAL CF
Total/NA	Analysis	SM 4500 H+ B		1	264318	12/11/19 22:51	JMH	TAL CF
Total/NA	Analysis	Field Sampling		1	265262	12/11/19 08:55	EAR	TAL CF

Client Sample ID: MW-308

Lab Sample ID: 310-171907-2

Date Collected: 12/11/19 09:50

Matrix: Water

Date Received: 12/11/19 17:25

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	9056A		5	264765	12/12/19 16:43	ACJ	TAL CF
Total/NA	Analysis	9056A		5	264765	12/13/19 10:41	ACJ	TAL CF
Total/NA	Analysis	9056A		10	264765	12/13/19 10:57	ACJ	TAL CF
Total/NA	Prep	3010A			264522	12/13/19 07:50	HED	TAL CF
Total/NA	Analysis	6020A		1	265032	12/17/19 20:00	SAD	TAL CF
Total/NA	Prep	3010A			264522	12/13/19 07:50	HED	TAL CF
Total/NA	Analysis	6020A		1	265426	12/19/19 11:43	SAD	TAL CF
Total/NA	Prep	7470A			264564	12/13/19 11:22	HIS	TAL CF
Total/NA	Analysis	7470A		1	264800	12/16/19 13:32	HIS	TAL CF
Total/NA	Analysis	SM 2540C		1	264588	12/13/19 11:40	SAS	TAL CF
Total/NA	Analysis	SM 4500 H+ B		1	264318	12/11/19 22:52	JMH	TAL CF
Total/NA	Analysis	Field Sampling		1	265262	12/11/19 09:50	EAR	TAL CF

Client Sample ID: MW-309

Lab Sample ID: 310-171907-3

Date Collected: 12/11/19 10:50

Matrix: Water

Date Received: 12/11/19 17:25

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	9056A		5	264765	12/12/19 16:58	ACJ	TAL CF
Total/NA	Analysis	9056A		5	264765	12/13/19 11:13	ACJ	TAL CF
Total/NA	Analysis	9056A		10	264765	12/13/19 11:28	ACJ	TAL CF
Total/NA	Prep	3010A			264522	12/13/19 07:50	HED	TAL CF
Total/NA	Analysis	6020A		1	265032	12/17/19 20:02	SAD	TAL CF
Total/NA	Prep	3010A			264522	12/13/19 07:50	HED	TAL CF
Total/NA	Analysis	6020A		1	265426	12/19/19 11:46	SAD	TAL CF

Lab Chronicle

Client: SCS Engineers
Job ID: 310-171907-1
Project/Site: Ottumwa Generating Station 25219072

Client Sample ID: MW-309

Lab Sample ID: 310-171907-3

Date Collected: 12/11/19 10:50

Matrix: Water

Date Received: 12/11/19 17:25

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	7470A			264564	12/13/19 11:22	HIS	TAL CF
Total/NA	Analysis	7470A		1	264800	12/16/19 13:26	HIS	TAL CF
Total/NA	Analysis	SM 2540C		1	264588	12/13/19 11:40	SAS	TAL CF
Total/NA	Analysis	SM 4500 H+ B		1	264318	12/11/19 22:53	JMH	TAL CF
Total/NA	Analysis	Field Sampling		1	265262	12/11/19 10:50	EAR	TAL CF

Client Sample ID: Field Blank

Lab Sample ID: 310-171907-4

Date Collected: 12/11/19 08:40

Matrix: Water

Date Received: 12/11/19 17:25

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	9056A		1	264765	12/12/19 17:14	ACJ	TAL CF
Total/NA	Analysis	9056A		1	264765	12/13/19 11:44	ACJ	TAL CF
Total/NA	Prep	3010A			264522	12/13/19 07:50	HED	TAL CF
Total/NA	Analysis	6020A		1	265032	12/17/19 20:05	SAD	TAL CF
Total/NA	Prep	3010A			264522	12/13/19 07:50	HED	TAL CF
Total/NA	Analysis	6020A		1	265426	12/19/19 11:48	SAD	TAL CF
Total/NA	Prep	7470A			264564	12/13/19 11:22	HIS	TAL CF
Total/NA	Analysis	7470A		1	264800	12/16/19 13:24	HIS	TAL CF
Total/NA	Analysis	SM 2540C		1	264588	12/13/19 11:40	SAS	TAL CF
Total/NA	Analysis	SM 4500 H+ B		1	264318	12/11/19 22:56	JMH	TAL CF

Laboratory References:

TAL CF = Eurofins TestAmerica, Cedar Falls, 3019 Venture Way, Cedar Falls, IA 50613, TEL (319)277-2401

Accreditation/Certification Summary

Client: SCS Engineers
Job ID: 310-171907-1
Project/Site: Ottumwa Generating Station 25219072

Laboratory: Eurofins TestAmerica, Cedar Falls

The accreditations/certifications listed below are applicable to this report.

Authority	Program	Identification Number	Expiration Date
Iowa	State Program	007	12-01-19 *

* Accreditation/Certification renewal pending - accreditation/certification considered valid.

Method Summary

Client: SCS Engineers
Project/Site: Ottumwa Generating Station 25219072

Job ID: 310-171907-1

Method	Method Description	Protocol	Laboratory
9056A	Anions, Ion Chromatography	SW846	TAL CF
6020A	Metals (ICP/MS)	SW846	TAL CF
7470A	Mercury (CVAA)	SW846	TAL CF
SM 2540C	Solids, Total Dissolved (TDS)	SM	TAL CF
SM 4500 H+ B	pH	SM	TAL CF
Field Sampling	Field Sampling	EPA	TAL CF
3010A	Preparation, Total Metals	SW846	TAL CF
7470A	Preparation, Mercury	SW846	TAL CF

Protocol References:

EPA = US Environmental Protection Agency

SM = "Standard Methods For The Examination Of Water And Wastewater"

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

TAL CF = Eurofins TestAmerica, Cedar Falls, 3019 Venture Way, Cedar Falls, IA 50613, TEL (319)277-2401

eurofins | Environment Testing
TestAmerica

310-171907 Chain of Custody

Cooler/Sample Receipt and Temperature Log Form

Client Information

Client: SCS Eng.

City/State: CITY Clive STATE IA

Project: Ottumwa Gen. Station

Receipt Information

Date/Time Received: DATE 12-11-19 TIME 1725

Received By: UTB

Delivery Type: ☐ UPS ☐ FedEx ☐ FedEx Ground ☐ US Mail ☐ Spee-Dee
☒ Lab Courier ☐ Lab Field Services ☐ Client Drop-off ☐ Other:________

Condition of Cooler/Containers

Sample(s) received in Cooler? ☒ Yes ☐ No *If yes:* Cooler ID:

Multiple Coolers? ☐ Yes ☒ No *If yes:* Cooler # ____ of ____

Cooler Custody Seals Present? ☐ Yes ☒ No *If yes:* Cooler custody seals intact? ☐ Yes ☐ No

Sample Custody Seals Present? ☐ Yes ☒ No *If yes:* Sample custody seals intact? ☐ Yes ☐ No

Trip Blank Present? ☐ Yes ☒ No *If yes:* Which VOA samples are in cooler? ↓

Temperature Record

Coolant: ☒ Wet ice ☐ Blue ice ☐ Dry ice ☐ Other:________ ☐ NONE

Thermometer ID: M

Correction Factor (°C): -0.1

• **Temp Blank Temperature** – If no temp blank, or temp blank temperature above criteria, proceed to Sample Container Temperature

Uncorrected Temp (°C): -0.1

Corrected Temp (°C): -0.2

• **Sample Container Temperature**

Container(s) used:	CONTAINER 1	CONTAINER 2
Uncorrected Temp (°C):		
Corrected Temp (°C):		

Exceptions Noted

1) If temperature exceeds criteria, was sample(s) received same day of sampling? ☐ Yes ☐ No
   a) *If yes:* Is there evidence that the chilling process began? ☐ Yes ☐ No

2) If temperature is <0°C, are there obvious signs that the integrity of sample containers is compromised? (e.g., bulging septa, broken/cracked bottles, frozen solid?) ☐ Yes ☐ No

NOTE: If yes, contact PM before proceeding. If no, proceed with login

Additional Comments

Document: CF-LG-WI-002
Revision: 25
Date: 06/17/2019

Eurofins TestAmerica, Cedar Falls

General temperature criteria is 0 to 6°C
Bacteria temperature criteria is 0 to 10°C

Eurofins TestAmerica, Cedar Falls
~~3019~~ Venture Way
Cedar Falls, IA 50613
Phone (319) 277-2401 Fax (319) 277-2425

Chain of Custody Record

TestAmerica Des Moines SC
214

eurofins | Environment Testing TestAmerica

Client Information	Sampler: Charlie Bills	Lab PM: Fredrick, Sandie	Carrier Tracking No(s):	COC No: 310-45502-14200.1
Client Contact: Louise Jennings	Phone: (262) 518-4085	E-Mail: sandie.fredrick@testamericainc.com		Page: Page 1 of 1
Company: SCS Engineers				Job #:
Address: 8450 Hickman Road Suite 20	Due Date Requested:			
City: Clive	TAT Requested (days):			
State, Zip: IA, 50325				
Phone:	PO #: 25219072			
Email: ljennings@scsengineers.com	WO #:			
Project Name: Ottumwa Generating Station 25219072	Project #: 31011020			
Site:	SSOW#:			

Analysis Requested

Preservation Codes:

A - HCL
B - NaOH
C - Zn Acetate
D - Nitric Acid
E - NaHSO4
F - MeOH
G - Amchlor
H - Ascorbic Acid
I - Ice
J - DI Water
K - EDTA
L - EDA

M - Hexane
N - None
O - AsNaO2
P - Na2O4S
Q - Na2SO3
R - Na2S2O3
S - H2SO4
T - TSP Dodecahydrate
U - Acetone
V - MCAA
W - pH 4-5
Z - other (specify)

Other:

Sample Identification	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	903.0, 904.0	6020A, 7470A	2540C_Calcd, 9056A_ORGFM_28D, SM4500_H+	Total Number of containers	Special Instructions/Note:
				Preservation Code:			D	D	N		
MW-307	12-11-19	0855	G	Water	N	N	X	X	X		
MW-308	12-11-19	0950	G	Water	N	N	X	X	X		
MW-309	12-11-19	1050	G	Water	N	N	X	X	X		
Field Blank	12-11-19	0840	G	Water	N	N	X	X	X		
				Water			X				

Possible Hazard Identification
☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☒ Disposal By Lab ☐ Archive For ______ Months

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements:

Empty Kit Relinquished by: | Date: | Time: | Method of Shipment:

Relinquished by: Charlie	Date/Time: 12-11-19 1315	Company: SCS	Received by:	Date/Time:	Company:
Relinquished by:	Date/Time:	Company:	Received by:	Date/Time:	Company:
Relinquished by:	Date/Time:	Company:	Received by:	Date/Time:	Company:

Custody Seals Intact: Δ Yes Δ No | Custody Seal No.: | Cooler Temperature(s) °C and Other Remarks:

Ver: 01/16/2019

12/12/2019

Login Container Summary Report

310-171908

Temperature readings: ____________________

Client Sample ID	Lab ID	Container Type	Container pH	Preservative Added (mls)	Lot #
MW-301	310-171908-A-1	Plastic 250ml - with Nitric Acid	<2		
MW-301	310-171908-C-1	Plastic 1 liter - Nitric Acid	<2		
MW-301	310-171908-D-1	Plastic 1 liter - Nitric Acid	<2		
MW-302	310-171908-A-2	Plastic 250ml - with Nitric Acid	<2		
MW-302	310-171908-C-2	Plastic 1 liter - Nitric Acid	<2		
MW-302	310-171908-D-2	Plastic 1 liter - Nitric Acid	<2		
MW-303	310-171908-A-3	Plastic 250ml - with Nitric Acid	<2		
MW-303	310-171908-C-3	Plastic 1 liter - Nitric Acid	<2		
MW-303	310-171908-D-3	Plastic 1 liter - Nitric Acid	<2		
MW-304	310-171908-A-4	Plastic 250ml - with Nitric Acid	<2		
MW-304	310-171908-C-4	Plastic 1 liter - Nitric Acid	<2		
MW-304	310-171908-D-4	Plastic 1 liter - Nitric Acid	<2		
MW-305	310-171908-A-5	Plastic 250ml - with Nitric Acid	<2		
MW-305	310-171908-C-5	Plastic 1 liter - Nitric Acid	<2		
MW-305	310-171908-D-5	Plastic 1 liter - Nitric Acid	<2		
MW-306	310-171908-A-6	Plastic 250ml - with Nitric Acid	<2		
MW-306	310-171908-C-6	Plastic 1 liter - Nitric Acid	<2		
MW-306	310-171908-D-6	Plastic 1 liter - Nitric Acid	<2		
Field Blank	310-171908-A-7	Plastic 250ml - with Nitric Acid	<2		
Field Blank	310-171908-C-7	Plastic 1 liter - Nitric Acid	<2		
Field Blank	310-171908-D-7	Plastic 1 liter - Nitric Acid	<2		

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Table 1. Sampling Points and Parameters - CCR Rule Sampling Program
Groundwater Monitoring - Ottumwa Generating Station / SCS Engineers Project #25219072

		Background		Primary Pond							Zero Liquid Discharge Pond			
	Parameter	MW-301	Field Blank	MW-302	MW-303	MW-304	MW-305	MW-306	MW-310	MW-311	MW-307	MW-308	MW-309	TOTAL
Appendix III Parameters	Boron		x								x	x	x	4
	Calcium		x								x	x	x	4
	Chloride		x								x	x	x	4
	Fluoride		x								x	x	x	4
	pH		x								x	x	x	4
	Sulfate		x								x	x	x	4
	TDS		x								x	x	x	4
Appendix IV Parameters	Antimony		x								x	x	x	4
	Arsenic		x								x	x	x	4
	Barium		x								x	x	x	4
	Beryllium		x								x	x	x	4
	Cadmium		x								x	x	x	4
	Chromium		x								x	x	x	4
	Cobalt		x								x	x	x	4
	Fluoride		x								x	x	x	4
	Lead		x								x	x	x	4
	Lithium		x								x	x	x	4
	Mercury		x								x	x	x	4
	Molybdenum		x								x	x	x	4
	Selenium		x								x	x	x	4
	Thallium		x								x	x	x	4
	Radium		x								x	x	x	4
Field Parameters	Groundwater Elevation										x	x	x	3
	Well Depth										x	x	x	3
	pH (field)										x	x	x	3
	Specific Conductance										x	x	x	3
	Dissolved Oxygen										x	x	x	3
	ORP										x	x	x	3
	Temperature										x	x	x	3
	Turbidity										x	x	x	3
	Color										x	x	x	3
	Odor										x	x	x	3

Notes: All samples are unfiltered (total).

C:\Users\FredrickS\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.Outlook\L7YR5M9Z\[OGS_CCR_Rule_Sampling_2019_D

1 2 3 4 5 6 7 8 9 10 11 12 13 14

Login Sample Receipt Checklist

Client: SCS Engineers

Job Number: 310-171907-1

Login Number: 171907
List Number: 1
Creator: Homolar, Dana J

List Source: Eurofins TestAmerica, Cedar Falls

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	N/A	
The cooler's custody seal, if present, is intact.	N/A	
Sample custody seals, if present, are intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

Alternative Source Demonstration
April 2020 Assessment Monitoring

Zero Liquid Discharge Pond
Ottumwa Generating Station
20775 Power Plant Road
Ottumwa, Iowa

Prepared for:

Alliant Energy

Interstate Power and Light Company
4902 N. Biltmore Lane
Madison, Wisconsin 53718

SCS ENGINEERS

25220072.00 October 12, 2020

2830 Dairy Drive
Madison, WI 53718-6751
608-224-2830

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PE CERTIFICATION

ERIC J. NELSON
23136

10/12/2020

I, Eric J. Nelson, hereby certify that that the information in this alternative source demonstration is accurate and meets the requirements of 40 CFR 257.95(g)(3)(ii). This certification is based on my review of the groundwater data and related site information available for the Ottumwa Generating Station. I am a duly licensed Professional Engineer under the laws of the State of Iowa.

October 12, 2020

(signature) (date)

Eric J. Nelson

(printed or typed name)

License number 23136

My license renewal date is December 31, 2020.

Pages or sheets covered by this seal:
Alternative Source Demonstration, April 2020
Assessment Monitoring, Zero Liquid Discharge Pond,
Ottumwa Generating Station, Ottumwa, Iowa

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1.0 INTRODUCTION

This Alternative Source Demonstration (ASD) was prepared to support compliance with the groundwater monitoring requirements of the “Coal Combustion Residuals (CCR) Final Rule” published by the U.S. Environmental Protection Agency (USEPA) in the Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule, dated April 17, 2015 (USEPA, 2015), and subsequent amendments. Specifically, this report was prepared to fulfill the requirements of 40 CFR 257.95(g)(3)(ii). The applicable sections of the Rule are provided below in *italics*.

This report was prepared to also fulfill the requirements of 40 CFR 257.100 for inactive CCR surface impoundments.

1.1 §257.95(G)(3) ALTERNATIVE SOURCE DEMONSTRATION REQUIREMENTS

(3) Within 90 days of finding that any of the constituents listed in appendix IV to this part have been detected at a statistically significant level exceeding the groundwater protection standards the owner or operator must either:

> *(i) Initiate an assessment of corrective measures as required by § 257.96; or*
>
> *(ii) Demonstrate that a source other than the CCR unit caused the contamination, or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. Any such demonstration must be supported by a report that includes the factual or evidentiary basis for any conclusions and must be certified to be accurate by a qualified professional engineer or approval from the Participating State Director or approval from EPA where EPA is the permitting authority. If a successful demonstration is made, the owner or operator must continue monitoring in accordance with the assessment monitoring program pursuant to this section, and may return to detection monitoring if the constituents in Appendix III and Appendix IV of this part are at or below background as specified in paragraph (e) of this section. The owner or operator must also include the demonstration in the annual groundwater monitoring and corrective action report required by § 257.90(e), in addition to the certification by a qualified professional engineer or the approval from the Participating State Director or the approval from EPA where EPA is the permitting authority.*

An ASD is completed when there are exceedances of one or more benchmarks established within the groundwater monitoring program. The ASD is completed to determine if any other sources are likely causes of the identified exceedance(s) of established benchmark(s) at the site. This ASD was performed in response to results showing cobalt at concentrations exceeding the groundwater protection standard (GPS) during assessment monitoring under the CCR Rule. Cobalt was detected above the GPS in samples collected from monitoring well MW-307 in December 2019, February 2020, and April 2020.

1.2 SITE INFORMATION AND MAP

Ottumwa Generating Station (OGS) is located at 20775 Power Plant Road in Ottumwa, Wapello County, Iowa (**Figure 1**). OGS is an active, coal-powered generating station. In addition to the ZLDP, which is an inactive CCR surface impoundment, there is one active existing CCR surface impoundment at OGS (OGS Ash Pond). There are no existing or closed CCR landfills or closed CCR surface impoundments at the site.

The CCR surface impoundments at OGS are monitored using single-unit groundwater monitoring systems. The single-unit system for the ZLDP is designed to detect monitored constituents at the waste boundary of the facility as required by 40 CFR 257.91(d). The groundwater monitoring system consists of one upgradient and three downgradient monitoring wells. A separate single-unit groundwater monitoring system is used to monitor the OGS Ash Pond CCR Unit, consisting of one upgradient well (shared with the ZLDP monitoring system) and five downgradient wells at the Ash Pond compliance boundary. Five additional downgradient monitoring wells have been installed as part of an Assessment of Corrective Measures (ACM) and Selection of Remedy (SOR) process for the Ash Pond CCR Unit.

A map showing the CCR Units and all background (or upgradient) and downgradient monitoring wells with identification numbers for the CCR groundwater monitoring program is provided as **Figure 2**.

1.3 STATISTICALLY SIGNIFICANT LEVELS ABOVE GPS IDENTIFIED

The Appendix IV parameters were compared to the Groundwater Protection Standard (GPS) values established under 40 CFR 257.95(h) in **Table 1**. The only assessment monitoring parameter for which a monitoring result exceeded the GPS was cobalt in the sample from MW-307. Cobalt exceeded the GPS in the samples from MW-307 for all three sampling events. The cobalt levels also exceeded the upper prediction limit (UPL) established based on background monitoring at the upgradient well.

USEPA's Unified Guidance for Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities (EPA 530-R-09-007, March 2009) recommends the use of confidence intervals for comparison of assessment monitoring data to fixed GPS values. Specifically, the suggested approach for comparing assessment groundwater monitoring data to GPS values based on long-term chronic health risk, such as drinking water Maximum Contaminant Levels (MCLs), is to compare the lower confidence limit around the arithmetic mean with the fixed GPS. Although a confidence interval approach is recommended, a minimum of four samples are required for this approach, and only three assessment monitoring compliance samples have been collected to date; therefore, this initial evaluation is based on a direct comparison of the results to the GPS values. A confidence interval approach will be used in future evaluations once a fourth sample is obtained.

1.4 OVERVIEW OF ALTERNATIVE SOURCE DEMONSTRATION APPROACH

This ASD report includes:

- Background information (**Section 2.0**)
- Evaluation of potential that GPS exceedances are due to methodology or analysis (**Section 3.0**)
- Evaluation of potential that GPS exceedances are due to natural sources or man-made sources other than the ZLDP CCR Unit (**Section 4.0**)
- ASD conclusions (**Section 5.0**)
- Monitoring recommendations (**Section 6.0**)

Historical monitoring results from background and compliance sampling for cobalt in the ZLDP monitoring wells are provided in **Table 2**, and the concentration trends are shown in **Appendix A.** Laboratory reports for the eight background monitoring events were included in the 2018 Annual Groundwater Monitoring and Corrective Action Report submitted in August 2019 (SCS, 2019). The laboratory report for the December 2019 assessment monitoring event was included in the 2019 Annual Groundwater Monitoring and Corrective Action Report submitted in August 2020. The laboratory report for the February and April 2020 assessment monitoring events will be included in the 2020 Annual Groundwater Monitoring and Corrective Action Report which will be submitted in August 2021.

2.0 BACKGROUND

To provide context for the ASD, the following background information is provided in this section of the report, prior to the ASD sections:

- Geologic and hydrogeologic setting
- CCR Rule monitoring system
- Other monitoring wells

2.1 GEOLOGIC AND HYDROGEOLOGIC SETTING

2.1.1 Regional Information

The uppermost aquifer unit at the site, as defined under 40 CFR 257.53, is the Mississippian bedrock aquifer and hydraulically connected overlying unconsolidated deposits. Regionally, unconsolidated alluvial aquifers near the Des Moines River and deeper bedrock aquifers are both used for water supply. The thickness and water-producing capacity of the unconsolidated material in the area is variable. A summary of the regional hydrogeologic stratigraphy is included in **Appendix B.**

The bedrock surface elevation is highly variable due to erosion. A map showing regional bedrock surface topography is included in **Appendix B.**

Although not encountered in drilling at the OGS site, the uppermost bedrock unit in the surrounding region consists of Pennsylvanian shales with minor siltstone, sandstone, limestone, and coal intervals. The continuity of these minor beds is highly variable. The Pennsylvanian bedrock unit is considered to be a regional aquitard. The thickness of the Pennsylvanian shale is variable; in some areas of Wapello County it is over 100 feet thick, while in other areas it is absent. The variation in thickness is due to erosion of the bedrock surface. Based on the available boring logs from the OGS site, it appears that the Pennsylvanian shale is absent at the site.

Underlying the Pennsylvanian shales are Mississippian limestone and dolomite, with some shale and sandstone. A map showing the elevation of the top of the Mississippian limestone in Southeastern Iowa is included in **Appendix B.** The Mississippian unit is the shallowest regional bedrock aquifer. The available boring logs from the site indicate that the Mississippian limestone is the uppermost bedrock unit at the site.

The Devonian units underlying the Mississippian are composed of shale, dolomite, and limestone, and are in turn underlain by Silurian dolomite and Cambrian-Ordovician dolomite and sandstone. The Cambrian-Ordovician aquifer is commonly the source of municipal and industrial high-capacity wells in the region (Coble, 1971).

Groundwater flow within the Mississippian limestone is generally to the east. A map showing the regional potentiometric surface in the Mississippian limestone is included with the hydrogeologic background information presented in **Appendix B**.

2.1.2 Site Information

Site boring logs indicate that the unconsolidated material at the site is fairly thin (approximately 20 to 30 feet or less) and consists of a clay layer overlying clay and sand. Monitoring wells MW-301 through MW-309 were installed to intersect the bedrock aquifer or unconsolidated material in contact with the bedrock aquifer at the site. The unconsolidated material at these well locations is generally clay, silt, and sand, and the uppermost bedrock appears to be weathered. The total boring depths were between 14.5 and 52 feet and weathered bedrock was encountered at depths between 7 and 44 feet below ground surface. Boring logs for the monitoring wells used to evaluate the ZLDP (MW-301, MW-307, MW-308, and MW-309) are included in **Appendix C**.

2.2 CCR RULE MONITORING SYSTEM

The groundwater monitoring system established in accordance with the CCR Rule consists of one upgradient (background) monitoring well and three downgradient monitoring for the OGS ZLDP. The background well is MW-301, and the three downgradient wells include MW-307, MW-308, and MW-309. The CCR Rule wells are installed in the Mississippian aquifer and/or hydraulically connected overlying unconsolidated deposits, which comprise the uppermost aquifer unit at the site. Well depths range from approximately 28 to 30 feet, measured from the top of the well casing.

The background well (MW-301) is located to the west of the site. The downgradient wells (MW-307, MW-308, and MW-309) are located along the eastern edge of the ZLDP. The downgradient wells were installed as close as practicable to the pond boundaries considering the site layout (**Figure 2**).

2.3 OTHER MONITORING WELLS

Additional groundwater monitoring wells currently exist at OGS as part of the single-unit monitoring system developed for the OGS Ash Pond CCR Unit.

The additional monitoring wells include five compliance wells at the Ash Pond boundary (MW-302 through MW306), two downgradient well nests (MW-310/MW-310A and MW-311/MW-311A), and a piezometer added in a nest with one of the existing compliance wells (MW-305A). The wells added to the Ash Pond monitoring system beyond the original background and compliance wells have been installed as part of an Assessment of Corrective Measures (ACM) and Selection of Remedy (SOR) process for the Ash Pond CCR Unit.

For monitoring wells installed to date, the total boring depths were between 14.5 and 82 feet. Weathered bedrock was encountered at depths between 7 and 44 feet below ground surface. The existing Ash Pond and the inactive ZLDP share the same upgradient (background) monitoring well, MW-301.

2.4 GROUNDWATER FLOW DIRECTION

Groundwater flow in the area of the ZLDP is generally to the east, following the same flow patterns observed in regional flow maps of the area. The potentiometric surface for the April 2020 water level measurements is shown on **Figure 3**. The potentiometric surface map shows groundwater flow moving to the east. The groundwater elevation data for the CCR monitoring wells are provided in **Table 3.**

3.0 METHODOLOGY AND ANALYSIS REVIEW

To evaluate the potential that the GPS exceedance is due to a source other than the regulated CCR Unit, SCS Engineers (SCS) used a two-step evaluation process. First, the sample collection, field and laboratory analysis, and statistical evaluation were reviewed to identify any potential error or analysis that led to an exceedance of the benchmark. Second, potential alternative sources, including natural variation and man-made sources other than the CCR Unit, were evaluated. This section of the report provides the findings of the methodology and analysis review. **Section 4.0** of the report addresses the potential alternative sources.

3.1 SAMPLING AND FIELD ANALYSIS REVIEW

Field notes and sampling results were reviewed to determine if any sampling error may have caused or contributed to the observed GPS exceedances. Potential field sampling errors or issues could include mislabeling of samples, improper sample handling, missed holding times, cross contamination during sampling, or other field error. Field blank sample results were also reviewed for any indication of potential contamination from sampling equipment or containers. Based on the review of the field notes and results, SCS did not identify any indication that the concentrations exceeding the GPS were due to a sampling error.

Because cobalt is a laboratory parameter, there is little potential for a field analysis error to contribute to a GPS exceedance for this parameter.

3.2 LABORATORY ANALYSIS REVIEW

The laboratory reports for the December 2019, February 2020, and April 2020 assessment monitoring event were reviewed to determine if any laboratory analysis error or issue may have caused or contributed to the observed cobalt concentrations above the GPS. The laboratory report review included reviewing the laboratory quality control flags and narrative, verifying that correct methods were used and desired detection limits were achieved, and checking the field and laboratory blank sample results.

Based on the review of the laboratory reports, SCS did not identify any indication that the GPS exceedances were due to a laboratory analysis error. There were no laboratory quality control flags or issues identified in the laboratory reports that affect the usability of the data for assessment monitoring.

A time series plot of the cobalt analytical data was also reviewed for any anomalous results that might indicate a possible sampling or laboratory error (e.g., dilution error or incorrect sample labeling). The time series plot is provided in **Appendix A**. Cobalt at MW-307 has followed an increasing trend since the start of assessment monitoring in the December 2019 sampling event, but no single result is clearly anomalous based on the data collected to date.

3.3 STATISTICAL EVALUATION REVIEW

As noted above, USEPA's Unified Guidance for Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities (EPA 530-R-09-007, March 2009) recommends the use of confidence intervals for comparison of assessment monitoring data to fixed GPS values. Specifically, the suggested approach for comparing assessment groundwater monitoring data to GPS values based on long-term chronic health risk, such as drinking water Maximum Contaminant Levels (MCLs), is to compare the lower confidence limit around the arithmetic mean with the fixed GPS. Although a confidence interval approach is recommended, a minimum of four samples are required for this approach, and only three assessment monitoring compliance samples have been collected to date; therefore, this initial evaluation is based on a direct comparison of the results to the GPS values. A confidence interval approach will be used in future evaluations once a fourth sample is obtained.

3.4 SUMMARY OF THE METHODOLOGY AND ANALYSIS REVIEW FINDINGS

In summary, there were no changes to the determination that cobalt concentrations exceeded the GPS at MW-307 based on the methodology and analysis review, and no errors or issues causing or contributing to the reported GPS exceedance were identified.

4.0 ALTERNATIVE SOURCES

This section of the report discusses the potential alternative sources for the cobalt GPS exceedance at MW-307, identifies the mostly alternative source(s), and presents lines of evidences indicating that an alternative source is most likely the cause of the observed GPS exceedance for cobalt.

4.1 POTENTIAL CAUSES OF STATISTICALLY SIGNIFICANT INCREASE

4.1.1 Natural Variation

If concentrations of a constituent that is naturally present in the aquifer vary spatially, then the potential exists that the downgradient concentrations may be higher than upgradient concentrations due to natural variation. Although natural variation is likely present in the aquifer, SCS has not identified evidence that natural variation is the likely primary source causing the cobalt GPS exceedance at MW-307.

4.1.2 Man-Made Alternative Sources

Man-made alternative sources that could potentially contribute to the cobalt GPS exceedances could include the active Ash Pond CCR Unit, c-stone pile, coal pile runoff pond, and coal storage area, impacts associated with roads or rail lines, or other on-site or off-site sources

Based on the groundwater flow directions and on previous investigations at the site, the Ash Pond CCR Unit appears to be the most likely cause of the cobalt GPS exceedances for well MW-307.

4.2 LINES OF EVIDENCE

The lines of evidence indicating that the GPS exceedances for cobalt in compliance well MW-307 are due to the Ash Pond include:

1. Monitoring well MW-307 is downgradient of the OGS Ash Pond CCR Unit and is downgradient from the Ash Pond monitoring wells with GPS exceedances for cobalt (MW-305 and MW-306).

2. The distribution of cobalt in groundwater based on the site monitoring wells is consistent with the Ash Pond as a source and is not consistent with the ZLDP as a source.

3. Based on historical use and the quantity and types of materials discharged to ponds, the Ash Pond is a more likely source of cobalt in groundwater than the ZLDP.

4.2.1 Groundwater Flow Direction

As shown on **Figure 3**, groundwater flow in the area of the Ash Pond and ZLDP is generally to the east, following the same flow patterns observed in regional flow maps of the area. MW-307 is located downgradient from a small portion of the ZLDP and is also downgradient from a larger portion of the Ash Pond. MW-307 is also downgradient from the area of the Ash Pond monitoring system where cobalt impacts attributed to the Ash Pond have been identified, including monitoring wells MW-305 and MW-306.

Water level data from the Ash Pond and ZLDP indicate that the water level in the Ash Pond is higher than the water level in the ZLDP (Hard Hat Services, 2016); therefore, shallow groundwater flow within the berm separating the two ponds is also to the east.

4.2.2 Cobalt Distribution in Groundwater

The distribution of cobalt in groundwater is consistent with an Ash Pond source and is not consistent with the ZLDP as a source. The three wells with cobalt concentrations exceeding the GPS are all downgradient from the northeast boundary of the Ash Pond. Cobalt concentrations for the ZLDP monitoring wells are shown in **Table 2**, and cobalt results for all monitoring wells at OGS are summarized in **Appendix D**.

The other downgradient monitoring wells for the ZLDP, MW-308 and MW-309, have consistently lower cobalt concentrations. All cobalt concentrations at MW-308 are J flagged values below the laboratory's limit of quantitation. All cobalt concentrations for samples from MW-308 and MW-309, including background and compliance monitoring events, have been below the cobalt GPS (6 micrograms per liter [µg/L]) (**Table 2**).

The OGS Ash Pond is currently in the corrective action process in response to the cobalt concentrations observed at the Ash Pond downgradient wells.

4.2.3 Historical Impoundment Use

As described in the History of Construction report for the OGS surface impoundments (Hard Hat Services, 2016), the Ash Pond has been the primary receiver of bottom ash and economizer ash sluiced from the generating plant. The bottom ash and economizer ash were originally discharged in the northwest corner of the ash pond. In addition to the sluiced CCR, the OGS Ash Pond was also a primary receiver of process water flows from the plant, including 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, as well as other miscellaneous flows. Cobalt in coal is commonly associated with sulfide minerals such as pyrite; therefore, the sluiced pyrites are a potential source of cobalt in groundwater downgradient from the Ash Pond.

The historical use of the ZLDP was to collect storm water runoff from dry fly ash stored on the west side of the ZLDP, north of the plant, as well as storm water from the surrounding embankments. Based on the location of the former fly ash storage along the northern portion of the ZLDP, impacts from the fly ash storage or runoff would be expected to be similar or greater in the northern ZLDP wells (MW-308 and MW-309) rather than the southern well (MW-307), which is located furthest from the source and downgradient from the narrowest width of the ZLDP.

5.0 ALTERNATIVE SOURCE DEMONSTRATION CONCLUSIONS

Based on the available data, the most likely source of the GPS exceedance for cobalt at MW-307 is the adjacent Ash Pond, and not the OGS ZLDP.

6.0 SITE GROUNDWATER MONITORING RECOMMENDATIONS

In accordance with section 257.94(e)(2) of the CCR Rule, the OGS ZLDP CCR Unit may continue with assessment monitoring based on this ASD. The ASD report will be included in the 2020 Annual Report due in August 2021.

7.0 REFERENCES

Coble, R.W., 1971, The Water Resources of Southeast Iowa, Iowa Geological Survey Water Atlas Number 4, 1971.

Hard Hat Services, 2016, History of Construction, CCR Surface Impoundment, Alliant Energy, Interstate Power and Light Company, Ottumwa Generating Station, issued September 29, 2016.

Kentucky Geological Survey, University of Kentucky website, Coal, Major, Minor, and Trace Elements, https://www.uky.edu/KGS/coal/coal-major-minor-trace-elements.php, downloaded October 1, 2020.

SCS Engineers, 2019, 2018 Annual Groundwater Monitoring and Corrective Action Report, Ottumwa Generating Station, Ottumwa, IA, 2019.

U.S. Environmental Protection Agency, 2015, Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule, April 2015.

Tables

Table 1. Groundwater Analytical Results Summary - Assessment Monitoring

Ottumwa Generating Station - Zero Liquid Discharge Pond (ZLDP) / SCS Engineers Project #25220072.00

				Background Well		Compliance Wells								
Parameter Name	UPL Method	UPL	GPS	MW-301		MW-307			MW-308			MW-309		
				2/5/2020	4/14/2020	12/11/2019	2/5/2020	4/14/2020	12/11/2019	2/5/2020	4/14/2020	12/11/2019	2/5/2020	4/14/2020
Appendix III														
Boron, ug/L	P	820		540	700	190 J	200	240	160 J	220	210	1,100	1300	1400
Calcium, mg/L	P	78.7		68	84	230	210	240	220	210	240	150	130	150
Chloride, mg/L	P	86.8		120	140	200	220	230	150	160	170	66	68	69
Fluoride, mg/L	P	0.484		NA	<0.23	<0.23	NA	<0.23	<0.23	NA	<0.23	<0.23	NA	0.36 J
Field pH, Std. Units	P	6.87		6.39	6.58	6.37	6.67	6.76	6.55	6.78	6.90	6.67	7.09	7.21
Sulfate, mg/L	P	199		130	140	92	100	99	280	300	290	370	370	390
Total Dissolved Solids, mg/L	P	628		570	550	1,000	970	980	1,100	1100	1,000	980	990	1000
Appendix IV														
Antimony, ug/L	P*	0.22	6	NA	<0.58	<0.53	NA	<0.58	<0.53	NA	<0.58	<0.53	NA	<0.58
Arsenic, ug/L	P*	0.53	10	<0.88	<0.88	<0.75	<0.88	<0.88	<0.75	<0.88	<0.88	1.1 J	<0.88	0.88 J
Barium, ug/L	P	68.8	2,000	43	54	140	130	140	130	130	140	54	46	50
Beryllium, ug/L	DQ	DQ	4	NA	<0.27	<0.27	NA	<0.27	<0.27	NA	<0.27	<0.27	NA	<0.27
Cadmium, ug/L	NP*	0.12	5	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039	<0.039	0.090 J	<0.039	<0.039
Chromium, ug/L	P	1.07	100	<1.1	<1.1	<0.98	<1.1	<1.1	5.9	<1.1	<1.1	1.7 J	<1.1	1.3 J
Cobalt, ug/L	NP	4.10	6	1.1	0.52	11	13	20	0.26 J	0.14 J	0.14 J	3.7	2.3	3.2
Fluoride, mg/L	P*	0.484	4	NA	<0.23	<0.23	NA	<0.23	<0.23	NA	<0.23	<0.23	NA	0.36 J
Lead, ug/L	NP*	0.10	15	<0.27	<0.27	0.71	<0.27	0.31 J	0.52	<0.27	<0.27	2.8	0.63	1.6
Lithium, ug/L	P	34.2	40	17	24	12	9.1 J	13	16	12	17	8.2 J	6.3 J	9.6 J
Mercury, ug/L	DQ	DQ	2	NA	<0.10	<0.10	NA	<0.10	<0.10	NA	<0.10	<0.10	NA	<0.10
Molybdenum, ug/L	P	1.74	100	NA	1.2 J	<1.1	NA	<1.1	<1.1	NA	<1.1	<1.1	NA	<1.1
Selenium, ug/L	P	8.55	50	NA	6.8	<1.0	NA	<1.0	<1.0	NA	<1.0	<1.0	NA	<1.0
Thallium, ug/L	NP*	0.14	2	NA	<0.26	<0.27	NA	<0.26	<0.27	NA	<0.26	<0.27	NA	<0.26
Radium 226/228 Combined, pCI/L	P	2.15	5	0.228	0.315	2.46	2.23	2.06	2.73	2.13	1.69	1.77	1.02	0.957

🟦 Blue shaded cell indicates the compliance well result exceeds the UPL (background) and the LOQ.

🟨 Yellow highlighted cell indicates the compliance well result exceeds the GPS.

See additional notes on Page 2.

Table 1. Groundwater Analytical Results Summary - Assessment Monitoring
Ottumwa Generating Station - Zero Liquid Discharge Pond (ZLDP) / SCS Engineers Project #25220072.00

Abbreviations:

UPL = Upper Prediction Limit
NA = Not Analyzed
P = Parametric UPL with 1-of-2 retesting
GPS = Groundwater Protection Standard

DQ = Double Quantification Rule (not detected in background)
NP = Nonparametric UPL (highest background value)
J = Estimated concentration at or above the LOD and below the LOQ.

mg/L = milligrams per liter
ug/L = micrograms per liter
LOD = Limit of Detection
LOQ = Limit of Quantitation

* = UPL is below the LOQ for background sampling. For compliance wells, only results confirmed above the LOQ are evaluated as potential SSIs above background or statistically significant level above GPS.

Notes:

1. An individual result above the UPL or GPS does not constitute a statistically significant increase (SSI) above background or statistically significant level above the GPS. See the accompanying letter text for identification of statistically significant results.
2. GPS is the United States Environmental Protection Agency (USEPA) Maximum Contamination Level (MCL), if established; otherwise, the values from 40 CFR 257.95(h)(2).
3. Interwell UPLs calculated based on results from background well MW-301.

Created by: NDK Date: 6/12/2019
Last revision by: NDK Date: 7/5/2020
Checked by: SCC Date: 7/6/2020
Proj Mgr QA/QC: TK Date: 7/6/2020

I:\25220072.00\Data and Calculations\Tables\[CCR GW Screening Summary_OGS ZLDP.xlsx]Table - Current Event

Table 2. Historical Analytical Results of Constituents with SSIs
Ottumwa Generating Station, Zero Liquid Discharge Pond

Well Group	Well	Collection Date	Cobalt (µg/L)
Background	MW-301	4/26/2016	4.10
		6/23/2016	3.10
		8/10/2016	1.80
		10/26/2016	1.80
		1/18/2017	1.30
		4/19/2017	0.97 J
		6/20/2017	1.00 J
		8/23/2017	0.96 J
		4/18/2018	0.46 J
		8/14/2018	1.40
		10/16/2018	0.36 J
		4/8/2019	0.44 J
		10/24/2019	0.60
		2/5/2020	1.10
		3/12/2020	0.43 J
		4/14/2020	0.52
Compliance	MW-307	1/19/2017	0.62 J
		4/20/2017	1.60
		6/21/2017	1.10
		8/21/2017	1.10
		11/8/2017	1.30
		4/16/2018	1.30
		6/28/2018	2.90
		10/16/2018	4.80
		12/11/2019	11.0
		2/5/2020	13.0
		4/14/2020	20.0
	MW-308	1/19/2017	0.52 J
		4/20/2017	0.43 J
		6/21/2017	0.25 J
		8/21/2017	0.26 J
		11/8/2017	0.23 J
		4/16/2018	0.18 J
		6/28/2018	0.19 J
		10/16/2018	0.15 J
		12/11/2019	0.26 J
		2/5/2020	0.14 J
		4/14/2020	0.14 J

Table 2. Historical Analytical Results of Constituents with SSIs
Ottumwa Generating Station, Zero Liquid Discharge Pond

Well Group	Well	Collection Date	Cobalt (µg/L)
Compliance (cont.)	MW-309	1/19/2017	2.00
		4/20/2017	3.10
		6/21/2017	2.40
		8/21/2017	2.10
		11/8/2017	2.00
		4/16/2018	2.40
		6/28/2018	4.70
		10/16/2018	2.70
		12/11/2019	3.70
		2/5/2020	2.30
		4/14/2020	3.20

Abbreviations:
µg/L = micrograms per liter or parts per billion (ppb)

Notes:
(1) Complete laboratory reports included in the Annual Groundwater Monitoring and Corrective Action Reports.
J = Estimated concentations at or above the limit of detection and the limit of quantitation.

Created by:	NDK	Date:	9/2/2020
Last revision by:	ZTW	Date:	9/2/2020
Checked by:	JSN	Date:	9/3/2020
Scientist check by:	NDK	Date:	9/29/2020

I:\25220072.00\Data and Calculations\Tables\ZLDP ASD Tables\[3 OGS ZLDP April 2020 ASD-Assessment.xlsx]Table 2. Analy. Rslts- CCR

Table 3. Groundwater Elevations - CCR Rule Monitoring Well Networks
IPL - Ottumwa Generating Station / SCS Engineers Project #25220072.00

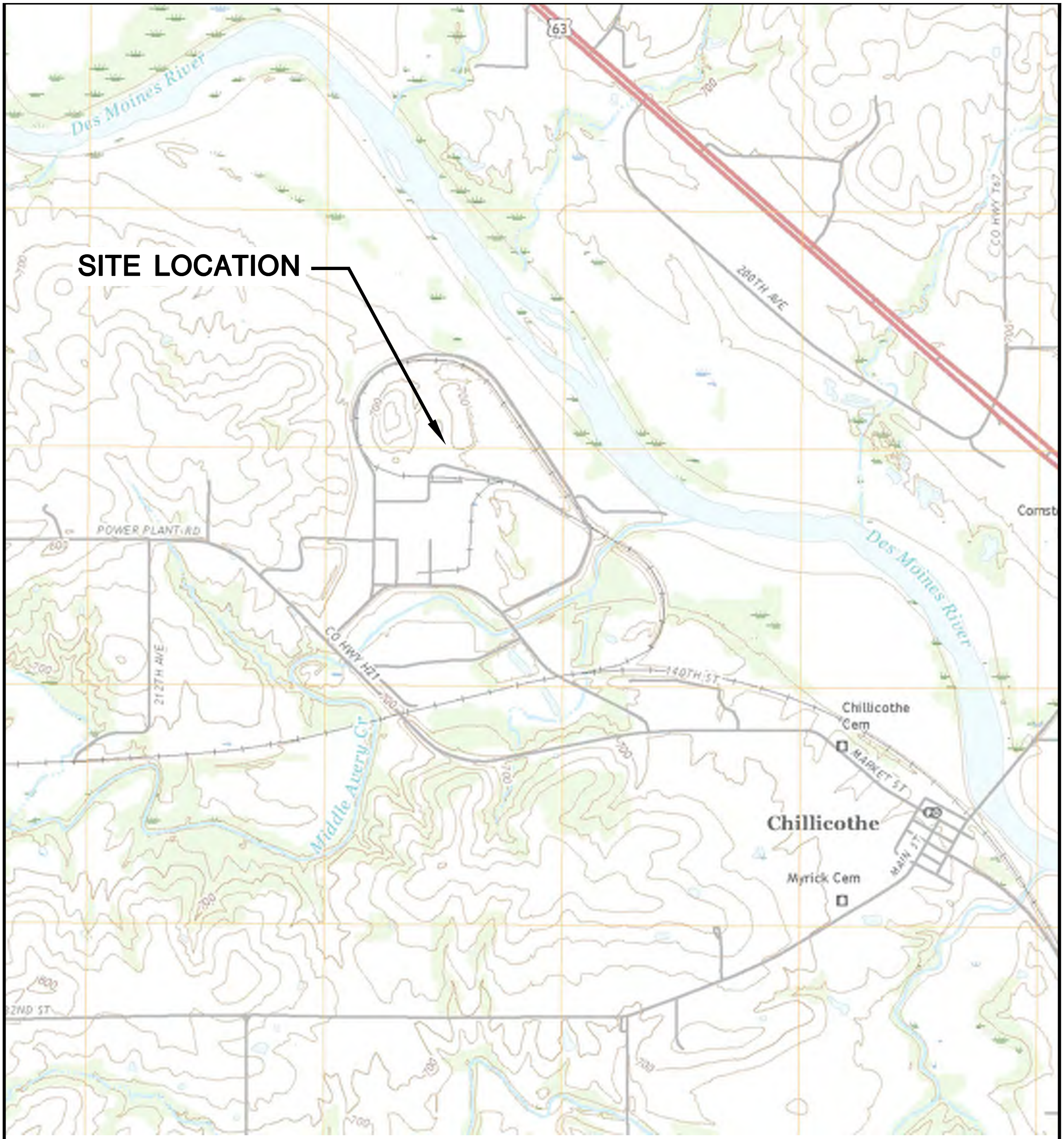
Ground Water or Surface Water Elevation in feet above mean sea level (amsl)														
Well Number	**MW-301**	**MW-302**	**MW-303**	**MW-304**	**MW-305**	**MW-305A**	**MW-306**	**MW-307**	**MW-308**	**MW-309**	**MW-310**	**MW-310A**	**MW-311**	**MW-311A**	**River at Intake**
Top of Well Casing Elevation / Surface Water Reference Elevation (feet amsl)	686.63	673.90	661.07	682.84	683.91	684.03	683.47	657.56	655.39	654.94	658.63	657.93	654.18	653.54	656.31
Screen Length (ft)	10.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	NA
Total Depth (ft from top of casing)	17.0	25.8	17.5	52.3	51.5	81.91	36.6	28.0	25.0	27.5	25.9	55.55	17.9	47.68	NA
Top of Well Screen Elevation (ft)	679.63	653.10	648.57	635.54	637.41	607.12	651.87	634.56	635.39	632.44	637.76	607.38	641.24	610.86	NA
Measurement Date															
April 26, 2016	682.80	655.63	652.42	655.37	661.67	NI	670.86	NI	NI	NI	NI	NI	NI	NI	NI
June 23, 2016	682.58	655.65	652.89	656.53	662.36	NI	670.64	NI	NI	NI	NI	NI	NI	NI	NI
August 9, 2016	682.27	655.52	651.76	653.79	660.78	NI	670.35	NI	NI	NI	NI	NI	NI	NI	NI
October 26-27, 2016	682.04	655.67	652.17	655.03	661.37	NI	670.21	NI	NI	NI	NI	NI	NI	NI	NI
January 18-19, 2017	681.67	655.46	651.74	654.50	660.87	NI	669.89	648.81	647.42	646.66	NI	NI	NI	NI	NI
April 19-20, 2017	682.15	656.35	654.57	657.48	663.27	NI	670.69	653.62	651.09	650.16	NI	NI	NI	NI	NI
June 20-21, 2017	681.91	655.65	652.42	654.75	661.26	NI	669.94	649.85	648.26	647.60	NI	NI	NI	NI	NI
August 21-23, 2017	681.28	655.13	650.58	652.39	659.00	NI	668.77	645.78	643.12	641.82	NI	NI	NI	NI	NI
November 8, 2017	681.54	655.40	651.34	653.03	659.76	NI	669.04	647.37	644.99	644.20	NI	NI	NI	NI	NI
April 18, 2018	681.53	655.71	652.47	655.55	660.99	NI	668.92	649.66	647.91	647.65	NI	NI	NI	NI	NI
May 30, 2018	NM	NM	NM	NM	NM	NI	NM	652.45	651.05	650.98	NI	NI	NI	NI	NI
June 28, 2018	NM	NM	NM	NM	NM	NI	NM	652.87	651.43	651.47	NI	NI	NI	NI	NI
July 18, 2018	NM	NM	NM	NM	NM	NI	NM	652.27	650.67	650.69	NI	NI	NI	NI	NI
August 14-15, 2018	680.91	656.05	652.57	656.35	661.56	NI	668.66	NM	NM	NM	NI	NI	NI	NI	NI
August 29, 2018	681.09	655.89	655.07	657.82	NM	NI	NM	NM	NM	NM	NI	NI	NI	NI	NI
October 16, 2018	682.50	656.91	656.17	658.20	663.37	NI	670.24	654.13	NM	651.61	NI	NI	NI	NI	NI
January 8, 2019	682.22	656.03	654.65	656.28	662.13	NI	669.84	NM	NM	NM	NI	NI	NI	NI	NI
April 8, 2019	682.69	657.23	655.55	659.33	664.01	NI	670.96	654.90	653.70	653.55	NI	NI	NI	NI	NI
August 28, 2019	NM	NM	NM	NM	NM	NI	NM	NM	NM	NM	640.98	NI	642.10	NI	NI
October 23-24, 2019	683.07	660.14	653.86	657.71	663.21	NI	671.28	651.89	651.31	651.28	649.31	NI	647.80	NI	NI
December 11, 2019	NM	NM	NM	NM	NM	NI	NM	649.59	647.39	647.24	NM	NI	NM	NI	NI
February 5, 2020	683.30	NM	NM	NM	NM	NI	NM	649.88	650.12	648.34	644.71	NI	645.00	NI	NI
March 12-13, 2020	682.82	NM	NM	NM	661.41	651.64	NM	NM	NM	NM	645.45	617.84	644.18	624.11	NI
April 1, 2020	683.27	657.00	655.89	658.57	660.59	655.05	671.13	653.76	651.88	651.23	651.09	649.16	649.35	648.27	649.71
April 13-14, 2020	683.25	656.45	654.08	656.42	662.44	653.69	670.71	650.66	650.09	649.19	645.91	647.50	646.79	648.42	645.71
May 4, 2020	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
June 30, 2020	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	647.73	NM
Bottom of Well Elevation (ft)	669.63	648.10	643.57	630.54	632.41	602.12	646.87	629.56	630.39	627.44	632.76	602.38	636.24	605.86	--

Notes:
NM = not measured
NI = not installed

Created by: KAK Date: 5/1/2017
Last rev. by: NDK Date: 7/22/2020
Checked by: AJR Date: 7/22/2020
Proj Mgr QA/QC: TK Date: 9/30/2020

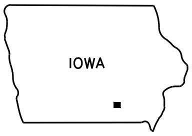
I:\25220072.00\Data and Calculations\Tables\[wlstat_OGS.xls]levels

Figures



N

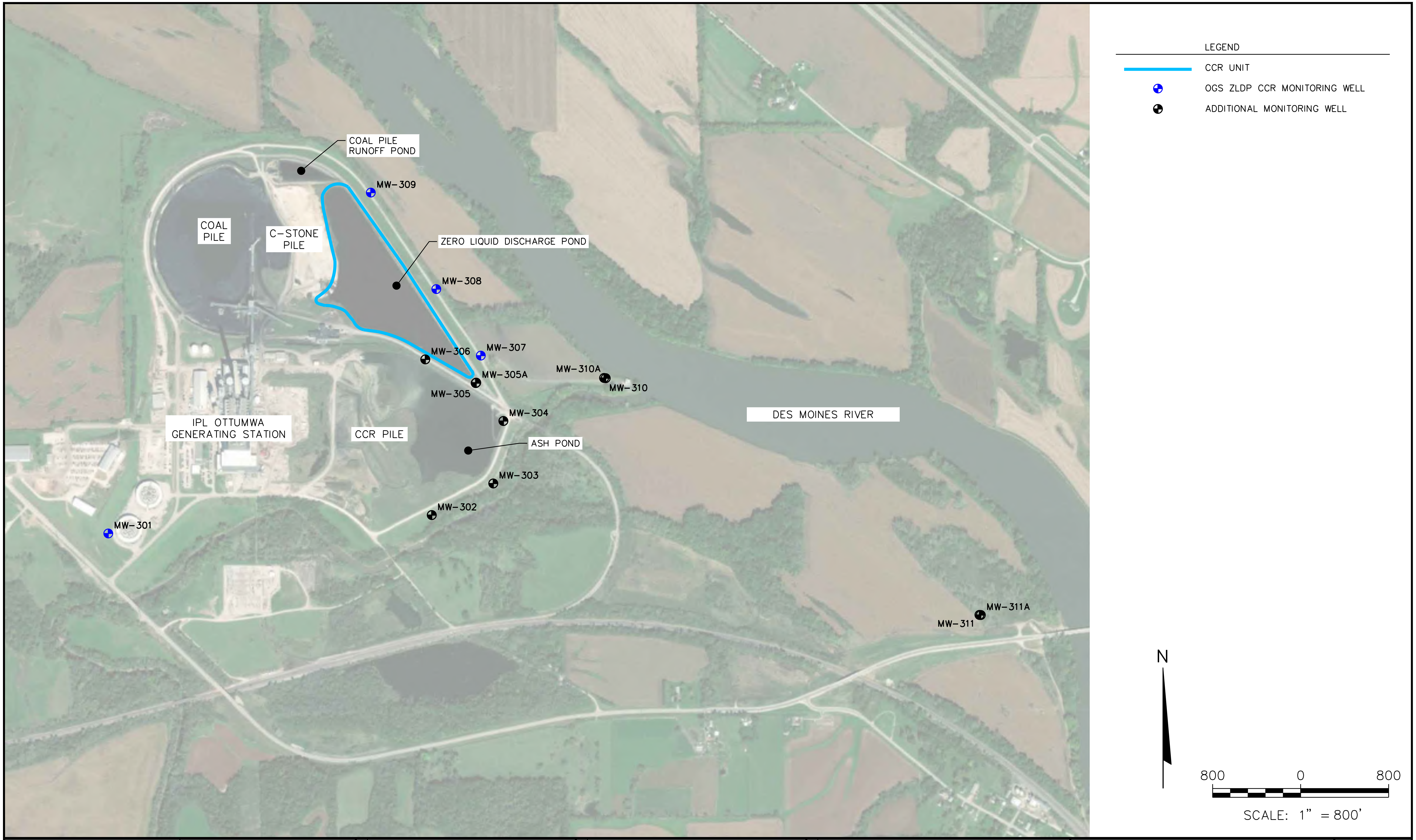
CHILLICOTHE QUADRANGLE
IOWA–WAPELLO CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
2018
SCALE: 1" = 2,000'



CLIENT	INTERSTATE POWER AND LIGHT CO. 20775 POWER PLANT ROAD OTTUMWA, IA 52501	SITE	ALLIANT ENERGY OTTUMWA GENERATING STATION OTTUMWA, IOWA	SITE LOCATION MAP

PROJECT NO.	25219072.00	DRAWN BY:	BSS	ENGINEER	SCS ENGINEERS 2830 DAIRY DRIVE MADISON, WI 53718-6751 PHONE: (608) 224-2830	FIGURE
DRAWN:	11/15/2019	CHECKED BY:	MDB			1
REVISED:	01/10/2020	APPROVED BY:	TK 01/30/2020			

I:\25219072.00\Drawings\□□□ 2019 Annua□□e□ort\Site Location Ma□.dwg, 1/□0/2020 □:51:□□ □M



PROJECT NO.	25220072.00	DRAWN BY:	KP/BSS/RJG
DRAWN:	04/28/2020	CHECKED BY:	NDK/SCC
REVISED:	10/09/2020	APPROVED BY:	TK 10/09/2020

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

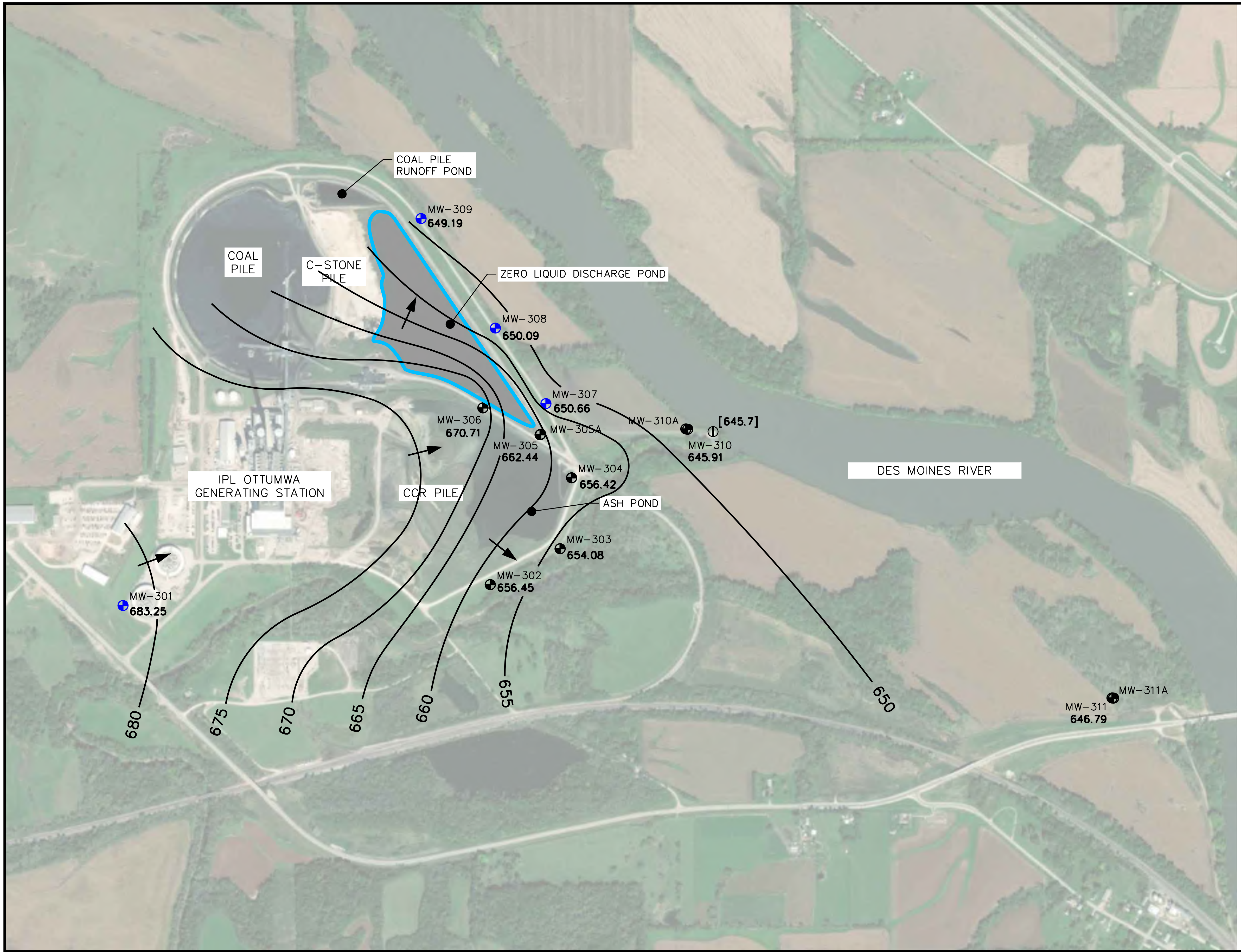
SITE

ALLIANT ENERGY
OTTUMWA GENERATING STATION
OTTUMWA, IOWA

SITE PLAN AND MONITORING WELL LOCATIONS

FIGURE
2

I:\25220072.00\Drawings\Site Plan and Monitoring Well Locations.dwg, 10/9/2020 8:19:58 AM



LEGEND

▬	CCR UNIT
⊕	OGS ZLDP CCR MONITORING WELL
⊕	ADDITIONAL CCR MONITORING WELL
⦶	RIVER ELEVATION MEASUREMENT LOCATION
645.91	POTENTIOMETRIC ELEVATION AT WELL (APRIL 13–14, 2020)
[645.7]	SURFACE WATER ELEVATION (APRIL 13, 2020)
—	POTENTIOMETRIC SURFACE CONTOUR
→	APPROXIMATE GROUNDWATER FLOW DIRECTION

N

800 0 800

SCALE: 1" = 800'

PROJECT NO.	25220072.00	DRAWN BY:	KP/BSS/RJG/ZTW
DRAWN:	04/28/2020	CHECKED BY:	NDK/SCC
REVISED:	07/30/2020	APPROVED BY:	SCC 09/25/2020

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

ALLIANT ENERGY
OTTUMWA GENERATING STATION
OTTUMWA, IOWA

SHALLOW POTENTIOMETRIC SURFACE
APRIL 13–14, 2020

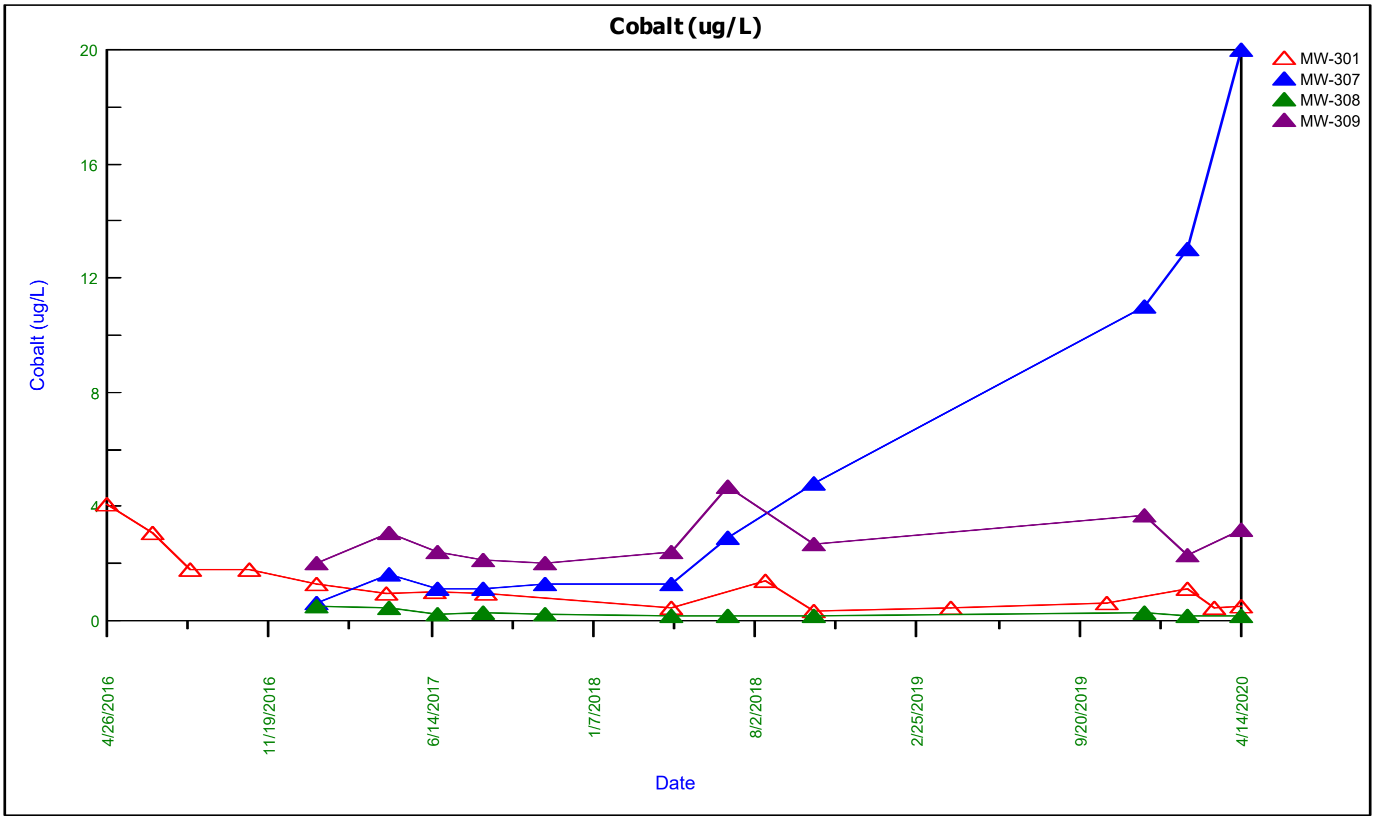
FIGURE
3

\\Mad s01\data\Projects\25220072.00\Drawings\Potentiometric Surface 2020.dwg. 9/25/2020 11: : 8 AM

11/23/2020 - Classification: Internal - ECRM7804260

Appendix A

CCR Well Trend Plot


Cobalt (ug/L)
MW-301
MW-307
MW-308
MW-309
Cobalt (ug/L)
20
16
12
8
4
0
4/26/2016
11/19/2016
6/14/2017
1/7/2018
8/2/2018
2/25/2019
9/20/2019
4/14/2020
Date

Appendix B

Regional Geologic and Hydrogeologic Background Information

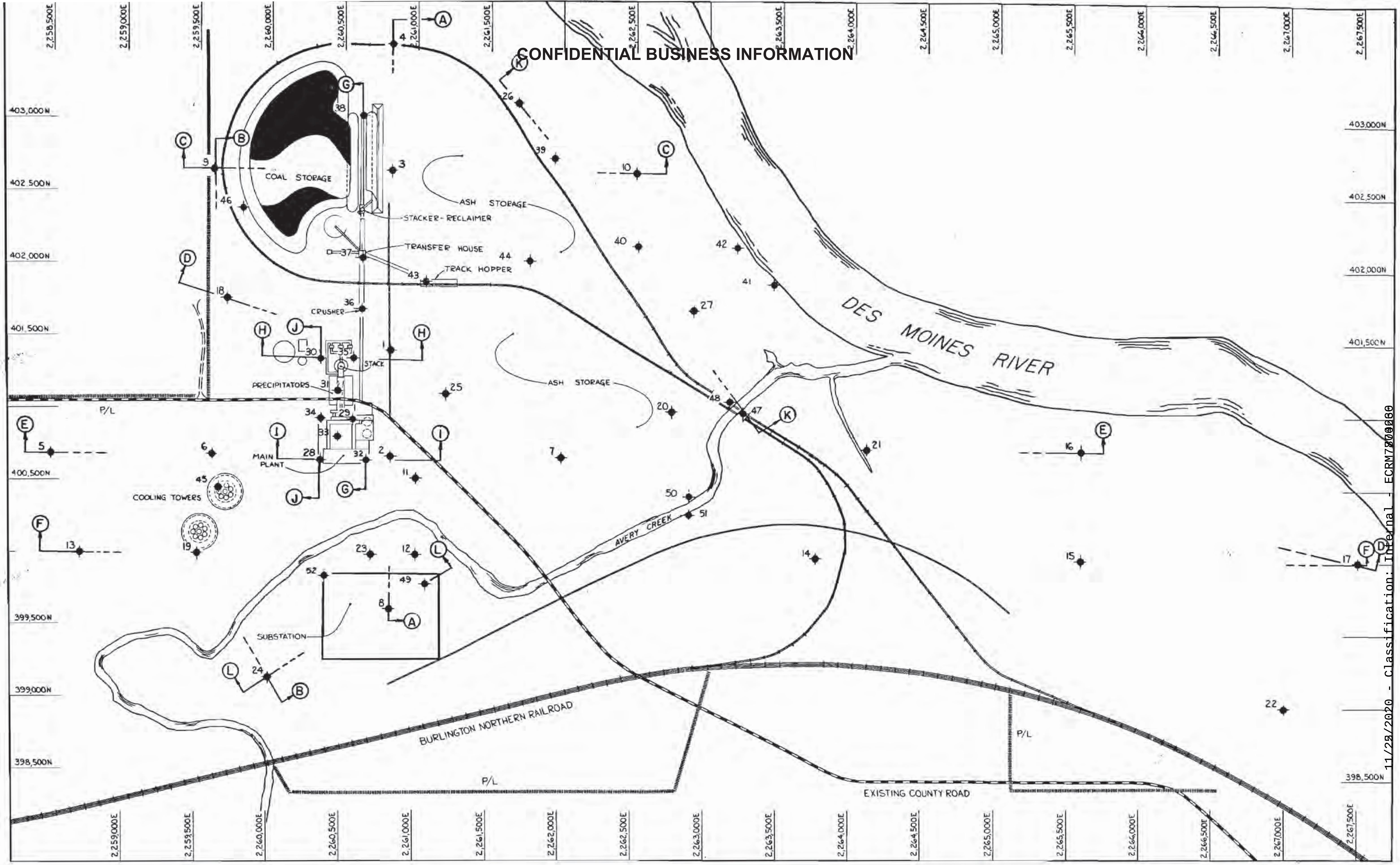
Table OGS-2. Regional Hydrogeologic Stratigraphy
Ottumwa Midland Landfill / SCS Engineers Project #25215053.01

Age of Rocks	Hydrogeologic Unit	General Thickness (feet)	Name of Rock Unit*	Type of Rock
Quaternary (0-1 million years old)	Surficial Aquifers • Alluvial • Buried-Channel • Drift	0 to 320	Undifferentiated	• Sand, gravel, silt, and clay • Sand, gravel, silt, and clay • Till (sandy, pebbly clay), sand, and silt
Pennsylvanian (180 to 310 million years old)	Aquiclude	0 to 370	Undifferentiated	• Shale, sandstone, limestone, and coal
Mississippian (310 to 345 million years old	Mississippian Aquifer • Upper	0 to 600	St. Louis Spergen	• Limestone and sandstone • Limestone
	• Lower		Warsaw Keokuk Burlington Hampton Starrs Cave	• Shale and dolomite • Dolomite, limestone, and shale • Dolomite and limestone • Limestone and dolomite • Limestone
	Aquiclude	0 to 425	Prospect Hill McCraney	• Siltstone • Limestone
Devonian (345 to 400 million years old)			Yellow Spring Lime Creek	• Shale, dolomite, and siltstone • Dolomite and shale
	Devonian Aquifer	110 to 420	Cedar Valley Wapsipinicon	• Limestone and dolomite • Dolomite, limestone, shale, and gypsum
Silurian (400 to 425 million years old)		0 to 105	Undifferentiated	• Dolomite
Ordovician (425 to 500 million years old)	Aquiclude	150 to 600	Maquoketa Galena Decorah Platteville	• Dolomite and shale • Dolomite and chert • Limestone and shale • Limestone, shale, and sandstone
	Cambrian-Ordovician aquifer	750 to 1,110	St. Peter Prairie du Chien	• Sandstone • Dolomite and sandstone
Cambrian (500 to 600 million years old)			Jordan St. Lawrence	• Sandstone • Dolomite
	Not considered an aquifer in southeast Iowa	450 to 750+	Franconia Galesville Eau Claire Mt. Simon	• Shale, siltstone, and sandstone • Sandstone • Sandstone, shale, and dolomite • Sandstone
Precambrian (600 million to 2 billion + years old)				• Sandstone, igneous rocks, and metamorphic rocks

*This nomenclature and classification of rock units in this report are those of the Iowa Geological Survey and do not necessarily coincide with those accepted by the U.S. Geological Survey.

Source: "Water Resources of Southeast Iowa," Iowa Geologic Survey Water Atlas No. 4.

CONFIDENTIAL BUSINESS INFORMATION



SCALE 1 INCH=600 FEET

0 500 1000 1500

FEET

ATEC ASSOCIATES

PLAN OF BORINGS

OTTUMWA GENERATING STATION-UNIT I
CHILLICOTHE, IOWA FIGURE 2

LOG OF BORING NO. 7

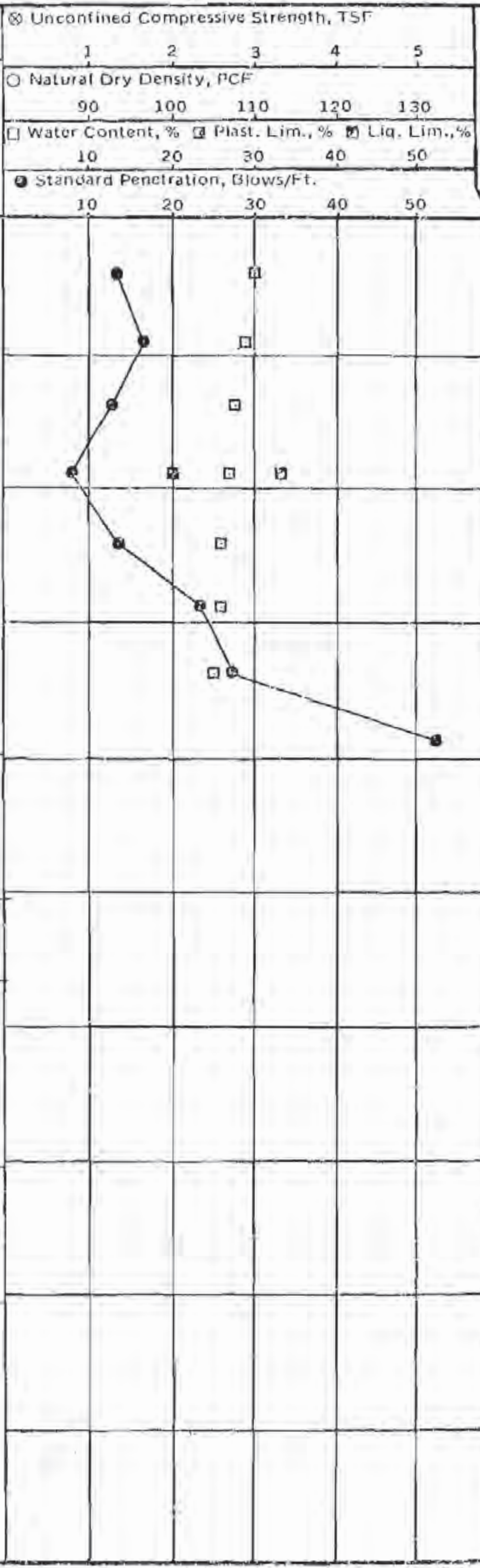
CONFIDENTIAL BUSINESS INFORMATION

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA
DATE: 5-30-75
LOCATION: N 400,675
E 2,262,000

SURFACE ELEVATION— 676

DEPTH SCALE, FT.		STRATUM DEPTH FT.	SAMPLE DEPTH	BLOWS/6 in. 3—6 in. INCREMENTS	RECOVERY, %	SHELBY TUBE
	Dark Brown moist stiff SILTY CLAY (CL)	2.5		4 6/7	25	
5	Brown moist stiff SILTY CLAY (CL)			6 7/9	25	
				3 5/7	100	
10	-medium stiff			3 3/5	90	
				3 5/8	100	
15	-very stiff			7 11/12	90	
	-very stiff	18.0		6 9/18	100	
20	Brown very moist soft SILTY CLAY (CL) w/trace Sand	19.0 20.3		3 2/50	100	
	Brown wet soft SANDY CLAYEY SILT (ML)			RC 1 RQD 18	96	
25	Gray fine grained LIMESTONE w/ several partings and Glauconitic Clay seams with Limestone rock fragments	28.7		RC 2 RQD 21	66	
30	Gray SANDY LIMESTONE	30.3				
	Gray LIMEY SANDSTONE	34.5		RC 3 RQD 42	76	
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				



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.

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA

DATE: 5-30-75

LOCATION: N 400,675
E 2,262,000

DEPTH SCALE, FT.	SURFACE ELEVATION—	STRATUM DEPTH FT.	SAMPLE DEPTH	STANDARD PENETRATION BLOWS/6 in. 3—6 in. INCREMENTS	RECOVERY, %	⊗ Unconfined Compressive Strength, TSF 1 2 3 4 5 ○ Natural Dry Density, PCF 90 100 110 120 130 □ Water Content, % ◪ Plast. Lim., % ◩ Liq. Lim., % 10 20 30 40 50 ● Standard Penetration, Blows/Ft. 10 20 30 40 50	SHELBY TUBE
55 60	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'	60.3		RC 6 RQD 56	97		
65	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.

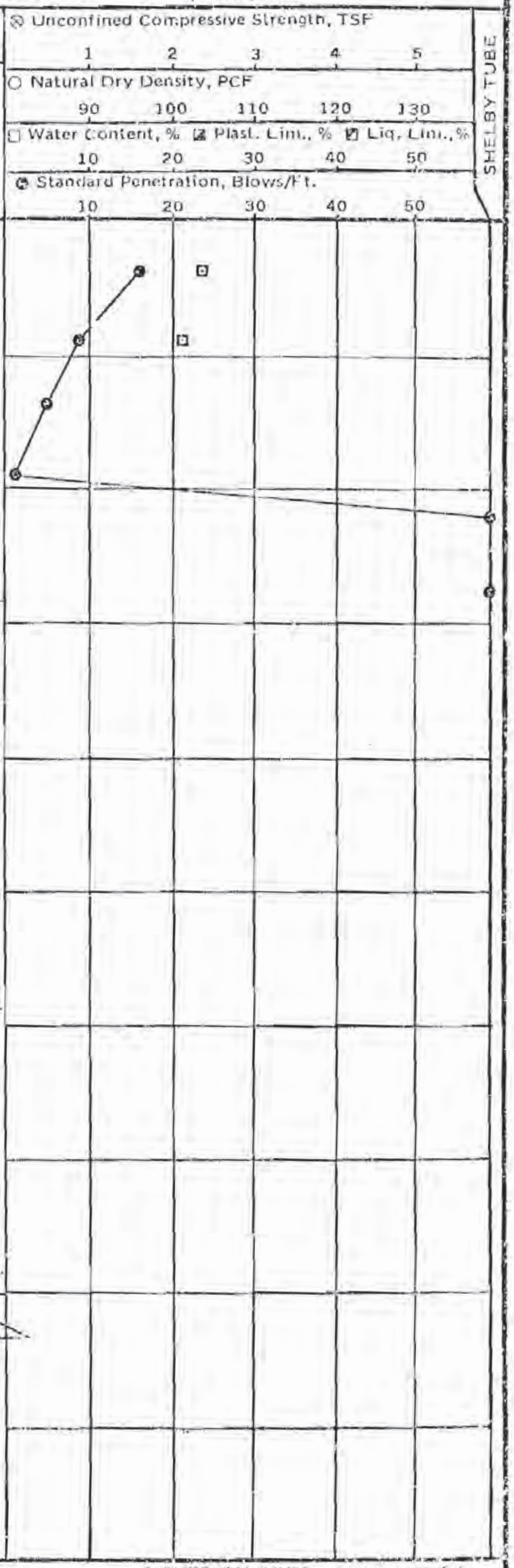
Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA

DATE: 6-13-75

LOCATION: N 401,000
E 2,262,750

DEPTH SCALE, FT.	SURFACE ELEVATION— 658	STRATUM DEPTH FT.	BLOWS/6 In. 3–6 In. INCREMENTS	RECOVERY, %
	Brown moist very stiff SILTY CLAY (CL)		6 7/9	50
	-medium stiff		5 5/4	10
5		5.5		
	Brown wet loose fine to medium SAND (SP-SM) with trace Silt		2 2/3	100
			2 1/1	
10		10.5		
	Gray dry hard Calcareous CLAY with LIMESTONE fragments (weathered limestone)		50/.2	
		14.3	50/.3	
15	Gray fine grained LIMESTONE with interbedded Glauconitic SHALE and SANDSTONE	17.2	RC 1 RQD 36	82
20	Gray fine grained SANDSTONE (loosely cemented)		RC 2 RQD 17	77
25	-friable sandstone 29.0 to 31.8' -sand sized limestone frags. 31.2 to 31.8'			
30		31.8	RC 3 RQD 95	99
	White LIMESTONE with irregular Clay Filled seams	32.8		
35	White fine grained massive LIMESTONE with Stylolites	38.5		
40	Gray fine grained massive LIMEY SANDSTONE	40.0	RC 4 RQD	100



COMPLETION DEPTH: 40.0'

ROCK CORE DIAMETER:

GROUND WATER: NOTED ON RODS 8.0 FT.
AT COMPLETION FT.
AFTER HRS. FT.

CONFIDENTIAL BUSINESS INFORMATION

LOG OF BORING NO. 39

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

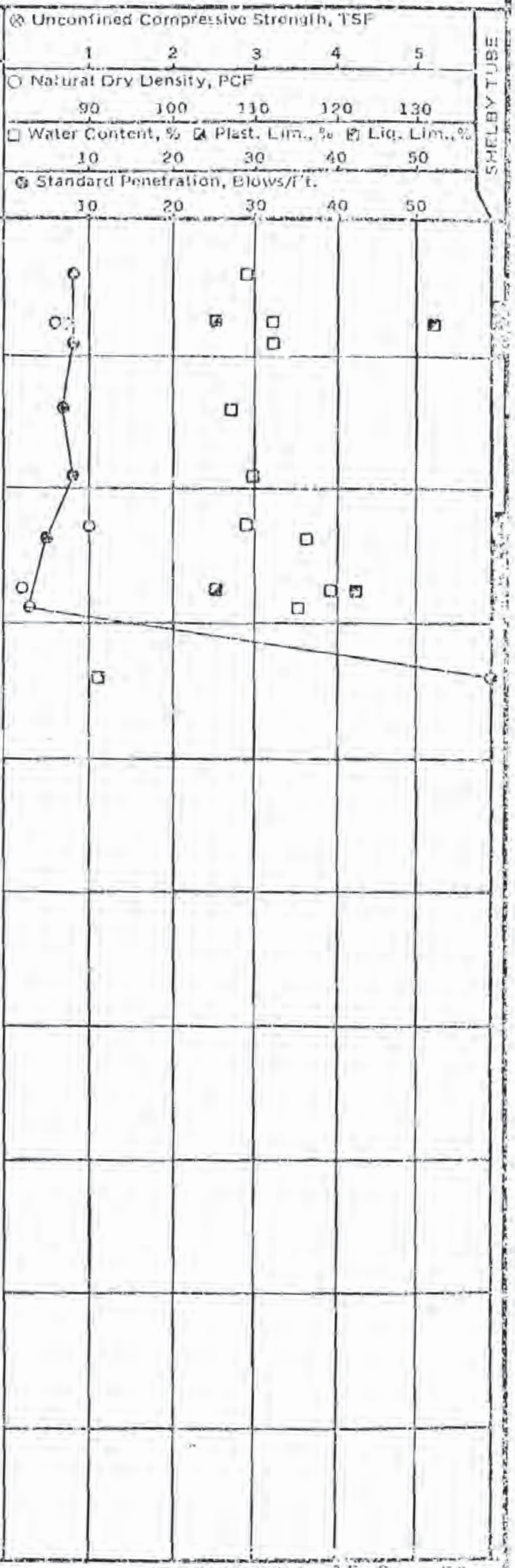
BORING METHOD: HSA
DATE: 10-3-75
LOCATION: N 402,725
E 2,261,050

SURFACE ELEVATION— 654

DEPTH SCALE, FT.	DESCRIPTION	STRATUM DEPTH FT.
0–10.5	Dark Gray medium stiff CLAY(CH) w/trace organic material	10.5
10.5–15.5	Dark Gray soft to very soft SILTY CLAY(CL) with trace Sand and fine Gravel	15.5
15.5–17.0	Dark Gray wet loose to medium dense SILTY SAND(SM)w/some f-m Gravel	17.0
17.0–18.0	Light Gray very moist very dense SILTY SAND(SM-ML) w/soft Rock frag. (calcareous)	18.0

STANDARD PENETRATION BLOWS/6 in. 3—6 in. INCREMENTS	RECOVERY, %
3 3/5	100
3 4/4	100
2 3/4	100
3 3/5	100
2 2/3	75
1 1/2	75
3/21	
100/.3	100

Note:
Auger refusal at 18.0 ft



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

ATEC ASSOCIATES

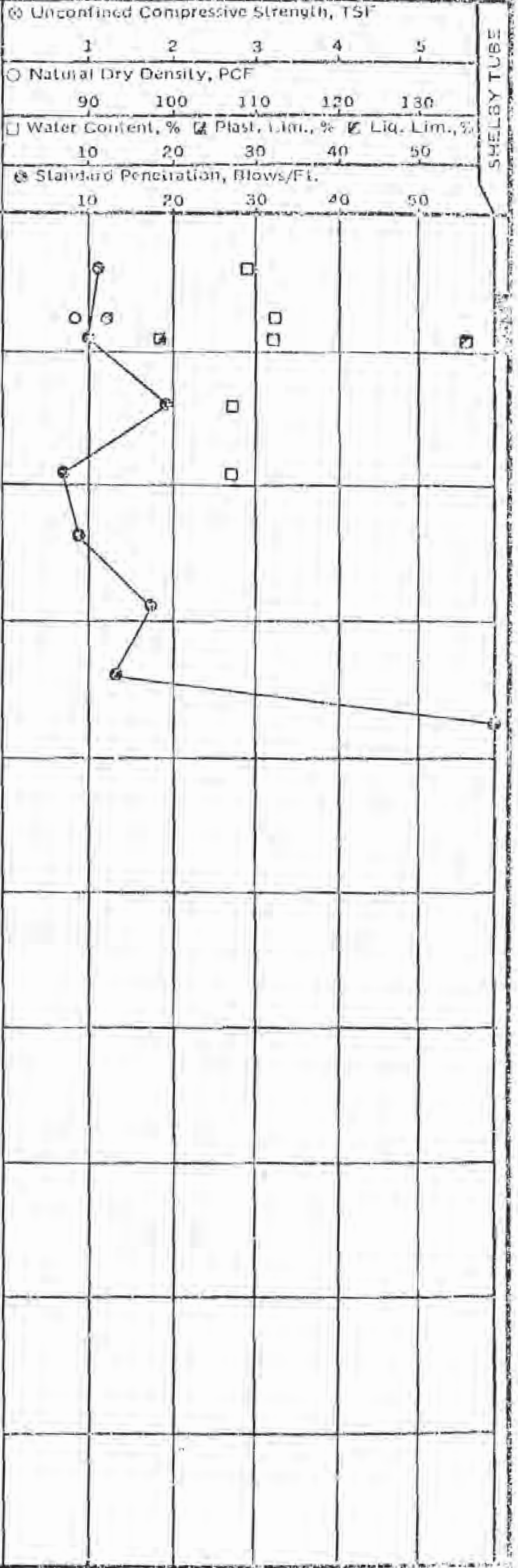
LOG OF BORING NO. 40

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 SCALE, FT.		STRATUM DEPTH FT.	BLOWS/6 in. 3—6 in. INCREMENTS	RECOVERY, %
	Dark Gray moist stiff CLAY(CH) w/ trace organic material		2 4/7	75
	-medium stiff		3 4/6	75
5				
			5 8/11	100
		9.0		
10	Dark Gray very moist loose SANDY SILT(ML) w/trace Clay		3 3/4	100
		11.0	4 4/5	100
15	Brown wet loose to medium dense fine to medium SAND (SP) with trace Silt		4 9/8	100
	-trace coarse sand		6 6/7	75
		18.8	50/.3	0
20	Note: Piezometer installed at 18.5 ft			



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

ATEC ASSOCIATES

CONFIDENTIAL BUSINESS INFORMATION

LOG OF BORING NO. 44

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA

DATE: 10-7-75

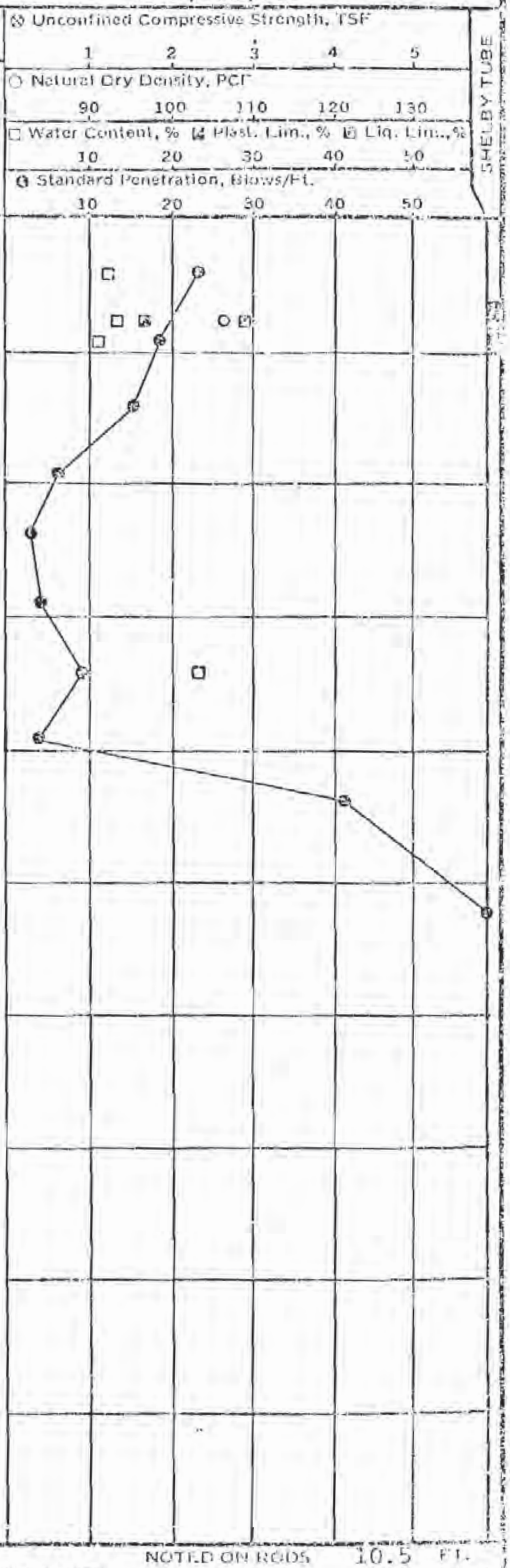
LOCATION: N 402,020
E 2,261,780

SURFACE ELEVATION— 662

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)	5.0		10 11/12	
5	Brown moist stiff SANDY CLAY (CL-SC)	6.5		6 8/10	
	Brown moist med.dense fine SAND (SP)	8.2		5 9/6	
10	Brown wet loose fine to medium SAND (SP) w/trace Silt -very loose	13.0		3 3/3 1 1/2	
15	Brown wet very loose CLAYEY SAND (SW-SC) w/little fine to med.Gvl	15.5		2 2/2	
	Brown very moist med.stiff CLAYEY SILT(ML) w/tr.Sand & fine Gvl	18.0		2 4/5	
20	Brown wet very loose SANDY SILT (ML)	20.5		2 2/2	
	Dark Gray very wet soft CLAY(CL-CH) with trace coarse Gravel	24.0		34 25/16	
25	Brown wet dense fine to coarse SAND(SW) w/trace Silt & Gravel	26.2		50/.2	
	Gray very moist very dense fine SAND(SP) w/trace Silt	26.3			
30					

Note: SPT from 23.5 to 25.0' driven on a boulder

* Caved to 11.8 ft at completion



COMPLETION DEPTH: 26.3

ROCK CORE DIAMETER:

GROUND WATER:
NOTED ON RODS 10.5 FT.
AT COMPLETION 8.2 FT.*
AFTER HRS. FT.

ATEC ASSOCIATES

CONFIDENTIAL BUSINESS INFORMATION

LOG OF BORING NO. 48

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

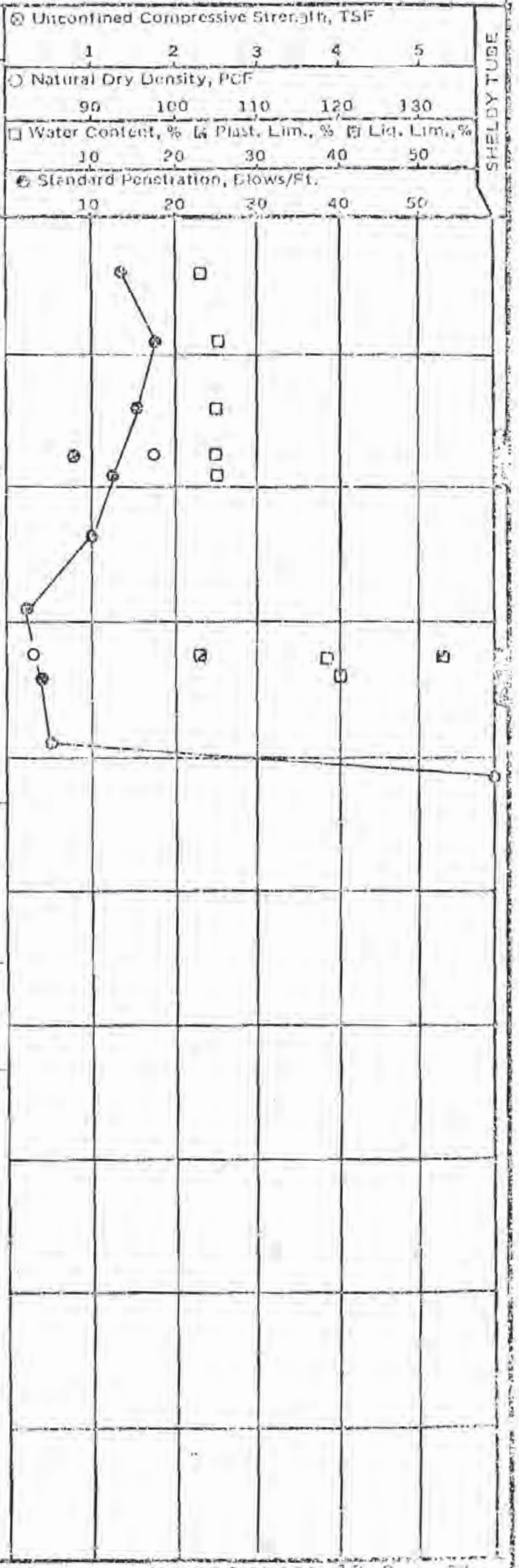
N 401,070

BORING METHOD: HSA

DATE: 10-7-75

LOCATION: E 2,263,160

DEPTH SCALE, FT.	SURFACE ELEVATION— 655	STRATUM DEPTH FT.	STANDARD PENETRATION SAMPLE DEPTH	BLOWS/6 in. 3—6 in. INCREMENTS	RECOVERY, %
	Dark Gray to Brown moist stiff CLAY (CL-CH)			6 6/7	100
5				4 7/10	100
				5 8/7	100
10		10.5		2 4/8	100
	Brown moist loose SILTY fine SAND (SM) -wet below 13.0'			2 4/6	75
15		15.5		0 1/1	50
	Dark Gray very moist soft CLAY (CH)	18.5		2 1/3	50
20	Dark Gray wet very loose SILTY fine SAND (SP-SM)	21.0		1 1/4	50
	Gray very loosely cemented fine grained LIMEY QUARTZ SANDSTONE -friable below 27.9' -limestone fragments 30.3 to 31.1' -white fine grained limestone w/ irregular clay filled seams 31.1 to 31.8'			50/.2	50
25				RC 1 RQD 0	33
30		31.8		RC 2 RQD 38	100
35	*Caved to 12.1 ft at completion				



COMPLETION DEPTH: 31.8'

ROCK CORE DIAMETER: 2 1/8"

GROUND WATER: NOTED ON RODS 13.0 FT.
AT COMPLETION 12.1 FT.*
AFTER HRS. FT.

ATEC ASSOCIATES

LOG OF BORING NO. 50

Ottumwa Generating Station-Unit 1
Chillicothe, Iowa

BORING METHOD: HSA

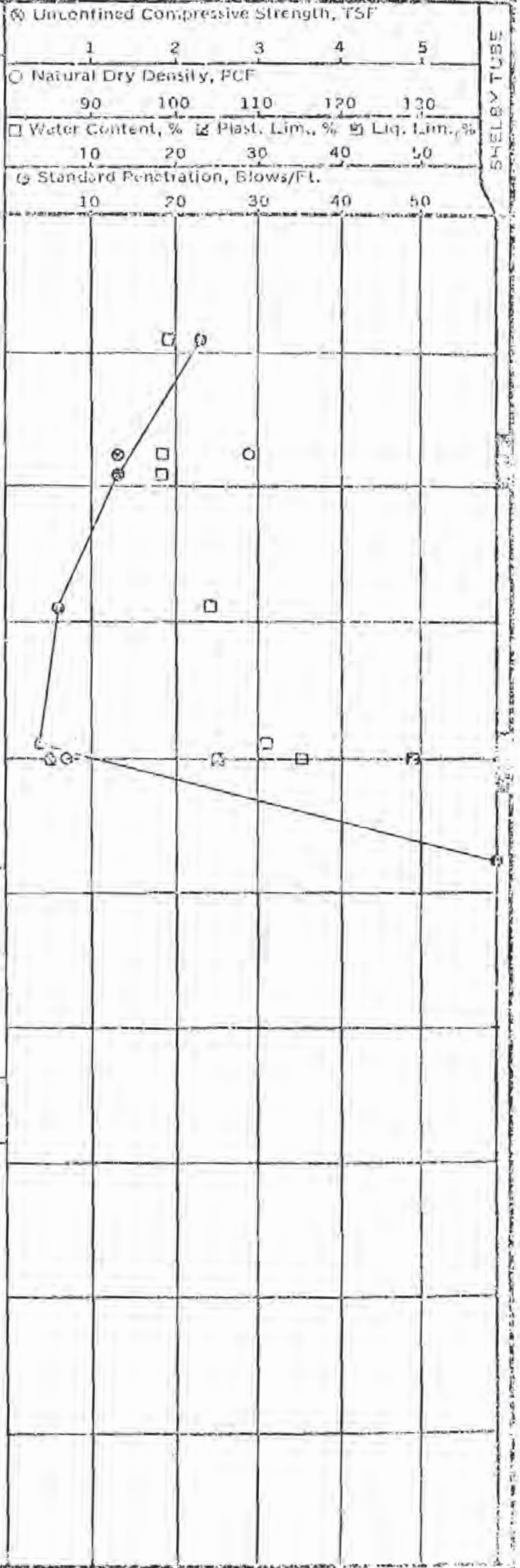
DATE: 10-8-75

LOCATION: N 400,410
E 2,262,880

SURFACE ELEVATION-- 654

DEPTH SCALE, FT.		STRATUM DEPTH FT.	STANDARD PENETRATION SAMPLE DEPTH	BLOWS/6 in. 3—6 in. INCREMENTS	RECOVERY, %
5	Dark Gray slightly moist very stiff CLAY (CL-CH)	6.0		9 10/13	100
10	Gray and Brown (mottled) moist stiff SILTY CLAY (CL)	11.5		4 6/7	100
15	Dark Gray very moist medium stiff CLAY (CL) with trace Sand			2 3/3	75
20	-soft	22.5		2 2/2	75
25	Light Gray slightly moist very dense SANDY SILT(ML-SM)(calcareous)	24.5		18 50/.5	75
30	White friable fine grained Quartz SANDSTONE -limestone fragments 24.5 to 25.3'	32.0		RC 1 RQD 36	55
35	White fine grained LIMESTONE -clay fillings 32.0-33.5'	34.5		RC 2 RQD 92	100

*Caved to 18.4 ft at completion

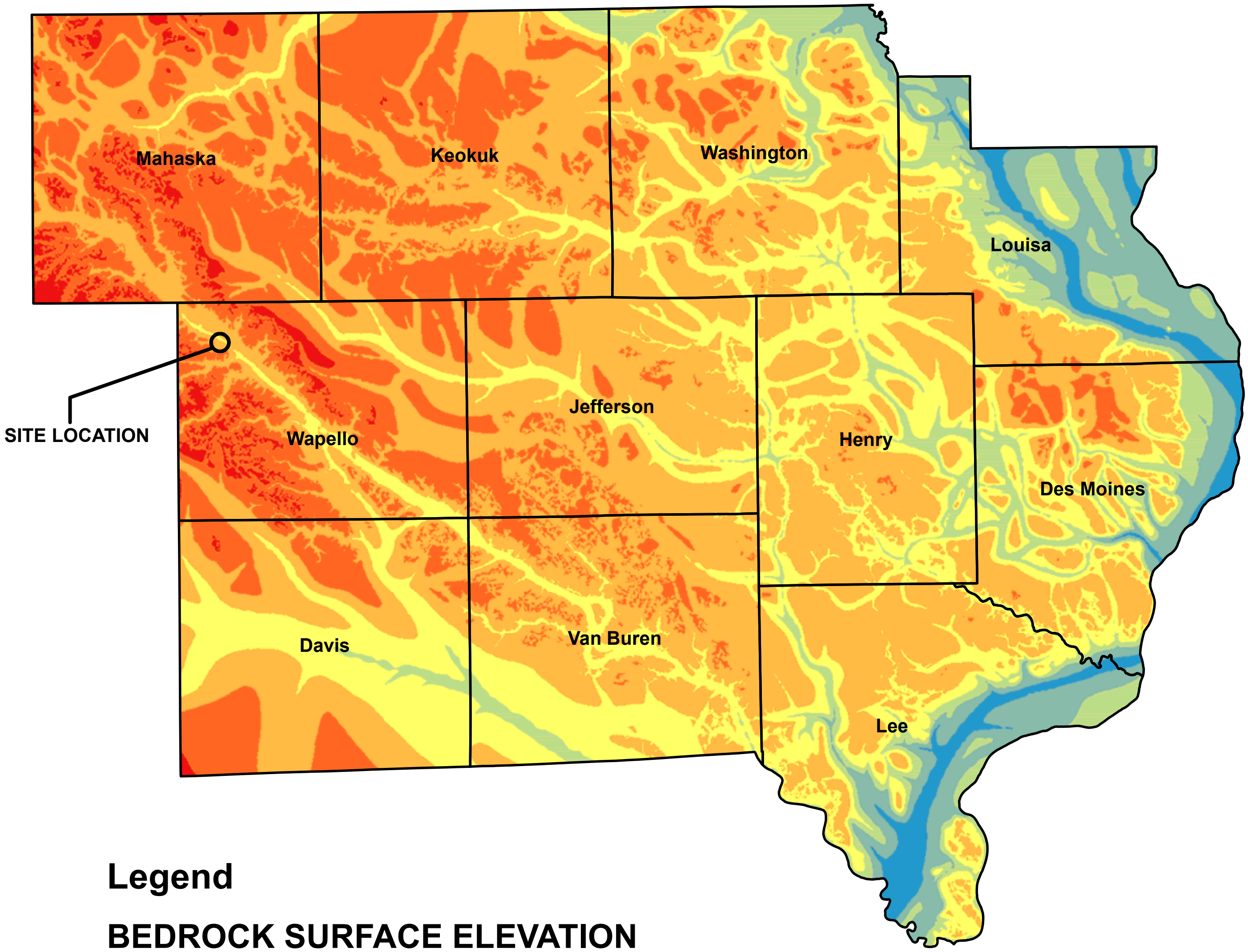


COMPLETION DEPTH: 34.5

ROCK CORE DIAMETER: 2 1/8"

GROUND WATER: NOTED ON RODS 11.5 FT.
AT COMPLETION 14.8 * FT.
AFTER HRS. FT.

ATEC ASSOCIATES

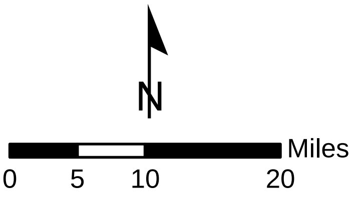


Legend

BEDROCK SURFACE ELEVATION

ELEVATION ABOVE MEAN SEA LEVEL IN FEET

🟦	BELOW 300
▨	300 TO 400
🟩	400 TO 500
🟨	500 TO 600
🟧	600 TO 700
🟧	700 TO 800
🟥	800 TO 900



MAP DATA DERIVED FROM IOWA GEOLOGICAL AND WATER SURVEY
IOWA BEDROCK SURFACE ELEVATION AS OBTAINED
FROM IOWA NATURAL RESOURCES
GEOGRAPHIC INFORMATION SYSTEMS LIBRARY

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

SITE
OTTUMWA GENERATING STATION
OTTUMWA, IOWA

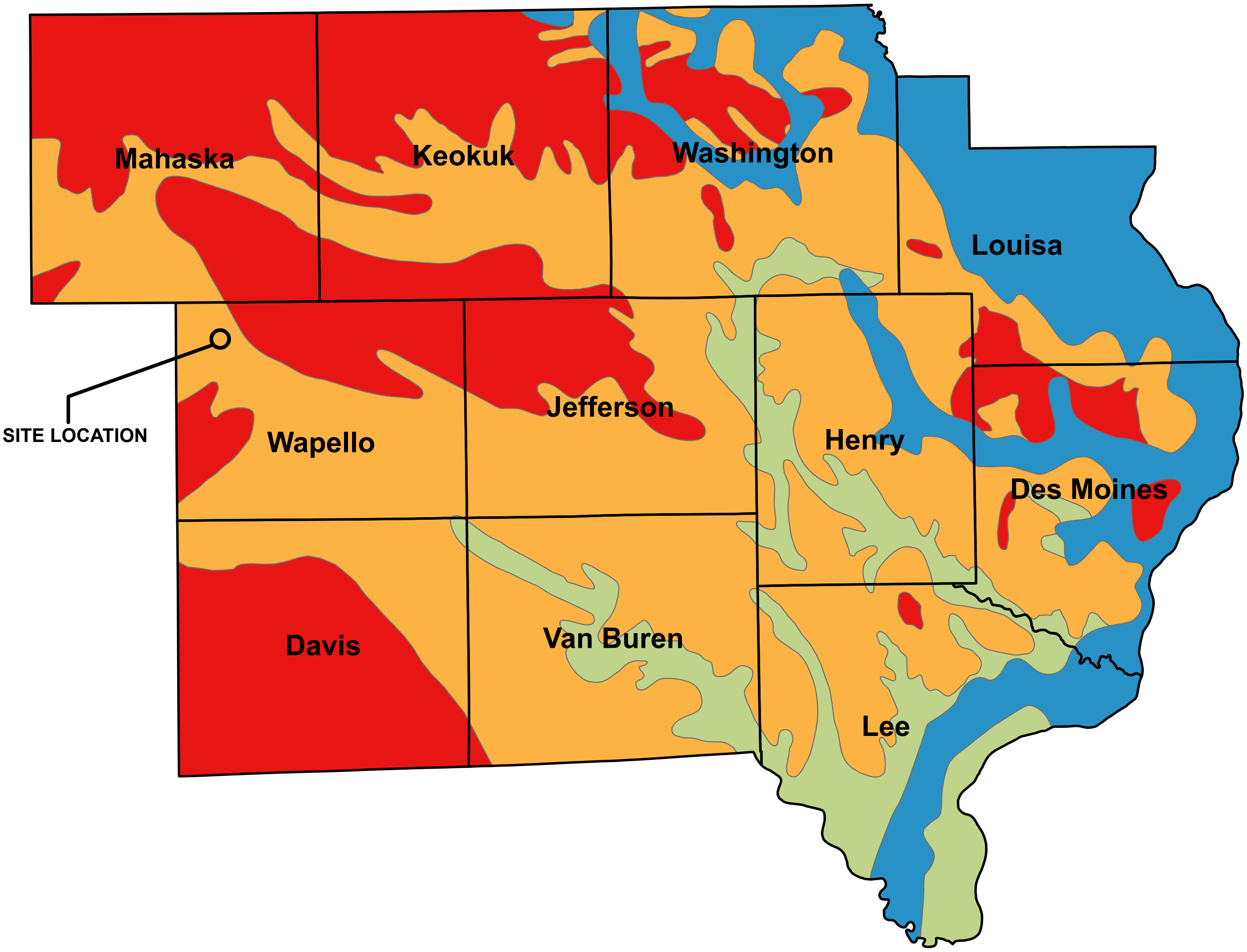
SE IOWA
REGIONAL BEDROCK
SURFACE ELEVATION

PROJECT NO.	25215053.03	DRAWN BY:	JB
DRAWN:	07/29/13	CHECKED BY:	MDB
REVISED:	05/29/15	APPROVED BY:	

ENGINEER
SCS ENGINEERS
2830 DAIRY DRIVE MADISON, WI 53718-6751
PHONE: (608) 224-2830 FAX: (608) 224-2839

FIGURE

I:\25215053\Drawings\OGS\ArcMAP\OML-BEDROCK TOPO 8.5X11 portrait.mxd

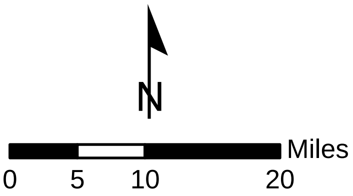


Legend

MISSISSIPIAN AQUIFER POTENTIOMETRIC SURFACE

ELEVATION ABOVE MEAN SEA LEVEL IN FEET

🟦	MISSISSIPPIAN NOT PRESENT
🟩	550
🟧	650
🟥	750



MAP DATA DERIVED FROM IOWA GEOLOGICAL AND WATER SURVEY
MISSISSIPIAN AQUIFER POTENTIOMETRIC SURFACE ELEVATION AS OBTAINED
FROM IOWA NATURAL RESOURCES
GEOGRAPHIC INFORMATION SYSTEMS LIBRARY

CLIENT	INTERSTATE POWER AND LIGHT CO. 20775 POWER PLANT ROAD OTTUMWA, IA 52501	SITE	OTTUMWA GENERATING STATION OTTUMWA, IOWA		SE IOWA REGIONAL MISSISSIPIAN AQUIFER POTENTIOMETRIC SURFACE ELEVATION

PROJECT NO.	25215053.03	DRAWN BY:	JB	ENGINEER	SCS ENGINEERS 2830 DAIRY DRIVE MADISON, WI 53718-6751 PHONE: (608) 224-2830 FAX: (608) 224-2839	FIGURE
DRAWN:	07/29/13	CHECKED BY:	MDB			
REVISED:	05/29/15	APPROVED BY:				

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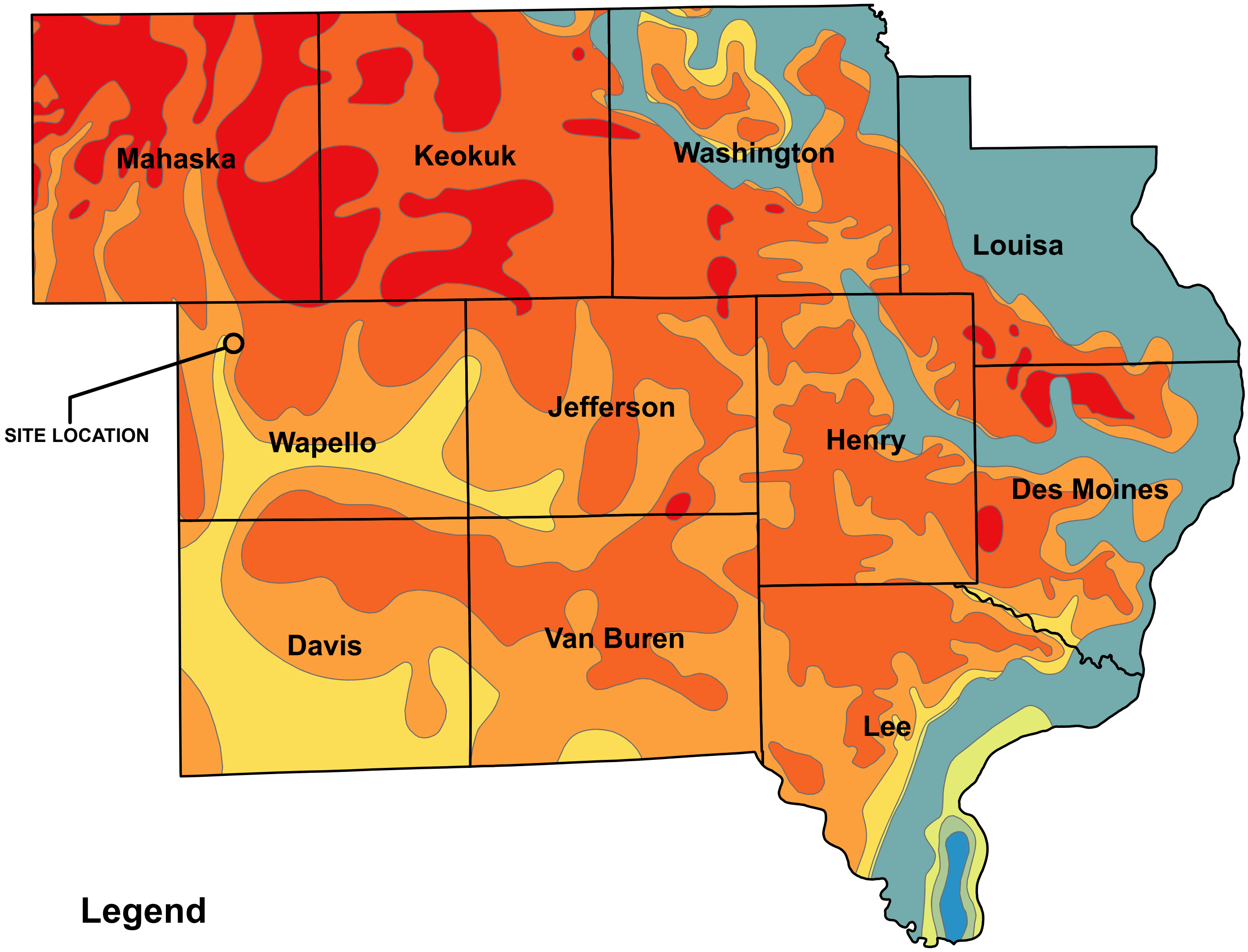
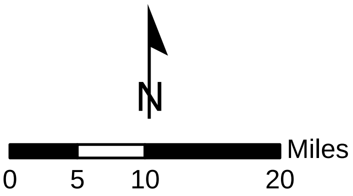


Legend

MISSISSIPIAN AQUIFER ELEVATION

ELEVATION ABOVE MEAN SEA LEVEL IN FEET

🟦 MISSISSIPPIAN NOT PRESENT
🟦 150
🟩 250
🟨 350
🟨 450
🟧 550
🟧 650
🟥 750



MAP DATA DERIVED FROM IOWA GEOLOGICAL AND WATER SURVEY
MISSISSIPPIAN AQUIFER SURFACE ELEVATION AS OBTAINED
FROM IOWA NATURAL RESOURCES
GEOGRAPHIC INFORMATION SYSTEMS LIBRARY

CLIENT	INTERSTATE POWER AND LIGHT CO. 20775 POWER PLANT ROAD OTTUMWA, IA 52501	SITE	OTTUMWA GENERATING STATION OTTUMWA, IOWA	SE IOWA REGIONAL MISSISSIPIAN AQUIFER SURFACE ELEVATION

PROJECT NO. 25215053.03	DRAWN BY: JB	ENGINEER	SCS ENGINEERS 2830 DAIRY DRIVE MADISON, WI 53718-6751 PHONE: (608) 224-2830 FAX: (608) 224-2839	FIGURE
DRAWN: 07/29/13	CHECKED BY: MDB			
REVISED: 05/29/15	APPROVED BY:			

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Appendix C

Boring Logs

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

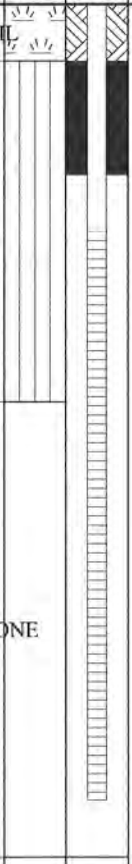
Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Page 1 of 1

Facility/Project Name IPL- Ottumwa Generating Station SCS#: 25215135.40		License/Permit/Monitoring Number		Boring Number MW-301
Boring Drilled By: Name of crew chief (first, last) and Firm Todd Schmalfeld Cascade Drilling		Date Drilling Started 11/10/2015	Date Drilling Completed 11/10/2015	Drilling Method 4-1/4 hollow stem auger
Unique Well No.	DNR Well ID No.	Common Well Name MW-301	Final Static Water Level Feet	Surface Elevation 684.3 Feet
				Borehole Diameter 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
Feet ☐ N ☐ S Feet ☐ E ☐ W

Facility ID
County: Wapello
Civil Town/City/ or Village: 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	U S C S	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
				TOPSOIL.	TOPSOIL									
			1 2 3 4	SANDY SILT WITH GRAVEL, gray (7.5YR 6/1), gravel is fine.	ML									
S1	10	woh 1 3 9	5 6							W				
			7	WEATHERED SANDSTONE, very weak, light gray matrix (10YR 7/1), scondary color very dark gray 910YR 3/1), massive.	SANDSTONE									
S2	13	24 50	8 9							W				
S3	5	50	10 11							W				
S4	6	50	12 13 14							W				
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 ☐

Page 1 of 2

Facility/Project Name IPL-Ottumwa Generating Station SCS#: 25216148.00		License/Permit/Monitoring Number	Boring Number MW-307	
Boring Drilled By: Name of crew chief (first, last) and Firm Mike Mueller Cascade Drilling		Date Drilling Started 10/25/2016	Date Drilling Completed 10/25/2016	Drilling Method HSA
Unique Well No.	DNR Well ID No.	Common Well Name MW-307	Final Static Water Level Feet	Surface Elevation 655.1 Feet
Borehole Diameter 8.5 in				

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 401,707 N, 1,903,070 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
Feet ☐ N ☐ S Feet ☐ E ☐ W

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

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			0–10	POORLY GRADED SAND WITH GRAVEL, tan, fine to coarse sand and gravel, (construction fill sand to fill in hydrovac hole cleared to 8.5 ft bgs).	SP									water level 6.5 ft bgs.
S1	24	2 2 3 2	9–10							W				
			10–15	LEAN CLAY, dark yellowish brown (10YR 4/4), slightly dense.	CL									
S2	14	4 1 4 4	13–14							W				

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

Signature	Firm SCS Engineers 2830 Dairy Drive Madison, WI 53711	Tel: (608) 224-2830 Fax:

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number MW-307

Page 2 of 2

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				LEAN CLAY, dark yellowish brown (10YR 4/4), slightly dense. *(continued)*	CL									
S3	24	1 2 2 4	16	SILT, dark yellowish brown (10YR 3/4), fine to medium sand.	ML					W				
			17											
			18											
S4	17	3 3 3	19							W				Bedrock @19.5 ft bgs.
			20	SANDSTONE, dark brown (10YR 3/3),										
S5	5	50/0.5	21							W				More competent @20.5' -24.5' bgs.
			22											
			23											
			24											
			25	more weathered.										
			26											
			27											
S6	1	100	28	Same as above except, gray (10YR 6/1).										
				End of boring at 28 ft bgs.										

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

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

Page 1 of 2

Facility/Project Name IPL-Ottumwa Generating Station SCS#: 25216148.00	License/Permit/Monitoring Number	Boring Number MW-308

Boring Drilled By: Name of crew chief (first, last) and Firm Mike Mueller Cascade Drilling	Date Drilling Started 10/25/2016	Date Drilling Completed 10/25/2016	Drilling Method HSA

Unique Well No.	DNR Well ID No.	Common Well Name MW-308	Final Static Water Level Feet	Surface Elevation 652.9 Feet	Borehole Diameter 8.5 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 402,312 N, 1,902,665 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 Feet ☐ S
☐ E Feet ☐ W

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

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			0–9.5	POORLY GRADED SAND WITH GRAVEL, tan, fine to coarse sand and gravel, (construction fill sand to fill in hydrovac hole cleared to 9.5 ft bgs).	SP									water @ 6.5 ft bgs.
			9.5–13	LEAN CLAY, brown (10YR 4/3), dense.	CL									
S1	24	19 4 2 2	11							W				
			13–15	SILT, brown (10YR 4/3), some clay.	ML									
S2	13	1 2 2 2	14							W				

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

Signature	Firm SCS Engineers 2830 Dairy Drive Madison, WI 53711	Tel: (608) 224-2830 Fax:

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number MW-308

Page 2 of 2

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				SILT, brown (10YR 4/3), some clay. *(continued)*	ML									
S3	18	1 2 1 3	16	SILTY SAND, brown (10YR 4/3).	SM					W				
			17	POORLY GRADED SAND, brown (10YR 4/3), fine grained.	SP									
S4	13	4 12 13 3	18	WELL GRADED SAND AND GRAVEL, dark grayish brown (10YR 3/2), fine to coarse grained, (weathered bedrock).	SW					W				
			19	SANDSTONE, dark grayish brown (10YR 4/2), weathered bedrock.										
S5	6	12 26 50/0.4	20	Same as above except, brown (10YR 4/3).						W				
			21											
			22											
			23											
			24	Same as above except, dark grayish brown (10YR 4/2).										
S6	4	50/0.4	25							W				
				End of boring at 25 ft bgs.										

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

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

Page 1 of 2

Facility/Project Name IPL-Ottumwa Generating Station SCS#: 25216148.00	License/Permit/Monitoring Number	Boring Number MW-309

Boring Drilled By: Name of crew chief (first, last) and Firm Mike Mueller Cascade Drilling	Date Drilling Started 10/27/2016	Date Drilling Completed 10/27/2016	Drilling Method HSA

Unique Well No.	DNR Well ID No.	Common Well Name MW-309	Final Static Water Level Feet	Surface Elevation 652.5 Feet	Borehole Diameter 8.5 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 403,189 N, 1,902,070 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 ☐ S Feet ☐ E ☐ W Feet

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

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			0	Hydrovac borehole to 10 ft bgs.										
			10	LEAN CLAY, very dark grayish brown (10YR 3/2), trace sand.	CL									
S1		3 3 6 7	11							W				
S2		2 2 2 2	13.5							W				
			15											

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

Signature	Firm SCS Engineers 2830 Dairy Drive Madison, WI 53711	Tel: (608) 224-2830 Fax:

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number MW-309

Page 2 of 2

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
S3		1 1 1 1	16 17	SILTY SAND, very dark grayish brown (10YR 3/2), fine to medium grained.	SM					W				
S4		3 5 4 6	18 19							W				
S5		2 3 7 50	20 21	POORLY GRADED SAND, yellowish brown (10YR 5/4), coarse grained.	SP					W				
			22 23 24	WEATHERED SANDSTONE.										
S6			25 26 27							W				
				End of boring at 27.5 ft bgs.										

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

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

Page 1 of 2

Facility/Project Name IPL-Ottumwa Generating Station SCS#: 25216148.00	License/Permit/Monitoring Number	Boring Number B-309X

Boring Drilled By: Name of crew chief (first, last) and Firm Mike Mueller Cascade Drilling	Date Drilling Started 10/26/2016	Date Drilling Completed 10/26/2016	Drilling Method HSA

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

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane N, 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
Feet ☐ N ☐ S
Feet ☐ E ☐ W

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

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			1 2 3 4 5 6 7 8	POORLY GRADED SAND WITH GRAVEL, tan, fine to coarse sand and gravel, (construction fill sand to fill in hydrovac hole cleared to 9 ft bgs).	SP									Water at 6.5 ft bgs
S1	12	1 3 3 4	9 10 11 12	LEAN CLAY, dark brown (10YR 3/3), medium dense.	CL					W				
S2	18	3 3 3 3	13 14 15	SILT, dark brown (10YR 3/3), some clay.	ML					W				

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

Signature	Firm SCS Engineers 2830 Dairy Drive Madison, WI 53711	Tel: (608) 224-2830 Fax:

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number B-309X

Page 2 of 2

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				SILT, dark brown (10YR 3/3), some clay. *(continued)*	ML									
S3	20	3 3 3 2	16	POORLY GRADED SAND, very dark grayish brown (10YR 3/2), fine grained.	SP					W				
			17	SILT, dark brown (10YR 3/3).	ML									
			18	POORLY GRADED SAND, brown (10YR 4/3).	SP									
S4	15	1 17 50/0.2	19	WEATHERED SANDSTONE, grayish brown (10YR 5/2).						W				Bedrock at18.5 ft bgs
S5	6	50/0.3	20							W				
			21											
			22											
			23											
			24											
			25											
			26											
				End of boring at 26.5 ft bgs.										

Appendix D

Ash Pond CCR Unit Cobalt Data

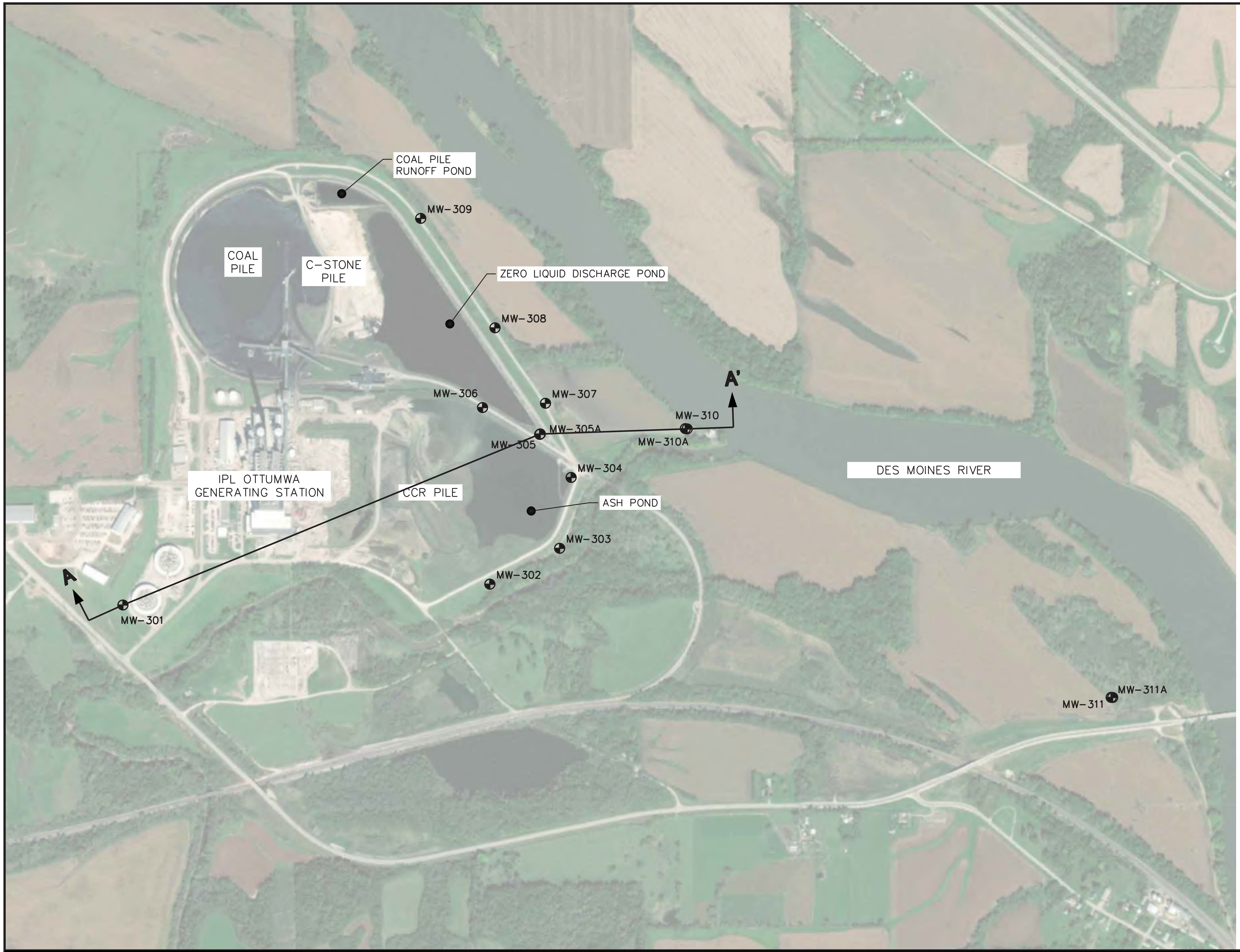
Cobalt Results for Ash Pond and ZLDP Wells

IPL - Ottumwa Generating Station

Parameter:	Cobalt
Number of Sampling Dates:	32
Units:	ug/L

	Background	Compliance - Ash Pond					Compliance - ZLDP			Additional Wells for ACM/SOR - Ash Pond				
Location ID	**MW-301**	**MW-302**	**MW-303**	**MW-304**	**MW-305**	**MW-306**	**MW-307**	**MW-308**	**MW-309**	**MW-310**	**MW-311**	**MW-305A**	**MW-310A**	**MW-311A**
4/26/2016	4.1	2.6	2.2	0.89	14.8	8.3	--	--	--	--	--	--	--	--
6/23/2016	3.1	1.4	2.5	1.1	15.1	7.7	--	--	--	--	--	--	--	--
8/10/2016	1.8	1.1	2.6	--	--	--	--	--	--	--	--	--	--	--
8/11/2016	--	--	--	<0.5	13.7	6.4	--	--	--	--	--	--	--	--
10/26/2016	1.8	1	3.1	--	--	--	--	--	--	--	--	--	--	--
10/27/2016	--	--	--	<0.5	14.8	6.6	--	--	--	--	--	--	--	--
1/18/2017	1.3	0.94	2.6	<0.5	15.2	6	--	--	--	--	--	--	--	--
1/19/2017	--	--	--	--	--	--	0.62	0.52	2	--	--	--	--	--
4/19/2017	0.97	0.95	1.8	0.37	14.6	5.7	--	--	--	--	--	--	--	--
4/20/2017	--	--	--	--	--	--	1.6	0.43	3.1	--	--	--	--	--
6/20/2017	1	0.86	1.9	--	--	--	--	--	--	--	--	--	--	--
6/21/2017	--	--	--	0.36	14.4	5.2	1.1	0.25	2.4	--	--	--	--	--
8/21/2017	--	--	--	--	--	--	1.1	0.26	2.1	--	--	--	--	--
8/22/2017	--	0.88	2.8	0.3	--	--	--	--	--	--	--	--	--	--
8/23/2017	0.96	--	--	--	14.7	5	--	--	--	--	--	--	--	--
11/8/2017	--	--	--	--	--	--	1.3	0.23	2	--	--	--	--	--
4/16/2018	--	--	--	--	--	--	1.3	0.18	2.4	--	--	--	--	--
4/18/2018	0.46	0.9	2.1	0.39	14.5	4.8	--	--	--	--	--	--	--	--
6/28/2018	--	--	--	--	--	--	2.9	0.19	4.7	--	--	--	--	--
8/14/2018	1.4	1.5	2.2	--	--	--	--	--	--	--	--	--	--	--
8/15/2018	--	--	--	0.92	15.6	5.5	--	--	--	--	--	--	--	--
10/16/2018	0.36	4	1.7	0.45	17.2	6.4	4.8	0.15	2.7	--	--	--	--	--
1/8/2019	--	--	--	--	16.4	6.2	--	--	--	--	--	--	--	--
4/8/2019	0.44	1.2	0.42	0.4	17	6.9	--	--	--	--	--	--	--	--
10/23/2019	--	--	--	0.5	17	6.2	--	--	--	--	--	--	--	--
10/24/2019	0.6	2.7	1.2	--	--	--	--	--	--	0.57	0.78	--	--	--
12/11/2019	--	--	--	--	--	--	11	0.26	3.7	--	--	--	--	--
2/5/2020	1.1	--	--	--	--	--	13	0.14	2.3	0.32	0.11	--	--	--
3/12/2020	0.43	--	--	--	--	--	--	--	--	0.32	--	--	--	--
3/13/2020	--	--	--	--	18	--	--	--	--	--	<0.091	2.4	0.63	0.19
4/13/2020	--	--	--	0.57	16	--	--	--	--	0.24	<0.091	--	--	0.13
4/14/2020	0.52	5.3	0.87	--	--	5.5	20	0.14	3.2	--	--	2.7	0.39	--

APPENDIX C5– STRATIGRAPHIC CROSS SECTION



LEGEND

● MONITORING WELL

GEOLOGIC CROSS SECTION

NOTES:

1. 2014 AERIAL PHOTOGRAPH SOURCES: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA FSA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY.
2. MONITORING WELLS MW-301, MW-302, AND MW-304, WERE INSTALLED BY CASCADE DRILLING, LLP. UNDER THE SUPERVISION OF SCS ENGINEERS FROM NOVEMBER 11-12, 2015.
3. MONITORING WELLS MW-303 AND MW-305 WERE INSTALLED BY CASCADE DRILLING LLP. UNDER THE SUPERVISION OF SCS ENGINEERS ON DECEMBER 7-8, 2015.
4. MONITORING WELLS MW-307, MW-308, AND MW-309 WERE INSTALLED BY CASCADE DRILLING, LLP. UNDER THE SUPERVISION OF SCS ENGINEERS FROM OCTOBER 25-27, 2016.
5. MONITORING WELLS MW-310 AND MW-311 WERE INSTALLED BY ROBERTS ENVIRONMENTAL DRILLING ON AUGUST 27, 2019.
6. MONITORING WELLS MW-305A, MW-310A, AND MW-311A WERE INSTALLED BY ROBERTS ENVIRONMENTAL DRILLING BETWEEN FEBRUARY 27, 2020 AND MARCH 3, 2020.

N

800 0 800

SCALE: 1" = 800'

PROJECT NO.	25220083.00	DRAWN BY:	BSS
DRAWN:	11/15/2019	CHECKED BY:	MDB
REVISED:	05/11/2020	APPROVED BY:	EJN 9/11/2020

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

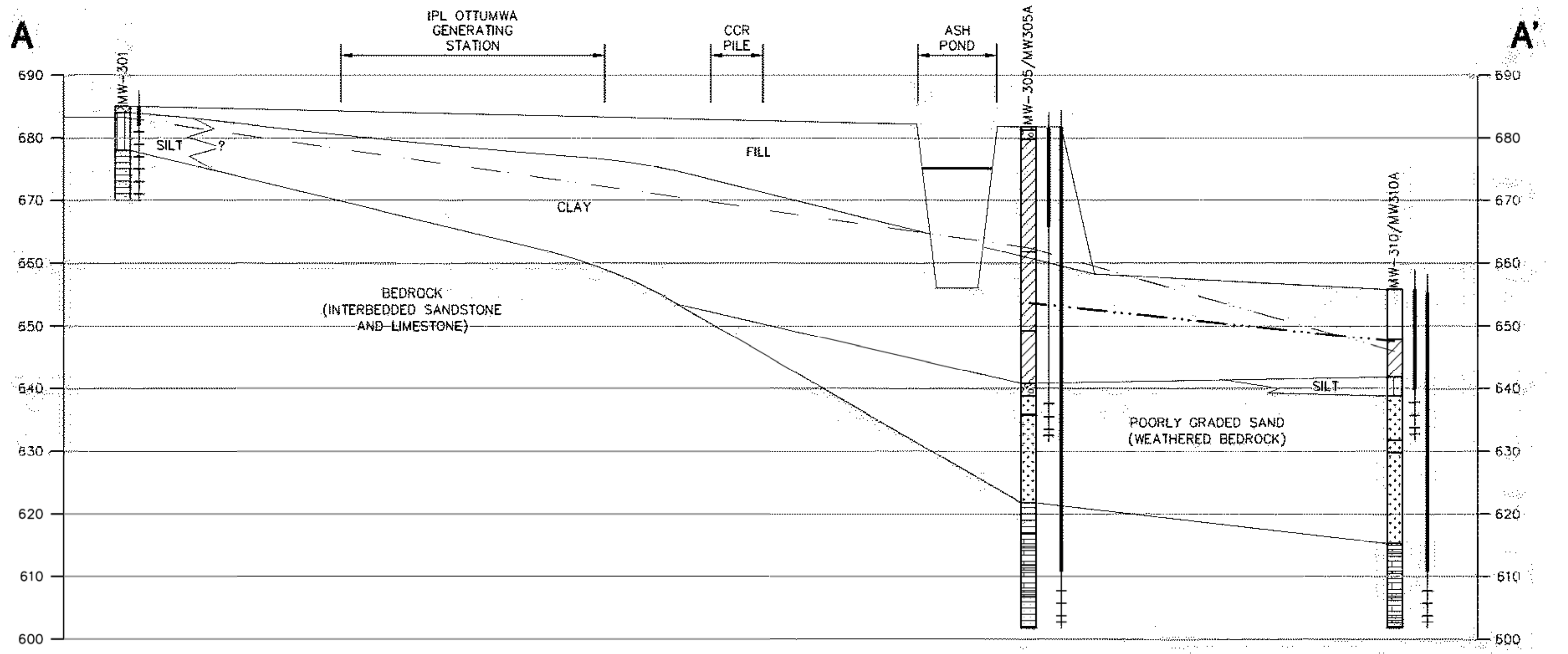
SITE

ALLIANT ENERGY
OTTUMWA GENERATING STATION
OTTUMWA, IOWA

SITE PLAN
AND MONITORING WELL LOCATIONS

FIGURE
2

I:\25220083.00\Drawings\Site Plan and Monitoring Well Locations.dwg, 5/11/2020 7:55:48 AM



LEGEND

▨ TOPSOIL/FILL

░ SAND, POORLY GRADED (SP)

▥ SILT, WITH SAND AND GRAVEL (ML)

▨ CLAY

░ GRAVEL, POORLY GRADED, LITTLE OR NO FINES (GP)

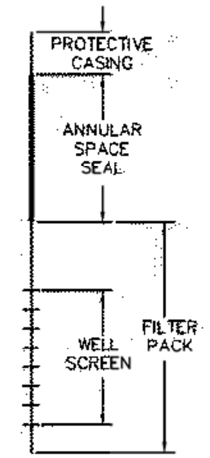
▤ SANDSTONE

▦ LIMESTONE

— · · · — DEEP POTENTIOMETRIC SURFACE MEASURED APRIL 13–14, 2020

— · · · — SHALLOW POTENTIOMETRIC SURFACE MEASURED APRIL 13–14, 2020

—— POND SURFACE ELEVATION MEASURED JUNE 10–11, 2019



WELL DETAIL

HORIZONTAL SCALE: 1" = 500'
VERTICAL SCALE: 1" = 20'
VERTICAL EXAGGERATION = 25X

NOTES:

1. MW-305 AND MW-305A WERE HYDROVACED TO APPROXIMATELY 8.5'. MW-310 AND MW-310A WERE HYDROVACED TO APPROXIMATELY 8.0'. HYDROVACING IS PERFORMED TO DETERMINE IF UNDERGROUND UTILITIES ARE PRESENT. HIGH PRESSURE WATER AND A VACUUM ARE USED TO CLEAR THE BOREHOLE AND GEOLOGIC SAMPLES ARE NOT COLLECTED. NATIVE SOIL IN THE VICINITY OF MW-307 IS CLAY.

2. ASH POND BOTTOM ELEVATION IS BASED ON THE EMBANKMENT CREST ELEVATION (681 FEET) AND INTERNAL STORAGE DEPTH (25 FEET) REPORTED IN THE HISTORY OF CONSTRUCTION REPORT ISSUED SEPTEMBER 29, 2016, BY HARD HAT SERVICES.

PROJECT NO.	25220083.00	DRAWN BY:	BSS/KP
DRAWN:	07/03/2019	CHECKED BY:	NDK/MDB
REVISED:	05/13/2020	APPROVED BY:	EJN 9/11/2020

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PHONE: (608) 224-2830

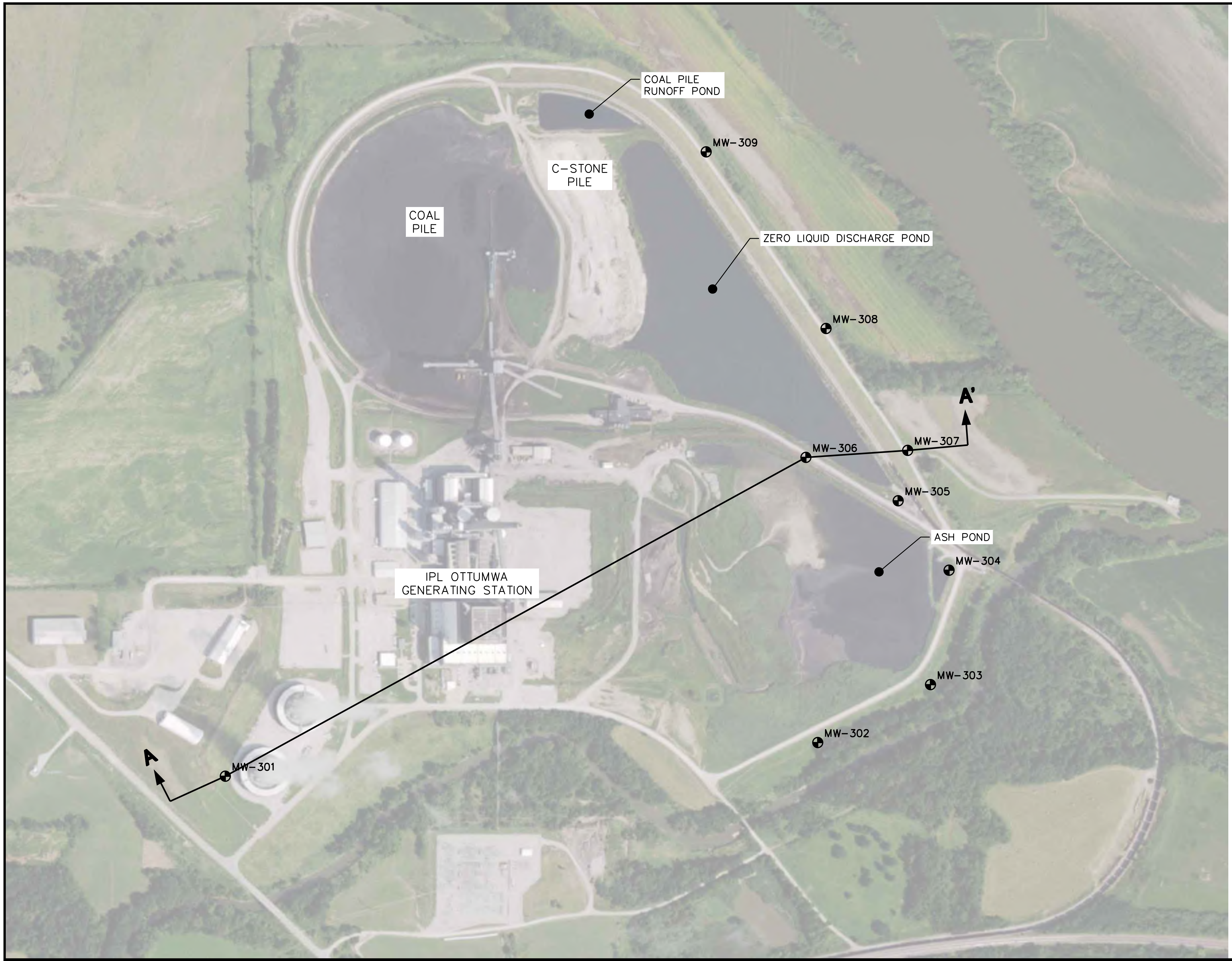
CLIENT
INTERSTATE POWER AND LIGHT CO.
15300 130th STREET
OTTUMWA, IA 52501

SITE
OTTUMWA GENERATING STATION
20775 POWER PLANT ROAD
OTTUMWA, IOWA

GEOLOGIC CROSS SECTION A–A'

FIGURE
4

I:\25220083.00\Drawings\Geologic Cross Section.dwg, 5/13/2020 8:26:34 AM

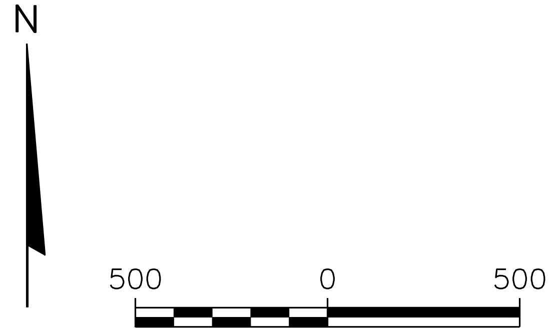


LEGEND

●	CCR MONITORING WELL LOCATION (APPROXIMATE)
↑__↑	GEOLOGIC CROSS SECTION

NOTES:

1. MONITORING WELLS MW-301 THROUGH MW-306 COMPRISE THE MONITORING SYSTEM FOR THE ASH POND. MONITORING WELLS MW-307 THROUGH MW-309 WERE ADDED TO MONITOR THE ZERO LIQUID DISCHARGE (ZLD) POND. MW-301 IS A SHARED BACKGROUND WELL FOR BOTH CCR UNITS.



SCALE: 1" = 500'

PROJECT NO.	25218201.00	DRAWN BY:	BSS
DRAWN:	07/03/19	CHECKED BY:	MDB
REVISED:	08/13/19	APPROVED BY:	TJK 09/10/19

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15300 130th STREET
OTTUMWA, IA 52501

SITE

OTTUMWA GENERATING STATION
20775 POWER PLANT ROAD
OTTUMWA, IOWA

SITE PLAN AND MONITORING WELL LOCATIONS MAP

FIGURE
2

I:\25218201.00\Drawings\Ottumwa\2 Ottumwa Site an Monitoring e Location Ma .dwg, 9/10/2019 1: 8:0 M

LEGEND

▩ TOPSOIL/FILL

⛆ SAND, POORLY GRADED (SP)

▥ SILT, WITH SAND AND GRAVEL (ML)

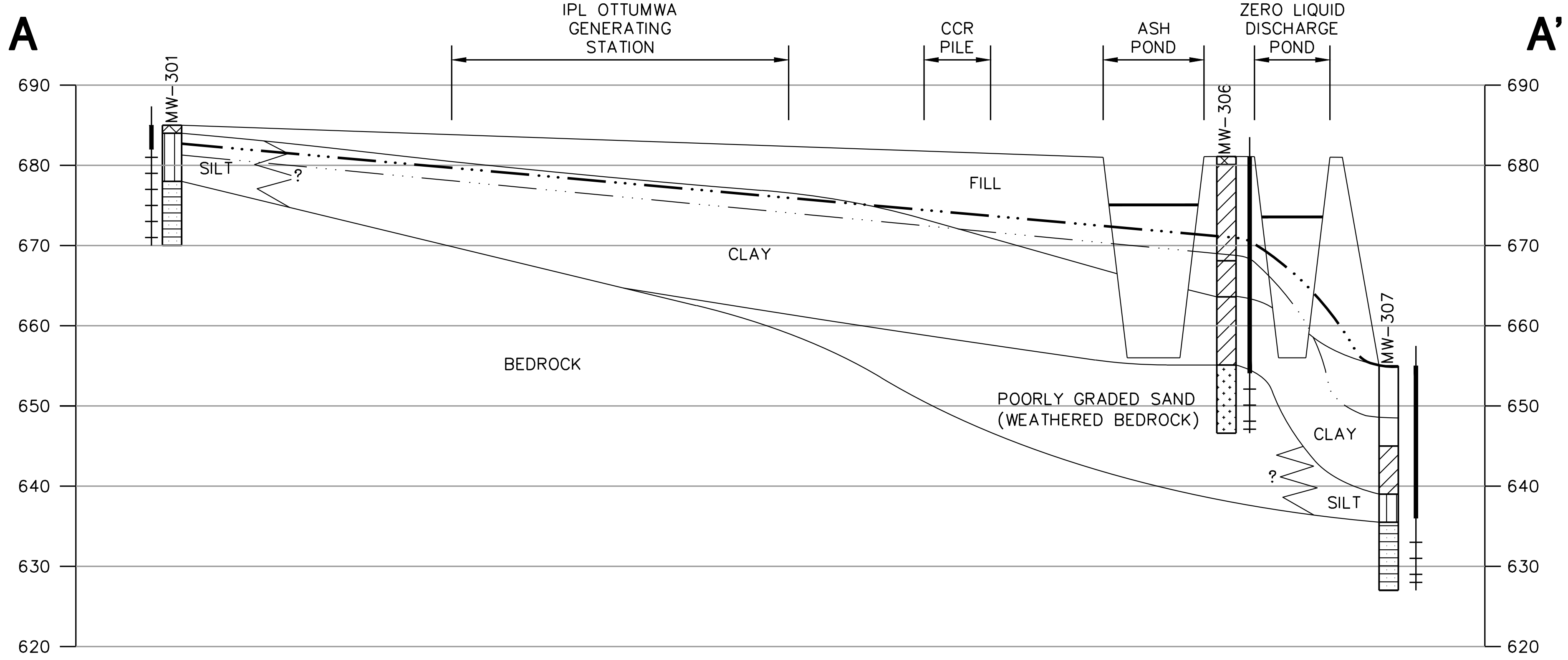
▨ CLAY

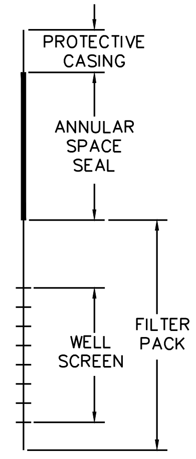
▤ SANDSTONE

—···— HIGH POTENTIOMETRIC SURFACE MEASURED APRIL 2019

—·—·— LOW POTENTIOMETRIC SURFACE MEASURED AUGUST 2017

▬ POND SURFACE ELEVATION MEASURED JUNE 10-11, 2019





WELL DETAIL

HORIZONTAL SCALE: 1" = 500'
VERTICAL SCALE: 1" = 20'
VERTICAL EXAGGERATION = 25X

NOTES:

1. MW-307 WAS HYDROVACED TO APPROXIMATELY 8.5'. HYDROVACING IS PERFORMED TO DETERMINE IF UNDERGROUND UTILITIES ARE PRESENT. HIGH PRESSURE WATER AND A VACUUM ARE USED TO CLEAR THE BOREHOLE AND GEOLOGIC SAMPLES ARE NOT COLLECTED. NATIVE SOIL IN THE VICINITY OF MW-307 IS CLAY.

2. ASH POND AND ZLD POND BOTTOM ELEVATIONS ARE BASED ON THE EMBANKMENT CREST ELEVATION (681 FEET) AND INTERNAL STORAGE DEPTH (25 FEET) REPORTED IN THE HISTORY OF CONSTRUCTION REPORT ISSUED SEPTEMBER 29, 2016, BY HARD HAT SERVICES.

PROJECT NO.	25218201.00	DRAWN BY:	BSS
DRAWN:	07/03/19	CHECKED BY:	NDK/MDB
REVISED:	08/13/19	APPROVED BY:	TJK 09/10/19

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OTTUMWA, IA 52501

SITE
OTTUMWA GENERATING STATION
20775 POWER PLANT ROAD
OTTUMWA, IOWA

GEOLOGIC CROSS SECTION A-A'

FIGURE
4

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APPENDIX C6– ASSESSMENT OF CORRECTIVE MEASURE

Assessment of Corrective Measures OGS Ash Pond

Ottumwa Generating Station
Ottumwa, Iowa

Prepared for:

Alliant Energy

SCS ENGINEERS

25218202.00 | September 12, 2019

2830 Dairy Drive
Madison, WI 53718-6751
608-224-2830

Table of Contents

Tables

Figures

Appendices

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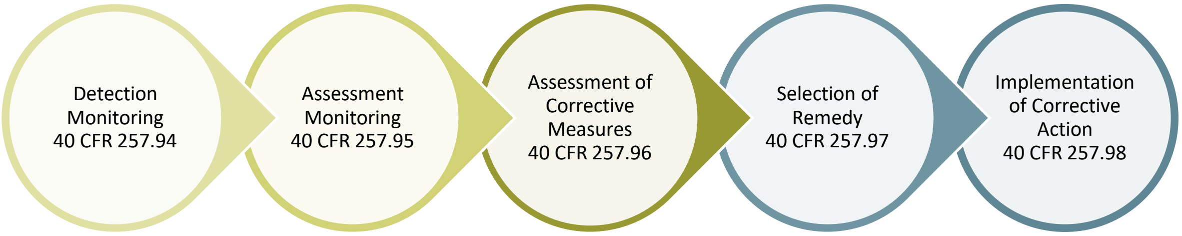
EXECUTIVE SUMMARY

Interstate Power and Light Company (IPL), an Alliant Energy company, operates two ash ponds at the Ottumwa Generating Station (OGS). The ponds are used to manage coal combustion residuals (CCR) and wastewater from the power plant, which burns coal to generate electricity.

IPL samples and tests the groundwater in the area of the ash ponds to comply with U.S. Environmental Protection Agency (USEPA) standards for the Disposal of CCR from Electric Utilities, or the “CCR Rule” (Rule).

Groundwater samples from two of the wells installed to monitor one of the ponds (OGS Ash Pond) contain cobalt at levels higher than the Groundwater Protection Standards (GPS) defined in the Rule. Cobalt occurs naturally and can be present in coal and CCR.

IPL has prepared this Assessment of Corrective Measures (ACM) Report in response to the groundwater sampling results at the OGS facility. The ACM process is one step in a series of steps defined in the Rule and shown below.



To prepare the ACM, IPL has worked to understand the following:

- Types of soil and rock deposits in the area of the OGS facility.
- Depth of groundwater.
- Direction that groundwater is moving.
- Potential sources of the cobalt in groundwater.
- The area where cobalt levels are higher than the USEPA standards.
- The people, plants, and animals that may be affected by levels of cobalt in groundwater that are above the GPS.

IPL has installed new wells to help identify where cobalt levels are higher than the USEPA standards. Because the time allowed by the Rule to prepare the ACM is limited, work to improve the understanding of the items listed above is still ongoing.

IPL has identified appropriate options, or Corrective Measures, to bring the levels of cobalt in groundwater below USEPA standards. In addition to stopping the discharge of CCR and OGS wastewater to the pond, these corrective measures include:

- Cap CCR in Place with Monitored Natural Attenuation (MNA)
- Consolidate CCR and Cap with MNA
- Excavate and Dispose CCR on Site with MNA
- Excavate and Dispose CCR in Off-site Landfill with MNA

IPL has also included a “No Action” alternative for comparison purposes only.

The ACM includes a preliminary evaluation of all five options using factors identified in the Rule.

Based on what is currently known, the groundwater impacts at OGS are limited, but are not completely understood. IPL will continue to work on understanding groundwater impacts at OGS, and will use this information to select one of the Corrective Measures identified above.

IPL will provide semiannual updates on its progress in evaluating Corrective Measures to address the groundwater impacts at OGS.

Before a remedy is selected, IPL will hold a public meeting with interested and affected parties to discuss the ACM.

For more information on Alliant Energy, view our 2019 Corporate Sustainability Report at http://www.alliantenergy.com/sustainability.

1.0 INTRODUCTION AND PURPOSE

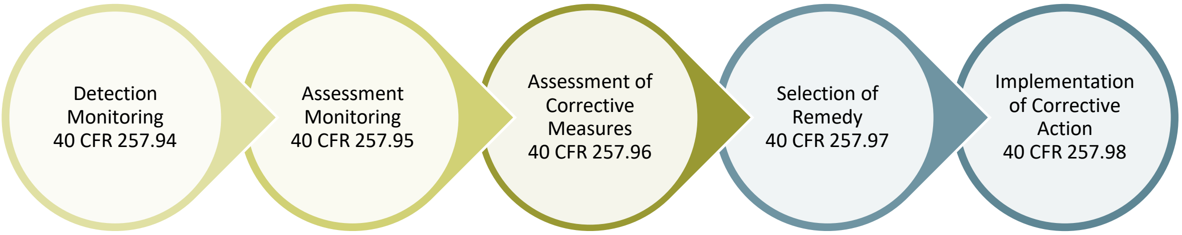
The Assessment of Corrective Measures (ACM) at the Interstate Power and Light Company (IPL) Ottumwa Generating Station (OGS) was prepared to comply with U.S. Environmental Protection Agency (USEPA) regulations regarding the Disposal of Coal Combustion Residuals (CCR) from Electric Utilities [40 CFR 257.50-107], or the "CCR Rule" (Rule). Specifically, the ACM was initiated and this report was prepared to fulfill the requirements of 40 CFR 257.96, including:

- Prevention of further releases
- Remediation of release
- Restoration of affected areas

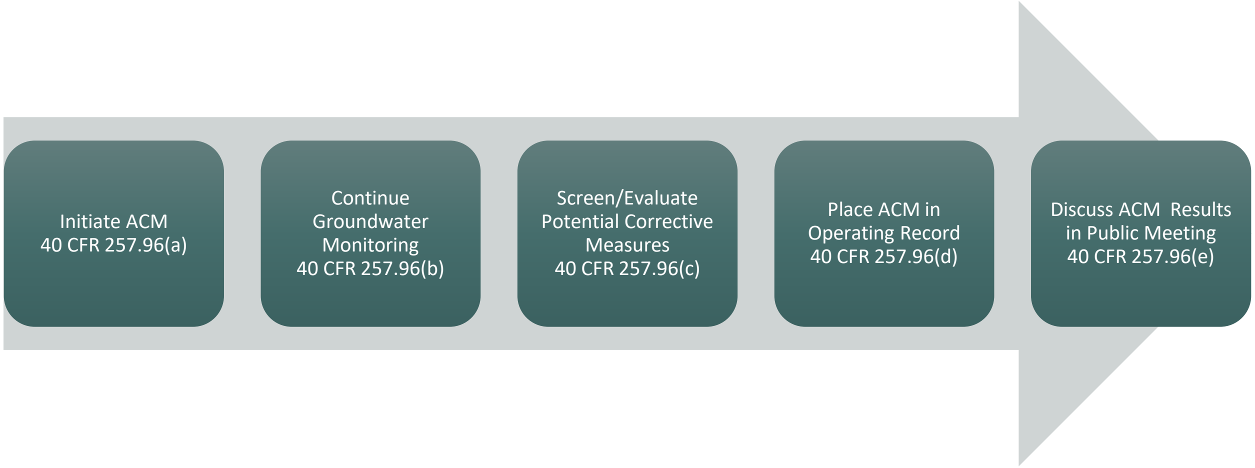
This ACM Report summarizes the remedial alternatives for addressing the Groundwater Protection Standard (GPS) exceedances observed in the October 2018 sampling event for the OGS Ash Pond, and identified in the Notification of Groundwater Protection Standard Exceedance dated January 14, 2019.

1.1 ASSESSMENT OF CORRECTIVE MEASURES REQUIREMENTS

As discussed above, this ACM Report has been prepared in response to GPS exceedances observed in groundwater samples collected at the OGS facility. The ACM process is one step in a series of steps defined in the CCR Rule and depicted in the graphic below. To date, IPL has implemented a detection monitoring program per 40 CFR 257.94 and completed assessment monitoring at OGS per 40 CFR 257.95. An ACM is now required based on the groundwater monitoring results obtained through October 2018. With the ACM completed, IPL is required to select a corrective measure (remedy) according to 40 CFR 257.97. The remedy selection process must be completed as soon as feasible, and, once selected, IPL is required to start the corrective action process within 90 days.



The process for developing the ACM is defined in 40 CFR 257.96 and is shown in the graphic below. IPL is required to discuss the ACM results in a public meeting at least 30 days before selecting a remedy. To facilitate the selection of a remedy for the GPS exceedances at OGS, IPL continues to investigate and assess the nature and extent of the groundwater impacts. Information about the site, the groundwater monitoring completed, the groundwater impacts as they are currently understood, and the ongoing assessment activities are discussed in the sections that follow.



1.2 SITE INFORMATION AND MAP

OGS is located southwest of the Des Moines River, approximately 8 miles northwest of the City of Ottumwa in Wapello County, Iowa (**Figure 1**). The address of the plant is 20775 Power Plant Road, Ottumwa, Iowa. In addition to the coal-fired generating station, the property also contains the OGS Ash Pond, the OGS Zero Liquid Discharge (ZLD) Pond, a coal stockpile, and a hydrated fly ash stockpile.

The two CCR units at the facility (OGS Ash Pond and OGS ZLD Pond) are each monitored with single-unit groundwater monitoring systems. The OGS Ash Pond is the subject of this ACM Report.

The pending closure of the OGS Ash Pond was discussed in the IPL Notification of Intent to Close CCR Surface Impoundment, dated April 3, 2019. A map showing the CCR units and all background (or upgradient) and downgradient monitoring wells with identification numbers for the CCR groundwater monitoring program is provided as **Figure 2**.

2.0 BACKGROUND

2.1 REGIONAL GEOLOGIC INFORMATION

The uppermost geologic formation beneath OGS that meets the definition of the "uppermost aquifer," as defined under 40 CFR 257.53, is the Mississippian bedrock aquifer and hydraulically connected overlying unconsolidated sediments. The thickness and water-producing capacity of the unconsolidated material in the area is variable. A summary of the regional hydrogeologic stratigraphy is included in **Attachment A**.

2.2 SITE GEOLOGIC INFORMATION

Monitoring wells MW-301 through MW-306 were installed to intersect the uppermost aquifer at the site. Due to variations in the unconsolidated material thickness and the bedrock surface, some wells are screened in unconsolidated material and some are in bedrock. The unconsolidated material at these well locations generally consists of a clay layer overlying clay and sand. The total monitoring well boring depths are between 14 and 50 feet. The depth to bedrock at the site is variable, and the bedrock surface is highly weathered in some areas. Bedrock was encountered as shallow as 7 feet and as deep as 44 feet below ground surface (bgs) in the monitoring well borings. The boring logs for MW-301 through MW-306 are included in **Appendix B**.

Shallow groundwater at the site generally flows toward the Des Moines River. The groundwater flow pattern in April 2019 is shown on **Figure 3**. The groundwater elevation data for the CCR monitoring wells are provided in **Table 1**.

A geologic cross section was prepared for OGS. The cross section line runs through upgradient well MW-301 and downgradient monitoring wells MW-306 and MW-307, and crosses the OGS Ash Pond. The cross section location is provided on **Figure 2**, and the geologic cross section is provided on **Figure 4**. Geologic material and estimated water table levels are identified on the cross section.

2.3 CCR RULE MONITORING SYSTEM

The groundwater monitoring system established in accordance with the CCR Rule consists of one upgradient (background) monitoring well and five downgradient monitoring wells. The CCR Rule wells are installed in the uppermost aquifer at the site. Well depths range from approximately 14 to 50 feet bgs.

The background well, MW-301, and five downgradient wells, MW-302, MW-303, MW-304, MW-305, and MW-306, were installed in November and December 2015.

3.0 NATURE AND EXTENT OF GROUNDWATER IMPACTS

3.1 POTENTIAL SOURCES

The potential sources of groundwater impacts detected in the Ash Pond monitoring system are currently under evaluation. The Closure Plan for CCR Surface Impoundments at OGS issued in September 2016 details the steps to be undertaken to close the OGS Ash Pond by leaving the CCR in place, in accordance with §257.102(b) of the CCR Rule. Based on the Closure Plan, potential sources of groundwater impacts from the Ash Pond CCR unit include the following:

CCR Unit	Potential Sources	Description	Quantity
OGS Ash Pond	CCR	Bottom ash, economizer ash, precipitator fly ash, hydrated fly ash, and pyrites	463,000 CY to this total
	Storm water	Annual precipitation, runoff from surrounding areas	94 AC-FT. (Watershed of 76 acres)
	Low-volume plant wastewater	Discharge from the oil water separator, SCU blowdown, plant drains, cooling tower blowdown, and contact water/leachate from OML	1.62 million gallons per day (MGD)

Note: Storm water volume is calculated based on the watershed area for the OGS Ash Pond and the annual average precipitation for Ottumwa, Iowa, of 37 inches/year. The volume of annual runoff from the surrounding areas that are not open water (58 acres), which are part of the OGS Ash Pond watershed, is estimated using Figure 1. Average Annual Runoff, 1951-1980 from USGS publication Average Annual Runoff in the United States, 1951-80 (Gebert 1987). Figure 1 shows approximately 8.0 inches of runoff from the 58 acres for an estimated 39 acre-feet of storm water annually. The quantity provided for plant wastewater is the average discharge from the ash pond (Outfall 001).

The OGS ZLD Pond is monitored separately from the Ash Pond and is not currently considered a potential source for the groundwater impacts detected in the Ash Pond monitoring system.

3.2 GROUNDWATER ASSESSMENT

3.2.1 Groundwater Depth and Flow Direction

Depth to groundwater as measured in the site monitoring wells varies from 1 to 25 feet bgs due to topographic variations across the facility and seasonal variations in water levels. Groundwater flow at the site is generally to the east-northeast, and the groundwater flow direction and water levels fluctuate seasonally due to the proximity to the river.

3.2.2 Groundwater Protection Standard Exceedances Identified

The ACM process was triggered by the detection of cobalt at statistically significant levels exceeding the Groundwater Protection Standards (GPSs) in samples from MW-305.

This statistical evaluation of the assessment monitoring results was based on the first four sampling events for the Appendix IV assessment monitoring parameters, including complete sampling events in April, August, and October 2018, and a resampling event for cobalt at selected wells in January 2019. The complete results for these sampling events are summarized in **Table 3**.

For comparison of assessment monitoring data to fixed GPS values, the USEPA's Unified Guidance for Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities (EPA 530-R-09-007, March 2009) recommends the use of confidence intervals. Specifically, the suggested approach for comparing assessment groundwater monitoring data to GPS values based on long-term chronic health risk, such as drinking water Maximum Contaminant Levels (MCLs), is to compare to a lower confidence limit around the arithmetic mean with the fixed GPS.

The calculated lower confidence limit for the means were compared to the cobalt GPS for wells MW-305 and MW-306. Based on these comparisons, a statistically significant exceedance has not occurred for cobalt at MW-306. Monitoring well MW-306 had individual results exceeding the GPS for cobalt, but the exceedances were not determined to be at statistically significant levels.

Based on the results of assessment monitoring conducted through the April 2019 sampling event, statistically significant levels exceeding the GPSs were identified for the following well and parameter:

Assessment Monitoring Appendix IV Parameters	Location of GPS Exceedance(s)	Historic Range of Detections at Wells Exceeding GPS	Groundwater Protection Standards (GPS)
Cobalt (µg/L)	MW-305	14.5-17.2	6

µg/L = micrograms per liter

Note: Historic range includes results from assessment monitoring from April 2018 through April 2019.

3.2.3 Expanding the Groundwater Monitoring Network

Monitoring wells MW-310 and MW-311 were installed in the area between the current downgradient wells and the Des Moines River to fulfill the requirements of 40 CFR 257.95(g)(1), which requires additional characterization to support a complete and accurate assessment of corrective measures. The installation of these wells was originally scheduled for spring 2019, but due to state and federal permitting requirements and persistent flooding along the Des Moines River, the installation was delayed. The new wells have been installed and developed, but the initial sampling of these wells has not been completed as of the date of this report. The full schedule of groundwater samples collected to date is provided in **Table 2**.

3.3 CONCEPTUAL SITE MODEL

The following conceptual site model describes the compound and nature of the constituent above the GPS, discusses potential exposure pathways affecting human health and the environment, and presents a cursory review of their potential impacts. The conceptual site model for OGS has been prepared in general conformance with the Standard Guide for Developing Conceptual Site Models for Contaminated Sites (ASTM E1689-95). This conceptual site model is the basis for assessing the efficacy of likely corrective measures to address the source, release mechanisms, and exposure routes.

3.3.1 Nature of Constituent Above GPS

To describe the nature of the constituents in groundwater at OGS, we have reviewed a number of sources for information regarding cobalt in groundwater, and how that groundwater may impact potential receptors through the exposure pathways discussed in **Section 3.3.2**.

Cobalt

Cobalt (Co) is a naturally occurring element that has properties similar to those of iron and nickel (ATSDR 2004). Cobalt is naturally present in coal and is present in CCR after the coal is combusted.

Cobalt is commonly used to create blue pigment and coloration in jewelry, glass, metal, and other decorative uses. Industrially, Cobalt is primarily used in the manufacture of magnetic, wear-resistant and high-strength alloys (Campbell, 2008).

A summary of the properties, occurrences, and potential health effects of cobalt is provided in the Public Health Statement and ToxFAQs factsheet prepared by the Agency for Toxic Substances and Disease Registry (ATSDR), which is an agency of the U.S. Department of Health and Human Services. Copies of the ATSDR Public Health Statement and ToxFAQs factsheet are provided in **Appendix C.**

Cobalt Exposure

In January 2016, the United States Department of Health and Human Services (HHS) ATSDR provided a health consultation to the United States Department of HHS (ATSDR 2016). The report offered the following:

- Cobalt is an essential nutrient that humans need in small amounts for maintenance of vitamin B12 (TOX, 2008). However, when consumed in high amounts, cobalt can adversely affect the blood, liver, kidneys, and heart.

- Studies in animals suggest that exposure to high amounts of cobalt during pregnancy can affect the health of the developing fetus, but doses used in these studies were much higher than the amounts to which humans are usually exposed (ATSDR 2004). Birth defects have not been found in human children born to mothers who were treated with cobalt during pregnancy. Cardiomyopathy has been reported in humans exposed to cobalt, but these effects may have been confounded by the alcoholism of the patients. Much larger doses of cobalt were required to induce the same effects in animal studies (ATSDR, 2004).

- The International Agency for Research on Cancer (IARC) determined that certain forms of cobalt have been classified as possibly carcinogenic to humans (IARC, 2006), but cobalt has not been found to cause cancer in humans or animals following exposure in food or water. Studies indicate that cobalt is a potential carcinogen when inhaled.

- Animal studies suggest that children may absorb more cobalt than adults from food and liquids. It is estimated that humans absorb 5 to 45 percent of ingested cobalt (TOX, 2008).

The concentrations of cobalt detected to date in samples from the site monitoring wells range from below the detection limit to 17.2 µg/L. The GPS for cobalt is 6 µg/L. For drinking water, the USEPA has not established a maximum contaminant level (MCL) for cobalt. Based on the preamble to the CCR Rule amendments issued in the Federal Register (Volume 83, No. 146) on July 30, 2018, USEPA established the GPS for cobalt using guidelines for assessing human health risks for environmental pollutants. The GPS represents a concentration that people could be exposed to daily for a lifetime without negative effects (USEPA, 2018).

3.3.2 Potential Receptors and Pathways

As described in **Section 3.3**, ASTM E1689-95 provides a framework for identifying potential receptors (people or other organisms potentially affected by the groundwater impacts at OGS) and pathways (the ways groundwater impacts might reach receptors). In accordance with ASTM E1689-95, we have considered potential human and ecological exposures to groundwater impacted by the constituents identified in **Section 3.2.2**:

Human Health

In general, human health exposure routes to contaminants in the environment include ingestion, inhalation, and dermal contact with the following environmental media:

- Groundwater
- Surface Water and Sediments
- Air
- Soil
- Biota/Food

If people might be exposed to the impacts described in **Section 3.0** via one of the environmental media listed above, a potential exposure route exists and is evaluated further. For the groundwater impacts at OGS, the following potential exposure pathways have been identified with respect to human health:

- Groundwater – Ingestion and Dermal Contact: The potential for ingestion of, or dermal contact with, impacted groundwater from OGS exists if water supply wells are present in the area of impacted groundwater and are used as a potable water supply. Based on a review of the Iowa Department of Natural Resources GeoSam well database, and information provided by OGS:
  - No off-site water supply wells have been identified downgradient or sidegradient in the vicinity of the CCR units.
  - Potable water is not supplied from on-site wells. Potable water at OGS is provided by the Wapello Rural Water Association.

- Surface Water and Sediments – Ingestion and Dermal Contact: The potential for ingestion of or dermal contact with impacted surface water and sediments exists if impacted groundwater from the OGS facility has interacted with adjacent surface water and sediments, to the extent that cobalt is present in these media at concentrations that represent a risk to human health.

- Biota/Food – Ingestion: The potential for ingestion of impacted food exists if impacted groundwater from the OGS facility has interacted with elements of the human food chain. Elements of the food chain may also be exposed indirectly through groundwater-to-surface water interactions, which are subject to additional assessment.

Based on the lack of groundwater exposure, only the surface water, sediment, and biota/food exposure pathways were retained for further consideration until the nature and extent of cobalt impacts via groundwater have been evaluated with additional monitoring wells. If the impacts do not extend to the river, then the surface water and sediment pathways will not be complete. Implementation of potential corrective measures may introduce secondary exposure pathways that are discussed in **Section 6.0** and will be evaluated further as a corrective measure is selected for OGS.

Ecological Health

In addition to human exposures to impacted groundwater, potential ecological exposures are also considered. If ecological receptors might be exposed to impacted groundwater, the potential exposure routes are evaluated further. Ecological receptors include living organisms, other than humans, the habitat supporting those organisms, or natural resources potentially adversely affected by CCR impacts. This includes:

- Transfer from an environmental media to animal and plant life. This can occur by bioaccumulation, bioconcentration, and biomagnification.
  - Bioaccumulation is the general term describing a process by which chemicals are taken up by a plant or animal either directly from exposure to impacted media (soil, sediment, water) or by eating food containing the chemical.
  - Bioconcentration is a process in which chemicals are absorbed by an animal or plant to levels higher than the surrounding environment.
  - Biomagnification is a process in which chemical levels in plants or animals increase from transfer through the food web (e.g., predators have greater concentrations of a particular chemical than their prey).
- Benthic invertebrates within adjacent waters.

Based on the information presented in **Section 3.2.3** and the location of the Des Moines River downgradient from the current area of known groundwater impacts, both of these ecological exposure routes need to be evaluated further.

Both potential ecological exposure pathways require groundwater-to-surface water interactions for the exposure pathway to be complete. The groundwater-to-surface water interactions at OGS are the subject of ongoing assessment.

The surface water/sediment, biota/food, and ecological exposure assessment is presently incomplete as the extent of groundwater impacts is still being evaluated. If groundwater impacts extend to the river, then these exposure pathways will be evaluated further.

4.0 POTENTIAL CORRECTIVE MEASURES

In this section, we identify potential corrective measures to meet the ACM goals identified in 40 CFR 257.96(a), which are to:

- Prevent further releases
- Remediate releases
- Restore affected areas to original conditions

The development of corrective measure alternatives is described further in the following sections. Corrective measure alternatives developed to address the groundwater impacts at OGS are described in **Section 5.0**. The alternatives selected are qualitatively evaluated in **Section 6.0**.

4.1 IDENTIFICATION OF CORRECTIVE MEASURES

As described in the USEPA Solid Waste Disposal Facility Criteria Technical Manual (USEPA 1998), corrective measures generally include up to three components, including:

- Source Control
- Containment
- Restoration

Within each component, there are alternative measures that may be used to accomplish the component objectives. The measures from one or more components are then combined to form corrective measure alternatives (discussed in **Section 5.0**) intended to address the observed groundwater impacts. Potential corrective measures were identified based on site information available during development of the ACM for the purpose of meeting the goals described in **Section 4.0**.

Each component and associated corrective measures are further identified in subsequent paragraphs. The corrective measures are evaluated for feasibility and combined to create the corrective action alternatives identified in this section, and further evaluated in **Section 5.0**. We continue to evaluate site conditions and may identify additional corrective measures based on new information regarding the nature and extent of the impacts.

4.1.1 Source Control

The source control component of a corrective measure is intended to identify and locate the source of impacts and provide a mechanism to prevent further releases from the source. For the OGS site, the sources to be controlled are the CCR materials in the OGS Ash Pond and the associated process water. Each of the source control measures below require closure of the impoundment, and for waste water to be re-directed from the CCR unit to eliminate the flows that may mobilize constituents from the CCR and transport them to groundwater. We have identified the following potential source control measures:

- **Close and cap in place.** Close the OGS Ash Pond and cap the CCR in place to reduce the infiltration of rain water into the impoundment, and prevent transport of CCR constituents from unsaturated CCR materials into the groundwater, and minimize the potential for CCR to interface with groundwater.

- **Consolidate and cap.** Consolidate CCR from the OGS Ash Pond into one or two areas to reduce the potential source footprint, prevent transport of CCR constituents from unsaturated CCR materials into the groundwater, and reduce the potential for CCR to interface with groundwater.

- **Excavate and create on-site disposal area.** Excavate and place CCR in a newly lined landfill area on site to prevent further releases from the OGS Ash Pond and isolate the CCR from potential groundwater interactions. Cap the new landfill with final cover to prevent the transport of CCR constituents from unsaturated CCR.

- **Excavate and dispose at a licensed off-site disposal area.** Remove all CCR from the OGS Ash Pond and haul it to a licensed landfill to prevent further releases from the CCR areas.

Water movement through the CCR materials is the mechanism for CCR impacts to groundwater, including surface water that moves vertically through the CCR materials via infiltration of precipitation and surface water runoff.

Based on the available information for this site, all the source control measures have potential to prevent further releases caused by infiltration, thus are retained for incorporation into alternatives for further evaluation. However, IPL continues to investigate the source of groundwater impacts and, with new information, source control measures may be added or removed from consideration.

4.1.2 Containment

The objective of containment is to limit the spread of the impacts beyond the source. The need for containment depends on the nature and extent of impacts, exposure pathways, and risks to receptors. Containment may also be implemented in combination with restoration as described in **Section 4.1.3**.

Containment may be a recommended element of a corrective measure if needed to:

- Prevent off-site migration of groundwater impacts
- Cease completion of an exposure pathway (e.g., water supply well)

Containment may also be used in lieu of active restoration if an active approach is needed but treatment is not warranted by the aquifer characteristics including:

- Water in the affected aquifer is naturally unsuited for human consumption.
- Contaminants present in low concentration with low mobility.
- Low potential for exposure to contaminants and low risk associated with exposure.
- Low transmissivity and low future user demand.

The following measures have potential to limit the spread of continued or remaining groundwater impacts:

- **Gradient Control with Pumping.** Gradient control includes a measure to alter the groundwater velocity and direction to slow or isolate impacts. This can be accomplished with pumping wells and/or a trench/sump collection system. If groundwater pumping is considered for capturing an impacted groundwater plume, the impacted groundwater must be managed in conformance with all applicable Federal and State requirements.

- **Gradient Control with Phytotechnology.** Gradient control with phytotechnology relies on the ability of vegetation to evapotranspire sources of surface water and groundwater. Water interception capacity by the aboveground canopy and subsequent evapotranspiration through the root system can limit vertical migration of water from the surface downward. The horizontal migration of groundwater can be controlled or contained using deep-rooted species, such as prairie plants and trees, to intercept, take up, and transpire the water. Trees classified as phreatophytes are deep-rooted, high-transpiring, water-loving organisms that send their roots into regions of high moisture and can survive in conditions of temporary saturation.

- **Chemical Stabilization.** Stabilization refers to processes that involve chemical reactions that reduce the leachability of cobalt. Stabilization chemically immobilizes impacts or reduces their solubility through a chemical reaction. The desired results of stabilization methods include converting metals into a less soluble, mobile, or toxic form.

Based on the currently available information for this site, active containment (other than source control) is not included in the proposed alternatives. IPL will continue to investigate the nature and extent of the groundwater impacts at OGS and may add containment measures as warranted by data.

4.1.3 Restoration

Restoration is the process through which groundwater quality is restored to meet GPSs. This can be accomplished by way of Monitored Natural Attention (MNA) or intensively addressed by groundwater treatment with or without extraction.

MNA can be a viable remedy or component of a remedial alternative for groundwater impacted with metals. MNA requires ongoing involvement and potentially intense characterization of the geochemical environment to understand the attenuation processes involved, and to justify reliance on them and regular, long-term monitoring to ensure the attenuation processes are meeting remedial goals.

MNA is not a “do-nothing” alternative; rather it is an effective knowledge-based remedy where a thorough engineering analysis provides the basis for understanding, monitoring, predicting, and documenting natural processes. To properly employ this remedy, there needs to be a strong scientific basis supported by appropriate research and site-specific monitoring implemented in accordance with quality controls. The compelling evidence needed to support proper evaluation of the remedy requires that the processes that lower metal concentrations in groundwater be well understood.

If active treatment is implemented, water may be treated in-situ, on site, or off site. The need for active treatment depends on the nature and extent of impacts, potential exposure pathways, and current and anticipated future risks to receptors. If there are no receptors or if the risks are acceptably low, then MNA is an appropriate option. If existing or future risks require a more rapid restoration of groundwater quality, then active restoration may be needed.

Treated groundwater may be re-injected, sent to a local publicly owned treatment works (POTW), or discharged to a local body of surface water, depending on local, state, and federal requirements. Typical on-site treatment practices for metals include coagulation and precipitation, ion exchange, or reverse osmosis. Off-site wastewater treatment may include sending the impacted groundwater that is extracted to a local POTW or to a facility designed to treat the contaminants of concern.

The removal rate of groundwater constituents such as cobalt will depend on the rate of groundwater extraction, the cation exchange capacity of the soil, and partition coefficients of the constituents sorbed to the soil. As the concentration of metals in groundwater is reduced, the rate at which constituents become partitioned from the soil to the aqueous phase may also be reduced. The amount of flushing of the aquifer material required to remove the metals and reduce their concentration in groundwater below the GPS will generally determine the time frame required for restoration. This time frame is site-specific.

In-situ methods may be appropriate, particularly where pump and treat technologies may present adverse effects. In-situ methods may include biological restoration requiring pH control, addition of specific micro-organisms, and/or addition of nutrients and substrate to augment and encourage degradation by indigenous microbial populations. Bioremediation requires laboratory treatability studies and pilot field studies to determine the feasibility and the reliability of full-scale treatment.

Based on current information, MNA is retained for incorporation into alternatives for further evaluation. Other restoration measures are not currently required for this site, but may be added following continued investigation of the nature and extent of groundwater impacts.

5.0 CORRECTIVE MEASURE ALTERNATIVES

We have preliminarily identified the following corrective measure alternatives for the groundwater impacts at OGS:

- Alternative 1 – No Action
- Alternative 2 – Close and Cap in Place and MNA
- Alternative 3 – Consolidate On Site and Cap with MNA
- Alternative 4 – Excavate and Dispose On Site with MNA
- Alternative 5 – Excavate and Dispose Off Site with MNA

These alternatives were developed by selecting components from the reasonable and appropriate corrective measures components discussed above. With the exception of the No Action alternative, each of the corrective measure alternatives meet the requirements in 40 CFR 257.97(b)(1) through (5) based on the information available at the current time. We may identify additional alternatives based on the continued evaluation of site conditions.

5.1 ALTERNATIVE 1 – NO ACTION

IPL is committed to implementing corrective measures as required under the Rule, and the No-Action alternative is included as a baseline condition and a point of comparison for the other alternatives. The consideration of this alternative assumes the monitoring of groundwater continues under this action.

5.2 ALTERNATIVE 2 – CLOSE AND CAP IN PLACE WITH MNA

Alternative 2 includes closing the OGS Ash Pond (no further discharge), covering the CCR materials with a cap, and establishing vegetation in accordance with the requirements for closure in place in 40 CFR 257.102(d). This measure is consistent with landfill cover systems to prevent infiltration of surface water into the CCR as described in **Section 4.1.1**. The capped areas will be subject to enhanced groundwater monitoring via MNA.

This alternative eliminates CCR sluicing/plant process water discharges and, with the installation of a cap, will reduce infiltration through the CCR. This is expected to address the major contributor to the observed GPS exceedances, which is exposure of CCR material to precipitation/surface water infiltration. Further leaching of metals and migration within groundwater will be reduced and may be eliminated over time. MNA is included with this alternative to monitor changes in groundwater impacts and the effectiveness of degradation mechanisms on groundwater concentrations over time.

5.3 ALTERNATIVE 3 – CONSOLIDATE ON SITE AND CAP WITH MNA

Alternative 3 includes closing the OGS Ash Pond (no further discharge), relocating and consolidating CCR into a smaller footprint within the CCR surface impoundments, covering the CCR materials with a cap, and establishing vegetation in accordance with the requirements for closure in place in 40 CFR 257.102(d). This measure is consistent with landfill cover systems to prevent infiltration of surface water into the CCR as described in **Section 4.1.1**. The consolidated and capped areas will be subject to enhanced groundwater monitoring via MNA.

This alternative eliminates CCR sluicing/plant process water discharges and, with the consolidation of the CCR footprint and the installation of a cap, will reduce infiltration through the CCR. This is expected to address the major contributor to the observed GPS exceedances, which is exposure of CCR material to precipitation/surface water infiltration. Further leaching of metals and migration within groundwater will be reduced and may be eliminated over time. MNA is included with this alternative to monitor changes in groundwater impacts and the effectiveness of degradation mechanisms on groundwater concentrations over time.

5.4 ALTERNATIVE 4 – EXCAVATE AND DISPOSE ON SITE WITH MNA

Alternative 4 includes closing the OGS Ash Pond (no further discharge), excavation of CCR from the OGS Ash Pond, and creation of a new on-site disposal area with a liner and cap system. This alternative will serve to entomb the CCR from the OGS Ash Pond and allow for the collection and management of liquids generated from the disposal area. Further releases from the OGS Ash Pond will be prevented by the use of engineering controls constructed/installed to meet the design criteria for new CCR landfills required under 40 CFR 257.70.

This alternative eliminates CCR sluicing/plant process water discharges and, with the consolidation of the CCR footprint and the installation of a new on-site disposal area liner and cap, will reduce infiltration through the CCR. This is expected to address the major contributor to the observed GPS exceedances, which is exposure of CCR material to precipitation/surface water infiltration. MNA is included with this alternative to monitor changes in groundwater impacts and the effectiveness of degradation mechanisms on groundwater concentrations over time.

5.5 ALTERNATIVE 5 – EXCAVATE AND DISPOSE OFF SITE WITH MNA

Alternative 5 includes closing the OGS Ash Pond (no further discharge), excavation of all CCR from the OGS Ash Pond, and transport to an approved off-site landfill. Further on-site releases from the OGS Ash Pond will be prevented by removing the source material from the site, which eliminates the potential for ongoing leaching of constituents into groundwater at OGS.

This alternative eliminates CCR sluicing/plant process water discharges and, with the removal of CCR from the site, will eliminate infiltration through the CCR. This is expected to address the major contributor to the observed GPS exceedances, which is exposure of CCR material to precipitation/ surface water infiltration. MNA is included with this alternative to monitor changes in groundwater impacts and the effectiveness of degradation mechanisms on groundwater concentrations over time.

6.0 EVALUATION OF CORRECTIVE MEASURE ALTERNATIVES

As required by 40 CFR 257.96(c), the following sections provide an evaluation of the effectiveness of corrective measure alternatives in meeting the requirements and objectives outlined in 40 CFR 257.97. The evaluation addresses the requirements and objectives identified in 40 CFR 257.96(c)(1) through (3), which include:

- The performance, reliability, ease of implementation, and potential impacts of appropriate potential remedies, including safety impacts, cross-media impacts, and control of exposure to residual contamination;

- The time required to begin and complete the remedy; and

- The institutional requirements, such as state or local permit requirements or other environmental or public health requirements that may substantially affect implementation of the remedy.

In addition to the discussion of the items listed above, **Table 4** provides a summary of the initial evaluation of the alternatives including each of the criteria listed in 40 CFR 257.97.

6.1 ALTERNATIVE 1 – NO ACTION

As described in **Section 5.1**, the No Action alternative is only included as a baseline condition and a point of comparison for the other alternatives. This alternative does not satisfy all five criteria in 40 CFR 257.97(b)(1) through (5), so it is not an acceptable corrective measure under the CCR Rule. For comparison only, Alternative 1 is evaluated with regard to the criteria in 40 FR 257.96(c) below:

- **Performance, Reliability, Implementation, and Impacts.**
  - Performance – The ability to attain the GPS for cobalt without any additional action is unlikely.
  - Reliability – Alternative 1 does not provide any reduction in existing risk.
  - Implementation – Nothing is required to implement Alternative 1.
  - Impacts – No additional safety or cross-media impacts are expected with Alternative 1. This alternative does not control current suspected routes of exposure to residual contamination.

- **Timing.** No time is required to begin. However, the time required to attain the GPS for cobalt under Alternative 1 is unknown.

- **Institutional Requirements.** No institutional requirements beyond maintaining current regulatory approvals exist for Alternative 1.

6.2 ALTERNATIVE 2 – CLOSE AND CAP IN PLACE WITH MNA

As described in **Section 5.2**, Alternative 2 includes closing the OGS Ash Pond, covering the CCR materials with a cap, and establishing vegetation in accordance with the requirements for closure in place in 40 CFR 257.102(d).

- **Performance, Reliability, Implementation, and Impacts.**
  - Performance – Ceasing wastewater discharges and closing the impoundments by capping is expected to address infiltration, which is a key contributor to groundwater impacts. MNA monitoring will identify, if active, the natural attenuation processes that reduce mass, toxicity, mobility, volume, or concentrations of the constituents of concern in groundwater. Alternative 2 is capable of and expected to attain the GPS for cobalt.

  - Reliability – The expected reliability of capping is good. Capping is a common practice and standard remedial method for closure in place in remediation and solid waste management. There is significant industry experience with the design and construction of this method.

  - Implementation – The complexity of constructing the cap is low. Dewatering will be required to the extent a suitable subgrade is established for cap construction, which can likely be achieved through standard dewatering methods. The cap construction may put a high demand on the local supply of suitable cap materials. The local availability of cap materials will be evaluated further during remedy selection. The equipment and personnel required to implement Alternative 2 are not specialized and are generally readily available.

  - Impacts – Safety impacts associated with the implementation of Alternative 2 are not significantly different than other heavy civil construction projects. Cross-media impacts are expected to be limited due to the small volume of CCR expected to be relocated on site, the short duration of cap construction, the effectiveness of standard engineering controls during construction (e.g., dust control), and the lack of off-site transportation of CCR. The potential for exposure to residual contamination is low since CCR will be capped.

- **Timing.** Closure of the OGS Ash Pond can be completed within 1 to 2 years of remedy selection. At OGS, the closure of the OGS Ash Pond is expected to be completed by the end of 2022. The time required to attain the GPS for cobalt will be evaluated further during the remedy selection process, but is expected to take between 2 and 10 years after closure construction is complete. Alternative 2 can provide full protection within the 30-year post-closure monitoring period.

- **Institutional Requirements.** The following permits and approvals are expected to be required to implement Alternative 2:
  - IDNR Closure Permit
  - State and local erosion control/construction storm water management permits

6.3 ALTERNATIVE 3 – CONSOLIDATE ON SITE AND CAP WITH MNA

As described in **Section 5.3**, Alternative 3 includes closing the OGS Ash Pond, relocating and consolidating CCR into a smaller footprint within the CCR surface impoundments, covering the CCR materials with a cap, and establishing vegetation in accordance with the requirements for closure in place in 40 CFR 257.102(d).

- **Performance, Reliability, Implementation, and Impacts.**
  - Performance – Ceasing wastewater discharges and closing the impoundments by capping is expected to address infiltration, which is a key contributor to groundwater impacts. The consolidation of CCR into a smaller footprint may enhance the performance of the cap by further reducing the area exposed to limited post-construction infiltration through the cap. MNA monitoring will identify, if active, the natural attenuation processes that reduce mass, toxicity, mobility, volume, or concentrations of the constituents of concern in groundwater. Alternative 3 is capable of and expected to attain the GPS for cobalt.

  - Reliability – The expected reliability of capping is good. Capping is a common practice and standard remedial method for closure in place in remediation and solid waste management. There is significant industry experience with the design and construction of this method. A consolidated cap footprint may enhance reliability by reducing the scale of post-closure maintenance.

  - Implementation – The complexity of constructing the cap is low. The logistics of moving CCR around the site to consolidate the closure footprint increases the complexity of the alternative. CCR dewatering will be required to the extent required to excavate and relocate CCR within the CCR impoundments and provide a suitable subgrade for cap construction. Some conditioning (e.g., drying) of relocated CCR is expected during on-site re-disposal. Alternative 3 can likely be achieved through standard dewatering and conditioning methods. Although the cap footprint will be minimized, cap construction may put a high demand on the local supply of suitable cap materials. The local availability of cap materials will be evaluated further during remedy selection. The equipment and personnel required to implement Alternative 3 are not specialized and are generally readily available.

  - Impacts – Safety impacts associated with the implementation of Alternative 3 are not significantly different than other heavy civil construction projects. The level of disturbance required to consolidate CCR before capping may represent some increase in safety risk due to site conditions and on-site construction traffic. Cross-media impacts are expected to be limited due to the small volume of CCR expected to be relocated on site, the short duration of cap construction, the effectiveness of standard engineering controls during construction (e.g., dust control), and the lack of off-site transportation of CCR. The potential for exposure to residual contamination is low since CCR will be capped and the footprint of the cap minimized.

- **Timing.** Closure of the OGS Ash Pond can be completed within 1 to 2 years of remedy selection. At OGS, the closure of the OGS Ash Pond is expected to be completed by the end of 2022. The time required to attain the GPS for cobalt will be evaluated further during the remedy selection process, but is expected to take between 2 and 10 years after closure construction is complete. The level of source disturbance during construction may increase the time required to reach GPS. The consolidation of CCR into a smaller cap area may decrease the time to reach GPS. Alternative 3 can provide full protection within the 30-year post-closure monitoring period.

- **Institutional Requirements.** The following permits and approvals are expected to be required to implement Alternative 3:
  - IDNR Closure Permit
  - State and local erosion control/construction storm water management permits

6.4 ALTERNATIVE 4 – EXCAVATE AND DISPOSE ON SITE WITH MNA

As described in **Section 5.4**, Alternative 4 includes closing the OGS Ash Pond, excavation of CCR from the source area, and creation of a new on-site disposal that meets the design criteria for new CCR landfills required under 40 CFR 257.70

- **Performance, Reliability, Implementation, and Impacts.**
  - Performance – Ceasing wastewater discharges and closing the OGS Ash Pond by removing and re-disposing CCR in a new lined/capped disposal area is expected to address infiltration, which is a key contributor to groundwater impacts. The consolidation of CCR into a smaller footprint may enhance the performance of the cap by further reducing the area exposed to limited post-construction infiltration through the cap. The separation from groundwater and other location criteria for the new on-site disposal facility may enhance the performance of this alternative. MNA monitoring will identify, if active, the natural attenuation processes that reduce mass, toxicity, mobility, volume, or concentrations of the constituents of concern in groundwater. Alternative 4 is capable of and expected to attain the GPS for cobalt.

- Reliability – The expected reliability of on-site re-disposal with a composite liner and cap is good. Disposal facilities that meet the requirements in 40 CFR 257.70 or other similar requirements have been used for solid waste disposal including municipal and industrial waste for numerous years. There is significant industry experience with the design and construction of similar disposal facilities. The composite liner and cover, combined with a consolidated disposal footprint, may enhance reliability by reducing infiltration and the scale of post-closure maintenance. At the same time, post-closure maintenance is likely more complex due to maintenance of a leachate collection system and geosynthetic repairs requiring specialized personnel, material, and equipment.

- Implementation – The complexity of constructing the new liner and cap is moderate due to the composite design. The limited area available at the facility for developing an on-site disposal facility makes this alternative logistically complex. Significant volumes of CCR will be excavated and stored on site while the disposal facility is constructed. Significant dewatering will be required to excavate and relocate CCR to a temporary storage area. Conditioning (e.g., drying) of relocated CCR is expected to facilitate temporary storage and on-site re-disposal. Alternative 4 can likely be achieved through standard dewatering and conditioning methods, but may be impacted by the space available for these activities. Although the post-closure CCR footprint will be minimized, composite liner and cap construction may put a high demand on the local supply of suitable cap materials. The local availability of liner and cap materials will be evaluated further during remedy selection. The equipment and personnel required to implement Alternative 4 are not specialized and are generally readily available, with the exception of the resources needed to install the geosynthetic portions of the composite liner and cover, which are not locally available.

- Impacts – Safety impacts associated with the implementation of Alternative 4 are not significantly different than other heavy civil construction projects. However, the level of disturbance required to excavate, store, and re-dispose CCR on site and the traffic required to import composite liner and cap material are not typical and likely represent an increase in safety risk due to site conditions, on-site construction traffic, and incoming/outgoing off-site construction traffic. A risk of cross-media impacts is possible due to the large volume of CCR to be excavated, stored, and relocated on site. The potential for exposure to residual contamination is low since CCR will be capped and the footprint of the cap minimized.

- **Timing.** Closure of the OGS Ash Pond can be completed within 1 to 2 years of remedy selection. At OGS, the closure of the OGS Ash Pond is expected to be completed by the end of 2022. However, the time required to permit and develop the on-site disposal facility may extend this schedule. The time required to attain the GPS for cobalt will be evaluated further during the remedy selection process, but is expected to take between 2 and 10 years after closure construction is complete. The level of source disturbance during construction may increase the time required to reach GPS. The consolidation of CCR into a new on-site disposal facility with a composite liner and cap may decrease the time to reach GPS. Alternative 4 can provide full protection within the 30-year post-closure monitoring period.

- **Institutional Requirements.** The following permits and approvals are expected to be required to implement Alternative 4:

  - IDNR Closure Permit
  - IDNR Disposal Facility (Landfill) Permit
  - State and local erosion control/construction storm water management permits

6.5 ALTERNATIVE 5 – EXCAVATE AND DISPOSE OFF SITE WITH MNA

As described in **Section 5.5**, Alternative 5 includes closing the OGS Ash Pond, excavation of CCR from the source area, and transporting the CCR off site for disposal.

- **Performance, Reliability, Implementation, and Impacts.**
  - Performance – Ceasing wastewater discharges and closing the OGS Ash Pond by removing and re-disposing CCR off site will eliminate the source material exposed to infiltration, which is a key contributor to groundwater impacts. The off-site disposal of CCR prevents further releases at OGS, but introduces the possibility of releases at the receiving facility. MNA monitoring will identify, if active, the natural attenuation processes that reduce mass, toxicity, mobility, volume, or concentrations of the constituents of concern in groundwater. Alternative 5 is capable of and expected to attain the GPS for cobalt.

  - Reliability – The expected reliability of excavation and off-site disposal is good. Off-site disposal facilities are required to meet the requirements in 40 CFR 257.70 or other similar requirements, which have been used for solid waste disposal including municipal and industrial waste for numerous years. There is significant industry experience with the design and construction of these disposal facilities.

  - Implementation – The complexity of excavating CCR for off-site disposal is low. The scale of CCR excavation (expected to exceed 450,000 cy), off-site transportation, and the permitting/development of off-site disposal facility airspace makes this alternative logistically complex. Significant dewatering will be required to excavate CCR. Conditioning (e.g., drying) of excavated CCR is expected to facilitate off-site transportation and re-disposal. Alternative 5 can likely be achieved through standard dewatering and conditioning methods, but may be impacted by the space available for these activities. Although the source area at OGS is eliminated, the development of off-site disposal airspace will put a high demand on the receiving disposal facility, which may not have the current physical or logistical capacity to receive large volumes of CCR in a short period of time. The equipment and personnel required to implement on-site and off-site aspects of Alternative 5 are not specialized and are generally readily available, with the exception of the resources needed to install the geosynthetic portions of the off-site composite liner and cover, which are not locally available.

  - Impacts – Safety impacts associated with the implementation of Alternative 5 are not significantly different than other heavy civil construction projects. However, the level of disturbance required to excavate, transport, and re-dispose CCR and the traffic required to import composite liner and cap material at the receiving disposal facility are not typical and likely represent an increase in safety risk due to large volumes of incoming/outgoing off-site construction traffic at both sites. A risk of cross-media impacts is possible due to the large volume of CCR to be excavated and transported from the site. The potential for exposure to residual contamination on site is very low since CCR will be removed; however, the off-site potential for exposure to CCR is increased due to the relocation of the source material.

- **Timing.** Closure of the OGS Ash Pond can be completed within 1 to 2 years of remedy selection. At OGS, the closure of the OGS Ash Pond is expected to be completed by the end of 2022. However, the time required to secure the off-site disposal airspace required to complete this alternative, including potential procurement, permitting, and construction, may extend this schedule significantly. The time required to attain the GPS for cobalt will be evaluated further during the remedy selection process, but is expected to take between 2 and 10 years after closure construction is complete. The level of source disturbance during construction may increase the time required to reach GPS. The removal of CCR from OGS may decrease the time to reach GPS. Alternative 5 can provide full protection within the 30-year post-closure monitoring period.

- **Institutional Requirements.** The following permits and approvals are expected to be required to implement Alternative 5:
  - IDNR Closure Permit
  - Depending on the off-site disposal facility, approval of off-site disposal facility owner or landfill permit for new off-site facility
  - State and local erosion control/construction storm water management permits
  - Transportation agreements and permits (local roads and railroads)

  Depending on the off-site disposal facility, state solid waste comprehensive planning approvals may also be required.

7.0 SUMMARY OF ASSESSMENT

An initial qualitative assessment of the advantages and disadvantages of each Corrective Measure Alternative presented in **Section 4.0** is provided in **Table 4**. Each of the identified Corrective Measure Alternatives exhibits both favorable and unfavorable outcomes with respect to the assessment criteria. In accordance with 40 CFR 257.97(c), the facility must consider all of the evaluation factors and select a remedy that meets the standards of 257.97(b) as soon as feasible.

We continue to advance additional data collection efforts to identify the appropriate corrective action measure for the Site. We will continue to update **Table 4** and develop a quantitative scoring matrix to identify a preferred corrective action.

8.0 REFERENCES

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Tables

Table 1. Water Level Summary
IPL - Ottumwa Generating Station / SCS Engineers Project #25218202.00

Ground Water Elevation in feet above mean sea level (amsl)									
Well Number	**MW-301**	**MW-302**	**MW-303**	**MW-304**	**MW-305**	**MW-306**	**MW-307**	**MW-308**	**MW-309**
Top of Casing Elevation (feet amsl)	686.63	673.90	661.07	682.84	683.91	683.47	657.56	655.39	654.94
Screen Length (ft)	10.00	5.00	5.00	5.00	5.00	5.00	5	5	5
Total Depth (ft from top of casing)	17.0	25.8	17.5	52.3	51.5	36.6	28	25	27.5
Top of Well Screen Elevation (ft)	567.40	563.24	579.60	577.48	577.48	577.48	633.08	633.87	630.95
Measurement Date									
April 26, 2016	682.80	655.63	652.42	655.37	661.67	670.86			
June 23, 2016	682.58	655.65	652.89	656.53	662.36	670.64			
August 9, 2016	682.27	655.52	651.76	653.79	660.78	670.35			
October 26-27, 2016	682.04	655.67	652.17	655.03	661.37	670.21			
January 18-19, 2017	681.67	655.46	651.74	654.50	660.87	669.89	648.81	647.42	646.66
April 19-20, 2017	682.15	656.35	654.57	657.48	663.27	670.69	653.62	651.09	650.16
June 20-21, 2017	681.91	655.65	652.42	654.75	661.26	669.94	649.85	648.26	647.60
August 21-23, 2017	681.28	655.13	650.58	652.39	659.00	668.77	645.78	643.12	641.82
November 8, 2017	681.54	655.40	651.34	653.03	659.76	669.04	647.37	644.99	644.20
April 18, 2018	681.53	655.71	652.47	655.55	660.99	668.92	649.66	647.91	647.65
May 30, 2018	NM	NM	NM	NM	NM	NM	652.45	651.05	650.98
June 28, 2018	NM	NM	NM	NM	NM	NM	652.87	651.43	651.47
July 18, 2018	NM	NM	NM	NM	NM	NM	652.27	650.67	650.69
August 14-15, 2018	680.91	656.05	652.57	656.35	661.56	668.66	NM	NM	NM
August 29, 2018	681.09	655.89	655.07	657.82	NM	NM	NM	NM	NM
October 16, 2018	682.50	656.91	656.17	658.20	663.37	670.24	654.13	NM	651.61
January 8, 2019	682.22	656.03	654.65	656.28	662.13	669.84	NM	NM	NM
April 8, 2019	682.69	657.23	655.55	659.33	664.01	670.96	654.90	653.70	653.55
Bottom of Well Elevation (ft)	669.63	648.10	643.57	630.54	632.41	646.87	629.56	630.39	627.44

Notes:
NM = not measured

Created by: KAK Date: 5/1/2017
Last rev. by: JR Date: 4/12/2019
Checked by: MDB Date: 4/12/2019

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Table 2. CCR Rule Groundwater Samples Summary
Ottumwa Generating Station / SCS Engineers Project #25218202.00

Sample Dates	**Downgradient Wells**					**Background Well**
	MW-302	MW-303	MW-304	MW-305	MW-306	MW-301
4/26/2016	B	B	B	B	B	B
6/23/2016	B	B	B	B	B	B
8/10-11/2016	B	B	B	B	B	B
10/26-27/2016	B	B	B	B	B	B
1/18/2017	B	B	B	B	B	B
4/19/2017	B	B	B	B	B	B
6/20-21/2017	B	B	B	B	B	B
8/22-23/2017	B	B	B	B	B	B
11/8/2017	D	D	D	D	D	D
4/18/2018	A	A	A	A	A	A
8/14-15/2018	A	A	A	A	A	A
8/29/2018	A-R	A-R	A-R	--	--	A-R
10/16/2018	A	A	A	A	A	A
1/8/2019	A-R	A-R	A-R	A-R	A-R	A-R
4/8/2019	A	A	A	A	A	A

Abbreviations:

B = Background Sample Event

D = Detection Monitoring Sampling Event

-- = Not Applicable

A = Assessment Monitoring Sampling Event

A-R = Assessment Monitoring Resampling Event

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Checked by:	NDK	Date:	8/8/2019

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Table 3. Groundwater Analytical Results Summary - CCR Program - Detection Monitoring
Ottumwa Generating Station Ash Pond / SCS Engineers Project #25218202.00

				Background Well					Compliance Wells																													
				MW-301					MW-302						MW-303						MW-304						MW-305						MW-306					
Parameter Name	UPL Method	UPL	GPS	4/18/2018	8/14/2018, 8/29/2018 ^	10/16/2018, 1/8/2019 ^^	1/8/2019^^	4/8/2019	11/8/2017	4/18/2018	8/14/2018, 8/29/2018 ^	10/16/2018, 1/8/2019 ^^	1/8/2019^^	4/8/2019	11/8/2017	4/18/2018	8/14/2018, 8/29/2018 ^	10/16/2018, 1/8/2019 ^^	1/8/2019^^	4/8/2019	11/8/2017	4/18/2018	8/14/2018, 8/29/2018 ^	10/16/2018, 1/8/2019 ^^	1/8/2019^^	4/8/2019	11/8/2017	4/18/2018	8/15/2018	10/16/2018	1/8/2019^^	4/8/2019	11/8/2017	4/18/2018	8/15/2018	10/16/2018	1/8/2019^^	4/8/2019
Appendix III																																						
Boron, ug/L	P	820		480	735	410	NA	375	1,320	1,200	1,240	1,100	NA	1,340	1,070	987	1,010	549	NA	286	1,040	991	1,000	930	NA	1,110	925	886	911	835	NA	1,040	881	919	915	862	NA	1,070
Calcium, mg/L	P	78.7		63.0	72.5	47.2	NA	43.5	183	177	185	146	NA	199	234	212	213	195	NA	172	136	131	138	123	NA	131	99.5	97.6	102.0	96.2	NA	114	73.1	74.1	78.9	80.0	NA	95.4
Chloride, mg/L	P	86.8		63.4	63.1	33.9	NA	50.2	254	246	259	214	NA	240	185	198	64.8	57	NA	22.1	417	400	375	410	NA	325	282	289	265	281	NA	248	50.4	54.4	58.2	83.3	NA	97.6
Fluoride, mg/L	P	0.484		0.22	0.27	0.3	NA	<0.500	0.20 J	0.26	0.26	0.24	NA	<0.500	0.19 J	0.22	0.31	0.24	NA	<0.500	0.96	0.92	1.00	1.0	NA	1.28	0.40	0.40	0.44	0.40	NA	0.748	0.11 J	0.11 J	0.13 J	<0.19	NA	<0.500
Field pH, Std. Units	P	6.87		6.41	6.26	6.27	5.68	6.61	6.55	6.47	6.76	6.37	6.58	6.61	6.60	6.63	6.83	6.66	6.83	7.00	7.00	6.9	7.34	6.86	7.16	7.17	7.01	6.9	7.21	6.86	6.99	7.06	6.49	6.42	6.74	6.42	6.65	6.66
Sulfate, mg/L	P	199		186	181	164	NA	80.8	786	899	847	785	NA	840	348	328	164	389	NA	261	194	198	185	184	NA	182	138	147	139	129	NA	108	274	289	275	285	NA	272
Total Dissolved Solids, mg/L	P	628		514	532	392	NA	340	1,620	1,690	1,840	1,400	NA	1,640	1,290	1,300	832	1,150	NA	886	1,270	1,300	3,680	1,180	NA	1,140	1,040	1,070	1,060	1,070	NA	1,010	773	805	840	884	NA	930
Appendix IV		UPL	GPS																																			
Antimony, ug/L	P*	0.22	6	<0.026	0.20 J	<0.078	NA	<1.00	NA	<0.026	<0.15	0.26 J,B	NA	<1.00	NA	0.098 J	0.16 J	0.2 J,B	NA	<1.00	NA	<0.026	0.19 J	<0.078	NA	<1.00	NA	0.089 J	<0.15	0.096 J,B	NA	<1.00	NA	0.094 J	<0.15	0.10 J,B	NA	<1.00
Arsenic, ug/L	P*	0.53	10	0.074 J	0.29 J	0.16 J	NA	<2.00	NA	0.16 J	0.30 J	1.9	NA	<2.00	NA	0.43 J	0.60 J	0.55 J	NA	<2.00	NA	0.68 J	1.3	0.96 J	NA	<2.00	NA	0.51 J	0.72 J	0.66 J	NA	<2.00	NA	0.38 J	0.65 J	0.60 J	NA	<2.00
Barium, ug/L	P	68.8	2,000	31.6	44.5	28.1	NA	25.5	NA	17.7	18.3	28.9	NA	19.2	NA	69.5	77.3	95.2	NA	54.1	NA	88.5	87.4	91	NA	80.5	NA	116	118	125	NA	119	NA	48.2	51.6	56.0	NA	58.4
Beryllium, ug/L	DQ	DQ	4	<0.012	0.14 J	<0.089	NA	<1.00	NA	<0.012	<0.12	0.22 J	NA	<1.00	NA	0.017 J	<0.12	<0.089	NA	<1.00	NA	0.026 J	0.21 J	<0.089	NA	<1.00	NA	<0.012	<0.12	<0.089	NA	<1.00	NA	<0.012	<0.12	<0.089	NA	<1.00
Cadmium, ug/L	NP*	0.12	5	0.023 J	0.16 J	<0.033	NA	<0.500	NA	0.22 J	0.21 J	0.67	NA	<0.500	NA	0.44 J	0.36 J	0.24 J	NA	<0.500	NA	<0.018	0.17 J	0.07 J	NA	<0.500	NA	0.054 J	0.086 J	0.044 J	NA	<0.500	NA	0.88	0.76	0.96	NA	1.08
Chromium, ug/L	P	1.07	100	<0.054	0.25 J	0.11 J,B	NA	<5.00	NA	0.46 J	0.48 J	1.6	NA	<5.00	NA	0.12 J	0.19 J	0.15 J,B	NA	<5.00	NA	2.0	5.9	1.4	NA	<5.00	NA	0.26 J	0.41 J	0.3 J,B	NA	<5.00	NA	0.37 J	0.70 J	0.46 J,B	NA	<5.00
Cobalt, ug/L	NP	4.1	6	0.46 J	1.4	0.36 J,B		<0.500	NA	0.90 J	1.50	4.0		1.2	NA	2.1	2.2	1.7 B		<0.500	NA	0.39 J	0.92 J	0.45 J,B		<0.500	NA	14.5	15.6	17.2	16.4	17	NA	4.8	5.5	6.4	6.2	6.92
Fluoride, mg/L	P	0.48	4	0.22	0.27	0.3	NA	<0.500	NA	0.26	0.26	0.24	NA	<0.500	NA	0.22	0.31	0.24	NA	<0.500	NA	0.92	1.00	1.0	NA	1.28	NA	0.40	0.44	0.40	NA	0.748	NA	0.11 J	0.13 J	<0.19	NA	<0.500
Lead, ug/L	NP*	0.10	15	0.041 J	0.18 J	<0.13	NA	<0.500	NA	0.098 J	0.12 J	3.9	NA	<0.500	NA	0.069 J	0.13 J	<0.13	NA	<0.500	NA	0.37 J	0.81 J	0.66 J	NA	<0.500	NA	0.12 J	0.31 J	<0.13	NA	<0.500	NA	0.040 J	0.20 J	<0.13	NA	<0.500
Lithium, ug/L	P	34.2	40	19.1	26.5	19.4	NA	15.5	NA	7.5 J	6.9 J	8.6 J	NA	10.4	NA	<4.6	6.9 J	<4.6	NA	<10.0	NA	<4.6	<4.6	<4.6	NA	<10.0	NA	<4.6	<4.6	<4.6	NA	<10.0	NA	<4.6	<4.6	<4.6	NA	<10.0
Mercury, ug/L	DQ	DQ	2	<0.090	<0.083	<0.090	NA^^	<0.200	NA	0.096 J	<0.083	NA^^	<0.090	<0.200	NA	<0.090	<0.083	NA^^	<0.090	<0.200	NA	<0.090	<0.083	NA^^	<0.090	<0.200	NA	<0.090	<0.090	NA^^	<0.090	<0.200	NA	<0.090	<0.083	NA^^	<0.090	<0.200
Molybdenum, ug/L	P	1.74	100	0.67 J	1.3	0.72 J	NA	<2.00	NA	0.59 J	0.54 J	<0.57	NA	<2.00	NA	0.61 J	0.98 J	5.5	NA	7.46	NA	2.0	2.4	1.9	NA	<2.00	NA	7.1	6.5	7.3	NA	7.17	NA	5.7	4.7	5.1	NA	4.32
Selenium, ug/L	P	8.55	50	4.3	6.3	3.4	NA	<5.00	NA	<0.086	<0.16	0.84 J,B	NA	<5.00	NA	0.23 J	0.35 J	0.37 J,B	NA	<5.00	NA	<0.086	0.50 J	0.26 J,B	NA	<5.00	NA	0.12 J	0.36 J	0.33 J,B	NA	<5.00	NA	<0.086	0.21 J	0.22 J,B	NA	<5.00
Thallium, ug/L	NP*	0.14	2	<0.036	0.16 J	<0.099	NA	<1.00	NA	<0.036	<0.14	0.16 J	NA	<1.00	NA	<0.036	<0.14	<0.099	NA	<1.00	NA	<0.036	0.15 J	<0.099	NA	<1.00	NA	0.32 J	0.33 J	0.33 J	NA	<1.00	NA	0.083 J	<0.14	0.12 J	NA	<1.00
Radium 226/228 Combined, pCI/L	P	2.15	5	0.513	1.19	1.7	NA	0.0956	NA	0.746	1.12	1.7	NA	0.116	NA	0.529	1.82	1.68	NA	0.391	NA	2.08	3.74	1.25	NA	2.42	NA	0.676	1.33	1.32	NA	0.685	NA	0.305	0.985	1.34	NA	0.155

4.4	Italics and blue shaded cell indicates the compliance well result exceeds the UPL (background) and the Limit of Quantitation (LOQ).
30.8	Bold and yellow highlighted cell indicates the compliance well result exceeds the GPS.

Abbreviations:

UPL = Upper Prediction Limit
NA = Not Analyzed
P = Parametric UPL with 1-of-2 retesting
GPS = Groundwater Protection Standard
DQ = Double Quantification Rule (not detected in background)
NP = Nonparametric UPL (highest background value)
LOD = Limit of Detection
LOQ = Limit of Quantitation
J = Estimated concentration at or above the LOD and below the LOQ.
B = Analyte was detected in the associated Method Blank.

* = UPL is below the LOQ for background sampling. For compliance wells, only results confirmed above the LOQ are evaluated as potential SSIs above background.
^ = During the August 2018 sampling event, samples for chloride, fluoride, sulfate, and total dissolved solids at MW-301, MW-302, MW-303, and MW-304 were received by the lab above the required temperature. The wells were resampled for these parameters on 8/29/2018.
^^ = During the October 2018 sampling event, samples were not analyzed for mercury due a laboratory error. The wells were resampled for mercury on 1/8/2019. The 1/8/2019 samples from MW-305 and MW-306 were also analyzed for cobalt.

Notes:
1. An individual result above the UPL or GPS does not constitute a statistically significant increase (SSI) above background or statistically significant level above the GPS. See the accompanying letter text for identification of statistically significant results.
2. GPS is the United States Environmental Protection Agency (US EPA) Maximum Contamination Level (MCL), if established; otherwise, the values are from 40 CFR 257.95(h)(2).
3. Interwell UPLs calculated based on results from background well MW-301.

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Last revision by:	MDB	Date:	7/31/2019
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I:\25218202.00\Deliverables\OGS ACM\Tables\[3_CCR GW Screening Summary_OGS.xlsx]Table

Table 4. Preliminary Evaluation of Corrective Measure Alternatives
Ottumwa Generating Station / SCS Engineers Project #25218202.00

	Alternative #1 **No Action**	**Alternative #2** **Close and Cap in place with MNA**	**Alternative #3** **Consolidate on Site and Cap with MNA**	**Alternative #4** **Excavate and Dispose on site with MNA**	**Alternative #5** **Excavate and Dispose in Off-Site Landfill**
CORRECTIVE ACTION ASSESSMENT - 40 CFR 257.97(b)					
257.97(b)(1) Is remedy protective of human health and the environment?	No	Yes	Yes	Yes	Yes
257.97(b)(2) Can the remedy attain the groundwater protection standard?	Unlikely	Yes	Yes	Yes	Yes
257.97(b)(3) Can the remedy control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of constituents in appendix IV to this part into the environment?	No	Yes	Yes	Yes	Yes
257.97(b)(4) Can the remedy remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible?	Not Applicable - No release of CCR	Not Applicable - No release of CCR	Not Applicable - No release of CCR	Not Applicable - No release of CCR	Not Applicable - No release of CCR
257.97(b)(5) Can the remedy comply with standards for management of wastes as specified in §257.98(d)?	Not Applicable	Yes	Yes	Yes	Yes
LONG- AND SHORT-TERM EFFECTIVENESS - 40 CFR 257.97(c)(1)					
257.97(c)(1)(i) Magnitude of reduction of existing risks	No reduction of existing risk	Existing risk reduced by achieving GPS	Same as Alternative #2	Same as Alternative #2	Same as Alternative #2
257.97(c)(1)(ii) Magnitude of residual risks in terms of likelihood of further releases due to CCR remaining following implementation of a remedy	No reduction of existing risk. Residual risk is limited for all alternatives due to limited extent of impacts and lack of receptors.	Magnitude of residual risk of further releases is lower than current conditions due to final cover eliminating infiltration through CCR; Residual risk is limited for all alternatives due to limited extent of impacts and lack of receptors	Same as Alternative #2 with potential further reduction in release risk due to CCR material footprint; However, limited to no overall risk reduction is provided due to lack of current/anticipated future receptors for groundwater impacts	Same as Alternative #3 with potential further reduction in release risk due to composite liner and cover; However, limited to no overall risk reduction is provided due to lack of current/anticipated future receptors for groundwater impacts	Same as Alternative #3 with potential further reduction in release risk due to removal of CCR from site; However, limited to no overall risk reduction is provided due to lack of current/anticipated future receptors for groundwater impacts
257.97(c)(1)(iii) The type and degree of long-term management required, including monitoring, operation, and maintenance	Not Applicable	30-year post-closure groundwater monitoring; Groundwater monitoring network maintenance and as-needed repair/replacement Final cover maintenance (e.g., mowing and as-needed repair); Periodic final cover inspections; Additional corrective action as required based on post-closure groundwater monitoring	Same as Alternative #2	Same as Alternative #2	No on-site long-term management required; Limited on-site post-closure groundwater monitoring until GPS are achieved; Receiving disposal facility will have same/similar long-term monitoring, operation, and maintenance requirements as Alternative #2

Table 4. Preliminary Evaluation of Corrective Measure Alternatives
Ottumwa Generating Station / SCS Engineers Project #25218202.00

	Alternative #1 No Action	Alternative #2 Close and Cap in place with MNA	Alternative #3 Consolidate on Site and Cap with MNA	Alternative #4 Excavate and Dispose on site with MNA	Alternative #5 Excavate and Dispose in Off-Site Landfill
LONG- AND SHORT-TERM EFFECTIVENESS - 40 CFR 257.97(c)(1) (continued)					
257.97(c)(1)(iv) Short-term risks - Implementation					
Excavation	None	Limited risk to community and environment due to limited amount of excavation (likely <100K cy) required to establish final cover subgrades and no off-site excavation	Same as Alternative #2 with increased risk to environment due to increased excavation volumes required for consolidation (likely >100K cy but <463K cy)	Same as Alternative #3 with increased risk to environment due to increased excavation volumes (~463K cy) and temporary CCR storage during disposal site construction required for removal and on-site re-disposal	Same as Alternative #4 with reduced risk to environment from excavation due to limited on-site storage
Transportation	None	No risk to community or environment from off-site CCR transportation; Typical risk due to construction traffic delivering final cover materials to site	Same as Alternative #2 with reduced risk from construction traffic due to reduced final cover material requirements (smaller cap footprint)	Same as Alternative #2 with increased risk from construction traffic due to increased material import requirements (liner and cap construction required)	Highest level of community and environmental risk due to CCR volume export (~463K cy)
Re-Disposal	None	Limited risk to community and environment due to limited volume of CCR re-disposal (likely <100K cy)	Same as Alternative #2 with increased risk to environment due to increased excavation volumes (likely >100K cy but <463K cy) required for consolidation	Same as Alternative #3 with increased risk to environment due to increased excavation volumes (~463K cy) and temporary CCR storage during disposal site construction required for removal and on-site re-disposal	Same as Alternative #4 with increased risk to community and environment due to re-disposal of large CCR volume (~463K cy) at another facility; Re-disposal risks are managed by the receiving disposal facility
257.97(c)(1)(v) Time until full protection is achieved	Unknown	To be evaluated further during remedy selection. Closure and capping anticipated by end of 2022. Groundwater protection timeframe to reach GPS potentially 2 to 10 years following closure construction, achievable within 30-year post-closure monitoring period.	Similar to Alternative #2. Potential for increase in time to reach GPS due to significant source disturbance during construction. Potential for decrease in time to reach GPS due to consolidation of CCR.	Similar to Alternative #2. Potential for increase in time to reach GPS due to significant source disturbance during construction. Potential decrease in time to reach GPS due to source isolation within liner/cover system.	Similar to Alternative #2. Potential for increase in time to reach GPS due to significant source disturbance during construction. Potential decrease in time to reach GPS due to impounded CCR source removal.
257.97(c)(1)(vi) Potential for exposure of humans and environmental receptors to remaining wastes, considering the potential threat to human health and the environment associated with excavation, transportation, re-disposal, or containment	No change in potential exposure	Potential for exposure is low. Remaining waste is capped.	Same as Alternative #2	Same as Alternative #2	No potential for on-site exposure to remaining waste since no waste remains on site; Risk of potential exposure is transferred to receiving disposal facility and is likely similar to Alternative #2
257.97(c)(1)(vii) Long-term reliability of the engineering and institutional controls	Not Applicable	Long-term reliability of cap is good; Significant industry experience with methods/controls; Capping is common practice/industry standard for closure in place for remediation and solid waste management	Same as Alternative #2 with potentially increased reliability due to smaller footprint and reduced maintenance	Same as Alternative #3	Success of remedy at OGS does not rely on long-term reliability of engineering or institutional controls; Overall success relies on reliability of the engineering and institutional controls at the receiving facility
257.97(c)(1)(viii) Potential need for replacement of the remedy	Not Applicable	Limited potential for remedy replacement if maintained; Some potential for remedy enhancement due to residual groundwater impacts following source control	Same as Alternative #2 with reduced potential need for remedy enhancement with consolidated/smaller closure area footprint	Same as Alternative #2 with further reduction in potential need for remedy enhancement composite with liner	No potential for remedy replacement; Limited potential for remedy enhancement due to residual groundwater impacts following source control

Table 4. Preliminary Evaluation of Corrective Measure Alternatives
Ottumwa Generating Station / SCS Engineers Project #25218202.00

	Alternative #1	Alternative #2	Alternative #3	Alternative #4	Alternative #5
	No Action	**Close and Cap in place with MNA**	**Consolidate on Site and Cap with MNA**	**Excavate and Dispose on site with MNA**	**Excavate and Dispose in Off-Site Landfill**
SOURCE CONTROL TO MITIGATE FUTURE RELEASES - 40 CFR 257.97(c)(2)					
257.97(c)(2)(i) The extent to which containment practices will reduce further releases	No reduction in further releases	Cap will reduce further releases by minimizing infiltration through CCR	Same as Alternative #2 with further reduction due to consolidated/smaller closure footprint	Same as Alternative #3 with further reduction due to composite liner and 5-foot groundwater separation required by CCR Rule	Removal of CCR prevents further releases at OGS; Receiving disposal site risk similar to Alternative #3
257.97(c)(2)(ii) The extent to which treatment technologies may be used	Alternative does not rely on treatment technologies	Alternative does not rely on treatment technologies	Alternative does not rely on treatment technologies	Alternative does not rely on treatment technologies	Alternative does not rely on treatment technologies
IMPLEMENTATION - 40 CFR 257.97(c)(3)					
257.97(c)(3)(i) Degree of difficulty associated with constructing the technology	Not Applicable	Low complexity construction; Potentially lowest level of dewatering effort - dewatering required for cap installation only	Low complexity construction; Moderate degree of logistical complexity; Moderate level of dewatering effort - dewatering required for material excavation/placement and capping	Moderately complex construction due to composite liner and cover; High degree of logistical complexity due to excavation and on-site storage of ~463K cy of CCR while new lined disposal area is constructed; High level of dewatering effort - dewatering required for excavation of full CCR volume	Low complexity construction; High degree of logistical complexity including the excavation and off-site transport of ~463K cy of CCR and permitting/development of off-site disposal facility airspace; High level of dewatering effort - dewatering required for excavation of full CCR volume
257.97(c)(3)(ii) Expected operational reliability of the technologies	Not Applicable	High reliability based on historic use of capping as corrective measure	Same as Alternative #2	Same as Alternative #2	Success at OGS does not rely on operational reliability of technologies; Overall success relies on off-site disposal facility, which is likely same/similar to Alternative #2
257.97(c)(3)(iii) Need to coordinate with and obtain necessary approvals and permits from other agencies	Not Applicable	Need is low in comparison to other alternatives; State Closure Permit required	Same as Alternative #2	Need is high in comparison to other alternatives State Closure Permit required; State Landfill Permit may be required	Need is highest in comparison to other alternatives; State Closure Permit required; Approval of off-site disposal site owner required; May require State solid waste comprehensive planning approval; Local road use permits likely required
257.97(c)(3)(iv) Availability of necessary equipment and specialists	Not Applicable	Necessary equipment and specialists are highly available; Highest level of demand for cap construction material	Same as Alternative #2; Lowest level of demand for cap construction material	Same as Alternative #2; Moderate level of demand for liner and cap construction material	Availability of necessary equipment to develop necessary off-site disposal facility airspace and transport ~463K cy of CCR to new disposal facility will be a limiting factor in the schedule for executing this alternative; No liner or cover material demands for on-site implementation of remedy;
257.97(c)(3)(v) Available capacity and location of needed treatment, storage, and disposal services	Not Applicable	Capacity and location of treatment, storage, and disposal services is not a factor for this alternative	Capacity and location of treatment, storage, and disposal services is unlikely to be a factor for this alternative	Available temporary on-site storage capacity for ~463K cy of CCR while composite liner is constructed is significant limiting factor	Off-site disposal capacity, facility logistical capacity, or the time required to develop the necessary off-site disposal and logistical capacity is a significant limiting factor.
COMMUNITY ACCEPTANCE - 40 CFR 257.97(c)(4)					
257.97(c)(4) The degree to which community concerns are addressed by a potential remedy (Anticipated)	To be determined based on input obtained through public meetings/outreach to be completed	To be determined based on input obtained through public meetings/outreach to be completed	To be determined based on input obtained through public meetings/outreach to be completed	To be determined based on input obtained through public meetings/outreach to be completed	To be determined based on input obtained through public meetings/outreach to be completed

Created by: LAB/SK Date: 6/20/2019
Last revision by: EJN Date: 8/9/2019
Checked by: TK Date: 9/12/2019

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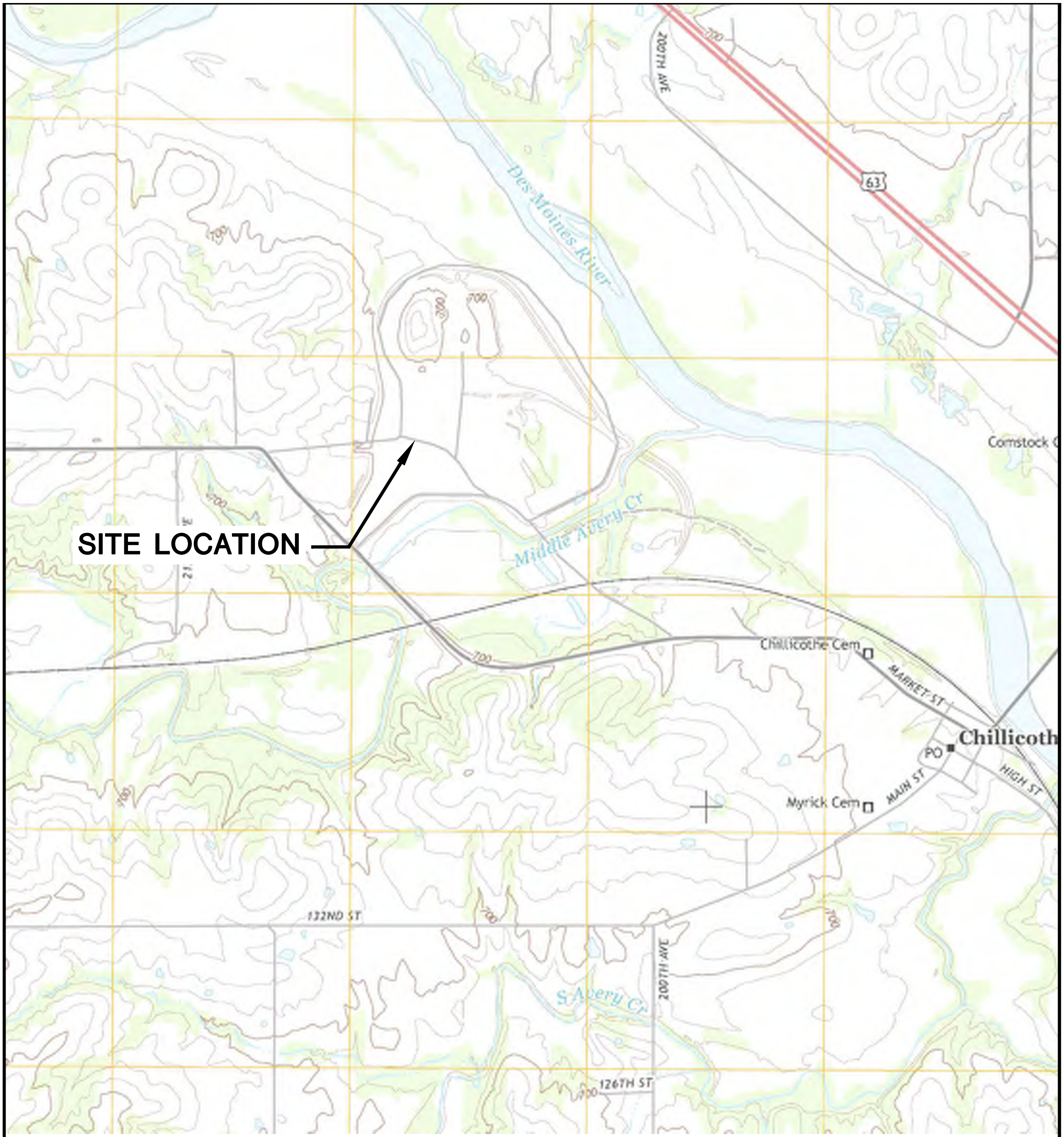
Figures



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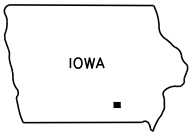
CHILLICOTHE QUADRANGLE
IOWA–WAPELLO CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
2013
SCALE: 1" = 2,000'



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

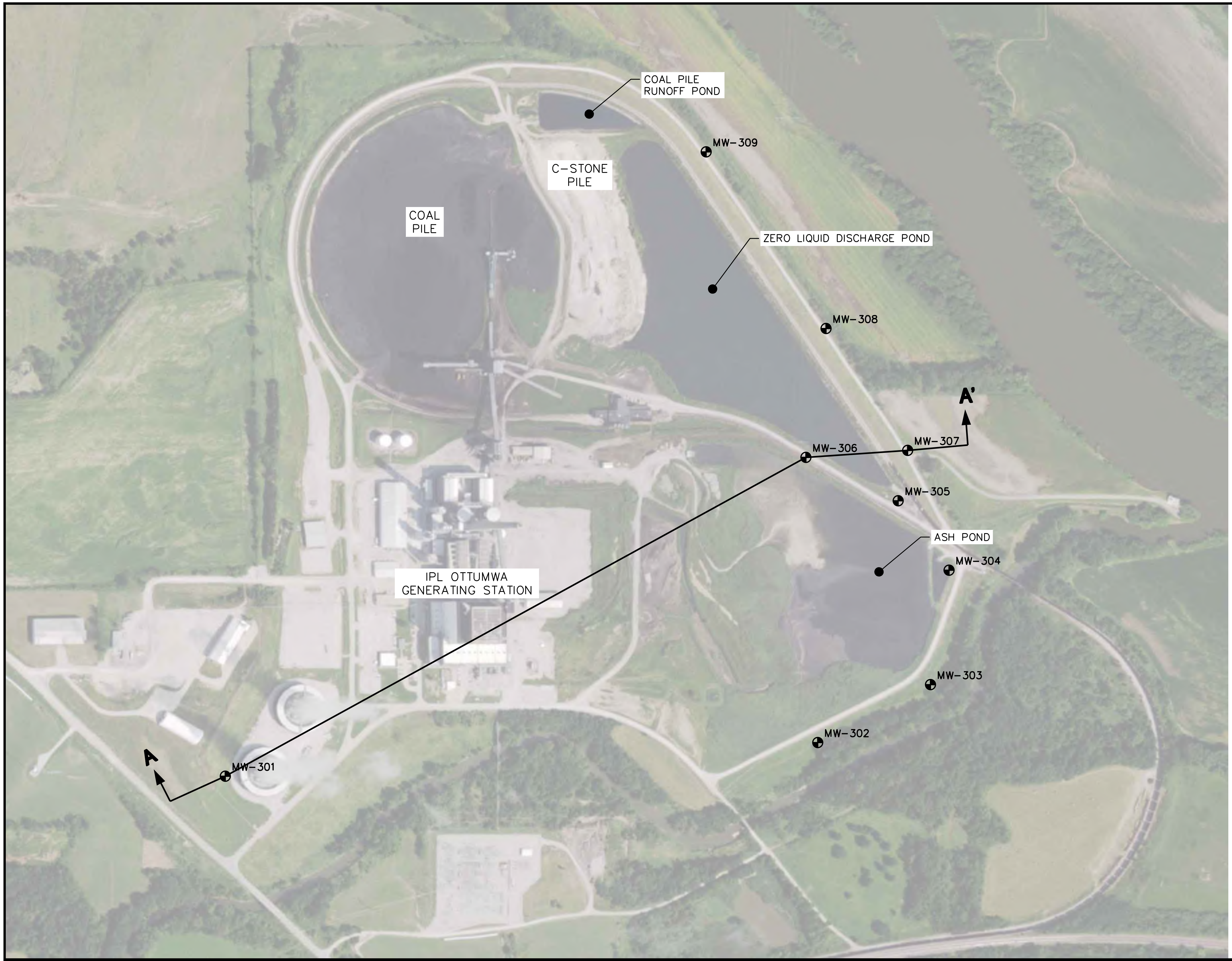
SITE
OTTUMWA GENERATING STATION
OTTUMWA, IOWA

SITE LOCATION MAP

PROJECT NO.	25218201.00	DRAWN BY:	AHB
DRAWN:	05/29/15	CHECKED BY:	KAK
REVISED:	03/08/16	APPROVED BY:	TJK 09/10/19

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

FIGURE
1



LEGEND

◒ CCR MONITORING WELL LOCATION (APPROXIMATE)

GEOLOGIC CROSS SECTION

NOTES:

1. MONITORING WELLS MW-301 THROUGH MW-306 COMPRISE THE MONITORING SYSTEM FOR THE ASH POND. MONITORING WELLS MW-307 THROUGH MW-309 WERE ADDED TO MONITOR THE ZERO LIQUID DISCHARGE (ZLD) POND. MW-301 IS A SHARED BACKGROUND WELL FOR BOTH CCR UNITS.

N

500 0 500

SCALE: 1" = 500'

PROJECT NO.	25218201.00	DRAWN BY:	BSS
DRAWN:	07/03/19	CHECKED BY:	MDB
REVISED:	08/13/19	APPROVED BY:	TJK 09/10/19

ENGINEER

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CLIENT

INTERSTATE POWER AND LIGHT CO.
15300 130th STREET
OTTUMWA, IA 52501

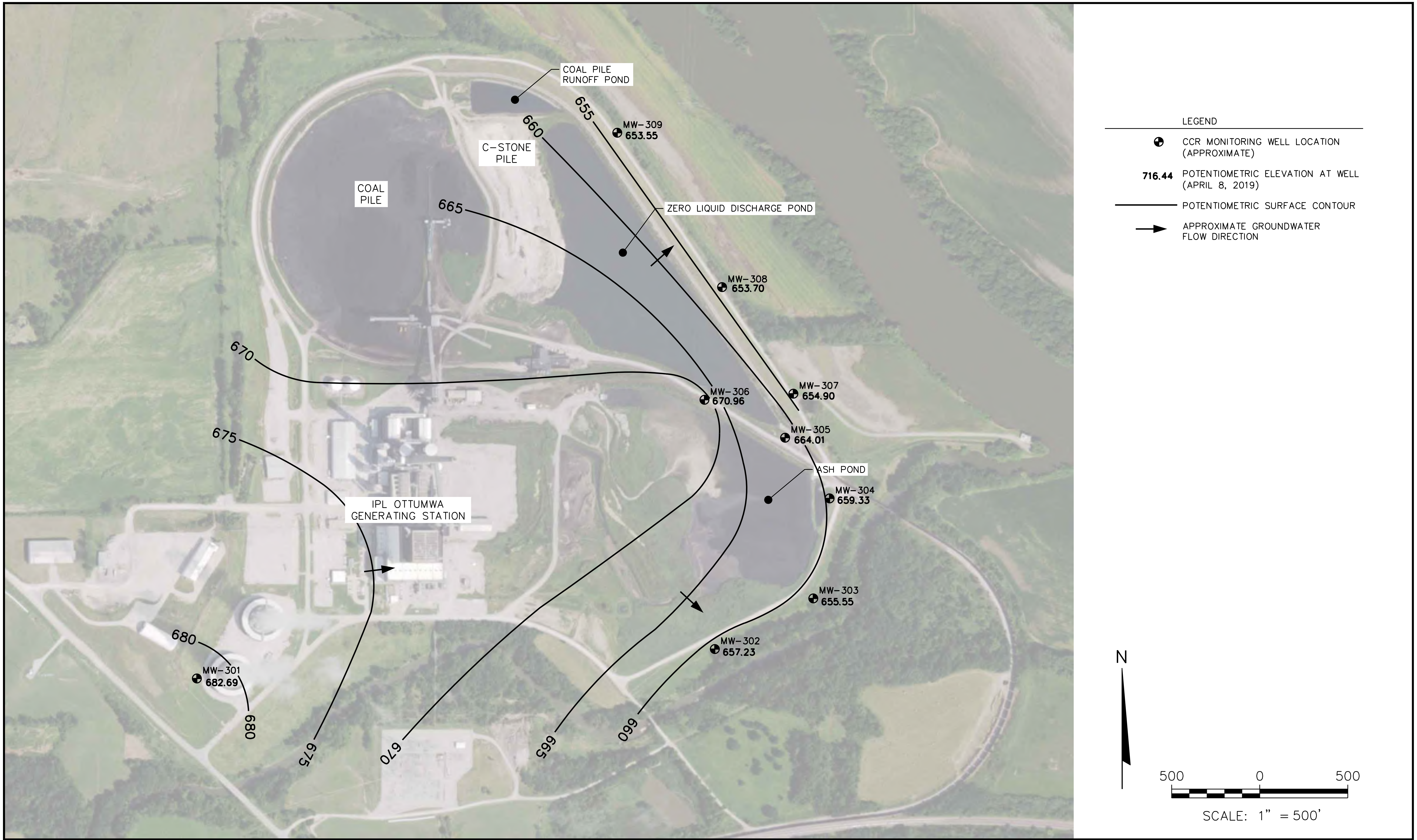
SITE

OTTUMWA GENERATING STATION
20775 POWER PLANT ROAD
OTTUMWA, IOWA

SITE PLAN AND MONITORING WELL LOCATIONS MAP

FIGURE
2

I:\25218201.00\Drawings\Ottumwa\2 Ottumwa Site an Monitoring e Location Ma .dwg, 9/10/2019 1: 8:0 M



PROJECT NO.	25218201.00	DRAWN BY:	BSS
DRAWN:	07/03/19	CHECKED BY:	NDK
REVISED:	08/13/19	APPROVED BY:	TJK 09/10/19

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15300 130th STREET
OTTUMWA, IA 52501

SITE

OTTUMWA GENERATING STATION
20775 POWER PLANT ROAD
OTTUMWA, IOWA

POTENTIOMETRIC SURFACE – APRIL 2019

FIGURE
3

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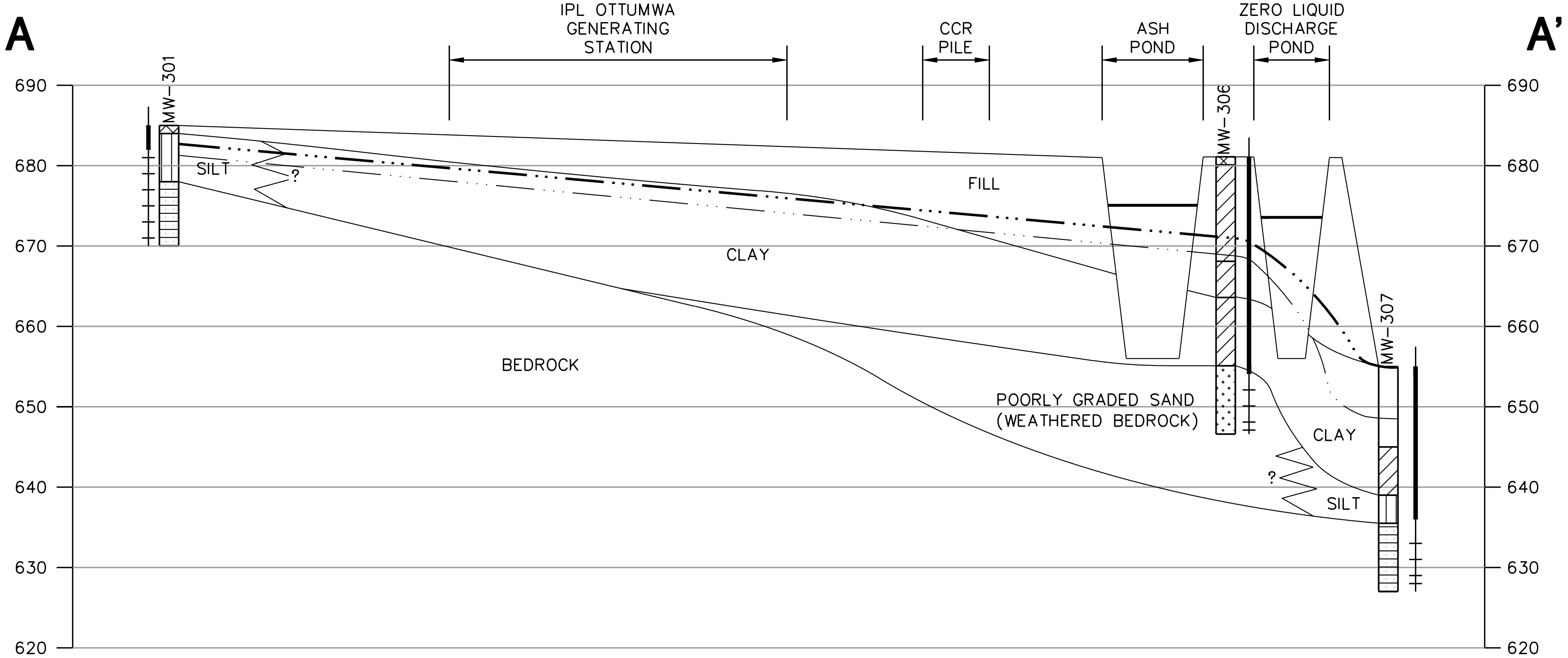
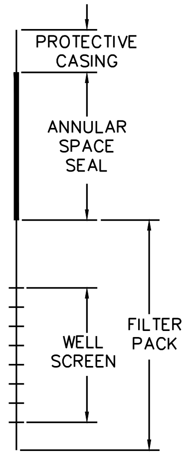


LEGEND

▩	TOPSOIL/FILL
░	SAND, POORLY GRADED (SP)
▥	SILT, WITH SAND AND GRAVEL (ML)
▨	CLAY
▤	SANDSTONE
— · · · —	HIGH POTENTIOMETRIC SURFACE MEASURED APRIL 2019
— · · · —	LOW POTENTIOMETRIC SURFACE MEASURED AUGUST 2017
━━	POND SURFACE ELEVATION MEASURED JUNE 10-11, 2019



WELL DETAIL

HORIZONTAL SCALE: 1" = 500'
VERTICAL SCALE: 1" = 20'
VERTICAL EXAGGERATION = 25X

NOTES:

1. MW-307 WAS HYDROVACED TO APPROXIMATELY 8.5'. HYDROVACING IS PERFORMED TO DETERMINE IF UNDERGROUND UTILITIES ARE PRESENT. HIGH PRESSURE WATER AND A VACUUM ARE USED TO CLEAR THE BOREHOLE AND GEOLOGIC SAMPLES ARE NOT COLLECTED. NATIVE SOIL IN THE VICINITY OF MW-307 IS CLAY.

2. ASH POND AND ZLD POND BOTTOM ELEVATIONS ARE BASED ON THE EMBANKMENT CREST ELEVATION (681 FEET) AND INTERNAL STORAGE DEPTH (25 FEET) REPORTED IN THE HISTORY OF CONSTRUCTION REPORT ISSUED SEPTEMBER 29, 2016, BY HARD HAT SERVICES.

PROJECT NO.	25218201.00	DRAWN BY:	BSS
DRAWN:	07/03/19	CHECKED BY:	NDK/MDB
REVISED:	08/13/19	APPROVED BY:	TJK 09/10/19

ENGINEER
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CLIENT
INTERSTATE POWER AND LIGHT CO.
15300 130th STREET
OTTUMWA, IA 52501

SITE
OTTUMWA GENERATING STATION
20775 POWER PLANT ROAD
OTTUMWA, IOWA

GEOLOGIC CROSS SECTION A-A'

FIGURE
4

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Appendix A

Regional Geological and Hydrogeological Information

Regional Hydrogeologic Stratigraphy
Ottumwa Generating Station / SCS Engineers Project #25215053.01

Age of Rocks	Hydrogeologic Unit	General Thickness (feet)	Name of Rock Unit*	Type of Rock
Quaternary (0-1 million years old)	Surficial Aquifers • Alluvial • Buried-Channel • Drift	0 to 320	Undifferentiated	• Sand, gravel, silt, and clay • Sand, gravel, silt, and clay • Till (sandy, pebbly clay), sand, and silt
Pennsylvanian (180 to 310 million years old)	Aquiclude	0 to 370	Undifferentiated	• Shale, sandstone, limestone, and coal
Mississippian (310 to 345 million years old	Mississippian Aquifer • Upper	0 to 600	St. Louis Spergen	• Limestone and sandstone • Limestone
	• Lower		Warsaw Keokuk Burlington Hampton Starrs Cave	• Shale and dolomite • Dolomite, limestone, and shale • Dolomite and limestone • Limestone and dolomite • Limestone
	Aquiclude	0 to 425	Prospect Hill McCraney	• Siltstone • Limestone
Devonian (345 to 400 million years old)			Yellow Spring Lime Creek	• Shale, dolomite, and siltstone • Dolomite and shale
	Devonian Aquifer	110 to 420	Cedar Valley Wapsipinicon	• Limestone and dolomite • Dolomite, limestone, shale, and gypsum
Silurian (400 to 425 million years old)		0 to 105	Undifferentiated	• Dolomite
Ordovician (425 to 500 million years old)	Aquiclude	150 to 600	Maquoketa Galena Decorah Platteville	• Dolomite and shale • Dolomite and chert • Limestone and shale • Limestone, shale, and sandstone
	Cambrian-Ordovician aquifer	750 to 1,110	St. Peter Prairie du Chien	• Sandstone • Dolomite and sandstone
Cambrian (500 to 600 million years old)			Jordan St. Lawrence	• Sandstone • Dolomite
	Not considered an aquifer in southeast Iowa	450 to 750+	Franconia Galesville Eau Claire Mt. Simon	• Shale, siltstone, and sandstone • Sandstone • Sandstone, shale, and dolomite • Sandstone
Precambrian (600 million to 2 billion + years old)				• Sandstone, igneous rocks, and metamorphic rocks

*This nomenclature and classification of rock units in this report are those of the Iowa Geological Survey and do not necessarily coincide with those accepted by the U.S. Geological Survey.

Source: "Water Resources of Southeast Iowa," Iowa Geologic Survey Water Atlas No. 4.

Appendix B

Boring Logs

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

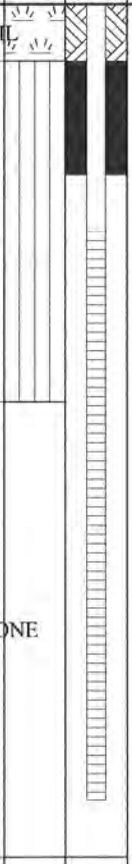
Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Page 1 of 1

Facility/Project Name IPL- Ottumwa Generating Station SCS#: 25215135.40	License/Permit/Monitoring Number	Boring Number MW-301	
Boring Drilled By: Name of crew chief (first, last) and Firm Todd Schmalfeld Cascade Drilling	Date Drilling Started 11/10/2015	Date Drilling Completed 11/10/2015	Drilling Method 4-1/4 hollow stem auger
Unique Well No. / DNR Well ID No. / Common Well Name MW-301	Final Static Water Level Feet	Surface Elevation 684.3 Feet	Borehole Diameter 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 ☐ E
Feet ☐ S Feet ☐ W

Facility ID
County: Wapello
Civil Town/City/ or Village: 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	U S C S	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
				TOPSOIL.	TOPSOIL									
			1	SANDY SILT WITH GRAVEL, gray (7.5YR 6/1), gravel is fine.	ML									
S1	10	woh 1 3 9								W				
			7	WEATHERED SANDSTONE, very weak, light gray matrix (10YR 7/1), scondary color very dark gray 910YR 3/1), massive.	SANDSTONE									
S2	13	24 50								W				
S3	5	50								W				
S4	6	50								W				
S5	4	50								W				
			15	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 ☐

Page 1 of 2

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

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

Unique Well No.:
DNR Well ID No.:
Common Well Name: MW-302
Final Static Water Level: Feet
Surface Elevation: 671.6 Feet
Borehole Diameter: 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: Feet ☐ N ☐ S Feet ☐ E ☐ W

Facility ID:
County: Wapello
Civil Town/City/ or Village: 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	U S C S	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
				TOPSOIL.	TOPSOIL									
			1 2 3 4 5 6 7 8 9 10	LEAN CLAY WITH SAND, dark gray (10YR 4/1).	CL									
S1	19	1 4 5 7	11 12							M				
S2	19	2 4 7 11	13							M				
			14 15 16	LEAN CLAY WITH SAND, very dark gray (5Y 3/1).	CL									

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-302

Page 2 of 2

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

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

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

Page 1 of 1

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

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

Unique Well No.:
DNR Well ID No.:
Common Well Name: MW-303
Final Static Water Level: Feet
Surface Elevation: 659.0 Feet
Borehole Diameter: 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: Feet ☐ N ☐ S Feet ☐ E ☐ W

Facility ID:
County: Wapello
Civil Town/City/ or Village: 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	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			0–9	FILL, boring location was cleared to 9' bgs by hydrovac, then back filled.	FILL	▨								
			9–14.5	WEATHERED SANDSTONE, medium grained, brown (10YR 5/4).	SANDSTONE									
S1	1	50	11							W				
S2	NR		13.5											
			14.5	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 ☐

Page 1 of 3

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

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

Unique Well No.	DNR Well ID No.	Common Well Name MW-304	Final Static Water Level Feet	Surface Elevation 680.1 Feet	Borehole Diameter 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
Feet ☐ N ☐ S
Feet ☐ E ☐ W

Facility ID	County Wapello	Civil Town/City/ or Village 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	U S C S	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
				TOPSOIL.	TOPSOIL									
			1	FAT CLAY, black (10YR 2/1).	CH									
S1	23	4 5 4 5	11							M				
			12.5	FAT CLAY, yellowish brown (10YR 5/4).	CH									
S2	19.5	4 4 5 5	14							M				
			15	FAT CLAY, yellowish brown (10YR 3/4).	CH									

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									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	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 22							M				
S6	23	3 4 8 6	23 24							M				
S7	23	5 11 15 11	25 26 27		CH					M				
S8	15	4 4 5 6	28 29							M				
S9	18	4 6 9 9	30 31 32							M				
S10	24	4 6 7 6	33 34							M				
S11	16	2 2 4 6	35 36 37	FAT CLAY, DARK OLIVE BROWN (2.5Y 3/3).						M				
S12	24	4 3 5 5	38 39		CH					M				
S13	18	2 3 3 3	40 41 42							M				

SOIL BORING LOG INFORMATION SUPPLEMENT

Form 4400-122A

Boring Number MW-304

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

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SOIL BORING LOG INFORMATION

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

Page 1 of 3

Facility/Project Name: IPL- Ottumwa Generating Station SCS#: 25215135.40
License/Permit/Monitoring Number:
Boring Number: MW-305
Boring Drilled By: Name of crew chief (first, last) and Firm: Todd Schmalfeld, Cascade Drilling
Date Drilling Started: 12/7/2015
Date Drilling Completed: 12/8/2015
Drilling Method: 4-1/4 hollow stem auger
Unique Well No.:
DNR Well ID No.:
Common Well Name: MW-305
Final Static Water Level: Feet
Surface Elevation: 681.5 Feet
Borehole Diameter: 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 ☐ S Feet; ☐ E ☐ W Feet
Facility ID:
County: Wapello
Civil Town/City/ or Village: 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	U S C S	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
				TOPSOIL	TOPSOIL									
			1	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: Per Kyle Kramer

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

Boring Number MW-305

Sample										Soil Properties				
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	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		CH									
			20	FAT CLAY WITH SILT, dark gray (10YR 4/1).										
S5	24	4 5 7 11	21 22							M				
			23	same as above except, very dark brown (10YR 2/2).										
S6	20	7 11 15 20	24							M				
			25	same as above except, very dark gray (10YR 3/1).										
S7	24	4 8 11 12	26 27		CH					M				
S8	24	8 12 16 21	28 29 30							M				
S9	13	4 4 7 12	31 32							M				
				LEAN CLAY, very dark brown (10YR 2/2).										
S10	24	5 6 9	33 34 35							W				
S11	24	4 4 5 7	36 37		CL					W				
			38	same as above except, very dark grayish brown (10YR 3/2).										
S12	22	2 2 3 5	39 40							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

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

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SOIL BORING LOG INFORMATION

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

Page 1 of 2

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

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

Unique Well No.	DNR Well ID No.	Common Well Name MW-306	Final Static Water Level Feet	Surface Elevation 681.1 Feet	Borehole Diameter 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 ☐ E
Feet ☐ S Feet ☐ W

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

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

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number MW-306

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

Appendix C

Information on Cobalt

ATSDR
AGENCY FOR TOXIC SUBSTANCES
AND DISEASE REGISTRY

COBALT
CAS #7440-48-4

Division of Toxicology ToxFAQs™ April 2004

This fact sheet answers the most frequently asked health questions (FAQs) about cobalt. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: The general population is exposed to low levels of cobalt in air, water, and food. Cobalt has both beneficial and harmful effects on health. At low levels, it is part of vitamin B12, which is essential for good health. At high levels, it may harm the lungs and heart. This chemical has been found in at least 426 of the 1,636 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is cobalt?

Cobalt is a naturally occurring element found in rocks, soil, water, plants, and animals. Cobalt is used to produce alloys used in the manufacture of aircraft engines, magnets, grinding and cutting tools, artificial hip and knee joints. Cobalt compounds are also used to color glass, ceramics and paints, and used as a drier for porcelain enamel and paints.

Radioactive cobalt is used for commercial and medical purposes. ^{60}Co (read as cobalt sixty) is used for sterilizing medical equipment and consumer products, radiation therapy for treating cancer patients, manufacturing plastics, and irradiating food. ^{57}Co is used in medical and scientific research. It takes about 5.27 years for half of ^{60}Co to give off its radiation and about 272 days for ^{57}Co; this is called the half-life.

What happens to cobalt when it enters the environment?

❑ Cobalt enters the environment from natural sources and the burning of coal or oil or the production of cobalt alloys.
❑ In the air, cobalt will be associated with particles that settle to the ground within a few days.
❑ Cobalt released into water or soil will stick to particles. Some cobalt compounds may dissolve.
❑ Cobalt cannot be destroyed. It can change form or attach to or separate from particles. Radioactive decay is a way of decreasing the amount of radioactive cobalt in the environment.

How might I be exposed to cobalt?

❑ You can be exposed to low levels of cobalt by breathing air, eating food, or drinking water. Food and drinking water are the largest sources of exposure to cobalt for the general population.
❑ Working in industries that make or use cutting or grinding tools; mine, smelt, refine, or process cobalt metal or ores; or that produce cobalt alloys or use cobalt.
❑ The general population is rarely exposed to radioactive cobalt unless a person is undergoing radiation therapy. However, workers at nuclear facilities, irradiation facilities, or nuclear waste storage sites may be exposed to radiation from these sources.

How can cobalt affect my health?

Cobalt can benefit or harm human health. Cobalt is beneficial for humans because it is part of vitamin B12.

Exposure to high levels of cobalt can result in lung and heart effects and dermatitis. Liver and kidney effects have also been observed in animals exposed to high levels of cobalt.

Exposure to large amounts of radiation from radioactive cobalt can damage cells in your body from the radiation.

You might also experience acute radiation syndrome that includes nausea, vomiting, diarrhea, bleeding, coma, and even death. This would be a rare event.

How likely is cobalt to cause cancer?

Nonradioactive cobalt has not been found to cause cancer in humans or animals following exposure in food or water. Cancer has been shown, however, in animals that breathed cobalt or when cobalt was placed directly into the muscle or under the skin. Based on the laboratory animal data, the International Agency for Research on Cancer (IARC) has determined that cobalt and cobalt compounds are possibly carcinogenic to humans.

Exposure to high levels of cobalt radiation can cause changes in the genetic materials within cells and may result in the development of some types of cancer.

How can cobalt affect children?

We do not know whether children differ from adults in their susceptibility to cobalt. However, it is likely that health effects in children would be similar those in adults. Studies in animals suggest that children may absorb more cobalt than adults from foods and liquids containing cobalt.

We do not know if exposure to cobalt will result in birth defects or other developmental effects in people. Birth defects have been observed in animals exposed to nonradioactive cobalt. Exposure to cobalt radiation can also result in developmental effects.

How can families reduce the risk of exposure to cobalt?

Children should avoid playing in soils near hazardous waste sites where cobalt may be present.

Is there a medical test to show whether I've been exposed to cobalt?

Cobalt levels can be tested in the urine and blood within a couple of days of exposure. Your doctor can take samples, but must send them to a laboratory to be tested. The amount of cobalt in your blood or urine can be used to estimate how much cobalt you were exposed to. However, these tests cannot predict whether you will experience any health effects.

Two types of tests are available for radioactive cobalt. One is to see if you have been exposed to a large dose of radiation, and the other is to see if radioactive cobalt is in your body. The first looks for changes in blood cell counts or in your chromosomes that occur at 3 to 5 times the annual occupational dose limit. It cannot tell if the radiation came from cobalt. The second type of test involves examining your blood, feces, saliva, urine, and even your entire body. It is to see if cobalt is being excreted from or remains inside your body. Either the doctor's office collects and sends the samples to a special lab for testing, or you must go to the lab for testing.

Has the federal government made recommendations to protect human health?

The Occupational Safety and Health Administration (OSHA) has set a limit of 0.1 milligrams of nonradioactive cobalt per cubic meter of workplace air (0.1 mg/m^3) for an 8-hour workday and 40-hour work week.

The Nuclear Regulatory Commission limits radioactive cobalt in workplace air to $1x10^{-5}$ microcurie per milliliter (µCi/mL) for ^{57}Co and $7x10^{-8}$ µCi/mL for ^{60}Co. EPA has set an average annual drinking water limit of 1000 picocurie per liter (pCi/L) for ^{57}Co or 100 pCi/L for ^{60}Co so the public radiation dose will not exceed 4 millirem.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2004. Toxicological Profile for Cobalt Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

PUBLIC HEALTH STATEMENT

Cobalt

CAS#: 7440-48-4

Division of Toxicology **April 2004**

This Public Health Statement is the summary chapter from the Toxicological Profile for cobalt. It is one in a series of Public Health Statements about hazardous substances and their health effects. A shorter version, the ToxFAQs™, is also available. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present. For more information, call the ATSDR Information Center at 1-888-422-8737.

This public health statement tells you about cobalt and the effects of exposure.

The Environmental Protection Agency (EPA) identifies the most serious hazardous waste sites in the nation. These sites make up the National Priorities List (NPL) and are the sites targeted for long-term federal cleanup activities. Stable cobalt has been found in at least 426 of the 1,636 current or former NPL sites. Radioactive cobalt, as ^{60}Co, has been found in at least 13 of the 1,636 current or former NPL sites. However, the total number of NPL sites evaluated for this substance is not known. As more sites are evaluated, the sites at which cobalt is found may increase. This information is important because exposure to this substance may harm you and because these sites may be sources of exposure.

When a substance is released from a large area, such as an industrial plant, or from a container, such as a drum or bottle, it enters the environment. This release does not always lead to exposure. You are exposed to a substance only when you come in contact with it. You may be exposed by breathing, eating, or drinking the substance, or by skin contact.

External exposure to radiation may occur from natural or man-made sources. Naturally occurring sources of radiation are cosmic radiation from space or radioactive materials in soil or building materials. Man-made sources of radioactive materials are found in consumer products, industrial equipment, atom bomb fallout, and to a smaller extent from hospital waste and nuclear reactors.

If you are exposed to cobalt, many factors determine whether you'll be harmed. These factors include the dose (how much), the duration (how long), and how you come in contact with it. You must also consider the other chemicals you're exposed to and your age, sex, diet, family traits, lifestyle, and state of health.

1.1 WHAT IS COBALT?

Cobalt is a naturally-occurring element that has properties similar to those of iron and nickel. It has an atomic number of 27. There is only one stable isotope of cobalt, which has an atomic mass number of 59. (An element may have several different forms, called isotopes, with different weights depending on the number of neutrons that it contains. The isotopes of an element, therefore, have different atomic mass numbers [number of protons and neutrons], although the atomic number [number of protons] remains the same.) However, there are many unstable or radioactive isotopes, two of which are commercially important, cobalt-60 and cobalt-57, also written as Co-60 or ^{60}Co and Co-57 or ^{57}Co, and read as cobalt sixty and cobalt fifty-seven. All isotopes of cobalt behave the same chemically and will therefore have the same chemical behavior in the environment and the same chemical effects on your body. However, isotopes have different mass numbers and the radioactive isotopes have different radioactive properties, such as their half-life and the nature of the radiation they give off. The half-life of a cobalt isotope is the time that it takes for half of that isotope to give off its radiation and change into a different isotope. After one half-life, one-half of the radioactivity is gone. After a second half-life, one-fourth of the original radioactivity is left, and so on. Radioactive isotopes are constantly changing into different isotopes by giving off radiation, a process referred to as radioactive decay. The new isotope may be a different element or the same element with a different mass.

Small amounts of cobalt are naturally found in most rocks, soil, water, plants, and animals, typically in small amounts. Cobalt is also found in meteorites. Elemental cobalt is a hard, silvery grey metal. However, cobalt is usually found in the environment combined with other elements such as oxygen, sulfur, and arsenic. Small amounts of these chemical compounds can be found in rocks, soil, plants, and animals. Cobalt is even found in water in dissolved or ionic form, typically in small amounts. (Ions are atoms, collections of atoms, or molecules containing a positive or negative electric charge.) A biochemically important cobalt compound is vitamin B_{12} or cyanocobalamin. Vitamin B_{12} is essential for good health in animals and humans. Cobalt is not currently mined in the United States, but has been mined in the past. Therefore, we obtain cobalt and its other chemical forms from imported materials and by recycling scrap metal that contains cobalt.

Cobalt metal is usually mixed with other metals to form alloys, which are harder or more resistant to wear and corrosion. These alloys are used in a number of military and industrial applications such as aircraft engines, magnets, and grinding and cutting tools. They are also used in artificial hip and knee joints. Cobalt compounds are used as colorants in glass, ceramics, and paints, as catalysts, and as paint driers. Cobalt colorants have a characteristic blue color; however, not all cobalt compounds are blue. Cobalt compounds are also used as trace element additives in agriculture and medicine.

Cobalt can also exist in radioactive forms. A radioactive isotope of an element constantly gives off radiation, which can change it into an isotope of a different element or a different isotope of the same element. This newly formed nuclide may be stable or radioactive. This process is called radioactive decay. ^{60}Co is the most important radioisotope of cobalt. It is produced by bombarding natural cobalt, ^{59}Co, with neutrons in a nuclear reactor. ^{60}Co decays by giving off a beta ray (or electron), and is changed into a stable nuclide of nickel (atomic number 28). The half-life of ^{60}Co is 5.27 years. The decay is accompanied by the emission of high energy radiation called gamma rays. ^{60}Co is used as a source of gamma rays for sterilizing medical equipment and consumer products, radiation therapy for treating cancer patients, and for manufacturing plastics. ^{60}Co has also been used for food irradiation; depending on the radiation dose, this process may be used to sterilize food, destroy pathogens, extend the shelf-life of food, disinfest fruits and grain, delay ripening, and retard sprouting (e.g., potatoes and onions). ^{57}Co is used in medical and scientific research and has a half-life of 272 days. ^{57}Co undergoes a decay process called electron capture to form a stable isotope of iron (^{57}Fe). Another important cobalt isotope, ^{58}Co, is produced when nickel is exposed to a source of neutrons. Since nickel is used in nuclear reactors, ^{58}Co may be unintentionally produced and appear as a contaminant in cooling water released by nuclear reactors. ^{58}Co also decays by electron capture, forming another stable isotope of iron (^{58}Fe). ^{60}Co may be similarly produced from cobalt alloys in nuclear reactors and released as a contaminant in cooling water. ^{58}Co has a half-life of 71 days and gives off beta and gamma radiation in the decay process.

Quantities of radioactive cobalt are normally measured in units of radioactivity (curies or becquerels) rather than in units of mass (grams). The becquerel (Bq) is a new international unit, and the curie (Ci) is the traditional unit; both are currently used. A becquerel is the amount of radioactive material in which 1 atom transforms every second, and a curie is the amount of radioactive material in which 37 billion atoms transform every second. For an overview of basic radiation physics, chemistry, and biology see Appendix D of the cobalt profile. For more information on radiation, see the *ATSDR Toxicological Profile for Ionizing Radiation*.

1.2 WHAT HAPPENS TO COBALT WHEN IT ENTERS THE ENVIRONMENT?

Cobalt may enter the environment from both natural sources and human activities. Cobalt occurs naturally in soil, rock, air, water, plants, and animals. It may enter air and water, and settle on land from windblown dust, seawater spray, volcanic eruptions, and forest fires and may additionally get into surface water from runoff and leaching when rainwater washes through soil and rock containing cobalt. Soils near ore deposits, phosphate rocks, or ore smelting facilities, and soils contaminated by airport traffic, highway traffic, or other industrial pollution may contain high concentrations of cobalt. Small amounts of cobalt may be released into the atmosphere from coal-fired power plants and incinerators, vehicular exhaust, industrial activities relating to the mining and processing of cobalt-containing ores, and the production and use of cobalt alloys and chemicals. ^{58}Co and ^{60}Co may be released to the environment as a result of nuclear accidents (i.e, Chernobyl), radioactive waste dumping in the sea or from radioactive waste landfills, and nuclear power plant operations.

Cobalt cannot be destroyed in the environment. It can only change its form or become attached or separated from particles. Cobalt released from power plants and other combustion processes is usually attached to very small particles. Cobalt contained in windborne soil is generally found in larger particles than those released from power plants. These large particles settle to the ground or are washed out of the air by rain. Cobalt that is attached to very small particles may stay in the air for many days. Cobalt released into water may stick to particles in the water column or to the sediment at the bottom of the body of water into which it was released, or remain in the water column in ionic form. The specific fate of cobalt will depend on many factors such as the chemistry of the water and sediment at a site as well as the cobalt concentration and water flow. Cobalt deposited on soil is often strongly attached to soil particles and therefore would not travel very far into the ground. However, the form of the cobalt and the nature of the soil at a particular site will affect how far cobalt will penetrate into the soil. Both in soil and sediment, the amount of cobalt that is mobile will increase under more acidic conditions. Ultimately, most cobalt ends up in the soil or sediment.

Plants can accumulate very small amounts of cobalt from the soil, especially in the parts of the plant that you eat most often, such as the fruit, grain, and seeds. While animals that eat these plants will accumulate cobalt, cobalt is not known to biomagnify (produce increasingly higher concentrations) up the food chain. Therefore, vegetables, fruits, fish, and meat that you consume will generally not contain high amounts of cobalt. Cobalt is an essential element, required for good health in animals and humans, and therefore, it is important that foodstuffs contain adequate quantities of cobalt.

^{60}Co and ^{58}Co are moderately short-lived, manufactured radioactive isotopes that are produced in nuclear reactors. Although these isotopes are not produced by nuclear fission, small amounts of these radioisotopes are also produced by the neutron interaction with the structural materials found in the reactor of nuclear plants, and are produced during the routine operation of nuclear plants. Small amounts may be released to the environment as contaminants in cooling water or in radioactive waste. Since these isotopes are not fission products, they are not produced in nuclear weapons testing and are not associated with nuclear fallout. In the environment, radioactive isotopes of cobalt will behave chemically like stable cobalt. However, ^{60}Co and ^{58}Co will also undergo radioactive decay according to their respective half-lives, 5.27 years and 71 days.

1.3 HOW MIGHT I BE EXPOSED TO COBALT?

Cobalt is widely dispersed in the environment in low concentrations. You may be exposed to small amounts of cobalt by breathing air, drinking water, and eating food containing it. Children may also be exposed to cobalt by eating dirt. You may also be exposed by skin contact with soil, water, cobalt alloys, or other substances that contain cobalt.

Analytical methods used by scientists to determine the levels of cobalt in the environment generally do not determine the specific chemical form of cobalt present. Therefore, we do not always know the chemical form of cobalt to which a person may be exposed. Similarly, we do not know what forms of cobalt are present at hazardous waste sites. Some forms of cobalt may be insoluble or so tightly attached to particles or embedded in minerals that they are not taken up by plants and animals. Other forms of cobalt that are weakly attached to particles may be taken up by plants and animals.

The concentration of cobalt in soil varies widely, generally ranging from about 1 to 40 ppm (1 ppm=1 part of cobalt in a million parts of soil by weight), with an average level of 7 ppm. Soils containing less than about 3 ppm of cobalt are considered cobalt-deficient because plants growing in them do not have sufficient cobalt to meet the dietary requirements of cattle and sheep. Such cobalt-deficient soils are found in some areas in the southeast and northeast parts of the United States. On the other hand, soils near cobalt-containing mineral deposits, mining and smelting facilities, or industries manufacturing or using cobalt alloys or chemicals may contain much higher levels of cobalt.

Usually, the air contains very small amounts of cobalt, less than 2 nanograms (1 nanogram=one-billionth part of a gram) per cubic meter (ng/m^3). The amount of cobalt that you breathe in a day is much less than what you consume in food and water. You may breathe in higher levels of cobalt in dust in areas near cobalt-related industries or near certain hazardous waste sites.

The concentration of cobalt in surface and groundwater in the United States is generally low—

between 1 and 10 parts of cobalt in 1 billion parts of water (ppb) in populated areas; concentration may be hundreds or thousands times higher in areas that are rich in cobalt-containing minerals or in areas near mining or smelting operations. In most drinking water, cobalt levels are less than 1–2 ppb.

For most people, food is the largest source of cobalt intake. The average person consumes about 11 micrograms of cobalt a day in their diet. Included in this food is vitamin B_{12}, which is found in meat and diary products. The recommended daily intake of vitamin B_{12} is 6 micrograms (1 microgram=one-millionth part of a gram).

You may also be exposed to higher levels of cobalt if you work in metal mining, smelting, and refining, in industries that make or use cutting or grinding tools, or in other industries that produce or use cobalt metal and cobalt compounds. If good industrial hygiene is practiced, such as the use of exhaust systems in the workplace, exposure can be reduced to safe levels. Industrial exposure results mainly from breathing cobalt-containing dust.

When we speak of exposure to ^{60}Co, we are interested in exposure to the radiation given off by this isotope, primarily the gamma rays. The general population is rarely exposed to this radiation unless a person is undergoing radiation therapy. However, workers at nuclear facilities, irradiation facilities, or nuclear waste storage sites may be exposed to ^{60}Co or ^{58}Co. Exposures to radiation at these facilities are regulated and carefully monitored and controlled.

1.4 HOW CAN COBALT ENTER AND LEAVE MY BODY?

Cobalt can enter your body when you breathe in air containing cobalt dust, when you drink water that contains cobalt, when you eat food that contains cobalt, or when your skin touches materials that contain cobalt. If you breathe in air that contains cobalt dust, the amount of inhaled cobalt that stays in your lungs depends on the size of the dust particles. The amount that is then absorbed into your blood depends on how well the particles dissolve. If the particles dissolve easily, then it is easier for the cobalt to pass into your blood from the particles in your lungs. If the particles dissolve slowly, then they will remain in your lungs longer. Some of the particles will leave your lungs as they normally clean themselves out. Some of the particles will be swallowed into your stomach. The most likely way you will be exposed to excess cobalt is by eating contaminated food or drinking contaminated water. Levels of cobalt normally found in the environment, however, are not high enough to result in excess amounts of cobalt in food or water. The amount of cobalt that is absorbed into your body from food or water depends on many things including your state of health, the amount you eat or drink, and the number of days, weeks, or years you eat foods or drink fluids containing cobalt. If you do not have enough iron in your body, the body may absorb more cobalt from the foods you eat. Once cobalt enters your body, it is distributed into all tissues, but mainly into the liver, kidney, and bones. After cobalt is breathed in or eaten, some of it leaves the body quickly in the feces. The rest is absorbed into the blood and then into the tissues throughout the body. The absorbed cobalt leaves the body slowly, mainly in the urine. Studies have shown that cobalt does not readily enter the body through normal skin, but it can if the skin has been cut.

1.5 HOW CAN COBALT AFFECT MY HEALTH?

To protect the public from the harmful effects of toxic chemicals and to find ways to treat people who have been harmed, scientists use many tests.

One way to see if a chemical will hurt people is to learn how the chemical is absorbed, used, and released by the body. In the case of a radioactive chemical, it is also important to gather information concerning the radiation dose and dose rate to the body. For some chemicals, animal testing may be necessary. Animal testing may also be used to identify health effects such as cancer or birth defects. Without laboratory animals, scientists would lose a basic method to get information needed to make wise decisions to protect public health. Scientists have the responsibility to treat research animals with care and compassion. Laws today protect the welfare of research animals, and scientists must comply with strict animal care guidelines.

Cobalt has both beneficial and harmful effects on human health. Cobalt is beneficial for humans because it is part of vitamin B_{12}, which is essential to maintain human health. Cobalt (0.16–1.0 mg cobalt/kg of body weight) has also been used as a treatment for anemia (less than normal number of red blood cells), including in pregnant women, because it causes red blood cells to be produced. Cobalt also increases red blood cell production in healthy people, but only at very high exposure levels. Cobalt is also essential for the health of various animals, such as cattle and sheep. Exposure of humans and animals to levels of cobalt normally found in the environment is not harmful.

When too much cobalt is taken into your body, however, harmful health effects can occur. Workers who breathed air containing 0.038 mg cobalt/m^3 (about 100,000 times the concentration normally found in ambient air) for 6 hours had trouble breathing. Serious effects on the lungs, including asthma, pneumonia, and wheezing, have been found in people exposed to 0.005 mg cobalt/m^3 while working with hard metal, a cobalt-tungsten carbide alloy. People exposed to 0.007 mg cobalt/m^3 at work have also developed allergies to cobalt that resulted in asthma and skin rashes. The general public, however, is not likely to be exposed to the same type or amount of cobalt dust that caused these effects in workers.

In the 1960s, some breweries added cobalt salts to beer to stabilize the foam (resulting in exposures of 0.04–0.14 mg cobalt/kg). Some people who drank excessive amounts of beer (8–25 pints/day) experienced serious effects on the heart. In some cases, these effects resulted in death. Nausea and vomiting were usually reported before the effects on the heart were noticed. Cobalt is no longer added to beer so you will not be exposed from this source. The effects on the heart, however, may have also been due to the fact that the beer-drinkers had protein-poor diets and may have already had heart damage from alcohol abuse. Effects on the heart were not seen, however, in people with anemia treated with up to 1 mg cobalt/kg, or in pregnant women with anemia treated with 0.6 mg cobalt/kg. Effects on the thyroid were found in people exposed to 0.5 mg cobalt/kg for a few weeks. Vision problems were found in one man following treatment with 1.3 mg cobalt/kg for 6 weeks, but this effect has not been seen in other human or animal studies.

Being exposed to radioactive cobalt may be very dangerous to your health. If you come near radioactive cobalt, cells in your body can become damaged from gamma rays that can penetrate your entire body, even if you do not touch the radioactive cobalt. Radiation from radioactive cobalt can also damage cells in your body if you eat, drink, breathe, or touch anything that contains radioactive cobalt. The amount of damage depends on the amount of radiation to which you are exposed, which is related to the amount of activity in the radioactive material and the length of time that you are exposed. Most of the information regarding health effects from exposure to radiation comes from exposures for only short time periods. The risk of damage from exposure to very low levels of radiation for long time periods is not known. If you are exposed to enough radiation, you might experience a reduction in white blood cell number, which could lower your resistance to infections. Your skin might blister or burn, and you may lose hair from the exposed areas. This happens to cancer patients treated with large amounts of radiation to kill cancer. Cells in your reproductive system could become damaged and cause temporary sterility. Exposure to lower levels of radiation might cause nausea, and higher levels can cause vomiting, diarrhea, bleeding, coma, and even death. Exposure to radiation can also cause changes in the genetic materials within cells and may result in the development of some types of cancer.

Studies in animals suggest that exposure to high amounts of nonradioactive cobalt during pregnancy might affect the health of the developing fetus. Birth defects, however, have not been found in children born to mothers who were treated with cobalt for anemia during pregnancy. The doses of cobalt used in the animal studies were much higher than the amounts of cobalt to which humans would normally be exposed.

Nonradioactive cobalt has not been found to cause cancer in humans or in animals following exposure in the food or water. Cancer has been shown, however, in animals who breathed cobalt or when cobalt was placed directly into the muscle or under the skin. Based on the animal data, the International Agency for Research on Cancer (IARC) has determined that cobalt is possibly carcinogenic to humans.

Much of our knowledge of cobalt toxicity is based on animal studies. Cobalt is essential for the growth and development of certain animals, such as cows and sheep. Short-term exposure of rats to high levels of cobalt in the air results in death and lung damage. Longer-term exposure of rats, guinea pigs, hamsters, and pigs to lower levels of cobalt in the air results in lung damage and an increase in red blood cells. Short-term exposure of rats to high levels of cobalt in the food or drinking water results in effects on the blood, liver, kidneys, and heart. Longer-term exposure of rats, mice, and guinea pigs to lower levels of cobalt in the food or drinking water results in effects on the same tissues (heart, liver, kidneys, and blood) as well as the testes, and also causes effects on behavior. Sores were seen on the skin of guinea pigs following skin contact with cobalt for 18 days. Generally, cobalt compounds that dissolve easily in water are more harmful than those that are hard to dissolve in water.

Much of what we know about the effects of radioactive cobalt comes from studies in animals. The greatest danger of radiation seen in animals is the risk to the developing animal, with even moderate amounts of radiation causing changes in the fetus. High radiation doses in animals have also been shown to cause temporary or permanent sterility and changes in the lungs, which affected the animals' breathing. The blood of exposed animals has lower numbers of white blood cells, the cells that aid in resistance to infections, and red blood cells, which carry oxygen in the blood. Radioactive cobalt exposures in animals have also caused genetic damage to cells, cancer, and even death.

1.6 HOW CAN COBALT AFFECT CHILDREN?

This section discusses potential health effects from exposures during the period from conception to maturity at 18 years of age in humans.

Children can be exposed to cobalt in the same ways as adults. In addition, cobalt may be transferred from the pregnant mother to the fetus or from the mother to the infant in the breast milk. Children may be affected by cobalt the same ways as adults. Studies in animals have suggested that children may absorb more cobalt from foods and liquids containing cobalt than adults. Babies exposed to radiation while in their mother's womb are believed to be much more sensitive to the effects of radiation than adults.

1.7 HOW CAN FAMILIES REDUCE THE RISK OF EXPOSURE TO COBALT

If your doctor finds that you have been exposed to significant amounts of cobalt, ask whether your children might also be exposed. Your doctor might need to ask your state health department to investigate.

Since cobalt is naturally found in the environment, people cannot avoid being exposed to it. However, the relatively low concentrations present do not warrant any immediate steps to reduce exposure. If you are accidentally exposed to large amounts of cobalt, consult a physician immediately.

Children living near waste sites containing cobalt are likely to be exposed to higher environmental levels of cobalt through breathing, touching soil, and eating contaminated soil. Some children eat a lot of dirt. You should discourage your children from eating dirt. Make sure they wash their hands frequently and before eating. Discourage your children from putting their hands in their mouths or hand-to-mouth activity.

You are unlikely to be exposed to high levels of radioactive cobalt unless you are exposed as part of a radiotherapy treatment, there is an accident involving a cobalt sterilization or radiotherapy unit, or there is an accidental release from a nuclear power plant. In such cases, follow the advice of public health officials who will publish guidelines for reducing exposure to radioactive material when necessary. Workers who work near or with radioactive cobalt should follow the workplace safety guidelines of their institution carefully to reduce the risk of accidental irradiation.

1.8 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO COBALT?

We have reliable tests that can measure cobalt in the urine and the blood for periods up to a few days after exposure. The amount of cobalt in your blood or urine can be used to estimate how much cobalt you had taken into your body. The tests are not able to accurately predict potential health effects following exposure to cobalt.

It is difficult to determine whether a person has been exposed only to external radiation from radioactive cobalt unless the radiation dose was rather large. Health professionals examining people who have health problems similar to those resulting from radiation exposure would need to rely on additional information in order to establish if such people had been near a source of radioactivity. It is relatively easy to determine whether a person has been internally exposed to radioactive cobalt.

1.9 WHAT RECOMMENDATIONS HAS THE FEDERAL GOVERNMENT MADE TO PROTECT HUMAN HEALTH?

The federal government develops regulations and recommendations to protect public health. Regulations can be enforced by law. Federal agencies that develop regulations for toxic substances include the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), the Food and Drug Administration (FDA), and the U.S. Nuclear Regulatory Commission (USNRC).

Recommendations provide valuable guidelines to protect public health but cannot be enforced by law. Federal organizations that develop recommendations for toxic substances include the Agency for Toxic Substances and Disease Registry (ATSDR), the National Institute for Occupational Safety and Health (NIOSH), and the FDA.

Regulations and recommendations can be expressed in not-to-exceed levels in air, water, soil, or food that are usually based on levels that affect animals; they are then adjusted to help protect people. Sometimes these not-to-exceed levels differ among federal organizations because of different exposure times (an 8-hour workday or a 24-hour day), the use of different animal studies, or other factors.

Recommendations and regulations are also periodically updated as more information becomes available. For the most current information, check with the federal agency or organization that provides it. Some regulations and recommendations for cobalt include the following:

EPA requires that the federal government be notified if more than 1,000 pounds of cobalt (as the bromide, formate, and sulfamate compounds) are released into the environment in a 24-hour period. OSHA regulates levels of nonradioactive cobalt in workplace air. The limit for an 8-hour workday, 40-hour workweek is an average of 0.1 mg/m^3. The USNRC and the Department of Energy (DOE) regulate occupational exposures as well as exposures of the general public to radioactive cobalt.

1.10 WHERE CAN I GET MORE INFORMATION?

If you have any more questions or concerns, please contact your community or state health or environmental quality department, your regional Nuclear Regulatory Commission office, or contact ATSDR at the address and phone number below.

ATSDR can also tell you the location of occupational and environmental health clinics. These clinics specialize in recognizing, evaluating, and treating illnesses resulting from exposure to hazardous substances.

Toxicological profiles are also available on-line at www.atsdr.cdc.gov and on CD-ROM. You may request a copy of the ATSDR ToxProfiles CD-ROM by calling the information and technical assistance toll-free number at 1-888-42ATSDR (1-888-422-8737), by email at atsdric@cdc.gov, or by writing to:

Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road NE
Mailstop F-32
Atlanta, GA 30333
Fax: 1-770-488-4178

For-profit organizations may request a copy of final profiles from the following:

National Technical Information Service (NTIS)
5285 Port Royal Road
Springfield, VA 22161
Phone: 1-800-553-6847 or 1-703-605-6000
Web site: http://www.ntis.gov/

Addendum No. 1
Assessment of Corrective Measures
OGS Ash Pond

Ottumwa Generating Station
Ottumwa, Iowa

Prepared for:

Alliant Energy

SCS ENGINEERS

25220083.00 | November 25, 2020

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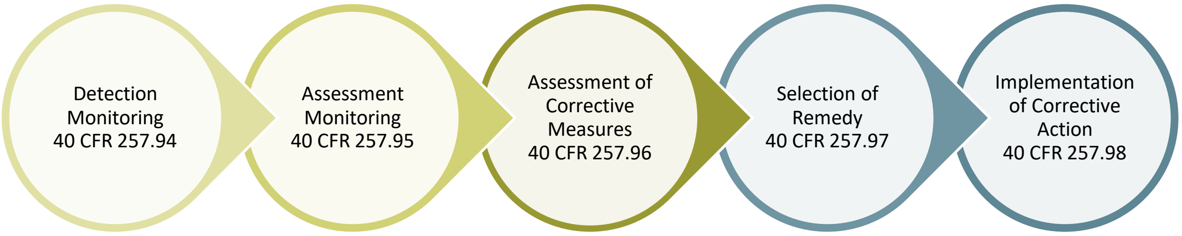
EXECUTIVE SUMMARY

Interstate Power and Light Company (IPL), an Alliant Energy company, operates two ash ponds at the Ottumwa Generating Station (OGS). The ponds are used to manage coal combustion residuals (CCR) and wastewater from the power plant, which burns coal to generate electricity.

IPL samples and tests the groundwater in the area of the ash ponds to comply with U.S. Environmental Protection Agency (USEPA) standards for the Disposal of CCR from Electric Utilities, or the “CCR Rule” (Rule).

Groundwater samples from two of the wells installed to monitor one of the ponds (OGS Ash Pond) contain cobalt at levels higher than the Groundwater Protection Standards (GPS) defined in the Rule. Cobalt occurs naturally and can be present in coal and CCR.

IPL prepared an Assessment of Corrective Measures (ACM) Report in September 2019 response to the groundwater sampling results at the OGS facility. The ACM process is one step in a series of steps defined in the Rule and shown below.



To prepare the ACM, IPL worked to understand the following:

- Types of soil and rock deposits in the area of the OGS facility.
- Depth of groundwater.
- Direction that groundwater is moving.
- Potential sources of the cobalt in groundwater.
- The area where cobalt levels are higher than the USEPA standards.
- The people, plants, and animals that may be affected by levels of cobalt in groundwater that are above the GPS.

Because the time allowed by the Rule to prepare the ACM was limited, IPL has continued work to improve the understanding of the items listed above. Using information obtained between September 2019 and September 2020, IPL selected a remedy and issued a Selection of Remedy Report on September 11, 2020. New information was received following issuance of the Selection of Remedy report, resulting in this addendum to the ACM (Addendum No. 1). Addendum No. 1 includes an update of available site data obtained since the initial ACM was completed and additional Corrective Measures. IPL held a public meeting on June 4, 2020, to discuss the contents of the September 2019 ACM. IPL will hold an additional public meeting with interested and affected parties to discuss the amended ACM and will issue a revised Selection of Remedy report.

IPL has identified appropriate options, or Corrective Measures, to bring the levels of cobalt in groundwater below USEPA standards. In addition to stopping the discharge of CCR and OGS wastewater to the pond, these corrective measures include:

- Cap CCR in Place with Monitored Natural Attenuation (MNA)
- Consolidate CCR and Cap with MNA
- Excavate and Dispose CCR on Site with MNA
- Excavate and Dispose CCR in Off-site Landfill with MNA
- Consolidate and Cap with Chemical Amendment
- Consolidate and Cap with Groundwater Collection
- Consolidate and Cap with Barrier Wall

IPL has also included a “No Action” alternative for comparison purposes only. This alternative will not be selected as a remedy.

Addendum No. 1 includes an updated evaluation that includes all eight options using factors identified in the Rule.

IPL provided a semiannual update in March 2020 on its progress in evaluating Corrective Measures to address the groundwater impacts at OGS. The initial Selection of Remedy report issued in September 2020 also describes progress in evaluating the Corrective Measures.

For more information on Alliant Energy, view our Corporate Responsibility Report at https://poweringwhatsnext.alliantenergy.com/crr/.

1.0 INTRODUCTION AND PURPOSE

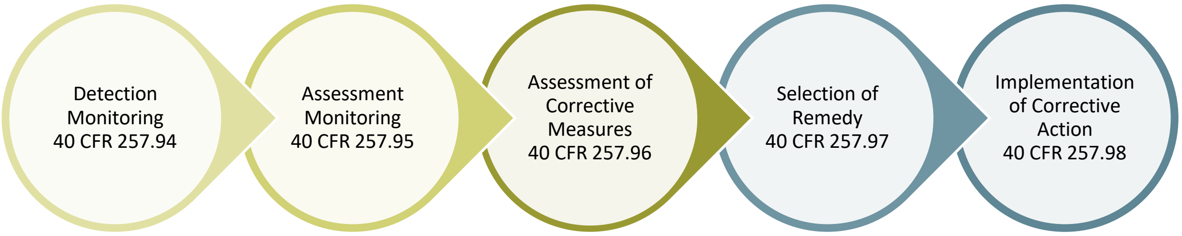
An Assessment of Corrective Measures (ACM) at the Interstate Power and Light Company (IPL) Ottumwa Generating Station (OGS) was prepared to comply with U.S. Environmental Protection Agency (USEPA) regulations regarding the Disposal of Coal Combustion Residuals (CCR) from Electric Utilities [40 CFR 257.50-107], or the "CCR Rule" (Rule). Specifically, the ACM was initiated and this report was prepared to fulfill the requirements of 40 CFR 257.96, including:

- Prevention of further releases
- Remediation of release
- Restoration of affected areas

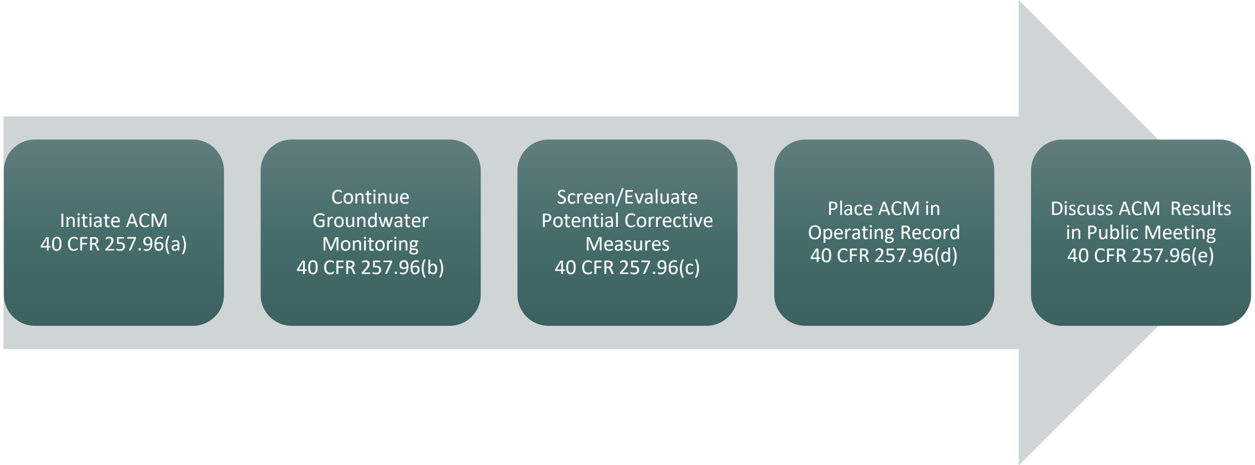
An ACM Report was issued in September 2019 to summarize the remedial alternatives for addressing the Groundwater Protection Standard (GPS) exceedances observed in the October 2018 sampling event for the OGS Ash Pond, and identified in the Notification of Groundwater Protection Standard Exceedance dated January 14, 2019. The September 2019 ACM identified additional information needed to inform the selection of a corrective measure (remedy) for OGS according to 40 CFR 257.97. Using information obtained between September 2019 and September 2020, IPL selected a remedy and issued a Selection of Remedy Report on September 11, 2020. New information was received following issuance of the Selection of Remedy report, resulting in this addendum to the ACM (Addendum No. 1). Addendum No. 1 includes an update of available site data obtained since the initial ACM was completed and additional Corrective Measures. IPL held a public meeting on June 4, 2020, to discuss the contents of the September 2019 ACM. IPL will hold an additional public meeting with interested and affected parties to discuss the amended ACM and will issue a revised Selection of Remedy report.

1.1 ASSESSMENT OF CORRECTIVE MEASURES REQUIREMENTS

As discussed above, Addendum No. 1 was prepared to update the ACM Report developed in response to GPS exceedances observed in groundwater samples collected at the OGS facility. The ACM process is one step in a series of steps defined in the CCR Rule and depicted in the graphic below. To date, IPL has implemented a detection monitoring program per 40 CFR 257.94 and completed assessment monitoring at OGS per 40 CFR 257.95. The September 2019 ACM was required based on the groundwater monitoring results obtained through October 2018. With the ACM completed and now updated with new information, IPL is required to revisit the remedy selection process in 40 CFR 257.97. The remedy selection process must be completed as soon as feasible, and, once selected, IPL is required to start the corrective action process within 90 days.



The process for developing the ACM is defined in 40 CFR 257.96 and is shown in the graphic below. IPL held a public meeting on June 4, 2020, to discuss the September 2019 ACM with interested and affected parties. Additional corrective measure alternatives are identified in Addendum No. 1 that were not discussed at the June 4 meeting. Since IPL is required to discuss the ACM results in a public meeting at least 30 days before selecting a remedy, a second public meeting will be held to discuss the new alternatives. To facilitate the selection of a remedy for the GPS exceedances at OGS, IPL continues to investigate and assess the nature and extent of the groundwater impacts. Information about the site, the groundwater monitoring completed, the groundwater impacts as they are currently understood, and the ongoing assessment activities are discussed in the sections that follow.



1.2 SITE INFORMATION AND MAP

OGS is located southwest of the Des Moines River, approximately 8 miles northwest of the City of Ottumwa in Wapello County, Iowa (**Figure 1**). The address of the plant is 20775 Power Plant Road, Ottumwa, Iowa. In addition to the coal-fired generating station, the property also contains the OGS Ash Pond, the OGS Zero Liquid Discharge (ZLD) Pond, a coal stockpile, and a hydrated fly ash stockpile.

The two CCR units at the facility (OGS Ash Pond and OGS ZLD Pond) are each monitored with single-unit groundwater monitoring systems. The OGS Ash Pond is the subject of this ACM Report.

The pending closure of the OGS Ash Pond was discussed in the IPL Notification of Intent to Close CCR Surface Impoundment, dated April 3, 2019. A map showing the CCR units and all background (or upgradient) and downgradient monitoring wells with identification numbers for the CCR groundwater monitoring program is provided as **Figure 2**.

2.0 BACKGROUND

2.1 REGIONAL GEOLOGIC INFORMATION

The uppermost geologic formation beneath OGS that meets the definition of the “uppermost aquifer,” as defined under 40 CFR 257.53, is the Mississippian bedrock aquifer and hydraulically connected overlying unconsolidated sediments. The thickness and water-producing capacity of the unconsolidated material in the area is variable. A summary of the regional hydrogeologic stratigraphy is included in **Attachment A**.

2.2 SITE GEOLOGIC INFORMATION

Monitoring wells MW-301 through MW-306 and MW-305A, MW-310, MW-310A, MW-311, and MW-311A were installed to intersect the uppermost aquifer at the site. Due to variations in the unconsolidated material thickness and the bedrock surface, some wells are screened in unconsolidated material and some are in bedrock. The unconsolidated material at these well locations generally consists of a clay layer overlying clay and sand. The total monitoring well boring depths are between 14 and 79 feet. The depth to bedrock at the site is variable, and the bedrock surface is highly weathered in some areas. Bedrock was encountered as shallow as 7 feet and as deep as 44 feet below ground surface (bgs) in the monitoring well borings. The boring logs for MW-301 through MW-306 and MW-305A, MW-310, MW-310A, MW-311, and MW-311A are included in **Appendix B**.

Shallow and deep groundwater at the site generally flows toward the Des Moines River. The groundwater flow patterns in April and October 2019, and the shallow and deep flow pattern in April 2020 are shown on **Figures 3** through **6**. The groundwater elevation data for the CCR monitoring wells are provided in **Table 1**.

A geologic cross section was prepared for OGS. The cross section line runs through upgradient well MW-301 and downgradient monitoring wells MW-305/MW-305A and MW-310/MW-310A, and crosses the OGS Ash Pond. The cross section location is provided on **Figure 2**, and the geologic cross section is provided on **Figure 3**. Geologic material and estimated water table levels are identified on the cross section.

2.3 CCR RULE MONITORING SYSTEM

The original groundwater monitoring system established in accordance with the CCR Rule consists of one upgradient (background) monitoring well and five downgradient monitoring wells. The upgradient well is MW-301 and the downgradient wells, MW-302 through MW-306 were installed in November and December 2015. Two additional downgradient assessment wells, MW-310 and MW-311 were installed along the Des Moines River in August 2019 to evaluate the downgradient extent of groundwater impacts and groundwater flow direction. Three deeper piezometers, MW-305A, MW-310A, and MW-311A were installed in February and March 2020 to evaluate the vertical components of groundwater impacts and flow. The CCR Rule wells are installed in the uppermost aquifer at the site. Well depths range from approximately 14 to 79 feet bgs.

3.0 NATURE AND EXTENT OF GROUNDWATER IMPACTS

3.1 POTENTIAL SOURCES

The potential sources of groundwater impacts detected in the Ash Pond monitoring system are currently under evaluation. The Closure Plan for CCR Surface Impoundments at OGS issued in September 2016 details the steps to be undertaken to close the OGS Ash Pond by leaving the CCR in place, in accordance with §257.102(b) of the CCR Rule. Based on the Closure Plan, potential sources of groundwater impacts from the Ash Pond CCR unit include the following:

CCR Unit	Potential Sources	Description	Quantity
OGS Ash Pond	CCR	Bottom ash, economizer ash, precipitator fly ash, hydrated fly ash, and pyrites	463,000 CY to this total
	Storm water	Annual precipitation, runoff from surrounding areas	94 AC-FT. (Watershed of 76 acres)
	Low-volume plant wastewater	Discharge from the oil water separator, SCU blowdown, plant drains, cooling tower blowdown, and contact water/leachate from OML	1.62 million gallons per day (MGD)

Note: Storm water volume is calculated based on the watershed area for the OGS Ash Pond and the annual average precipitation for Ottumwa, Iowa, of 37 inches per year. The volume of annual runoff from the surrounding areas that are not open water (58 acres), which are part of the OGS Ash Pond watershed, is estimated using Figure 1. Average Annual Runoff, 1951-1980 from USGS publication Average Annual Runoff in the United States, 1951-80 (Gebert 1987). Figure 1 shows approximately 8.0 inches of runoff from the 58 acres for an estimated 39 acre-feet of storm water annually. The quantity provided for plant wastewater is the average discharge from the ash pond (Outfall 001).

The OGS ZLD Pond is monitored separately from the Ash Pond and is not currently considered a potential source for the groundwater impacts detected in the Ash Pond monitoring system.

3.2 GROUNDWATER ASSESSMENT

3.2.1 Groundwater Depth and Flow Direction

Depth to groundwater as measured in the site CCR monitoring wells varies from 1 to 28 feet bgs due to topographic variations across the facility and seasonal variations in water levels. Groundwater flow at the site is generally to the east-northeast, and the groundwater flow direction and water levels fluctuate seasonally due to the proximity to the river. Groundwater elevations and flow directions are shown on the April and October 2019, and April 2020 potentiometric surface maps (**Figures 3** through **6**)

3.2.2 Groundwater Protection Standard Exceedances Identified

The ACM process was triggered by the detection of cobalt at statistically significant levels exceeding the GPSs in samples from MW-305.

This statistical evaluation of the assessment monitoring results was based on the first four sampling events for the Appendix IV assessment monitoring parameters, including complete sampling events in April, August, and October 2018, and a resampling event for cobalt at selected wells in January 2019. The complete results for these sampling events are summarized in **Table 3**.

For comparison of assessment monitoring data to fixed GPS values, the USEPA's Unified Guidance for Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities (EPA 530-R-09-007, March 2009) recommends the use of confidence intervals. Specifically, the suggested approach for comparing assessment groundwater monitoring data to GPS values based on long-term chronic health risk, such as drinking water Maximum Contaminant Levels (MCLs), is to compare to a lower confidence limit around the arithmetic mean with the fixed GPS.

The calculated lower confidence limit for the means were compared to the cobalt GPS for wells MW-305 and MW-306. Based on these comparisons, a statistically significant exceedance has not occurred for cobalt at MW-306. Monitoring well MW-306 had individual results exceeding the GPS for cobalt, but the exceedances were not determined to be at statistically significant levels.

Lithium was detected above the GPS at new monitoring wells MW-310, MW-310A, and MW-311A. Fluoride was also detected in the deep piezometer MW-311A at a concentration above the GPS in two of the four sampling events. These exceedances have not yet been determined to be statistically significant. Lithium and fluoride concentrations above the GPSs in these three wells are discussed in the technical memorandum provided in Appendix B of the September 2019 ACM, and are most likely due to natural background conditions in the Mississippian bedrock aquifer, rather than a release from the ash pond or other man-made source. Lines of evidence supporting this finding include:

- No lithium or fluoride GPS exceedances have been detected at monitoring wells MW-302, MW-304, MW-305, MW-306, or MW-305A, located adjacent to the OGS Ash Pond, as would be expected if the OGS Ash Pond was the source of elevated fluoride and lithium at wells located further downgradient.

- The lithium and fluoride concentrations detected in samples from MW-310A and MW-311A are well within the range of concentrations naturally present in the Mississippian aquifer based on results from background monitoring wells in the same aquifer at the nearby Ottumwa Midland Landfill (OML) located approximately 5 miles to the east-southeast.

- Analysis of major anions and cations indicates that the water quality in deep piezometers MW-310A and MW-311A is similar to regional water quality for the Mississippian aquifer and different from water quality in the shallower on-site wells.

- Vertical gradients at monitoring well pairs MW-310/MW-310A and MW-311/MW-311A based on water level measurement events in April and October 2020 indicate that groundwater flow is at least intermittently upward from the Mississippian bedrock into the overlying unconsolidated material.

If the lithium and fluoride exceedances are determined to be statistically significant, IPL will be required to either prepare an alternative source demonstration (ASD) or initiate an ACM for these constituents.

Based on the results of assessment monitoring conducted through the April 2019 sampling event, and subsequent sampling rounds in October 2019 and April, June, and October 2020, statistically significant levels exceeding the GPSs were identified for the following well and parameter:

Assessment Monitoring Appendix IV Parameters	Location of GPS Exceedance(s)	Historic Range of Detections at Wells With SSL Above GPS	Groundwater Protection Standard (GPS)
Cobalt (µg/L)	MW-305	14.5-18.	6

µg/L = micrograms per liter

Note: Historic range includes results from assessment monitoring from April 2018 through October 2020.

3.2.3 Expanding the Groundwater Monitoring Network

Monitoring wells MW-310 and MW-311 were installed in the area between the current downgradient wells and the Des Moines River to fulfill the requirements of 40 CFR 257.95(g)(1), which requires additional characterization to support a complete and accurate assessment of corrective measures. The installation of these wells was originally scheduled for spring 2019, but due to state and federal permitting requirements and persistent flooding along the Des Moines River, the installation was delayed. Three deeper piezometers, MW-305A, MW-310A, and MW-311A were installed in February and March 2020 to evaluate the vertical components of groundwater impacts and flow.

3.2.4 Monitored Natural Attenuation Data Collection and Evaluation

An evaluation of the potential for OGS to utilize monitored natural attenuation (MNA) as a corrective action alternative began with the initiation of an ACM at OGS. The tiered analysis approach in the USEPA guidance, “Monitored Natural Attenuation of Inorganic Contaminants in Groundwater, Volume 1 – Technical Basis for Assessment” (USEPA, 2007), is being used as a guide for evaluating MNA as a potential corrective action alternative at OGS.

There are four tiers of analysis to be addressed in evaluating the site for MNA:

1. Demonstrate active contaminant removal from groundwater
2. Determine mechanism and rate of attenuation
3. Determine system capacity and stability of attenuation
4. Design a performance monitoring program and identify an alternative remedy

Data collection activities during the assessment monitoring and ACM process that begins to address the objectives of tiers 1 and 2 include:

- Installation of downgradient assessment wells MW-310 and MW-311 and deeper downgradient piezometers MW-305A, MW-310A, and MW311A to evaluate groundwater flow direction and horizontal and vertical hydraulic gradients.
- Additional groundwater sampling events and analysis of data from all site wells to evaluate contaminant distribution in groundwater and stability of groundwater concentrations over time.
- Analysis of general groundwater chemistry and field parameters in addition to the App III and IV constituents to provide further characterization of groundwater chemistry.
- Analysis of both total and dissolved constituents for selected parameters.

A hydrogeochemical conceptual model and summary of preliminary evaluation of cobalt attenuation in the aquifer at OGS is included in **Appendix C.** Preliminary findings include:

- Cobalt has likely been released from the primary pond to the alluvial aquifer beneath the site.
- Immobilization within the saturated sand is the mechanism that drives natural attenuation of cobalt.
- If cobalt were not attenuated, the 40-year groundwater travel time from the OGS Ash Pond to well MW-310 suggest that cobalt would have already arrived in the approximate 40 year time frame since the primary pond was commissioned if it was not attenuated.

- The cobalt concentration from MW-305 located at the downgradient edge of the primary pond to MW-310, located near the Des Moines River, appears to decrease by a factor of about 60.
- Dilution by mixing with upward flowing deep groundwater at MW-310 may be a factor in the decrease of cobalt concentrations beyond the MW-305 location. Cobalt precipitation, coprecipitation or adsorption likely account for the remaining decrease.
- The groundwater becomes more oxic from the OGS Ash Pond perimeter to MW-310 at the Des Moines River. As the ORP increases, iron precipitates from the water and provides adsorption sites on iron oxyhydroxides for cobalt which is then also removed from the groundwater.
- The iron oxyhydroxides on the aquifer matrix provide potential adsorption sites for the sequestration of cobalt.
- The mass of cobalt in the groundwater where the GPS may be exceeded between MW-305 and MW-310 is estimated at 0.60 kilograms.

A preliminary evaluation of whether the cobalt plume is stable, growing, or decreasing has been completed using a Mann-Kendall trend test. The results of the trend tests are provided in **Appendix D**. No statistically significant increasing or decreasing trends were identified in the results obtained since assessment monitoring was initiated. Additional groundwater sampling rounds that include the deep piezometers are required before a complete evaluation is possible.

Based on the investigations completed to date, evidence of cobalt attenuation by precipitation, coprecipitation, and adsorption is observed making MNA a viable alternative for site remediation. Additional investigation is warranted to increase the understanding of contributing factors to attenuation and to provide the basis for a long term corrective action monitoring program. Recommendations for additional investigation are provided below:

- Install two additional monitoring wells between MW-305 and MW-310 (at ~400-foot spacing) to better define aqueous geochemical trends from the OGS Ash Pond to the Des Moines River. The data will also refine the estimate of cobalt mass in the groundwater downgradient of the OGS Ash Pond.

- Perform additional rounds of groundwater monitoring at the new and existing monitoring wells. In addition to the existing parameters, the following should be added or continued:

    - In-field measurement of pH, ORP, DO, temperature, specific electrical conductance, turbidity, ferrous iron and sulfide; and laboratory analyses of dissolved (0.45 µm filtered) Ca, Mg, Na, K, Fe, Mn, alkalinity (as $CaCO_3$), Cl, SO_4, and TDS to better define the groundwater chemistry and evolution with flow.

    - Laboratory analyses of dissolved (0.45 µm filtered) cobalt to better define the aqueous or “mobile” plume.

    - Laboratory analyses of 0.20 µm filtered cobalt and iron to assess potential adsorption of cobalt to “colloidal” iron.

    - Filtration of turbid groundwater produced by the monitoring wells and analysis of the solid filtrate for aluminum, iron, and cobalt to determine the degree to which the cobalt is associated with suspended solids.

  - Continued monitoring of cobalt concentrations over time to determine cobalt migration is completely attenuated or slowed by attenuation.

  - Laboratory analyses of the degree of iron precipitation and cobalt coprecipitation and adsorption from MW-305 groundwater with aeration (i.e. redox increase) to better understand the degree to which cobalt adsorption and coprecipitation are contributing to attenuation.

- Collect samples of the saturated sand from the two new well locations and from the area adjacent to MW-305 and MW-310. Analyses of sand would include:

  - Iron and manganese concentrations to assess potential for adsorption.

  - Cobalt concentrations to assess the degree to which cobalt has adsorbed or coprecipitated on to the sand matrix (i.e. defining the "immobile plume").

  - Cobalt adsorption isotherms to assess capacity of the sand to absorb cobalt and determine maximum adsorption capacity.

3.3 CONCEPTUAL SITE MODEL

The following conceptual site model describes the compound and nature of the constituent above the GPS, discusses potential exposure pathways affecting human health and the environment, and presents a cursory review of their potential impacts. The conceptual site model for OGS has been prepared in general conformance with the Standard Guide for Developing Conceptual Site Models for Contaminated Sites (ASTM E1689-95). This conceptual site model is the basis for assessing the efficacy of likely corrective measures to address the source, release mechanisms, and exposure routes.

3.3.1 Nature of Constituent Above Groundwater Protection Standards

The nature and extent of the constituent in groundwater at OGS that is present at a statistically significant concentration greater than the GPS (Cobalt) is described in the September 2019 ACM.

Lithium was detected above the GPS in the new well MW-310, MW-310A, and MW-311A. Fluoride was detected above the GPS in MW-311A. The lithium and fluoride results above the GPS have not yet been determined to be statistically significant and are attributed to natural groundwater quality in the bedrock aquifer; therefore, these constituents are not addressed in the ACM or Addendum No. 1. A discussion of the GPS exceedances is included in **Section 3.2.2** and in Appendix B of the September 2019 ACM.

3.3.2 Potential Receptors and Pathways

As described in **Section 3.3**, ASTM E1689-95 provides a framework for identifying potential receptors (people or other organisms potentially affected by the groundwater impacts at OGS) and pathways (the ways groundwater impacts might reach receptors). In accordance with ASTM E1689-95, we have considered potential human and ecological exposures to groundwater impacted by the constituents identified in **Section 3.2.2**:

Human Health

In general, human health exposure routes to contaminants in the environment include ingestion, inhalation, and dermal contact with the following environmental media:

- Groundwater
- Surface Water and Sediments
- Air
- Soil
- Biota/Food

If people might be exposed to the impacts described in **Section 3.0** via one of the environmental media listed above, a potential exposure route exists and is evaluated further. For the groundwater impacts at OGS, the following potential exposure pathways have been identified with respect to human health:

- Groundwater – Ingestion and Dermal Contact: The potential for ingestion of, or dermal contact with, impacted groundwater from OGS exists if water supply wells are present in the area of impacted groundwater and are used as a potable water supply. Based on a review of the Iowa Department of Natural Resources GeoSam well database, and information provided by OGS:
  - No off-site water supply wells have been identified downgradient or sidegradient in the vicinity of the CCR units.
  - Potable water is not supplied from on-site wells. Potable water at OGS is provided by the Wapello Rural Water Association.

- Surface Water and Sediments – Ingestion and Dermal Contact: The potential for ingestion of or dermal contact with impacted surface water and sediments exists if impacted groundwater from the OGS facility has interacted with adjacent surface water and sediments, to the extent that cobalt is present in these media at concentrations that represent a risk to human health.

- Biota/Food – Ingestion: The potential for ingestion of impacted food exists if impacted groundwater from the OGS facility has interacted with elements of the human food chain. Elements of the food chain may also be exposed indirectly through groundwater-to-surface water interactions.

Based on the lack of groundwater exposure, only the surface water, sediment, and biota/food exposure pathways were retained for further consideration in the September 2019 ACM. Groundwater samples collected from the piezometer nests installed downgradient of the OGS Ash Pond and adjacent to the Des Moines River do not contain cobalt at a concentration above the GPS. None of the additional information obtained since the September 2019 ACM suggests that cobalt is reaching the new wells, and samples indicate that elevated concentrations of cobalt are only present near the pond. Therefore, cobalt does not appear to be migrating to a location where it can impact human health or the environment. In other words, there is no pathway for exposure to cobalt. Implementation of potential corrective measures may introduce secondary exposure pathways that are discussed in **Section 6.0** and will be evaluated further as a corrective measure is selected for OGS.

Ecological Health

In addition to human exposures to impacted groundwater, potential ecological exposures are also considered. If ecological receptors might be exposed to impacted groundwater, the potential exposure routes are evaluated further. Ecological receptors include living organisms, other than humans, the habitat supporting those organisms, or natural resources potentially adversely affected by CCR impacts. This includes:

- Transfer from an environmental media to animal and plant life. This can occur by bioaccumulation, bioconcentration, and biomagnification.
    - Bioaccumulation is the general term describing a process by which chemicals are taken up by a plant or animal either directly from exposure to impacted media (soil, sediment, water) or by eating food containing the chemical.
    - Bioconcentration is a process in which chemicals are absorbed by an animal or plant to levels higher than the surrounding environment.
    - Biomagnification is a process in which chemical levels in plants or animals increase from transfer through the food web (e.g., predators have greater concentrations of a particular chemical than their prey).
- Benthic invertebrates within adjacent waters.

Based on the information available and presented in the September 2019 ACM, both of these ecological exposure routes required additional evaluation at the time.

Both potential ecological exposure pathways require groundwater-to-surface water interactions for the exposure pathway to be complete. As discussed above, none of the additional information obtained since the September 2019 ACM suggests that cobalt is reaching the new wells, and samples indicate that elevated concentrations of cobalt are only present near the pond. Therefore, cobalt does not appear to be migrating to a location where it can impact ecological health.

The surface water/sediment, biota/food, and ecological exposure assessment is incomplete as the extent of groundwater impacts is still being evaluated. If groundwater impacts extend to the river, then these exposure pathways will be evaluated further.

4.0 POTENTIAL CORRECTIVE MEASURES

In this section, we identify potential corrective measures to meet the ACM goals identified in 40 CFR 257.96(a), which are to:

- Prevent further releases
- Remediate releases
- Restore affected areas to original conditions

The development of corrective measure alternatives is described further in the following sections. Corrective measure alternatives developed to address the groundwater impacts at OGS are described in **Section 5.0**. The alternatives selected are qualitatively evaluated in **Section 6.0**.

4.1 IDENTIFICATION OF CORRECTIVE MEASURES

As described in the USEPA Solid Waste Disposal Facility Criteria Technical Manual (USEPA 1998), corrective measures generally include up to three components, including:

- Source Control
- Containment
- Restoration

Within each component, there are alternative measures that may be used to accomplish the component objectives. The measures from one or more components are then combined to form corrective measure alternatives (discussed in **Section 5.0**) intended to address the observed groundwater impacts. Potential corrective measures were identified based on site information available during development of the ACM for the purpose of meeting the goals described in **Section 4.0**.

Each component and associated corrective measures are further identified in subsequent paragraphs. The corrective measures are evaluated for feasibility and combined to create the corrective action alternatives identified in this section, and further evaluated in **Section 5.0**. We continue to evaluate site conditions and may identify additional corrective measures based on new information regarding the nature and extent of the impacts.

4.1.1 Source Control

The source control component of a corrective measure is intended to identify and locate the source of impacts and provide a mechanism to prevent further releases from the source. For the OGS site, the sources to be controlled are the CCR materials in the OGS Ash Pond and the associated process water. Each of the source control measures below require closure of the impoundment, and for waste water to be re-directed from the CCR unit to eliminate the flows that may mobilize constituents from the CCR and transport them to groundwater. We have identified the following potential source control measures:

- **Close and cap in place.** Close the OGS Ash Pond and cap the CCR in place to reduce the infiltration of rain water into the impoundment, and prevent transport of CCR constituents from unsaturated CCR materials into the groundwater, and minimize the potential for CCR to interface with groundwater.

- **Consolidate and cap.** Consolidate CCR from the OGS Ash Pond into one or two areas to reduce the cap area exposed to infiltration, reduce the potential source footprint, prevent transport of CCR constituents from unsaturated CCR materials into the groundwater, and reduce the potential for CCR to interface with groundwater.

- **Consolidate and cap with chemical stabilization.** Consolidate CCR into one or two areas to reduce the cap area exposed to infiltration, reduce the potential source footprint, prevent transport of CCR constituents from unsaturated CCR materials into the groundwater, and minimize the potential for CCR to interface with groundwater. Mix a chemical amendment into CCR in-situ prior to placing additional CCR for consolidation and mix the amendment into CCR as it is excavated and placed for consolidation to reduce the mobility of select CCR constituents in the environment. Chemical stabilization may include the use of one or multiple admixtures that serve to physically and/or chemically stabilize the constituents of concern within the CCR. Physically, this may include solidification with cementitious or polymeric materials. Chemically, this may include precipitation or alteration to render cobalt less mobile in the environment. Evaluation of an appropriate high organic carbon commodity amendment, that may include activated carbon, biochar, locally available aged mulch, and/or proprietary chemicals such as PlumeStop, will occur during the remedy selection process.

- **Excavate and create on-site disposal area.** Excavate and place CCR in a newly lined landfill area on site to prevent further releases from the OGS Ash Pond and isolate the CCR from potential groundwater interactions. Cap the new landfill with final cover to prevent the transport of CCR constituents from unsaturated CCR.

- **Excavate and dispose at a licensed off-site disposal area.** Remove all CCR from the OGS Ash Pond and haul it to a licensed landfill to prevent further releases from the CCR areas.

Water movement through the CCR materials is the mechanism for CCR impacts to groundwater, including surface water that moves vertically through the CCR materials via infiltration of precipitation and surface water runoff. Groundwater can move horizontally through the CCR material in areas where CCR material is at an elevation that is below the water table. Source control measures have been considered to prevent "vertical" migration of water through the CCR via cap and cover systems and potential contact with groundwater.

Based on the available information for this site, all the source control measures have potential to prevent further releases caused by infiltration, thus are retained for incorporation into alternatives for further evaluation.

In conjunction with the ongoing evaluation of MNA mechanisms and site attenuation capacity, chemical stabilization has been added as a source control alternative. Additional source control may be needed to address CCR that could be in contact with groundwater after closure in place, or if further investigation indicates that MNA mechanisms are not sufficient for reaching the groundwater quality objectives at OGS or the site does not have the attenuation capacity to reduce groundwater concentrations of cobalt below the GPS.

4.1.2 Containment

The objective of containment is to limit the spread of the impacts beyond the source. The need for containment depends on the nature and extent of impacts, exposure pathways, and risks to receptors. Containment may also be implemented in combination with restoration as described in **Section 4.1.3**.

Containment may be a recommended element of a corrective measure if needed to:

- Prevent off-site migration of groundwater impacts
- Cease completion of an exposure pathway (e.g., water supply well)

Containment may also be used in lieu of active restoration if an active approach is needed but treatment is not warranted by the aquifer characteristics including:

- Water in the affected aquifer is naturally unsuited for human consumption.
- Contaminants present in low concentration with low mobility.
- Low potential for exposure to contaminants and low risk associated with exposure.
- Low transmissivity and low future user demand.

The following measures have potential to limit the spread of continued or remaining groundwater impacts:

- **Gradient Control with Pumping.** Gradient control includes a measure to alter the groundwater velocity and direction to slow or isolate impacts. This can be accomplished with pumping wells and/or a trench/sump collection system. If groundwater pumping is considered for capturing an impacted groundwater plume, the impacted groundwater must be managed in conformance with all applicable Federal and State requirements.

- **Gradient Control with Phytotechnology.** Gradient control with phytotechnology relies on the ability of vegetation to evapotranspire sources of surface water and groundwater. Water interception capacity by the aboveground canopy and subsequent evapotranspiration through the root system can limit vertical migration of water from the surface downward. The horizontal migration of groundwater can be controlled or contained using deep-rooted species, such as prairie plants and trees, to intercept, take up, and transpire the water. Trees classified as phreatophytes are deep-rooted, high-transpiring, water-loving organisms that send their roots into regions of high moisture and can survive in conditions of temporary saturation.

- **Chemical Stabilization.** Stabilization refers to processes that involve chemical reactions that reduce the leachability of cobalt. Stabilization chemically immobilizes impacts or reduces their solubility through a chemical reaction. The desired results of stabilization methods include converting metals into a less soluble, mobile, or toxic form.

- **Containment Walls.** Containment walls can be applied in two ways. First, a wall that creates a physical barrier to the flow of groundwater to limit the movement of constituents of concern in groundwater. Second, a passive barrier installed to intercept the flow of groundwater and constructed with a reactive media designed to adsorb, precipitate, or degrade groundwater constituents to limit their movement in the environment (FRTR 2020).

Based on the currently available information for this site, active MNA mechanisms including precipitation, coprecipitation, and adsorption of cobalt are observed. The assessment of the site capacity to attenuate the cobalt impacts to groundwater is ongoing. Active containment may be needed to address CCR that could be in contact with groundwater after closure in place, or if further investigation indicates that MNA mechanisms are not sufficient for reaching the groundwater quality objectives at OGS or the site does not have the attenuation capacity to reduce groundwater concentrations of cobalt below the GPS.

4.1.3 Restoration

Restoration is the process through which groundwater quality is restored to meet GPSs. This can be accomplished by way of MNA or intensively addressed by groundwater treatment with or without extraction.

MNA can be a viable remedy or component of a remedial alternative for groundwater impacted with metals. MNA requires ongoing involvement and potentially intense characterization of the geochemical environment to understand the attenuation processes involved, and to justify reliance on them and regular, long-term monitoring to ensure the attenuation processes are meeting remedial goals.

MNA is not a “do-nothing” alternative; rather it is an effective knowledge-based remedy where a thorough engineering analysis provides the basis for understanding, monitoring, predicting, and documenting natural processes. To properly employ this remedy, there needs to be a strong scientific basis supported by appropriate research and site-specific monitoring implemented in accordance with quality controls. The compelling evidence needed to support proper evaluation of the remedy requires that the processes that lower metal concentrations in groundwater be well understood.

If active treatment is implemented, water may be treated in-situ, on site, or off site. The need for active treatment depends on the nature and extent of impacts, potential exposure pathways, and current and anticipated future risks to receptors. If there are no receptors or if the risks are acceptably low, then MNA is an appropriate option. If existing or future risks require a more rapid restoration of groundwater quality, then active restoration may be needed.

Treated groundwater may be re-injected, sent to a local publicly owned treatment works (POTW), or discharged to a local body of surface water, depending on local, state, and federal requirements. Typical on-site treatment practices for metals include coagulation and precipitation, ion exchange, or reverse osmosis. Off-site wastewater treatment may include sending the impacted groundwater that is extracted to a local POTW or to a facility designed to treat the contaminants of concern.

The removal rate of groundwater constituents such as cobalt will depend on the rate of groundwater extraction, the cation exchange capacity of the soil, and partition coefficients of the constituents sorbed to the soil. As the concentration of metals in groundwater is reduced, the rate at which constituents become partitioned from the soil to the aqueous phase may also be reduced. The amount of flushing of the aquifer material required to remove the metals and reduce their concentration in groundwater below the GPS will generally determine the time frame required for restoration. This time frame is site-specific.

In-situ methods may be appropriate, particularly where pump and treat technologies may present adverse effects. In-situ methods may include the introduction of a chemical amendment to adsorb, precipitate, or degrade a contaminant or biological restoration requiring pH control, addition of specific micro-organisms, and/or addition of nutrients and substrate to augment and encourage degradation by indigenous microbial populations. Bioremediation requires laboratory treatability studies and pilot field studies to determine the feasibility and the reliability of full-scale treatment.

Based on current available information, active MNA mechanisms at OGS have been identified, but are still being refined along with the capacity of the site to attenuate the cobalt impacts to groundwater. Other restoration measures have been included in this addendum to increase the breadth of alternatives evaluated and available for consideration during the remedy selection process. These additional alternatives are discussed in **Section 5.0**.

5.0 CORRECTIVE MEASURE ALTERNATIVES

We have preliminarily identified the following corrective measure alternatives for the groundwater impacts at OGS:

- Alternative 1 – No Action
- Alternative 2 – Close and Cap in Place and MNA
- Alternative 3 – Consolidate On Site and Cap with MNA
- Alternative 4 – Excavate and Dispose On Site with MNA
- Alternative 5 – Excavate and Dispose Off Site with MNA

- Alternative 6 – Consolidate and Cap with Chemical Amendment
- Alternative 7 – Consolidate and Cap with Groundwater Collection
- Alternative 8 – Consolidate and Cap with Barrier Wall

These alternatives were developed by selecting components from the reasonable and appropriate corrective measures components discussed above. With the exception of the No Action alternative, each of the corrective measure alternatives meet the requirements in 40 CFR 257.97(b)(1) through (5) based on the information available at the current time. We may identify additional alternatives based on the continued evaluation of site conditions.

5.1 ALTERNATIVE 1 – NO ACTION

IPL is committed to implementing corrective measures as required under the Rule, and the No-Action alternative is included as a baseline condition and a point of comparison for the other alternatives. The consideration of this alternative assumes the monitoring of groundwater continues under this action.

5.2 ALTERNATIVE 2 – CLOSE AND CAP IN PLACE WITH MONITORED NATURAL ATTENUATION

Alternative 2 includes closing the OGS Ash Pond (no further discharge), covering the CCR materials with a cap, and establishing vegetation in accordance with the requirements for closure in place in 40 CFR 257.102(d). This measure is consistent with landfill cover systems to prevent infiltration of surface water into the CCR as described in **Section 4.1.1**. The capped areas will be subject to enhanced groundwater monitoring via MNA.

This alternative eliminates CCR sluicing/plant process water discharges and, with the installation of a cap, will reduce infiltration through the CCR. This is expected to address the major contributor to the observed GPS exceedances, which is exposure of CCR material to precipitation/surface water infiltration. Further leaching of metals and migration within groundwater will be reduced and may be eliminated over time. MNA is included with this alternative to monitor changes in groundwater impacts and the effectiveness of degradation mechanisms on groundwater concentrations over time.

5.3 ALTERNATIVE 3 – CONSOLIDATE ON SITE AND CAP WITH MONITORED NATURAL ATTENUATION

Alternative 3 includes closing the OGS Ash Pond (no further discharge), relocating and consolidating CCR into a smaller footprint within the CCR surface impoundments, covering the CCR materials with a cap, and establishing vegetation in accordance with the requirements for closure in place in 40 CFR 257.102(d). This measure is consistent with landfill cover systems to prevent infiltration of surface water into the CCR as described in **Section 4.1.1**. The consolidated and capped areas will be subject to enhanced groundwater monitoring via MNA.

This alternative eliminates CCR sluicing/plant process water discharges and, with the consolidation of the CCR footprint and the installation of a cap, will reduce infiltration through the CCR. This is expected to address the major contributor to the observed GPS exceedances, which is exposure of CCR material to precipitation/surface water infiltration. Consolidation of CCR into a smaller footprint during closure also reduces the volume of potential source materials that may be in contact with groundwater after closure. Further leaching of metals and migration within groundwater will be reduced and may be eliminated over time. MNA is included with this alternative to monitor changes in groundwater impacts and the effectiveness of degradation mechanisms on groundwater concentrations over time.

5.4 ALTERNATIVE 4 – EXCAVATE AND DISPOSE ON SITE WITH MONITORED NATURAL ATTENUATION

Alternative 4 includes closing the OGS Ash Pond (no further discharge), excavation of CCR from the OGS Ash Pond, and creation of a new on-site disposal area with a liner and cap system. This alternative will serve to entomb the CCR from the OGS Ash Pond and allow for the collection and management of liquids generated from the disposal area. Further releases from the OGS Ash Pond will be prevented by the use of engineering controls constructed/installed to meet the design criteria for new CCR landfills required under 40 CFR 257.70.

This alternative eliminates CCR sluicing/plant process water discharges and, with the consolidation of the CCR footprint and the installation of a new on-site disposal area liner and cap, will reduce infiltration through the CCR. This is expected to address the major contributor to the observed GPS exceedances, which is exposure of CCR material to precipitation/surface water infiltration. MNA is included with this alternative to monitor changes in groundwater impacts and the effectiveness of degradation mechanisms on groundwater concentrations over time.

5.5 ALTERNATIVE 5 – EXCAVATE AND DISPOSE OFF SITE WITH MONITORED NATURAL ATTENUATION

Alternative 5 includes closing the OGS Ash Pond (no further discharge), excavation of all CCR from the OGS Ash Pond, and transport to an approved off-site landfill. Further on-site releases from the OGS Ash Pond will be prevented by removing the source material from the site, which eliminates the potential for ongoing leaching of constituents into groundwater at OGS.

This alternative eliminates CCR sluicing/plant process water discharges and, with the removal of CCR from the site, will eliminate infiltration through the CCR. This is expected to address the major contributor to the observed GPS exceedances, which is exposure of CCR material to precipitation/ surface water infiltration. MNA is included with this alternative to monitor changes in groundwater impacts and the effectiveness of degradation mechanisms on groundwater concentrations over time.

5.6 ALTERNATIVE 6 – CONSOLIDATE AND CAP WITH CHEMICAL AMENDMENT

Alternative 6 includes closing the OGS Ash Pond (no further discharge), adding a chemical amendment to in-place CCR and relocated CCR to reduce the mobilization of cobalt prior to relocating and consolidating CCR into a smaller footprint within the CCR surface impoundments, covering the CCR materials with a cap, and establishing vegetation in accordance with the requirements for closure in place in 40 CFR 257.102(d). This measure is consistent with landfill cover systems to prevent infiltration of surface water into the CCR and the reduced contaminant mobilization achieved by chemical amendment as described in **Section 4.1.1**.

This alternative eliminates CCR sluicing/plant process water discharges and, with the consolidation of the CCR footprint and the installation of a cap, will reduce infiltration through the CCR. This is expected to address the major contributor to the observed GPS exceedances, which is exposure of

CCR material to precipitation/surface water infiltration. Consolidation of CCR into a smaller footprint during closure also reduces the volume of potential source materials that may be in contact with groundwater after closure. Further leaching of metals and migration within groundwater will be reduced by minimizing the footprint of CCR in contact with groundwater and by fixation using a chemical amendment.

5.7 ALTERNATIVE 7 – CONSOLIDATE AND CAP WITH GROUNDWATER COLLECTION

Alternative 7 includes closing the OGS Ash Pond (no further discharge), relocating and consolidating CCR into a smaller footprint within the CCR surface impoundments, covering the CCR materials with a cap, and establishing vegetation in accordance with the requirements for closure in place in 40 CFR 257.102(d). This measure is consistent with landfill cover systems to prevent infiltration of surface water into the CCR as described in **Section 4.1.1**. Impacted groundwater will be collected using pumps and treated prior to discharge according to state and federal requirements as described in **Section 4.1.2**.

This alternative eliminates CCR sluicing/plant process water discharges and, with the consolidation of the CCR footprint and the installation of a cap, will reduce infiltration through the CCR. This is expected to address the major contributor to the observed GPS exceedances, which is exposure of CCR material to precipitation/surface water infiltration. Consolidation of CCR into a smaller footprint during closure also reduces the volume of potential source materials that may be in contact with groundwater after closure. Further leaching of metals and migration within groundwater will be reduced and may be eliminated over time as impacted groundwater is collected to contain and restore cobalt concentrations in groundwater to levels below the GPS.

5.8 ALTERNATIVE 8 – CONSOLIDATE AND CAP WITH BARRIER WALL

Alternative 8 includes closing the OGS Ash Pond (no further discharge), relocating and consolidating CCR into a smaller footprint within the CCR surface impoundments, covering the CCR materials with a cap, and establishing vegetation in accordance with the requirements for closure in place in 40 CFR 257.102(d). This measure is consistent with landfill cover systems to prevent infiltration of surface water into the CCR as described in **Section 4.1.1**. Impacted groundwater will be intercepted with a barrier wall to minimize the migration of cobalt as described in **Section 4.1.2**.

This alternative eliminates CCR sluicing/plant process water discharges and, with the consolidation of the CCR footprint and the installation of a cap, will reduce infiltration through the CCR. This is expected to address the major contributor to the observed GPS exceedances, which is exposure of CCR material to precipitation/surface water infiltration. Consolidation of CCR into a smaller footprint during closure also reduces the volume of potential source materials that may be in contact with groundwater after closure. Further leaching of metals and migration within groundwater will be reduced and may be eliminated over time as impacted groundwater is intercepted with a barrier wall to minimize the spread of cobalt in groundwater.

6.0 EVALUATION OF CORRECTIVE MEASURE ALTERNATIVES

As required by 40 CFR 257.96(c), the following sections provide an evaluation of the effectiveness of corrective measure alternatives in meeting the requirements and objectives outlined in 40 CFR 257.97. The evaluation addresses the requirements and objectives identified in 40 CFR 257.96(c)(1) through (3), which include:

- The performance, reliability, ease of implementation, and potential impacts of appropriate potential remedies, including safety impacts, cross-media impacts, and control of exposure to residual contamination;

- The time required to begin and complete the remedy; and

- The institutional requirements, such as state or local permit requirements or other environmental or public health requirements that may substantially affect implementation of the remedy.

In addition to the discussion of the items listed above, **Table 5** provides a summary of the initial evaluation of the alternatives including each of the criteria listed in 40 CFR 257.97.

6.1 ALTERNATIVE 1 – NO ACTION

As described in **Section 5.1**, the No Action alternative is only included as a baseline condition and a point of comparison for the other alternatives. This alternative does not satisfy all five criteria in 40 CFR 257.97(b)(1) through (5), so it is not an acceptable corrective measure under the CCR Rule. For comparison only, Alternative 1 is evaluated with regard to the criteria in 40 FR 257.96(c) below:

- **Performance, Reliability, Implementation, and Impacts.**
  - Performance – The ability to attain the GPS for cobalt without any additional action is unlikely.
  - Reliability – Alternative 1 does not provide any reduction in existing risk.
  - Implementation – Nothing is required to implement Alternative 1.
  - Impacts – No additional safety or cross-media impacts are expected with Alternative 1. This alternative does not control current suspected routes of exposure to residual contamination.

- **Timing.** No time is required to begin. However, the time required to attain the GPS for cobalt under Alternative 1 is unknown.

- **Institutional Requirements.** No institutional requirements beyond maintaining current regulatory approvals exist for Alternative 1.

6.2 ALTERNATIVE 2 – CLOSE AND CAP IN PLACE WITH MONITORED NATURAL ATTENUATION

As described in **Section 5.2**, Alternative 2 includes closing the OGS Ash Pond, covering the CCR materials with a cap, and establishing vegetation in accordance with the requirements for closure in place in 40 CFR 257.102(d).

- **Performance, Reliability, Implementation, and Impacts.**
  - Performance – Ceasing wastewater discharges and closing the impoundments by capping is expected to address infiltration, which is a key contributor to groundwater impacts. MNA monitoring will identify, if active, the natural attenuation processes that reduce mass, toxicity, mobility, volume, or concentrations of the constituents of concern in groundwater. Alternative 2 is capable of and expected to attain the GPS for cobalt.

  - Reliability – The expected reliability of capping is good. Capping is a common practice and standard remedial method for closure in place in remediation and solid waste management. There is significant industry experience with the design and construction of this method.

  - Implementation – The complexity of constructing the cap is low. Dewatering will be required to the extent a suitable subgrade is established for cap construction, which can likely be achieved through standard dewatering methods. The cap construction may put a high demand on the local supply of suitable cap materials. The local availability of cap materials will be evaluated further during remedy selection. The equipment and personnel required to implement Alternative 2 are not specialized and are generally readily available.

  - Impacts – Safety impacts associated with the implementation of Alternative 2 are not significantly different than other heavy civil construction projects. Cross-media impacts are expected to be limited due to the small volume of CCR expected to be relocated on site, the short duration of cap construction, the effectiveness of standard engineering controls during construction (e.g., dust control), and the lack of off-site transportation of CCR. Although the risk to surface water receptors is already low and ending wastewater discharges and capping the impoundment minimizes infiltration (a significant source of water and CCR interaction), the potential for interaction between CCR in the impoundment and groundwater after closure will need to be evaluated. The ease of implementation and low-impact nature of MNA as a groundwater restoration method must be evaluated against the effectiveness of passive groundwater restoration, which is the subject of ongoing evaluations. An insufficient MNA mechanism, insufficient site attenuation capacity, or changes in groundwater conditions may require additional action to restore groundwater or prevent cross-media impacts between groundwater and surface water. The potential for exposure to residual contamination is low since CCR will be capped.

- **Timing.** Closure of the OGS Ash Pond can be completed within 1 to 2 years of remedy selection. At OGS, the closure of the OGS Ash Pond is expected to be complete by August 15, 2023. The time required to attain the GPS for cobalt will be evaluated further during the remedy selection process, but is expected to take between 2 and 10 years after closure construction is complete. Alternative 2 can provide full protection within the 30-year post-closure monitoring period.

- **Institutional Requirements.** The following permits and approvals are expected to be required to implement Alternative 2:
  - Iowa Department of Natural Resources (IDNR) Closure Permit
  - State and local erosion control/construction storm water management permits

6.3 ALTERNATIVE 3 – CONSOLIDATE ON SITE AND CAP WITH MONITORED NATURAL ATTENUATION

As described in **Section 5.3**, Alternative 3 includes closing the OGS Ash Pond, relocating and consolidating CCR into a smaller footprint within the CCR surface impoundments, covering the CCR materials with a cap, and establishing vegetation in accordance with the requirements for closure in place in 40 CFR 257.102(d).

- **Performance, Reliability, Implementation, and Impacts.**
  - Performance – Ceasing wastewater discharges and closing the impoundments by capping is expected to address infiltration, which is a key contributor to groundwater impacts. The consolidation of CCR into a smaller footprint may enhance the performance of the cap by further reducing the area exposed to limited post-construction infiltration through the cap. The smaller closure footprint also reduces the potential for ongoing CCR contact with groundwater. MNA monitoring will identify, if active, the natural attenuation processes that reduce mass, toxicity, mobility, volume, or concentrations of the constituents of concern in groundwater. Alternative 3 is capable of and expected to attain the GPS for cobalt.

  - Reliability – The expected reliability of capping is good. Capping is a common practice and standard remedial method for closure in place in remediation and solid waste management. There is significant industry experience with the design and construction of this method. A consolidated cap footprint may enhance reliability by reducing the scale of post-closure maintenance.

  - Implementation – The complexity of constructing the cap is low. The logistics of moving CCR around the site to consolidate the closure footprint increases the complexity of the alternative. CCR dewatering will be required to the extent required to excavate and relocate CCR within the CCR impoundments and provide a suitable subgrade for cap construction. Some conditioning (e.g., drying) of relocated CCR is expected during on-site re-disposal. Alternative 3 can likely be achieved through standard dewatering and conditioning methods. Although the cap footprint will be minimized, cap construction may put a high demand on the local supply of suitable cap materials. The local availability of cap materials will be evaluated further during remedy selection. The equipment and personnel required to implement Alternative 3 are not specialized and are generally readily available.

  - Impacts – Safety impacts associated with the implementation of Alternative 3 are not significantly different than other heavy civil construction projects. The level of disturbance required to consolidate CCR before capping may represent some increase in safety risk due to site conditions and on-site construction traffic. Cross-media impacts are expected to be limited due to the small volume of CCR expected to be relocated on site, the short duration of cap construction, the effectiveness of standard engineering controls during construction (e.g., dust control), and the lack of off-site transportation of CCR. Although the risk to surface water receptors is already low and ending wastewater discharges and capping the impoundment minimizes infiltration (a significant source of water and CCR interaction), the potential for interaction between CCR in the impoundment and groundwater after closure will need to be evaluated. The consolidation of CCR prior to capping under Alternative 3 reduces the potential for CCR and groundwater interaction after closure. The ease of implementation and low-impact nature of MNA as a groundwater restoration method must be evaluated against the effectiveness of passive groundwater restoration, which is the subject of ongoing evaluations. An insufficient MNA mechanism, insufficient site attenuation capacity, or changes in groundwater conditions may require additional action to restore groundwater or prevent cross-media impacts between groundwater and surface water. The potential for exposure to residual contamination is low since CCR will be capped and the footprint of the cap minimized.

- **Timing.** Closure of the OGS Ash Pond can be completed within 1 to 2 years of remedy selection. At OGS, the closure of the OGS Ash Pond is expected to be complete by August 15, 2023. The time required to attain the GPS for cobalt will be evaluated further during the remedy selection process, but is expected to take between 2 and 10 years after closure construction is complete. The level of source disturbance during construction may increase the time required to reach GPS. The consolidation of CCR into a smaller cap area may decrease the time to reach GPS. Alternative 3 can provide full protection within the 30-year post-closure monitoring period.

- **Institutional Requirements.** The following permits and approvals are expected to be required to implement Alternative 3:
  - IDNR Closure Permit
  - State and local erosion control/construction storm water management permits

6.4 ALTERNATIVE 4 – EXCAVATE AND DISPOSE ON SITE WITH MONITORED NATURAL ATTENUATION

As described in **Section 5.4**, Alternative 4 includes closing the OGS Ash Pond, excavation of CCR from the source area, and creation of a new on-site disposal area that meets the design criteria for new CCR landfills required under 40 CFR 257.70

- **Performance, Reliability, Implementation, and Impacts.**
  - Performance – Ceasing wastewater discharges and closing the OGS Ash Pond by removing and re-disposing CCR in a new lined/capped disposal area is expected to address infiltration, which is a key contributor to groundwater impacts. The consolidation of CCR into a smaller footprint may enhance the performance of the cap by further reducing the area exposed to limited post-construction infiltration through the cap. The separation from groundwater and other location criteria for the new on-site disposal facility may enhance the performance of this alternative. MNA monitoring will identify, if active, the natural attenuation processes that reduce mass, toxicity, mobility, volume, or concentrations of the constituents of concern in groundwater. Alternative 4 is capable of and expected to attain the GPS for cobalt.

  - Reliability – The expected reliability of on-site re-disposal with a composite liner and cap is good. Disposal facilities that meet the requirements in 40 CFR 257.70 or other similar requirements have been used for solid waste disposal including municipal and industrial waste for numerous years. There is significant industry experience with the design and construction of similar disposal facilities. The composite liner and cover, combined with a consolidated disposal footprint, may enhance reliability by reducing infiltration and the scale of post-closure maintenance. At the same time, post-closure maintenance is likely more complex due to maintenance of a leachate collection system and geosynthetic repairs requiring specialized personnel, material, and equipment.

  - Implementation – The complexity of constructing the new liner and cap is moderate due to the composite design. The limited area available at the facility for developing an on-site disposal facility makes this alternative logistically complex. Significant volumes of CCR will be excavated and stored on site while the disposal facility is constructed. Significant dewatering will be required to excavate and relocate CCR to a temporary storage area. Conditioning (e.g., drying) of relocated CCR is expected to facilitate temporary storage and on-site re-disposal. Alternative 4 can likely be achieved through standard dewatering and conditioning methods, but may be impacted by the space available for these activities. Although the post-closure CCR footprint will be minimized, composite liner and cap construction may put a high demand on the local supply of suitable cap materials. The local availability of liner and cap materials will be evaluated further during remedy selection. The equipment and personnel required to implement Alternative 4 are not specialized and are generally readily available, with the exception of the resources needed to install the geosynthetic portions of the composite liner and cover, which are not locally available.

  - Impacts – Safety impacts associated with the implementation of Alternative 4 are not significantly different than other heavy civil construction projects. However, the level of disturbance required to excavate, store, and re-dispose CCR on site and the traffic required to import composite liner and cap material are not typical and likely represent an increase in safety risk due to site conditions, on-site construction traffic, and incoming/outgoing off-site construction traffic. A risk of cross-media impacts is possible due to the large volume of CCR to be excavated, stored, and relocated on site. Although the risk to surface water receptors is already low, Alternative 4 significantly reduces the potential interaction between CCR and water after closure. The ease of implementation and low-impact nature of MNA as a groundwater restoration method must be evaluated against the effectiveness of passive groundwater restoration, which is the subject of ongoing evaluations. An insufficient MNA mechanism, insufficient site attenuation capacity, or changes in groundwater conditions may require additional action to restore groundwater or prevent cross-media impacts between groundwater and surface water. The potential for exposure to residual contamination is low since CCR will be capped and the footprint of the cap minimized.

- **Timing.** Closure of the OGS Ash Pond can be completed within 1 to 2 years of remedy selection. At OGS, the closure of the OGS Ash Pond is expected to be complete by August 15, 2023. However, the time required to permit and develop the on-site disposal facility may extend this schedule. The time required to attain the GPS for cobalt will be evaluated further during the remedy selection process, but is expected to take between 2 and 10 years after closure construction is complete. The level of source disturbance during construction may increase the time required to reach GPS. The consolidation of CCR into a new on-site disposal facility with a composite liner and cap may decrease the time to reach GPS. Alternative 4 can provide full protection within the 30-year post-closure monitoring period.

- **Institutional Requirements.** The following permits and approvals are expected to be required to implement Alternative 4:
  - IDNR Closure Permit
  - IDNR Disposal Facility (Landfill) Permit
  - State and local erosion control/construction storm water management permits

6.5 ALTERNATIVE 5 – EXCAVATE AND DISPOSE OFF SITE WITH MONITORED NATURAL ATTENUATION

As described in **Section 5.5**, Alternative 5 includes closing the OGS Ash Pond, excavation of CCR from the source area, and transporting the CCR off site for disposal.

- **Performance, Reliability, Implementation, and Impacts.**
  - Performance – Ceasing wastewater discharges and closing the OGS Ash Pond by removing and re-disposing CCR off site will eliminate the source material exposed to infiltration, which is a key contributor to groundwater impacts. The off-site disposal of CCR prevents further releases at OGS, but introduces the possibility of releases at the receiving facility. MNA monitoring will identify, if active, the natural attenuation processes that reduce mass, toxicity, mobility, volume, or concentrations of the constituents of concern in groundwater. Alternative 5 is capable of and expected to attain the GPS for cobalt.

  - Reliability – The expected reliability of excavation and off-site disposal is good. Off-site disposal facilities are required to meet the requirements in 40 CFR 257.70 or other similar requirements, which have been used for solid waste disposal including municipal and industrial waste for numerous years. There is significant industry experience with the design and construction of these disposal facilities.

  - Implementation – The complexity of excavating CCR for off-site disposal is low. The scale of CCR excavation (expected to exceed 450,000 cy), off-site transportation, and the permitting/development of off-site disposal facility airspace makes this alternative logistically complex. Significant dewatering will be required to excavate CCR. Conditioning (e.g., drying) of excavated CCR is expected to facilitate off-site transportation and re-disposal. Alternative 5 can likely be achieved through standard dewatering and conditioning methods, but may be impacted by the space available for these activities. Although the source area at OGS is eliminated, the development of off-site disposal airspace will put a high demand on the receiving disposal facility, which may not have the current physical or logistical capacity to receive large volumes of CCR in a short period of time. The equipment and personnel required to implement on-site and off-site aspects of Alternative 5 are not specialized and are generally readily available, with the exception of the resources needed to install the geosynthetic portions of the off-site composite liner and cover, which are not locally available.

  - Impacts – Safety impacts associated with the implementation of Alternative 5 are not significantly different than other heavy civil construction projects. However, the level of disturbance required to excavate, transport, and re-dispose CCR and the traffic required to import composite liner and cap material at the receiving disposal facility are not typical and likely represent an increase in safety risk due to large volumes of incoming/outgoing off-site construction traffic at both sites. A risk of cross-media impacts is possible due to the large volume of CCR to be excavated and transported from the site. Although the risk to surface water receptors is already low, Alternative 5 nearly eliminates the potential interaction between CCR and water after closure. The ease of implementation and low-impact nature of MNA as a groundwater restoration method must be evaluated against the effectiveness of passive groundwater restoration, which is the subject of ongoing evaluations. An insufficient MNA mechanism, insufficient site attenuation capacity, or changes in groundwater conditions may require additional action to restore groundwater or prevent cross-media impacts between groundwater and surface water. The potential for exposure to residual contamination on site is very low since CCR will be removed; however, the off-site potential for exposure to CCR is increased due to the relocation of the source material.

- **Timing.** Closure of the OGS Ash Pond can be completed within 1 to 2 years of remedy selection. At OGS, the closure of the OGS Ash Pond is expected to be complete by August 15, 2023. However, the time required to secure the off-site disposal airspace required to complete this alternative, including potential procurement, permitting, and construction, may extend this schedule significantly. The time required to attain the GPS for cobalt will be evaluated further during the remedy selection process, but is expected to take between 2 and 10 years after closure construction is complete. The level of source disturbance during construction may increase the time required to reach GPS. The removal of CCR from OGS may decrease the time to reach GPS. Alternative 5 can provide full protection within the 30-year post-closure monitoring period.

- **Institutional Requirements.** The following permits and approvals are expected to be required to implement Alternative 5:
  - IDNR Closure Permit
  - Depending on the off-site disposal facility, approval of off-site disposal facility owner or landfill permit for new off-site facility
  - State and local erosion control/construction storm water management permits
  - Transportation agreements and permits (local roads and railroads)

  Depending on the off-site disposal facility, state solid waste comprehensive planning approvals may also be required.

6.6 ALTERNATIVE 6 – CONSOLIDATE AND CAP WITH CHEMICAL AMENDMENT

As described in **Section 5.6**, Alternative 6 includes closing the OGS Ash Pond, relocating and consolidating CCR into a smaller footprint within the CCR surface impoundments, adding a chemical amendment to the CCR to reduce the mobilization of cobalt prior to relocating, covering the CCR materials with a cap, and establishing vegetation in accordance with the requirements for closure in place in 40 CFR 257.102(d).

- **Performance, Reliability, Implementation, and Impacts.**
  - Performance – Ceasing wastewater discharges and closing the impoundment by capping is expected to address infiltration, which is a key contributor to groundwater impacts. The consolidation of CCR into a smaller footprint may enhance the performance of the cap by further reducing the area exposed to limited post-construction infiltration through the cap. The smaller closure footprint also reduces the potential for ongoing CCR contact with groundwater. The application of a chemical amendment to the CCR that will remain on site may further reduce the potential for ongoing groundwater impacts after closure. Although the risk to surface water receptors is already low, the potential for CCR to interact with groundwater will remain after closure. Alternative 6 further reduces the potential for ongoing groundwater impacts from that interaction between CCR and water. If needed to address changes in groundwater conditions or prevent cross-media impacts between

groundwater and surface water, the initial application of a chemical amendment during closure can be supplemented with additional applications in the future outside of capped area. Alternative 6 is capable of and expected to attain the GPS for cobalt.

- Reliability – The expected reliability of capping is good. Capping is a common practice and standard remedial method for closure in place in remediation and solid waste management. There is significant industry experience with the design and construction of this method. A consolidated cap footprint may enhance reliability by reducing the scale of post-closure maintenance. Based on a review of information in the Federal Remediation Technologies Roundtable (FRTR) Technology Screening Matrix, amending source material using site-specific chemistries can be an effective means of sequestering metals to limit the future release to groundwater from residual source material. The technology can be applied to source material and groundwater plumes. The approach has been used at full scale to remediate inorganics (FRTR 2020).

- Implementation – The complexity of constructing the cap is low. The logistics of moving CCR around the site to consolidate the closure footprint increases the complexity of the alternative. CCR dewatering will be required to the extent required to excavate and relocate CCR within the CCR impoundments and provide a suitable subgrade for cap construction. Some conditioning (e.g., drying) of relocated CCR is expected during on-site re-disposal. So long as an appropriate amendment chemistry can be identified for OGS, the technology and equipment used for the in-situ application or mixing as part of excavation/consolidation activities is commercially available. Alternative 6 can likely be achieved through standard dewatering and conditioning methods. Although the cap footprint will be minimized, cap construction may put a high demand on the local supply of suitable cap materials. The local availability of cap materials will be evaluated further during remedy selection. The equipment and personnel required to implement the consolidation and capping portion of Alternative 6 are not specialized and are generally readily available. However, the equipment for the in-situ chemical amendment application is more specialized and may be in high demand.

- Impacts – Safety impacts associated with the implementation of Alternative 6 are not significantly different than other heavy civil construction projects. The level of disturbance required to consolidate CCR before capping may represent some increase in safety risk due to site conditions and on-site construction traffic. Some elevated risk may exist due to the use of and application of amendment chemistry, but can likely be addressed with additional worker protective measures. Cross-media impacts are expected to be limited due to the small volume of CCR expected to be relocated on site, the short duration of cap construction, the effectiveness of standard engineering controls during construction (e.g., dust control), and the lack of offsite transportation of CCR. Although the risk to surface water receptors is already low based on available data, the additional source control provided by Alternative 6 may offer further reduction of risks if groundwater conditions change. The potential for exposure to residual contamination is low since the CCR will be chemically stabilized, capped, and the footprint of the cap minimized.

- **Timing.** Closure of the OGS Ash Pond can be completed within 1 to 2 years of remedy selection. At OGS, the closure of the OGS Ash Pond is expected to be complete by

August 15, 2023. The time required to attain the GPS for cobalt will be evaluated further during the remedy selection process, but is expected to take between 2 and 10 years after closure construction is complete. The level of source disturbance during construction may increase the time required to reach GPS. The consolidation of CCR into a smaller cap area may decrease the time to reach GPS. Alternative 6 can provide full protection within the 30-year post-closure monitoring period.

- **Institutional Requirements.** The following permits and approvals are expected to be required to implement Alternative 6:
  - IDNR Closure Permit
  - Federal, state, and local floodplain permits
  - Injection permits
  - State and local erosion control/construction stormwater management permits
  - Federal and state wetland permitting may also be required

6.7 ALTERNATIVE 7 – CONSOLIDATE AND CAP WITH GROUNDWATER COLLECTION

As described in **Section 5.7**, Alternative 7 includes closing the OGS Ash Pond, relocating and consolidating CCR into a smaller footprint within the CCR surface impoundments, covering the CCR materials with a cap, establishing vegetation in accordance with the requirements for closure in place in 40 CFR 257.102(d), and installing a groundwater pump and treat system to prevent the migration of and/or recover groundwater with cobalt concentrations greater than the GPS.

- **Performance, Reliability, Implementation, and Impacts.**
  - Performance – Ceasing wastewater discharges and closing the impoundment by capping is expected to address infiltration, which is a key contributor to groundwater impacts. The consolidation of CCR into a smaller footprint may enhance the performance of the cap by further reducing the area exposed to limited post-construction infiltration through the cap. The groundwater pump and treat system may further reduce the potential for down-gradient migration of groundwater impacts after closure. Although the risk to surface water receptors is already low, the potential for CCR to interact with groundwater will remain after closure. Alternative 7 further reduces the risk of potential ongoing groundwater impacts from that interaction between CCR and water. The groundwater pump and treat system offers additional flexibility to address changes in groundwater conditions or prevent cross-media impacts between groundwater and surface water. Alternative 7 is capable of and expected to attain the GPS for cobalt.

  - Reliability – The expected reliability of capping is good. Capping is a common practice and standard remedial method for closure in place in remediation and solid waste management. There is significant industry experience with the design and construction of this method. A consolidated cap footprint may enhance reliability by reducing the scale of post-closure maintenance. Similar to capping, groundwater pump and treat is a common method used to limit the migration of impacted groundwater or remove impacted groundwater to restore groundwater concentrations to levels below the GPS.

  - Implementation – The complexity of constructing the cap is low. The logistics of moving CCR around the site to consolidate the closure footprint increases the complexity of the alternative. CCR dewatering will be required to the extent required to excavate and relocate CCR within the CCR impoundments and provide a suitable subgrade for cap construction. Some conditioning (e.g., drying) of relocated CCR is expected during on-site re-disposal. The complexity of the groundwater pump and treat system is also low. Alternative 7 can likely be achieved through standard dewatering and conditioning methods. Although the cap footprint will be minimized, cap construction may put a high demand on the local supply of suitable cap materials. The local availability of cap materials will be evaluated further during remedy selection. The equipment and personnel required to implement Alternative 7 are not specialized and are generally readily available. The development, operation, maintenance and monitoring of adequate treatment for large volumes of groundwater with relatively low concentrations of cobalt likely increases the complexity of implementing this alternative.

  - Impacts – Safety impacts associated with the implementation of Alternative 7 are not significantly different than other heavy civil construction projects. The level of disturbance required to consolidate CCR before capping may represent some increase in safety risk due to site conditions and on-site construction traffic. Some elevated risk may exist due to the additional construction involved with the groundwater pump and treat system and the higher complexity of the long term maintenance required. Cross-media impacts are expected to be limited due to the small volume of CCR expected to be relocated on site, the short duration of cap construction, the effectiveness of standard engineering controls during construction (e.g., dust control), and the lack of offsite transportation of CCR. Although the risk to surface water receptors is already low based on available data, the active nature of the groundwater plume containment provided by Alternative 7 may offer further reduction of risks if groundwater conditions change. The potential for exposure to residual contaminated source material is low since CCR will be capped and the footprint of the cap minimized. The potential exposure to contaminated groundwater is increased due to the ex-situ groundwater treatment required and the potential for worker exposure and spills.

- **Timing.** Closure of the OGS Ash Pond can be completed within 1 to 2 years of remedy selection. At OGS, the closure of the OGS Ash Pond is expected to be complete by August 15, 2023. The time required to attain the GPS for cobalt will be evaluated further during the remedy selection process, but is expected to take between 2 and 10 years after closure construction is complete. The level of source disturbance during construction may increase the time required to reach GPS. The additional time required to design and install the groundwater pump and treat system is unlikely to have a significant impact on the implementation timing but may reduce the time required to attain the GPS. The consolidation of CCR into a smaller cap area may decrease the time to reach GPS. Alternative 7 can provide full protection within the 30-year post-closure monitoring period.

- **Institutional Requirements.** The following permits and approvals are expected to be required to implement Alternative 7:
  - IDNR Closure Permit
  - Federal, state, and local floodplain permits
  - State and local well installation permits
  - NPDES permitting for post-treatment groundwater discharges

  - State and local erosion control/construction stormwater management permits
  - Federal and state wetland permitting may also be required

6.8 ALTERNATIVE 8 – CONSOLIDATE AND CAP WITH BARRIER WALL

As described in **Section 5.8**, Alternative 8 includes closing the OGS Ash Pond, relocating and consolidating CCR into a smaller footprint within the CCR surface impoundments, covering the CCR materials with a cap, establishing vegetation in accordance with the requirements for closure in place in 40 CFR 257.102(d), and installing a downgradient barrier wall to prevent the migration of groundwater with lithium and molybdenum concentrations greater than the GPS.

- **Performance, Reliability, Implementation, and Impacts.**
  - Performance – Ceasing wastewater discharges and closing the impoundment by capping is expected to address infiltration, which is a key contributor to groundwater impacts. The consolidation of CCR into a smaller footprint may enhance the performance of the cap by further reducing the area exposed to limited post-construction infiltration through the cap. The barrier wall may further reduce the potential for ongoing groundwater impacts after closure. Although the risk to surface water receptors is already low, the potential for CCR to interact with groundwater will remain after closure. Alternative 8 further reduces the risk of potential ongoing groundwater impacts from that interaction between CCR and water. Although it acts passively, the barrier wall reduces the risk from a more passive groundwater restoration approach such as MNA if MNA mechanisms are not active, the site has insufficient site attenuation capacity, or groundwater conditions change in a way that increases the potential for cross-media impacts between groundwater and surface water. Alternative 8 is capable of and expected to attain the GPS for lithium and molybdenum.

    Reliability – The expected reliability of capping is good. Capping is a common practice and standard remedial method for closure in place in remediation and solid waste management. There is significant industry experience with the design and construction of this method. A consolidated cap footprint may enhance reliability by reducing the scale of post-closure maintenance. A barrier wall at OGS will likely have to consist of a permeable reactive barrier (PRB) due to the lack of an impermeable layer to key a low permeability barrier wall into. In general the reliability of PRBs for containment of inorganics is favorable based on information available in the FRTR Technology Screening Matrix (FRTR 2020). The reliability of a PRB requires the identification of a suitable reactive media for the conditions at OGS and the ability to effectively locate the barrier, which are both likely but require additional evaluations. PRB performance can diminish over time as consumptive media is exhausted or hydraulic conditions change due to chemical precipitation or biofouling. Long-term monitoring and maintenance is required to ensure continued performance.

  - Implementation – The complexity of constructing the cap is low. The logistics of moving CCR around the site to consolidate the closure footprint increases the complexity of the alternative. CCR dewatering will be required to the extent required to excavate and relocate CCR within the CCR impoundments and provide a suitable subgrade for cap construction. Some conditioning (e.g., drying) of relocated CCR is expected during on-site re-disposal. The complexity of the PRB wall significantly increases the level of complexity for implementing this alternative. PRB installation contractors and equipment have lengthy procurement timelines. Alternative 8 can likely be achieved through standard dewatering and conditioning methods. Although the cap footprint will be minimized, cap construction may put a high demand on the local supply of suitable cap materials. The equipment and personnel required to implement the consolidation and capping portion of Alternative 8 are not specialized and are generally readily available. However, the equipment for the barrier wall is more specialized and may be in high demand.

  - Impacts – Safety impacts associated with the implementation of Alternative 8 are not significantly different than other heavy civil construction projects. The level of disturbance required to consolidate CCR before capping may represent some increase in safety risk due to site conditions and on-site construction traffic. Some elevated risk may exist due to the additional construction involved with the barrier wall construction and the higher complexity of the long term barrier wall performance monitoring. Cross-media impacts are expected to be limited due to the small volume of CCR expected to be relocated on site, the short duration of cap construction, the effectiveness of standard engineering controls during construction (e.g., dust control), and the lack of offsite transportation of CCR. Although the risk to surface water receptors is already low based on available data, the enhanced nature of the passive groundwater plume containment provided by Alternative 8 may offer further reduction of risks if groundwater conditions change. The potential for exposure to residual contaminated source material is low since CCR will be capped and the footprint of the cap minimized.

- **Timing.** Closure of the OGS Ash Pond can be completed within 1 to 2 years of remedy selection. At OGS, the closure of the OGS Ash Pond is expected to be complete by August 15, 2023. The time required to attain the GPS for cobalt will be evaluated further during the remedy selection process, but is expected to take between 2 and 10 years after closure construction is complete. The level of source disturbance during construction may increase the time required to reach GPS. The additional time required to design and install the barrier wall is unlikely to have a significant impact on the implementation timing but may reduce the time required to attain the GPS. The consolidation of CCR into a smaller cap area may decrease the time to reach GPS. Alternative 8 can provide full protection within the 30-year post-closure monitoring period.

- **Institutional Requirements.** The following permits and approvals are expected to be required to implement Alternative 8:
  - IDNR Closure Permit
  - Federal, state, and local floodplain permits
  - State and local well installation permits
  - State and local erosion control/construction stormwater management permits
  - Federal and state wetland permitting may also be required

7.0 SUMMARY OF ASSESSMENT

An initial qualitative assessment of the advantages and disadvantages of each Corrective Measure Alternative presented in **Section 4.0** is provided in **Table 5**. Each of the identified Corrective Measure Alternatives exhibits both favorable and unfavorable outcomes with respect to the assessment criteria. In accordance with 40 CFR 257.97(c), the facility must consider all of the evaluation factors and select a remedy that meets the standards of 257.97(b) as soon as feasible.

We continue to advance additional data collection efforts to identify the appropriate corrective action measure for the Site. We will continue to update **Table 5** and develop a quantitative scoring matrix to identify a preferred corrective action.

8.0 REFERENCES

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United States Environmental Protection Agency (USEPA), (1998) "Solid Waste Disposal Facility Criteria Technical Manual (EPA530-R-93-017), Revised April 13, 1998." Solid Waste and Emergency Response.

USEPA (2007). "Monitored Natural Attenuation of Inorganic Contaminants in Groundwater, Volume 1 – Technical Basis for Assessment, (EPA600-R-07-139). Office of Research and Development, National Risk Management Laboratory, Ada, Oklahoma.

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Tables

Table 1. Groundwater Elevations - CCR Rule Monitoring Well Networks
IPL - Ottumwa Generating Station / SCS Engineers Project #25220083.00

Depth to Water in feet below top of well casing/reference elevation

Raw Data	MW-301	MW-302	MW-303	MW-304	MW-305	MW-305A	MW-306	MW-307	MW-308	MW-309	MW-310	MW-310A	MW-311	MW-311A	River at Intake
Measurement Date															
April 26, 2016	3.83	18.27	8.65	27.47	22.24	NI	12.61				NI	NI	NI	NI	NI
June 23, 2016	4.05	18.25	8.18	26.31	21.55	NI	12.83				NI	NI	NI	NI	NI
August 9, 2016	4.36	18.38	9.31	29.05	23.13	NI	13.12				NI	NI	NI	NI	NI
October 26-27, 2016	4.59	18.23	8.90	27.81	22.54	NI	13.26				NI	NI	NI	NI	NI
January 18-19, 2017	4.96	18.44	9.33	28.34	23.04	NI	13.58	8.75	7.97	8.28	NI	NI	NI	NI	NI
April 19-20, 2017	4.48	17.55	6.50	25.36	20.64	NI	12.78	3.94	4.30	4.78	NI	NI	NI	NI	NI
June 20-21, 2017	4.72	18.25	8.65	28.09	22.65	NI	13.53	7.71	7.13	7.34	NI	NI	NI	NI	NI
August 21-23, 2017	5.35	18.77	10.49	30.45	24.91	NI	14.70	11.78	12.27	13.12	NI	NI	NI	NI	NI
November 8, 2017	5.09	18.50	9.73	29.81	24.15	NI	14.43	10.19	10.40	10.74	NI	NI	NI	NI	NI
April 18, 2018	5.10	18.19	8.60	27.29	22.92	NI	14.55	7.90	7.48	7.29	NI	NI	NI	NI	NI
May 30, 2018	NM	NM	NM	NM	NM	NI	NM	5.11	4.34	3.96	NI	NI	NI	NI	NI
June 28, 2018	NM	NM	NM	NM	NM	NI	NM	4.69	3.96	3.47	NI	NI	NI	NI	NI
July 18, 2018	NM	NM	NM	NM	NM	NI	NM	5.29	4.72	4.25	NI	NI	NI	NI	NI
August 14-15, 2018	5.72	17.85	8.50	26.49	22.35	NI	14.81	NM	NM	NM	NI	NI	NI	NI	NI
August 29, 2018	5.54	18.01	6.00	25.02	NM	NI	NM	NM	NM	NM	NI	NI	NI	NI	NI
October 16, 2018	4.13	16.99	4.90	24.64	20.54	NI	13.23	3.43	NM	3.33	NI	NI	NI	NI	NI
January 8, 2019	4.41	17.87	6.42	26.56	21.78	NI	13.63	NM	NM	NM	NI	NI	NI	NI	NI
April 8, 2019	3.94	16.67	5.52	23.51	19.90	NI	12.51	2.66	1.69	1.39	NI	NI	NI	NI	NI
August 28, 2019	NM	NM	NM	NM	NM	NI	NM	NM	NM	NM	17.65	NI	12.08	NI	NI
October 23-24, 2019	3.56	13.76	7.21	25.13	20.70	NI	12.19	5.67	4.08	3.66	9.32	NI	6.38	NI	NI
December 11, 2019	NM	NM	NM	NM	NM	NI	NM	7.97	8.00	7.70	NM	NI	NM	NI	NI
February 5, 2020	3.33	NM	NM	NM	NM	NI	NM	7.68	5.27	6.60	13.92	NI	9.18	NI	NI
March 12-13, 2020	3.81	NM	NM	NM	22.50	32.39	NM	NM	NM	NM	13.18	40.09	10.00	29.43	NI
April 1, 2020	3.36	16.9	5.18	24.27	23.32	28.98	12.34	3.8	3.51	3.71	7.54	8.77	4.83	5.27	6.6
April 13-14, 2020	3.38	17.45	6.99	26.42	21.47	30.34	12.76	6.90	5.30	5.75	12.72	10.43	7.39	5.12	10.6
May 4, 2020	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
June 30, 2020	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	5.81	NM
October 5-12, 2020	4.29	18.10	10.70	29.89	24.10	36.02	13.29	11.38	12.54	13.44	20.17	17.73	15.45	12.45	NM

Ground Water or Surface Water Elevation in feet above mean sea level (amsl)

Well Number	MW-301	MW-302	MW-303	MW-304	MW-305	MW-305A	MW-306	MW-307	MW-308	MW-309	MW-310	MW-310A	MW-311	MW-311A	River at Intake
Top of Well Casing Elevation / Surface Water Reference Elevation (feet amsl)	686.63	673.90	661.07	682.84	683.91	684.03	683.47	657.56	655.39	654.94	658.63	657.93	654.18	653.54	656.31
Screen Length (ft)	10.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	NA
Total Depth (ft from top of casing)	17.0	25.8	17.5	52.3	51.5	81.91	36.6	28.0	25.0	27.5	25.9	55.55	17.9	47.68	NA
Top of Well Screen Elevation (ft)	679.63	653.10	648.57	635.54	637.41	607.12	651.87	634.56	635.39	632.44	637.76	607.38	641.24	610.86	NA
Measurement Date															
April 26, 2016	682.80	655.63	652.42	655.37	661.67	NI	670.86	NI	NI	NI	NI	NI	NI	NI	NI
June 23, 2016	682.58	655.65	652.89	656.53	662.36	NI	670.64	NI	NI	NI	NI	NI	NI	NI	NI
August 9, 2016	682.27	655.52	651.76	653.79	660.78	NI	670.35	NI	NI	NI	NI	NI	NI	NI	NI
October 26-27, 2016	682.04	655.67	652.17	655.03	661.37	NI	670.21	NI	NI	NI	NI	NI	NI	NI	NI
January 18-19, 2017	681.67	655.46	651.74	654.50	660.87	NI	669.89	648.81	647.42	646.66	NI	NI	NI	NI	NI
April 19-20, 2017	682.15	656.35	654.57	657.48	663.27	NI	670.69	653.62	651.09	650.16	NI	NI	NI	NI	NI
June 20-21, 2017	681.91	655.65	652.42	654.75	661.26	NI	669.94	649.85	648.26	647.60	NI	NI	NI	NI	NI
August 21-23, 2017	681.28	655.13	650.58	652.39	659.00	NI	668.77	645.78	643.12	641.82	NI	NI	NI	NI	NI
November 8, 2017	681.54	655.40	651.34	653.03	659.76	NI	669.04	647.37	644.99	644.20	NI	NI	NI	NI	NI
April 18, 2018	681.53	655.71	652.47	655.55	660.99	NI	668.92	649.66	647.91	647.65	NI	NI	NI	NI	NI
May 30, 2018	NM	NM	NM	NM	NM	NI	NM	652.45	651.05	650.98	NI	NI	NI	NI	NI
June 28, 2018	NM	NM	NM	NM	NM	NI	NM	652.87	651.43	651.47	NI	NI	NI	NI	NI
July 18, 2018	NM	NM	NM	NM	NM	NI	NM	652.27	650.67	650.69	NI	NI	NI	NI	NI
August 14-15, 2018	680.91	656.05	652.57	656.35	661.56	NI	668.66	NM	NM	NM	NI	NI	NI	NI	NI
August 29, 2018	681.09	655.89	655.07	657.82	NM	NI	NM	NM	NM	NM	NI	NI	NI	NI	NI
October 16, 2018	682.50	656.91	656.17	658.20	663.37	NI	670.24	654.13	NM	651.61	NI	NI	NI	NI	NI
January 8, 2019	682.22	656.03	654.65	656.28	662.13	NI	669.84	NM	NM	NM	NI	NI	NI	NI	NI
April 8, 2019	682.69	657.23	655.55	659.33	664.01	NI	670.96	654.90	653.70	653.55	NI	NI	NI	NI	NI
August 28, 2019	NM	NM	NM	NM	NM	NI	NM	NM	NM	NM	640.98	NI	642.10	NI	NI
October 23-24, 2019	683.07	660.14	653.86	657.71	663.21	NI	671.28	651.89	651.31	651.28	649.31	NI	647.80	NI	NI
December 11, 2019	NM	NM	NM	NM	NM	NI	NM	649.59	647.39	647.24	NM	NI	NM	NI	NI
February 5, 2020	683.30	NM	NM	NM	NM	NI	NM	649.88	650.12	648.34	644.71	NI	645.00	NI	NI
March 12-13, 2020	682.82	NM	NM	NM	661.41	651.64	NM	NM	NM	NM	645.45	617.84	644.18	624.11	NI
April 1, 2020	683.27	657.00	655.89	658.57	660.59	655.05	671.13	653.76	651.88	651.23	651.09	649.16	649.35	648.27	649.71
April 13-14, 2020	683.25	656.45	654.08	656.42	662.44	653.69	670.71	650.66	650.09	649.19	645.91	647.50	646.79	648.42	645.71
May 4, 2020	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
June 30, 2020	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	647.73	NM
October 5-12, 2020	682.34	655.80	650.37	652.95	659.81	648.01	670.18	646.18	642.85	641.50	638.46	640.20	638.73	641.09	NM
Bottom of Well Elevation (ft)	669.63	648.10	643.57	630.54	632.41	602.12	646.87	629.56	630.39	627.44	632.76	602.38	636.24	605.86	--

Notes:
NM = not measured
NI = not installed

Created by: KAK Date: 5/1/2017
Last rev. by: SK Date: 11/24/2020
Checked by: EJN Date: 11/24/2020
Proj Mgr QA/QC: TK Date: 11/25/2020

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Table 2. CCR Rule Groundwater Samples Summary
Ottumwa Generating Station / SCS Engineers Project #25220083.00

Sample Dates	Downgradient Wells										Background Well
	MW-302	MW-303	MW-304	MW-305	MW-305A	MW-306	MW-310	MW-310A	MW-311	MW-311A	MW-301
4/26/2016	B	B	B	B	NI	B	NI	NI	NI	NI	B
6/23/2016	B	B	B	B	NI	B	NI	NI	NI	NI	B
8/10-11/2016	B	B	B	B	NI	B	NI	NI	NI	NI	B
10/26-27/2016	B	B	B	B	NI	B	NI	NI	NI	NI	B
1/18/2017	B	B	B	B	NI	B	NI	NI	NI	NI	B
4/19/2017	B	B	B	B	NI	B	NI	NI	NI	NI	B
6/20-21/2017	B	B	B	B	NI	B	NI	NI	NI	NI	B
8/22-23/2017	B	B	B	B	NI	B	NI	NI	NI	NI	B
11/8/2017	D	D	D	D	NI	D	NI	NI	NI	NI	D
4/18/2018	A	A	A	A	NI	A	NI	NI	NI	NI	A
8/14-15/2018	A	A	A	A	NI	A	NI	NI	NI	NI	A
8/29/2018	A-R	A-R	A-R	--	NI	--	NI	NI	NI	NI	A-R
10/16/2018	A	A	A	A	NI	A	NI	NI	NI	NI	A
1/8/2019	A-R	A-R	A-R	A-R	NI	A-R	NI	NI	NI	NI	A-R
4/8/2019	A	A	A	A	NI	A	NI	NI	NI	NI	A
10/24/2019	A	A	A	A	NI	A	A	NI	A	NI	A
2/5/2020	--	--	--	--	NI	--	A	NI	A	NI	A
3/13/2020	--	--	--	A-R	A	--	A-R	A	A-R	A	A
4/14/2020	A	A	A	A	A	A	A	A	A	A	A
6/30/2020	--	--	--	--	--	--	--	--	--	A-R	--
10/8/2020	A	A	A	A	A	A	A	A	A	A	A

Abbreviations:

B = Background Sample Event
D = Detection Monitoring Sampling Event
-- = Not Applicable

A = Assessment Monitoring Sampling Event
A-R = Assessment Monitoring Resampling Event
NI - Not Installed

Created by: NDK Date: 1/8/2018
Last revision by: SK Date: 11/24/2020
Checked by: EJN Date: 11/24/2020

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Table 3. Groundwater Analytical Results Summary - CCR Program - Assessment Monitoring
Ottumwa Generating Station Ash Pond / SCS Engineers Project #25220083.00

Parameter Name	UPL Method	UPL	GPS	Background Well										Compliance Wells							
				MW-301										MW-302							
				11/8/2017	4/18/2018	8/14/2018, 8/29/2018 ^	10/16/2018, 1/8/2019 ^^	4/8/2019	10/24/2019	2/5/2020	3/12/2020	4/14/2020	10/8/2020	11/8/2017	4/18/2018	8/14/2018, 8/29/2018 ^	10/16/2018, 1/8/2019 ^^	4/8/2019	10/24/2019	4/14/2020	10/8/2020
Appendix III																					
Boron, ug/L	P	820		488	480	735	410	380	680	540	--	700	650 F1	1,320	1,200	1,240	1,100	1,340	1,200	1,200	1300
Calcium, mg/L	P	78.7		65.2	63.0	72.5	47.2	43	78	68	--	84	94	183	177	185	146	199	180	180	180
Chloride, mg/L	P	86.8		59.8	63.4	63.1	33.9	50	110	120	--	140	170	254	246	259	214	240	220	220	230
Fluoride, mg/L	P	0.484		0.27	0.22	0.27	0.3	0.44 J	<0.23	--	--	<0.23	<0.23	0.20 J	0.26	0.26	0.24	<0.23	<0.23	<0.23	<0.23 ^
Field pH, Std. Units	P	6.87		6.41	6.41	6.26	6.27	6.61	6.33	6.39	6.48	6.58	6.22	6.55	6.47	6.76	6.37	6.61	6.55	6.7	7.00
Sulfate, mg/L	P	199		178	186	181	164	81	130	130	--	140	140	786	899	847	785	840	810	790	840
Total Dissolved Solids, mg/L	P	628		448	514	532	392	340	510	570	--	550	660	1,620	1,690	1,840	1,400	1,600	1,600	1,500	1700
Appendix IV		**UPL**	**GPS**																		
Antimony, ug/L	P*	0.22	6	NA	<0.026	0.20 J	<0.078	<0.53	<0.53	--	--	<0.58	<0.51	--	<0.026	<0.15	0.26 J,B	<0.53	<0.53	<0.58	<0.51
Arsenic, ug/L	P*	0.53	10	NA	0.074 J	0.29 J	0.16 J	<0.75	<0.75	<0.88	--	<0.88	<0.88	--	0.16 J	0.30 J	1.9	<0.75	<0.75	<0.88	<0.88
Barium, ug/L	P	68.8	2,000	NA	31.6	44.5	28.1	25	56	43	--	54	58	--	17.7	18.3	28.9	19	21	23	18
Beryllium, ug/L	DQ	DQ	4	NA	<0.012	0.14 J	<0.089	<0.27	<0.27	--	--	<0.27	--	--	<0.012	<0.12	0.22 J	<0.27	<0.27	<0.27	--
Cadmium, ug/L	NP*	0.12	5	NA	0.023 J	0.16 J	<0.033	<0.077	0.040	<0.039	--	<0.039	0.0075 J	--	0.22 J	0.21 J	0.67	0.21 J	0.20	0.23	0.2
Chromium, ug/L	P	1.07	100	NA	<0.054	0.25 J	0.11 J,B	<0.98	<0.98	<1.1	--	<1.1	<1.1	--	0.46 J	0.48 J	1.6	<0.98	<0.98	1.4 J	<1.1
Cobalt, ug/L	NP	4.1	6	NA	0.46 J	1.4	0.36 J,B	0.44 J	0.60	1.1	0.43 J	0.52	0.41 J	--	0.90 J	1.50	4.0	1.2	2.7	5.3	1.5
Fluoride, mg/L	P	0.48	4	NA	0.22	0.27	0.3	0.44 J	<0.23	--	--	<0.23	<0.23	--	0.26	0.26	0.24	<0.23	<0.23	<0.23	<0.23 ^
Lead, ug/L	NP*	0.10	15	NA	0.041 J	0.18 J	<0.13	<0.27	<0.27	<0.27	--	<0.27	<0.11	--	0.098 J	0.12 J	3.9	<0.27	0.29 J	1.0	<0.11
Lithium, ug/L	P	34.2	40	NA	19.1	26.5	19.4	15	24	17	21	24	23	--	7.5 J	6.9 J	8.6 J	10	10	11	9.6 J
Mercury, ug/L	DQ	DQ	2	NA	<0.090	<0.083	<0.090	<0.10	<0.10	--	--	<0.10	--	--	0.096 J	<0.083	<0.090	<0.10	<0.10	<0.10	--
Molybdenum, ug/L	P	1.74	100	NA	0.67 J	1.3	0.72 J	<1.1	1.1	--	--	1.2 J	<1.1	--	0.59 J	0.54 J	<0.57	<1.1	<1.1	<1.1	<1.1
Selenium, ug/L	P	8.55	50	NA	4.3	6.3	3.4	3.1 J	6.2	--	--	6.8	7.7	--	<0.086	<0.16	0.84 J,B	<1.0	<1.0	<1.0	<1.0
Thallium, ug/L	NP*	0.14	2	NA	<0.036	0.16 J	<0.099	<0.27	<0.27	--	--	<0.26	<0.26	--	<0.036	<0.14	0.16 J	<0.27	<0.27	<0.26	<0.26
Radium 226/228 Combined, pCI/L	P	2.15	5	NA	0.513	1.19	1.7	0.0956	0.956	0.228	--	0.315	pending	--	0.746	1.12	1.7	0.116	0.79	1.26	pending
Additonal Parameters - Selection of Remedy																					
Cobalt - dissolved,$^{\#}$	UPL or GPS not applicable			--	--	--	--	--	--	--	0.32 J	0.44 J	--	--	--	--	--	--	--	0.81	--
Lithium - dissolved,$^{\#}$				--	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	--
Iron, dissolved,$^{\#}$ ug/L				--	--	--	--	--	--	--	<50	<50	<50	--	--	--	--	--	--	<50	<50
Iron, ug/L				--	--	--	--	--	--	--	<50	50 J	<50	--	--	--	--	--	--	500	100
Magnesium											--	33,000	38,000							50,000	57,000
Manganese, dissolved,$^{\#}$ ug/L				--	--	--	--	--	--	--	17	16	13	--	--	--	--	--	--	110	130
Manganese, ug/L				--	--	--	--	--	--	--	16	19	14	--	--	--	--	--	--	200	140
Potassium, ug/L				--	--	--	--	--	--	--	--	1,500	1,500	--	--	--	--	--	--	1,500	1,900
Sodium, ug/L				--	--	--	--	--	--	--	--	77,000	87,000	--	--	--	--	--	--	250,000	280,000
Total Alkalinity, mg/L				--	--	--	--	--	--	--	--	150	160	--	--	--	--	--	--	61	72
Cabonate Alkalinity, mg/L				--	--	--	--	--	--	--	--	<1.9	<3.8	--	--	--	--	--	--	<1.9	<1.9
Bicarbonate Alkalinity, mg/L				--	--	--	--	--	--	--	--	150	160	--	--	--	--	--	--	61	72

4.4	Blue highlighted cell indicates the compliance well result exceeds the UPL (background) and the LOQ.
30.8	Yellow highlighted cell indicates the compliance well result exceeds the GPS.
17	Yellow highlighted cell with bold text indicates the compliance well result exceeds the GPS and the result was determined to be statistically significant$^{(1)}$.
17	Grayscale indicates Additional Parameters sampled for selection of remedy and evaluation of MNA.

Table 3. Groundwater Analytical Results Summary - CCR Program - Assessment Monitoring
Ottumwa Generating Station Ash Pond / SCS Engineers Project #25220083.00

Parameter Name	UPL Method	UPL	GPS	Compliance Wells															
				MW-303								MW-304							
				11/8/2017	4/18/2018	8/14/2018, 8/29/2018 ^	10/16/2018, 1/8/2019 ^^	4/8/2019	10/24/2019	4/14/2020	10/8/2020	11/8/2017	4/18/2018	8/14/2018, 8/29/2018 ^	10/16/2018, 1/8/2019 ^^	4/8/2019	10/23/2019	4/13/2020	10/8/2020
Appendix III																			
Boron, ug/L	P	820		1,070	987	1,010	549	290	440	420	1100	1,040	991	1,000	930	1,110	970	1,000	1000
Calcium, mg/L	P	78.7		234	212	213	195	172	170	170	210	136	131	138	123	130	120	130	120
Chloride, mg/L	P	86.8		185	198	64.8	57	22	35	47	210	417	400	375	410	320	280	250	250
Fluoride, mg/L	P	0.484		0.19 J	0.22	0.31	0.24	<0.23	<0.23	<0.23	0.26 J^	0.96	0.92	1.00	1.0	1.3	0.74	1.1	1.1
Field pH, Std. Units	P	6.87		6.60	6.63	6.83	6.66	7.00	6.83	6.98	8.28	7.00	6.9	7.34	6.86	7.17	7.05	7.12	7.88
Sulfate, mg/L	P	199		348	328	164	389	260	180	180	190	194	198	185	184	180	190	220	230
Total Dissolved Solids, mg/L	P	628		1,290	1,300	832	1,150	890	810	810	1100	1,270	1,300	3,680	1,180	1,100	1100	1,000	1200
Appendix IV		**UPL**	**GPS**																
Antimony, ug/L	P*	0.22	6	--	0.098 J	0.16 J	0.2 J,B	<0.53	<0.53	<0.58	<0.51	--	<0.026	0.19 J	<0.078	<0.53	<0.53	<0.58	<0.51
Arsenic, ug/L	P*	0.53	10	--	0.43 J	0.60 J	0.55 J	<0.75	<0.75	<0.88	<0.88	--	0.68 J	1.3	0.96 J	<0.75	0.83 J	0.96 J	<0.88
Barium, ug/L	P	68.8	2,000	--	69.5	77.3	95.2	54	77	64	94	--	88.5	87.4	91	80	80	80	74
Beryllium, ug/L	DQ	DQ	4	--	0.017 J	<0.12	<0.089	<0.27	<0.27	<0.27	--	--	0.026 J	0.21 J	<0.089	<0.27	<0.27	<0.27	--
Cadmium, ug/L	NP*	0.12	5	--	0.44 J	0.36 J	0.24 J	0.092 J	0.21	0.18	0.46	--	<0.018	0.17 J	0.07 J	<0.077	<0.039	<0.039	<0.049
Chromium, ug/L	P	1.07	100	--	0.12 J	0.19 J	0.15 J,B	<0.098	<0.98	<1.1	<1.1	--	2.0	5.9	1.4	1.6 J	2 J	3.5 J	<1.1
Cobalt, ug/L	NP	4.1	6	--	2.1	2.2	1.7 B	0.42 J	1.2	0.87	2.4	--	0.39 J	0.92 J	0.45 J,B	0.40 J	0.5	0.57	0.41 J
Fluoride, mg/L	P	0.48	4	--	0.22	0.31	0.24	<0.23		<0.23	0.26 J^	--	0.92	1.00	1.0	1.3	0.74	1.1	1.1
Lead, ug/L	NP*	0.10	15	--	0.069 J	0.13 J	<0.13	<0.27	<0.27	<0.27	<0.11	--	0.37 J	0.81 J	0.66 J	<0.27	0.27 J	0.5	<0.11
Lithium, ug/L	P	34.2	40	--	<4.6	6.9 J	<4.6	<2.7	<2.7	4.7 J	5.6 J	--	<4.6	<4.6	<4.6	3.3 J	2.8 J	4.8 J	3.1 J
Mercury, ug/L	DQ	DQ	2	--	<0.090	<0.083	<0.090	<0.10	<0.10	<0.10	--	--	<0.090	<0.083	<0.090	<0.10	<0.10	<0.10	--
Molybdenum, ug/L	P	1.74	100	--	0.61 J	0.98 J	5.5	7.5	5.2	3.6	<1.1	--	2.0	2.4	1.9	1.5 J	2.3	2	1.5 J
Selenium, ug/L	P	8.55	50	--	0.23 J	0.35 J	0.37 J,B	2.1 J	<1.0	5.0	<1.0	--	<0.086	0.50 J	0.26 J,B	<1.0	<1.0	<1.0	<1.0
Thallium, ug/L	NP*	0.14	2	--	<0.036	<0.14	<0.099	<0.27	<0.27	<0.26	<0.26	--	<0.036	0.15 J	<0.099	<0.27	<0.27	<0.26	<0.26
Radium 226/228 Combined, pCI/L	P	2.15	5	--	0.529	1.82	1.68	0.391	0.336	0.229	pending	--	2.08	3.74	1.25	2.42	3.03	2.46	pending
Additonal Parameters - Selection of Remedy																			
Cobalt - dissolved,$^{\#}$	UPL or GPS not applicable			--	--	--	--	--	--	0.37 J	--	--	--	--	--	--	--	0.37 J	--
Lithium - dissolved,$^{\#}$				--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Iron, dissolved,$^{\#}$ ug/L				--	--	--	--	--	--	<50	<50	--	--	--	--	--	--	4,600	4,200
Iron, ug/L				--	--	--	--	--	--	280	310	--	--	--	--	--	--	5,200	4,200
Magnesium										23,000	31,000							43,000	40,000
Manganese, dissolved,$^{\#}$ ug/L				--	--	--	--	--	--	220	1,600	--	--	--	--	--	--	3,700	3,800
Manganese, ug/L				--	--	--	--	--	--	260	1,600	--	--	--	--	--	--	3,700	3,800
Potassium, ug/L				--	--	--	--	--	--	960	1,100	--	--	--	--	--	--	7,700	7,800
Sodium, ug/L				--	--	--	--	--	--	100,000	150,000	--	--	--	--	--	--	210,000	210,000
Total Alkalinity, mg/L				--	--	--	--	--	--	440	470	--	--	--	--	--	--	370	380
Cabonate Alkalinity, mg/L				--	--	--	--	--	--	<1.9	<3.8	--	--	--	--	--	--	<1.9	<3.8
Bicarbonate Alkalinity, mg/L				--	--	--	--	--	--	440	470	--	--	--	--	--	--	370	380

4.4	Blue highlighted cell indicates the compliance well result exceeds the UPL (background) and the LOQ.
30.8	Yellow highlighted cell indicates the compliance well result exceeds the GPS.
17	Yellow highlighted cell with bold text indicates the compliance well result exceeds the GPS and the result was determined to be statistically significant(1).
17	Grayscale indicates Additional Parameters sampled for selection of remedy and evaluation of MNA.

Table 3. Groundwater Analytical Results Summary - CCR Program - Assessment Monitoring
Ottumwa Generating Station Ash Pond / SCS Engineers Project #25220083.00

Parameter Name	UPL Method	UPL	GPS	Compliance Wells																			
				MW-305									MW-305A			MW-306							
				11/8/2017	4/18/2018	8/15/2018	10/16/2018, 1/8/2019 ^^	4/8/2019	10/23/2019	3/13/2020	4/13/2020	10/8/2020	3/13/2020	4/14/2020	10/8/2020	11/8/2017	4/18/2018	8/15/2018	10/16/2018, 1/8/2019 ^^	4/8/2019	10/23/2019	4/14/2020	10/8/2020
Appendix III																							
Boron, ug/L	P	820		925	886	911	835	1,000	880	--	920	900	250	280	180	881	919	915	862	1,100	980	1,000	1100
Calcium, mg/L	P	78.7		99.5	97.6	102.0	96.2	110	100	--	100	110	100	130	150	73.1	74.1	78.9	80.0	95	77	73	80
Chloride, mg/L	P	86.8		282	289	265	281	250	280	--	270	290	40	89	120	50.4	54.4	58.2	83.3	98	47	41	43
Fluoride, mg/L	P	0.484		0.40	0.40	0.44	0.40	0.75	<0.23	--	0.35 J	0.38 J^	0.77	0.73	0.73	0.11 J	0.11 J	0.13 J	<0.19	0.27 J	<0.23	<0.23	<0.23 ^
Field pH, Std. Units	P	6.87		7.01	6.9	7.21	6.86	7.06	6.91	7.02	7.0	7.44	8.09	7.63	7.46	6.49	6.42	6.74	6.42	6.66	6.74	6.68	6.54
Sulfate, mg/L	P	199		138	147	139	129	110	76	--	63	93	40	93	130	274	289	275	285	270	280	310	360
Total Dissolved Solids, mg/L	P	628		1,040	1,070	1,060	1,070	1,000	1000	--	960	1100	400	570	660	773	805	840	884	930	870	820	900
Appendix IV		**UPL**	**GPS**																				
Antimony, ug/L	P*	0.22	6	--	0.089 J	<0.15	0.096 J,B	<0.53	<0.53	--	<0.58	<0.51	1.3	0.88 J	<0.51	--	0.094 J	<0.15	0.10 J,B	<0.53	<0.53	<0.58	<0.51
Arsenic, ug/L	P*	0.53	10	--	0.51 J	0.72 J	0.66 J	<0.75	<0.75	--	<0.88	<0.88	<0.88	<0.88	<0.88	--	0.38 J	0.65 J	0.60 J	<0.75	0.78 J	<0.88	<0.88
Barium, ug/L	P	68.8	2,000	--	116	118	125	120	110	--	110	120	70	80	75	--	48.2	51.6	56.0	58	51	48	49
Beryllium, ug/L	DQ	DQ	4	--	<0.012	<0.12	<0.089	<0.27	<0.27	--	<0.27	--	<0.27	<0.27	--	--	<0.012	<0.12	<0.089	<0.27	<0.27	<0.27	--
Cadmium, ug/L	NP*	0.12	5	--	0.054 J	0.086 J	0.044 J	<0.077	0.087 J	--	0.14	0.097 J	<0.039	<0.039	<0.049	--	0.88	0.76	0.96	1.1	0.89	0.83	0.92
Chromium, ug/L	P	1.07	100	--	0.26 J	0.41 J	0.3 J,B	<0.98	<0.98	--	<1.1	<1.1	<1.1	<1.1	<1.1	--	0.37 J	0.70 J	0.46 J,B	<0.98	1.0 J	<1.1	<1.1
Cobalt, ug/L	NP	4.1	6	--	14.5	15.6	17.2	17	**17**	**18**	**16**	**17**	2.4	2.7	1.5	--	4.8	5.5	6.4	6.9	6.2	5.5	5.9
Fluoride, mg/L	P	0.48	4	--	0.40	0.44	0.40	0.75	<0.23	--	0.35 J	0.38 J^	0.77	0.73	0.73	--	0.11 J	0.13 J	<0.19	0.27 J	<0.23	<0.23	<0.23 ^
Lead, ug/L	NP*	0.10	15	--	0.12 J	0.31 J	<0.13	<0.27	<0.27	-	0.27 J	<0.11	0.68	<0.27	<0.11	--	0.040 J	0.20 J	<0.13	<0.27	0.34 J	0.37 J	<0.11
Lithium, ug/L	P	34.2	40	--	<4.6	<4.6	<4.6	<2.7	<2.7	2.3 J	3.2 J	<2.5	14	16	13	--	<4.6	<4.6	<4.6	<2.7	<2.7	<2.3	<2.5
Mercury, ug/L	DQ	DQ	2	--	<0.090	<0.090	<0.090	<0.10	<0.10	--	<0.10	--	<0.10	<0.10	--	--	<0.090	<0.083	<0.090	<0.10	<0.10	<0.10	--
Molybdenum, ug/L	P	1.74	100	--	7.1	6.5	7.3	7.2	7.2	--	6.9	7.9	9	17	6.4	--	5.7	4.7	5.1	4.3	4.9	4.4	5.6
Selenium, ug/L	P	8.55	50	--	0.12 J	0.36 J	0.33 J,B	<1.0	<1.0	--	<1.0	<1.0	2.3 J	1.7 J	<1.0	--	<0.086	0.21 J	0.22 J,B	<1.0	<1.0	<1.0	<1.0
Thallium, ug/L	NP*	0.14	2	--	0.32 J	0.33 J	0.33 J	0.33 J	0.38 J	--	0.35 J	0.35 J	<0.26	<0.26	<0.26	--	0.083 J	<0.14	0.12 J	<0.27	<0.27	<0.26	<0.26
Radium 226/228 Combined, pCI/L	P	2.15	5	--	0.676	1.33	1.32	0.685	0.46	--	0.909	pending	1.97	1.26	pending	--	0.305	0.985	1.34	0.155	0.624	0.0738	pending
Additonal Parameters - Selection of Remedy																							
Cobalt - dissolved,$^{\#}$	UPL or GPS not applicable			--	--	--	--	--	--	16	16	17	2.1	2.8	--	--	--	--	--	--	--	5.4	5.1
Lithium - dissolved,$^{\#}$				--	--	--	--	--	--	<2.3	--	--	15	--	--	--	--	--	--	--	--	--	--
Iron, dissolved,$^{\#}$ ug/L				--	--	--	--	--	--	51 J	66 J	63 J	<50	<50	<50	--	--	--	--	--	--	140	100
Iron, ug/L				--	--	--	--	--	--	390	330	200	720	64 J	64 J	--	--	--	--	--	--	590	340
Magnesium											47,000	48000	--	28,000	31000							26,000	23,000
Manganese, dissolved,$^{\#}$ ug/L				--	--	--	--	--	--	3,100	3,400	3600	150	240	160	--	--	--	--	--	--	16,000	15,000
Manganese, ug/L				--	--	--	--	--	--	3,200	3,300	3600	180	260	150	--	--	--	--	--	--	16,000	16,000
Potassium, ug/L				--	--	--	--	--	--	--	7,600	8300	--	3,800	4200	--	--	--	--	--	--	3,700	3,800
Sodium, ug/L				--	--	--	--	--	--	--	210,000	210000	--	46,000	64000	--	--	--	--	--	--	160,000	170,000
Total Alkalinity, mg/L				--	--	--	--	--	--	--	460	300	--	270	340	--	--	--	--	--	--	280	160
Cabonate Alkalinity, mg/L				--	--	--	--	--	--	--	<1.9	<3.8	--	<1.9	<3.8	--	--	--	--	--	--	<1.9	<3.8
Bicarbonate Alkalinity, mg/L				--	--	--	--	--	--	--	460	300	--	270	340	--	--	--	--	--	--	280	160

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Table 3. Groundwater Analytical Results Summary - CCR Program - Assessment Monitoring
Ottumwa Generating Station Ash Pond / SCS Engineers Project #25220083.00

Parameter Name	UPL Method	UPL	GPS	Compliance Wells																
				MW-310					MW-310A			MW-311					MW-311A			
				10/24/2019	2/5/2020	3/13/2020	4/13/2020	10/8/2020	3/13/2020	4/14/2020	10/8/2020	10/24/2019	2/5/2020	3/13/2020	4/13/2020	10/8/2020	3/13/2020	4/14/2020	6/30/2020	10/8/2020
Appendix III																				
Boron, ug/L	P	820		720	620	--	550	800	1500	1,600	1700	<110	<100	--	<100	<80	1400	1,500	NA	1600
Calcium, mg/L	P	78.7		230	160	--	200	180	82	87	94	170	130	--	170	160	44	48	NA	51
Chloride, mg/L	P	86.8		150	120	--	130	150	140	130	130	13	14	--	13	14	130	140	NA	150
Fluoride, mg/L	P	0.484		0.31 J	0.85	--	1.1	1	1.7	1.8	2	<0.23	<0.23	--	<0.23	<0.23 ^	3.4	4.1	3.7	4.4
Field pH, Std. Units	P	6.87		7.15	7.08	6.89	7	7.07	7.73	7.85	7.48	6.95	6.72	7.11	6.86	6.93	7.85	8.4	7.64	8.33
Sulfate, mg/L	P	199		610	530	--	590	570	1200	1,100	1100	47	54	--	54	70	1200	1,200	NA	1200
Total Dissolved Solids, mg/L	P	628		260	1200	--	1,300	1200	2300	2,300	2200	530	520	--	570	640	2300	2,400	NA	2400
Appendix IV		**UPL**	**GPS**																	
Antimony, ug/L	P*	0.22	6	<0.53	<0.58	--	<0.58	0.61 J	<0.58	<0.58	<0.51	<0.53	<0.58	--	<0.58	<0.51	<0.58	<0.58	NA	<0.51
Arsenic, ug/L	P*	0.53	10	0.78 J	<0.88	--	<0.88	0.94 J	<0.88	<0.88	<0.88	<0.75	<0.88	--	<0.88	1.7 J	<0.88	<0.88	NA	<0.88
Barium, ug/L	P	68.8	2,000	76	53	--	62	55	16	16	16	200	160	--	180	220	20	20	NA	15
Beryllium, ug/L	DQ	DQ	4	<0.27	<0.27	--	<0.27	--	<0.27	<0.27	--	<0.27	<0.27	--	<0.27	--	<0.27	<0.27	NA	--
Cadmium, ug/L	NP*	0.12	5	0.22	0.12	--	0.16	0.29	<0.039	<0.039	<0.049	0.04 J	<0.039	--	<0.039	0.12	<0.039	<0.039	NA	<0.049
Chromium, ug/L	P	1.07	100	<0.98	<1.1	--	<1.1	<1.1	<1.1	<1.1	<1.1	<0.98	<1.1	--	<1.1	<1.1	<1.1	<1.1	NA	<1.1
Cobalt, ug/L	NP	4.1	6	0.57	0.32 J	0.32 J	0.24 J	0.38 J	0.63	0.39 J	0.43 J	0.78	0.11 J	<0.091	<0.091	2.2	0.19 J	0.13 J	NA	0.12 J
Fluoride, mg/L	P	0.48	4	0.31 J	0.85	--	1.1	1	1.7	1.8	2	<0.23	<0.23	--	<0.23	<0.23 ^	3.4	4.1	3.7	4.4
Lead, ug/L	NP*	0.10	15	<0.27	<0.27	--	<0.27	<0.11	<0.27	<0.27	<0.11	<0.27	<0.27	--	<0.27	1.8	<0.27	<0.27	NA	<0.11
Lithium, ug/L	P	34.2	40	35	42	46	48	42	250	290	240	4.7 J	2.9 J	4.7 J	6.2 J	4.6 J	260	310	NA	240
Mercury, ug/L	DQ	DQ	2	<0.10	<0.10	--	<.10	--	<0.10	<0.10	--	<0.10 F1	<0.10	--	<0.10	--	<0.10	<0.10	NA	--
Molybdenum, ug/L	P	1.74	100	26	29	--	31	39	2.6	2.7	3	<1.1	<1.1	--	<1.1	<1.1	1.2 J	2.8	NA	3.1
Selenium, ug/L	P	8.55	50	5	3.3 J	--	4.5 J	2.4 J	<1.0	<1.0	<1.0	<1.0	1.2 J	--	<1.0	<1.0	<1.0	<1.0	NA	<1.0
Thallium, ug/L	NP*	0.14	2	<0.27	<0.26	--	<0.26	<0.26	<0.26	<0.26	<0.26	<0.27	<0.26	--	<0.26	<0.26	<0.26	<0.26	NA	<0.26
Radium 226/228 Combined, pCI/L	P	2.15	5	0.411	0.0344	--	0.271	pending	3.43	3.9	pending	0.411	0.108	--	0.17	pending	1.47	2.31	NA	pending
Additonal Parameters - Selection of Remedy																				
Cobalt - dissolved,$^{\#}$	UPL or GPS not applicable			--	--	0.31 J	0.23 J	--	0.67	0.40 J	--	--	--	0.11 J	<0.091	--	0.36 J	0.12 J	--	--
Lithium - dissolved,$^{\#}$				--	--	45	--	44	250	--	230	--	--	8.0 J	--	--	250	--	--	230
Iron, dissolved,$^{\#}$ ug/L				--	--	<50	<50	<50	<50	220	<50	--	--	<50	<50	<50	<50	<50	--	<50
Iron, ug/L				--	--	<50	<50	<50	99 J	230	280	--	--	<50	<50	630	<50	<50	--	<50
Magnesium							86,000	76,000	--	41,000	45,000			--	40,000	40,000	--	23,000	--	25000 J
Manganese, dissolved,$^{\#}$ ug/L				--	--	250	280	350	53	39	29	--	--	21	39	75	20	22	--	5.8 J
Manganese, ug/L				--	--	260	280	390	51	38	31	--	--	20	41	180	20	13	--	8.3
Potassium, ug/L				--	--	--	12,000	12,000	--	9,900	11,000	--	--	--	620	810	--	9,000	--	10,000
Sodium, ug/L				--	--	--	100,000	100,000	--	630,000	620,000	--	--	--	5,000	5,100	--	710,000	--	700,000
Total Alkalinity, mg/L				--	--	--	190	410	--	320	260	--	--	--	460	290	--	360	--	400
Cabonate Alkalinity, mg/L				--	--	--	<1.9	<3.8	--	<1.9	<3.8	--	--	--	<1.9	<3.8	--	<1.9	--	<3.8
Bicarbonate Alkalinity, mg/L				--	--	--	190	410	--	320	260	--	--	--	460	290	--	360	--	400

4.4	Blue highlighted cell indicates the compliance well result exceeds the UPL (background) and the LOQ.
30.8	Yellow highlighted cell indicates the compliance well result exceeds the GPS.
17	Yellow highlighted cell with bold text indicates the compliance well result exceeds the GPS and the result was determined to be statistically significant$^{(1)}$.
17	Grayscale indicates Additional Parameters sampled for selection of remedy and evaluation of MNA.

Table 3. Groundwater Analytical Results Summary - CCR Program - Assessment Monitoring
Ottumwa Generating Station Ash Pond / SCS Engineers Project #25220083.00

Abbreviations:

-- = Not Analyzed
mg/L = milligrams per liter
ug/L = micrograms per liter
J = Estimated concentration at or above the LOD and below the LOQ.
B = Analyte was detected in the associated Method Blank.
F1 = MS and/or MSD Recovery is outside acceptance limits.
$^{\#}$ = Dissolved parameter samples collected for MNA data review
* = UPL is below the LOQ for background sampling. For compliance wells, only results confirmed above the LOQ are evaluated as potential SSIs above background.

LOD = Limit of Detection
LOQ = Limit of Quantitation
GPS = Groundwater Protection Standard
UPL = Upper Prediction Limit
^ = ICV, CCV, ICB, ISA, ISB, CRI, CRA, DLCK, OR MRL standard: Instrument related QC is outside acceptance limits

P = Parametric UPL with 1-of-2 retesting
DQ = Double Quantification Rule (not detected in background)
NP = Nonparametric UPL (highest background value)

Notes:

1. An individual result above the UPL or GPS does not constitute a statistically significant increase (SSI) above background or statistically significant level above the GPS. The cobalt GPS exceedances at MW-305 have been determined to be statistically significant. The cobalt GPS exceedance at MW-306 has been determined not to be statistically significant. Lithium and fluoride GPS exceedances have either been determined not to be statistically significant or the determination is ongoing. See the accompanying reporttext for additional information regarding determinations of statistical significance.
2. GPS is the United States Environmental Protection Agency (US EPA) Maximum Contamination Level (MCL), if established; otherwise, the values are from 40 CFR 257.95(h)(2).
3. Interwell UPLs calculated based on results from background well MW-301.

Created by: NDK Date: 5/1/2018
Last revision by: ACW Date: 11/25/2020
Checked by: NDK Date: 11/25/2020
Proj Mgr QA/QC: TK Date: 11/25/2020

Table 4. Groundwater Field Parameters - CCR Program - Assessment Monitoring
Ottumwa Generating Station / SCS Project # 25220083.00
November 2017 - October 2020

Well	Sample Date	Groundwater Elevation (feet)	Field Temperature (deg C)	Field pH (Std. Units)	Oxygen, Dissolved (mg/L)	Field Specific Conductance (umhos/cm)	Field Oxidation Potential (mV)	Turbidity (NTU)
MW-301	11/8/2017	681.54	13.9	6.41	4.16	743	201	1.03
	4/18/2018	681.53	7.2	6.41	6.52	770	106	0.66
	8/14/2018	680.91	20.4	6.26	3.18	867	-56	0.52
	8/29/2018	681.09	20.6	6.31	4.71	781	--	0.63
	10/16/2018	682.50	16.6	6.27	4.12	599	120	2.91
	1/8/2019	682.22	7.9	5.68	5.68	310	118	0.77
	4/8/2019	682.69	7.3	6.61	8.32	501	38	1.87
	10/24/2019	683.07	13.7	6.33	4.94	902	10	1.6
	2/5/2020	683.30	5.4	6.39	7.28	966	68	1.43
	3/12/2020	682.82	6.9	6.48	5.3	962	258.5	1.33
	4/14/2020	683.25	8.7	6.58	5.1	939	176.3	0.87
	10/8/2020	682.34	15.4	6.22	4.2	1035	163.6	0.02
MW-302	11/8/2017	655.40	13.8	6.55	0.4	2274	191.7	1.63
	4/18/2018	655.71	10.7	6.47	0.2	2248	82.6	2.41
	8/14/2018	656.05	14.3	6.76	0.17	2304	-336.6	4.01
	8/29/2018	655.89	14.6	6.77	0.23	2357	--	1.42
	10/16/2018	656.91	14.1	6.37	0.26	1912	114.2	88.24
	1/8/2019	656.03	12.2	6.58	6.4	1473	70.2	4.39
	4/8/2019	657.23	12.3	6.61	0.86	2159	68.3	26.9
	10/24/2019	660.14	12.9	6.55	0.35	2184	-0.5	11.9
	4/14/2020	656.45	10.5	6.70	0.22	1971	135.6	31.1
	10/8/2020	655.80	14.4	7.00	0.14	2100	34.5	18.7

Table 4. Groundwater Field Parameters - CCR Program - Assessment Monitoring
Ottumwa Generating Station / SCS Project # 25220083.00
November 2017 - October 2020

Well	Sample Date	Groundwater Elevation (feet)	Field Temperature (deg C)	Field pH (Std. Units)	Oxygen, Dissolved (mg/L)	Field Specific Conductance (umhos/cm)	Field Oxidation Potential (mV)	Turbidity (NTU)
MW-303	11/8/2017	651.34	15.2	6.60	0.5	1896	176.8	3.67
	4/18/2018	652.47	8.2	6.63	0.17	1862	3.2	3.69
	8/14/2018	652.57	17.2	6.83	0.19	1833	-307.9	1.51
	8/29/2018	655.07	18.7	7.03	1.92	1161	--	10.13
	10/16/2018	656.17	17.1	6.66	0.29	1573	32.8	5.99
	1/8/2019	654.65	9.1	6.83	3.19	750	73.7	14.2
	4/8/2019	655.55	8.5	7.00	2.29	1181	51.7	3.49
	10/24/2019	653.86	15.3	6.83	0.28	1287	-5.1	4.24
	4/14/2020	654.08	8.9	6.98	1.94	1097	104.3	12.1
	10/8/2020	650.37	17.0	8.28	0.13	1602	-0.4	30.2
MW-304	11/8/2017	653.03	13.3	7.00	0.25	2205	162.7	3.88
	4/18/2018	655.55	12.8	6.90	0.15	2141	137.5	39.29
	8/15/2018	656.35	15.1	7.34	0.21	2085	35.5	81.42
	8/29/2018	657.82	13.7	7.22	0.16	2123	--	55.94
	10/16/2018	658.20	13.5	6.86	0.11	2058	-114.5	17.12
	1/8/2019	656.28	12.8	7.16	0.72	1368	-62.1	4.38
	4/8/2019	659.33	13.8	7.17	0.41	1876	-58.3	57.9
	10/23/2019	657.71	13.6	7.05	0.44	1871	-57.5	18.9
	4/13/2020	656.42	11.9	7.12	0.24	1764	-119.8	54.1
	10/8/2020	652.95	13.6	7.88	0.18	1675	-113	11.1

Table 4. Groundwater Field Parameters - CCR Program - Assessment Monitoring
Ottumwa Generating Station / SCS Project # 25220083.00
November 2017 - October 2020

Well	Sample Date	Groundwater Elevation (feet)	Field Temperature (deg C)	Field pH (Std. Units)	Oxygen, Dissolved (mg/L)	Field Specific Conductance (umhos/cm)	Field Oxidation Potential (mV)	Turbidity (NTU)
MW-305	11/8/2017	659.76	13.2	7.01	0.2	1738	146.1	2.68
	4/18/2018	660.99	12.8	6.90	0.15	1840	-32.7	7.37
	8/15/2018	661.56	14.8	7.21	0.18	1832	31	14.9
	10/16/2018	663.37	13.9	6.86	0.09	1836	-26.8	6.96
	1/8/2019	662.13	12.4	6.99	0.81	1235	36.4	4.76
	4/8/2019	664.01	13.8	7.06	0.59	1728	32.6	21.7
	10/23/2019	663.21	13.2	6.91	0.42	1794	-6.7	6.21
	3/13/2020	661.41	12.4	7.02	0.2	1788	192.6	42.68
	4/13/2020	662.44	9.1	7.00	0.28	1772	6.6	21.7
	10/9/2020	659.81	14.0	7.44	0.13	1810	-13	12.9
MW-305A	3/13/2020	--	11.8	8.09	3.79	745	204.2	63.2
	4/14/2020	--	11.2	7.63	2.26	807	106.7	4.91
	10/5/2020	648.01	14.2	7.46	0.19	1102	11	NM
MW-306	11/8/2017	669.04	13.6	6.49	0.18	1186	174.1	0.82
	4/18/2018	668.92	13.1	6.42	0.14	1228	14.2	0.59
	8/15/2018	668.66	14.6	6.74	0.15	1271	22.8	3.95
	10/16/2018	670.24	13.4	6.42	0.08	1340	13.3	7.07
	1/8/2019	669.84	13.3	6.65	0.47	965	59.5	0.89
	4/8/2019	670.96	13.6	6.66	0.92	1350	49.1	28.5
	10/23/2019	671.28	13.1	6.74	0.29	1266	-0.5	12.3
	4/14/2020	670.71	11.7	6.68	0.21	1158	49.7	15.7
	10/9/2020	670.18	13.4	6.54	0.12	1294	41.4	14

Table 4. Groundwater Field Parameters - CCR Program - Assessment Monitoring
Ottumwa Generating Station / SCS Project # 25220083.00
November 2017 - October 2020

Well	Sample Date	Groundwater Elevation (feet)	Field Temperature (deg C)	Field pH (Std. Units)	Oxygen, Dissolved (mg/L)	Field Specific Conductance (umhos/cm)	Field Oxidation Potential (mV)	Turbidity (NTU)
MW-307	11/8/2017	647.37	13.2	6.61	0.17	1656	176.7	11.16
	4/16/2018	649.66	11.6	7.04	0.29	1674	-105.9	11.93
	5/30/2018	652.45	12.7	6.44	0.18	1710	-45.8	18.58
	6/28/2018	652.87	13.4	6.87	0.21	1686	-43.4	53.34
	7/18/2018	652.27	12.9	6.62	0.21	1718	-416.3	14.94
	10/16/2018	654.13	14.3	6.54	0.08	1697	-65.7	14.08
	4/8/2019	654.90	12.5	6.76	0.51	1599	-3.7	26
	10/23/2019	651.89	13.4	6.68	0.25	1684	-24.8	12.5
	12/11/2019	649.59	11.5	6.37	0.18	1576	-45.8	43.13
	2/5/2020	649.88	11.7	6.67	0.9	1681	-15.6	9.74
	4/14/2020	650.66	10.6	6.76	0.69	1554	-52.9	28.9
	10/7/2020	646.18	13.2	6.97	0.08	1637	-62.2	4.56
MW-308	11/8/2017	644.99	13.0	6.76	0.12	1577	169.7	0.73
	4/16/2018	647.91	11.8	7.14	0.35	1577	-47.2	0.93
	5/30/2018	651.05	12.1	6.61	0.14	1611	-48.2	3.34
	6/28/2018	651.43	13.1	7.08	0.19	1584	-60.3	5.87
	7/18/2018	650.67	12.6	6.73	0.13	1628	-415.4	1.54
	10/16/2018	--	13.1	6.68	0.08	1594	-80.8	5.49
	4/8/2019	653.70	12.5	6.90	0.66	1539	-23	6.87
	10/23/2019	651.31	13.2	6.78	4.42	1637	-38.7	7.42
	12/11/2019	647.39	10.5	6.55	0.43	1532	-56.6	15.72
	2/5/2020	650.12	11.4	6.78	1.48	1630	-35.9	3.49
	4/14/2020	650.09	10.9	6.90	0.28	1502	-69.1	5.12
	10/7/2020	642.85	13.2	7.24	0.11	1575	-56.5	1.15

Table 4. Groundwater Field Parameters - CCR Program - Assessment Monitoring
Ottumwa Generating Station / SCS Project # 25220083.00
November 2017 - October 2020

Well	Sample Date	Groundwater Elevation (feet)	Field Temperature (deg C)	Field pH (Std. Units)	Oxygen, Dissolved (mg/L)	Field Specific Conductance (umhos/cm)	Field Oxidation Potential (mV)	Turbidity (NTU)
MW-309	11/8/2017	644.20	13.1	7.11	0.13	1431	149.7	3.71
	4/16/2018	647.65	11.2	7.52	0.37	1445	-58.5	36.7
	5/30/2018	650.98	12.4	6.92	0.12	1484	-38	40.55
	6/28/2018	651.47	13.8	7.36	0.17	1477	-45.5	241.4
	7/18/2018	650.69	12.6	7.02	0.11	1501	-432.6	40.38
	10/16/2018	651.61	13.5	6.95	0.03	1464	-81.6	28.27
	4/8/2019	653.55	12.4	7.18	0.66	1396	-3.3	72.1
	10/23/2019	651.28	12.8	6.98	0.36	1461	-27.5	42.6
	12/11/2019	647.24	11.5	6.67	0.26	1350	-37.8	413.6
	2/5/2020	648.34	11.4	7.09	1.07	1433	-7.8	18.1
	4/14/2020	649.19	11.2	7.21	0.16	1322	-51.5	100.1
	10/7/2020	641.50	13.3	7.57	0.09	1371	-71.1	7.7
MW-310	10/24/2019	649.31	13.7	7.15	0.41	1906	-9.3	2.29
	2/5/2020	644.71	12.5	7.08	0.68	1723	42.2	0.9
	3/12/2020	645.45	12.8	6.89	0.3	1902	252.2	2.77
	4/13/2020	645.91	10.3	7.00	0.22	1823	179.4	0.87
	10/12/2020	638.46	13.9	7.07	0.16	1709	146.5	0.02
MW-310A	3/13/2020	--	12.5	7.73	6.28	3160	178.9	109
	4/14/2020	--	8.8	7.85	6.39	2915	146.1	--
	10/5/2020	640.20	13.1	7.48	0.48	3122	89.7	NM
MW-311	10/24/2019	647.80	13.9	6.95	0.29	926	-24.7	3.88
	2/5/2020	645.00	10.2	6.72	2.11	891	21	1.89
	3/13/2020	644.18	10.0	7.11	0.23	877	222.6	3.44
	4/13/2020	646.79	8.8	6.86	0.29	912	103.4	0.44
	10/12/2020	638.73	14.4	6.93	7.12	1024	-53	NM
MW-311A	3/13/2020	--	12.1	7.85	2.29	3336	206	7.74
	4/13/2020	--	7.9	8.40	3.87	3027	115.8	3.19
	6/30/2020	647.73	12.6	7.64	1.51	3391	23.4	1.43
	10/6/2020	641.09	12.7	8.33	0.44	3177	39.6	NM

Table 5. Preliminary Evaluation of Corrective Measure Alternatives
Ottumwa Generating Station / SCS Engineers Project #25220083.00

	Alternative #1 No Action	Alternative #2 Close and Cap in place with MNA	Alternative #3 Consolidate on Site and Cap with MNA	Alternative #4 Excavate and Dispose on site with MNA	Alternative #5 Excavate and Dispose in Off-Site Landfill	Alternative #6 Consolidate and Cap with Chemical Amendment	Alternative #7 Consolidate and Cap with Groundwater Collection	Alternative #8 Consolidate and Cap with Barrier Wall
CORRECTIVE ACTION ASSESSMENT - 40 CFR 257.97(b)								
257.97(b)(1) Is remedy protective of human health and the environment?	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
257.97(b)(2) Can the remedy attain the groundwater protection standard?	Unlikely	Yes	Yes	Yes	Yes	Yes	Yes	Yes
257.97(b)(3) Can the remedy control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of constituents in appendix IV to this part into the environment?	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
257.97(b)(4) Can the remedy remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible?	Not Applicable - No release of CCR	Not Applicable - No release of CCR	Not Applicable - No release of CCR	Not Applicable - No release of CCR	Not Applicable - No release of CCR	Not Applicable - No release of CCR	Not Applicable - No release of CCR	Not Applicable - No release of CCR
257.97(b)(5) Can the remedy comply with standards for management of wastes as specified in §257.98(d)?	Not Applicable	Yes	Yes	Yes	Yes	Yes	Yes	Yes
LONG- AND SHORT-TERM EFFECTIVENESS - 40 CFR 257.97(c)(1)								
257.97(c)(1)(i) Magnitude of reduction of existing risks	No reduction of existing risk	Existing risk reduced by achieving GPS	Same as Alternative #2	Same as Alternative #2	Same as Alternative #2	Similar to Alternative #2. Long-term risk may be reduced with additional source control and in-situ stabilization/fixation of CCR that may be in contact with groundwater.	Similar to Alternative #2. Groundwater extraction and treatment presents an additonal risk and potential exposure pathways via surface release or disruption of treatment processes.	Similar to Alternative #2. Long-term risk may be reduced with additional containment offered by barrier wall.
257.97(c)(1)(ii) Magnitude of residual risks in terms of likelihood of further releases due to CCR remaining following implementation of a remedy	No reduction of existing risk. Residual risk is limited for all alternatives due to limited extent of impacts and lack of receptors.	Magnitude of residual risk of further releases is lower than current conditions due to final cover eliminating infiltration through CCR; Residual risk is limited for all alternatives due to limited extent of impacts and lack of receptors	Same as Alternative #2 with potential further reduction in release risk due to CCR material footprint; However, limited to no overall risk reduction is provided due to lack of current/anticipated future receptors for groundwater impacts	Same as Alternative #3 with potential further reduction in release risk due to composite liner and cover; However, limited to no overall risk reduction is provided due to lack of current/anticipated future receptors for groundwater impacts	Same as Alternative #3 with potential further reduction in release risk due to removal of CCR from site; However, limited to no overall risk reduction is provided due to lack of current/anticipated future receptors for groundwater impacts	Same as Alternative #2 with potential further reduction in release risk due to CCR material footprint; Residual risk is further reduced by way of chemical / physical alteration of the source of impacts. However, limited to no overall risk reduction is provided due to lack of current/anticipated future receptors for groundwater impacts.	Same as Alternative #2 with potential further reduction in release risk due to CCR material footprint; Residual risk is potentially reduced by way of the ability to respond to potential future/ongoing releases from CCR that might be in contact with groundwater following closure. However, limited to no overall risk reduction is provided due to lack of current/anticipated future receptors for groundwater impacts.	Same as Alternative #2 with potential further reduction in release risk due to CCR material footprint; Residual risk of source material in contact with groundwater is further reduced by the containment of groundwater impacts provided by barrier walls; However, limited to no overall risk reduction is provided due to lack of current/anticipated future receptors for groundwater impacts.
257.97(c)(1)(iii) The type and degree of long-term management required, including monitoring, operation, and maintenance	Not Applicable	30-year post-closure groundwater monitoring; Groundwater monitoring network maintenance and as-needed repair/replacement Final cover maintenance (e.g., mowing and as-needed repair); Periodic final cover inspections; Additional corrective action as required based on post-closure groundwater monitoring	Same as Alternative #2	Same as Alternative #2	No on-site long-term management required; Limited on-site post-closure groundwater monitoring until GPS are achieved; Receiving disposal facility will have same/similar long-term monitoring, operation, and maintenance requirements as Alternative #2	Same as Alternative #2	Same as Alternative #2 with additional effort for groundwater pump operation and maintenance (O&M), groundwater treatment system O&M, and treatment system discharge monitoring/reporting.	Same as Alternative #2 with additional monitoring of wall performance.

Table 5. Preliminary Evaluation of Corrective Measure Alternatives
Ottumwa Generating Station / SCS Engineers Project #25220083.00

	Alternative #1 No Action	Alternative #2 Close and Cap in place with MNA	Alternative #3 Consolidate on Site and Cap with MNA	Alternative #4 Excavate and Dispose on site with MNA	Alternative #5 Excavate and Dispose in Off-Site Landfill	Alternative #6 Consolidate and Cap with Chemical Amendment	Alternative #7 Consolidate and Cap with Groundwater Collection	Alternative #8 Consolidate and Cap with Barrier Wall
LONG- AND SHORT-TERM EFFECTIVENESS - 40 CFR 257.97(c)(1) (continued)								
257.97(c)(1)(iv) Short-term risks - Implementation								
Excavation	None	Limited risk to community and environment due to limited amount of excavation (likely <200K cy) required to establish final cover subgrades and no off-site excavation	Same as Alternative #2 with increased risk to environment due to increased excavation volumes required for consolidation (likely >200K cy but <463K cy)	Same as Alternative #3 with increased risk to environment due to increased excavation volumes (~463K cy) and temporary CCR storage during disposal site construction required for removal and on-site re-disposal	Same as Alternative #4 with reduced risk to environment from excavation due to limited on-site storage	Similar to Alternative #3 with some increased potential risk due to exposure during the application of the chemical amendment.	Similar to Alternative #3 with some increased construction risk due to drilling, trenching, and excavation for groundwater pumping and treatment system construction.	Similar to Alternative #3 with some increased construction risk due to excavation or installation of the barrier wall.
Transportation	None	No risk to community or environment from off-site CCR transportation; Typical risk due to construction traffic delivering final cover materials to site	Same as Alternative #2 with reduced risk from construction traffic due to reduced final cover material requirements (smaller cap footprint)	Same as Alternative #2 with increased risk from construction traffic due to increased material import requirements (liner and cap construction required)	Highest level of community and environmental risk due to CCR volume export (~463K cy)	Similar to Alternative #3 with increased risk from importing chemical material for stabilization/treatment.	Similar to Alternative #3 with increased risk from importing groundwater pumping and treatment system materials.	Similar to Alternative #3 with increased risk from importing barrier wall system materials.
Re-Disposal	None	Limited risk to community and environment due to limited volume of CCR re-disposal (likely <200K cy)	Same as Alternative #2 with increased risk to environment due to increased excavation volumes (likely >200K cy but <463K cy) required for consolidation	Same as Alternative #3 with increased risk to environment due to increased excavation volumes (~463K cy) and temporary CCR storage during disposal site construction required for removal and on-site re-disposal	Same as Alternative #4 with increased risk to community and environment due to re-disposal of large CCR volume (~463K cy) at another facility; Re-disposal risks are managed by the receiving disposal facility	Similar to Alternative #3 with some increased potential risk due to exposure during the application of the chemical amendment.	Same as Alternative #3	Same as Alternative #3
257.97(c)(1)(v) Time until full protection is achieved	Unknown	Closure and capping can be completed by end of 2023. Groundwater protection timeframe to reach GPS potentially 2 to 10 years following closure construction, achievable within 30-year post-closure monitoring period.	Similar to Alternative #2. Potential for increase in time to reach GPS due to significant source disturbance during construction. Potential for decrease in time to reach GPS due to consolidation of CCR. Scoring is based on balance between potential increase or decrease due to factors listed.	Increased time required to implement remedy in comparison to Alternative #2. Anticipated increase in time required to identify, site and develop onsite disposal capacity if located outside of existing impoundment footprint. Increased time required for closure construction due CCR excavation, temporary storage, liner construction, and redisposal if completed within impoundment footprint. Potential for increase in time to reach GPS due to significant source disturbance during construction. Potential decrease in time to reach GPS due to source isolation within liner/cover system.	Increased time required to implement remedy in comparison to Alternative #2, and potentially the longest required time to implement closure. Implementation schedule extends the time required to achieve full protection. Extended implementation timeframe is driven by the time required to identifying and secure off-site disposal capacity, or develop the capacity at an existing Alliant-owned facility. If landfill capacity is not owned by Alliant, additional time may be required to permit and develop the necessary disposal capacity. Increased construction time likely required due to the capacity of the receiving site to unload and place material. Potential for increase in time to reach GPS due to significant source disturbance during construction. Potential decrease in time to reach GPS due to impounded CCR source removal.	Similar to Alternative #2. Potential for reduction in time to reach GPS due to chemical/physical stability of CCR.	Similar to Alternative #2. Potential decrease in time to reach GPS from implementation of groundwater pumping.	Similar to Alternative #2. Potential decrease in time to reach GPS upon implementation of barrier wall.
257.97(c)(1)(vi) Potential for exposure of humans and environmental receptors to remaining wastes, considering the potential threat to human health and the environment associated with excavation, transportation, re-disposal, or containment	No change in potential exposure	Potential for exposure is low. Remaining waste is capped.	Similar to Alternative #2 with increased risk to construction workers during consolidation of CCR.	Similar to Alternative #2 with increased risk to construction workers during excavation and re-disposal. Increased risk over Alternative #3 due to higher material management volumes.	No potential for on-site exposure to remaining waste since no waste remains on site; Risk of potential exposure is transferred to receiving disposal facility and is likely similar to Alternative #2 Highest level of risk due to excavation, transportation, and re-disposal for construction workers removing CCR and solid waste workers at receiving facility.	Same as Alternative #2	Similar to Alternative #2 with potential for secondary impacts from releases of extracted groundwater or disruption in treatment.	Same as Alternative #2
257.97(c)(1)(vii) Long-term reliability of the engineering and institutional controls	Not Applicable	Long-term reliability of cap is good; Significant industry experience with methods/controls; Capping is common practice/industry standard for closure in place for remediation and solid waste management	Same as Alternative #2 with potentially increased reliability due to smaller footprint and reduced maintenance	Same as Alternative #3	Success of remedy at OGS does not rely on long-term reliability of engineering or institutional controls; Overall success relies on reliability of the engineering and institutional controls at the receiving facility	Same as Alternative #3.	Same as Alternative #3. Remedy relies upon active equipment that will require additonal operations and maintenance.	Same as Alternative #3. Remedy relies on continued hydraulic conductivity of the selected barrier. Breaches or short circuiting can develop and must be monitored.
257.97(c)(1)(viii) Potential need for replacement of the remedy	Not Applicable	Limited potential for remedy replacement if maintained; Some potential for remedy enhancement due to residual groundwater impacts following source control	Same as Alternative #2 with reduced potential need for remedy enhancement with consolidated/smaller closure area footprint	Same as Alternative #2 with further reduction in potential need for remedy enhancement composite with liner	No potential for remedy replacement; Limited potential for remedy enhancement due to residual groundwater impacts following source control	Similar to Alternative #3, with further reduction in potential need for remedy enhancement due to stabilized/solidified CCR material.	Similar to Alternative #2, with reduced potential of remedy replacement, but added expectation for pump, conveyance system and treatment system replacement.	Similar to Alternative #2, with reduced potential of remedy replacement, but added expectation for potential replenishment of consumptive barrier product.

Table 5. Preliminary Evaluation of Corrective Measure Alternatives
Ottumwa Generating Station / SCS Engineers Project #25220083.00

	Alternative #1	Alternative #2	Alternative #3	Alternative #4	Alternative #5	Alternative #6	Alternative #7	Alternative #8
	No Action	**Close and Cap in place with MNA**	**Consolidate on Site and Cap with MNA**	**Excavate and Dispose on site with MNA**	**Excavate and Dispose in Off-Site Landfill**	**Consolidate and Cap with Chemical Amendment**	**Consolidate and Cap with Groundwater Collection**	**Consolidate and Cap with Barrier Wall**
SOURCE CONTROL TO MITIGATE FUTURE RELEASES - 40 CFR 257.97(c)(2)								
257.97(c)(2)(i) The extent to which containment practices will reduce further releases	No reduction in further releases	Cap will reduce further releases by minimizing infiltration through CCR	Same as Alternative #2 with further reduction due to consolidated/smaller closure footprint	Same as Alternative #3 with further reduction due to composite liner and 5-foot groundwater separation required by CCR Rule	Removal of CCR prevents further releases at OGS; Receiving disposal site risk similar to Alternative #3	Similar to Alternative #3 with further reduction due to lower mobility of contaminants in residual source material as a result of chemical amendment.	Similar to Alternative #3 with the added ability to contain or restore groundwater impacts if MNA mechanisms are not active or site attenuation capacity is not adequate.	Similar to Alternative #3 with the added ability to contain groundwater impacts if MNA mechanisms are not active or site attenuation capacity is not adequate.
257.97(c)(2)(ii) The extent to which treatment technologies may be used	Alternative does not rely on treatment technologies	Alternative does not rely on treatment technologies	Alternative does not rely on treatment technologies	Alternative does not rely on treatment technologies	Alternative does not rely on treatment technologies	Alternative relies on the indentification and availability of a suitable chemical amendment. Implementation of and contact with physical/chemical stabilizing agent will require specialized field implementation methods and health and safety measures.	This alternative relies on conventional pump and treat remediation.	Alternative relies on the indentification and availability of a suitable barrier wall technology (e.g., permeable reactive barrier material or slurry wall). Implementation of and contact with barrier wall materials will require specialized field implementation methods and health and safety measures.
IMPLEMENTATION - 40 CFR 257.97(c)(3)								
257.97(c)(3)(i) Degree of difficulty associated with constructing the technology	Not Applicable	Low complexity construction; Potentially lowest level of dewatering effort - dewatering required for cap installation only	Low complexity construction; Moderate degree of logistical complexity; Moderate level of dewatering effort - dewatering required for material excavation/placement and capping	Moderately complex construction due to composite liner and cover; High degree of logistical complexity due to excavation and on-site storage of ~463K cy of CCR while new lined disposal area is constructed; High level of dewatering effort - dewatering required for excavation of full CCR volume	Low complexity construction; High degree of logistical complexity including the excavation and off-site transport of ~463K cy of CCR and permitting/development of off-site disposal facility airspace; High level of dewatering effort - dewatering required for excavation of full CCR volume	Moderate complexity construction due to the equipment required to apply the selected amendment; requirements to ensure consistent contact and dosing of amendment; Medium degree of logistical complexity involving the import of specialty chemicals; Moderate to low level of dewatering effort - dewatering required for material excavation/placement and capping	Low complexity construction; Moderate degree of logistical complexity; Moderate to low level of dewatering effort - dewatering required for material excavation/placement and capping. Moderate complexity contruction for the installation of extraction wells and conveyance to a site-specific groundwater treatment plant.	High complexity construction; Barrier walls require specialty installation equipment and knowledge. Highly specialized and experience contractors required to achieve proper installation. Moderate degree of logistical complexity; Moderate to low level of dewatering effort - dewatering required for material excavation/placement and capping.
257.97(c)(3)(ii) Expected operational reliability of the technologies	Not Applicable	High reliability based on historic use of capping as corrective measure	Same as Alternative #2	Same as Alternative #2	Success at OGS does not rely on operational reliability of technologies; Overall success relies on off-site disposal facility, which is likely same/similar to Alternative #2, but may not be controlled by the Owner.	Similar to Alternative #2; however, success at OGS relies on the successful application of specialty chemicals.	Similar to Alternative #2; however, success of this remedy relies on the successful operation of a site-specific groundwater treatment plant.	Similar to Alternative #2; however, success this remedy relies on continued hydraulic conductivity of the selected barrier. Breaches or short circuiting can develop and must be monitored.
257.97(c)(3)(iii) Need to coordinate with and obtain necessary approvals and permits from other agencies	Not Applicable	Need is low in comparison to other alternatives; State Closure Permit required	Same as Alternative #2	Need is high in comparison to other alternatives State Closure Permit required; State Landfill Permit may be required	Need is highest in comparison to other alternatives; State Closure Permit required; Approval of off-site disposal site owner required; May require State solid waste comprehensive planning approval; Local road use permits likely required	Need is moderate in comparison to other alternatives; State Closure Permit required; Underground Injection Control Permit may be required if chemical materials placed within groudwater. State and local erosion control/construction stormwater management permits required; Federal/State/Local Floodplain permitting likely required.	Need is moderate in comparison to other alternatives; State Closure Permit required; Well permitting for extraction well installation; NPDES Permit for groundwater treatment and discharge; State and local erosion control/construction stormwater management permits required; Federal/State/Local Floodplain permitting likely required.	Need is moderate in comparison to other alternatives State Closure Permit required; Well permitting for barrier wall monitoring; Federal/State/Local Floodplain permitting required; State and local erosion control/construction stormwater management permits required
257.97(c)(3)(iv) Availability of necessary equipment and specialists	Not Applicable	Necessary equipment and specialists are highly available; Highest level of demand for cap construction material, which are readily available and accessible in the area.	Same as Alternative #2; Lowest level of demand for cap construction material. Potentially increased demand for dewatering, treatment and conditioning of CCR.	Same as Alternative #2; Moderate level of demand for liner and cap construction material. Increase in demand for specialty materials and services due to composite liner construction.	Availability of necessary equipment to develop necessary off-site disposal facility airspace and transport ~463K cy of CCR to new disposal facility will be a limiting factor in the schedule for executing this alternative; No liner or cover material demands for on-site implementation of remedy	Similar to Alternative #3; Moderate level of demand for liner and cap construction material. Specialized mixing equipment likely required to apply chemical amendment and achieve required dosing.	Similar to Alternative #3; Moderate level of demand for liner and cap construction material. A site-specific, trained employee will be required to operate the groundwater treatment system.	Similar to Alternative #3; Moderate level of demand for liner and cap construction material; Availability of the necessary specailized equipment and extensive experience required for barrier installation is potentially low or in high demand.
257.97(c)(3)(v) Available capacity and location of needed treatment, storage, and disposal services	Not Applicable	Capacity and location of treatment, storage, and disposal services is not a factor for this alternative	Capacity and location of treatment, storage, and disposal services is unlikely to be a factor for this alternative	Available temporary on-site storage capacity for ~463K cy of CCR while composite liner is constructed is significant limiting factor	Off-site disposal capacity, facility logistical capacity, or the time required to develop the necessary off-site disposal and logistical capacity is a significant limiting factor.	Capacity and location of treatment, storage, and disposal services is unlikely to be a factor for this alternative	Capacity and location of treatment, storage, and disposal services is unlikely to be a factor for this alternative	Capacity and location of treatment, storage, and disposal services is unlikely to be a factor for this alternative
COMMUNITY ACCEPTANCE - 40 CFR 257.97(c)(4)								
257.97(c)(4) The degree to which community concerns are addressed by a potential remedy (Anticipated)	No comments were received during the public meeting held on June 4, 2020. Assume all alternatives are acceptable to interested/affected parties.	No comments were received during the public meeting held on June 4, 2020. Assume all alternatives are acceptable to interested/affected parties.	No comments were received during the public meeting held on June 4, 2020. Assume all alternatives are acceptable to interested/affected parties.	No comments were received during the public meeting held on June 4, 2020. Assume all alternatives are acceptable to interested/affected parties.	No comments were received during the public meeting held on June 4, 2020. Assume all alternatives are acceptable to interested/affected parties.	To be determined. Alternative added after public meeting held on June 4, 2020.	To be determined. Alternative added after public meeting held on June 4, 2020.	To be determined. Alternative added after public meeting held on June 4, 2020.

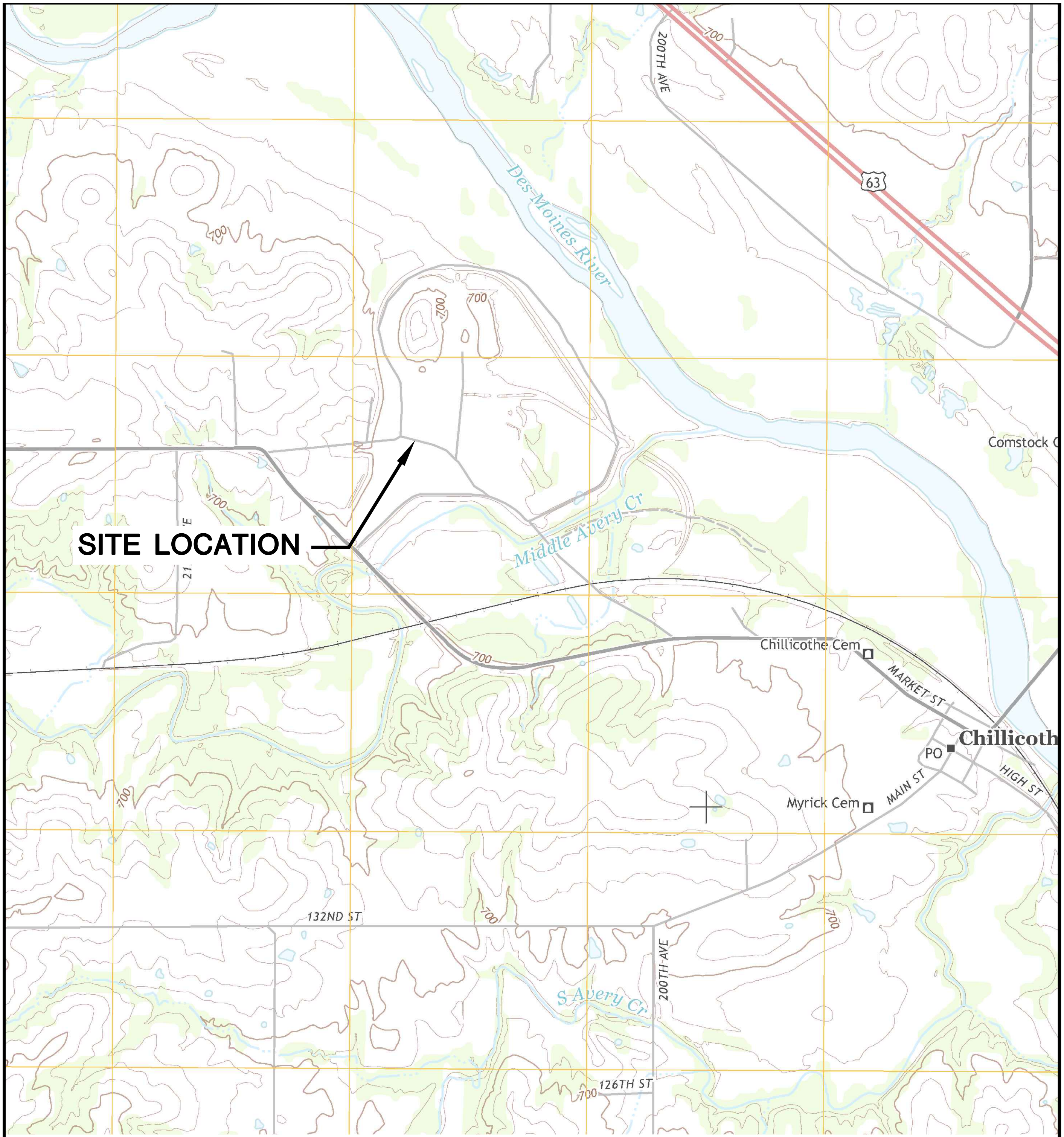
NOTES:

1) Alternatives #1 through #5 were developed and submitted within the Assessment of Correctvie Measures Report (ACM), dated September 2019
2) Alternatives #6 through #8 were added in November 2020 as part of Addendum #1 to the September 2020 ACM Report

Created by:	LAB/SK	Date: 6/20/2019
Last revision by:	SK	Date: 11/23/2020
Checked by:	EJN	Date: 11/25/2020

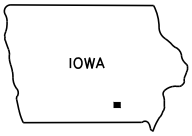
I:\25220083.00\Deliverables\ACM Addendum\Tables\[Table 5_Evaluation of Assessment of Corrective Measure_OGS.xlsx]OGS_Evaluation Matrix

Figures



N

CHILLICOTHE QUADRANGLE
IOWA–WAPELLO CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
2013
SCALE: 1" = 2,000'



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

SITE
OTTUMWA GENERATING STATION
OTTUMWA, IOWA

SITE LOCATION MAP

PROJECT NO.	25218201.00	DRAWN BY:	AHB
DRAWN:	05/29/15	CHECKED BY:	KAK
REVISED:	03/08/16	APPROVED BY:	TJK 09/10/19

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

FIGURE
1

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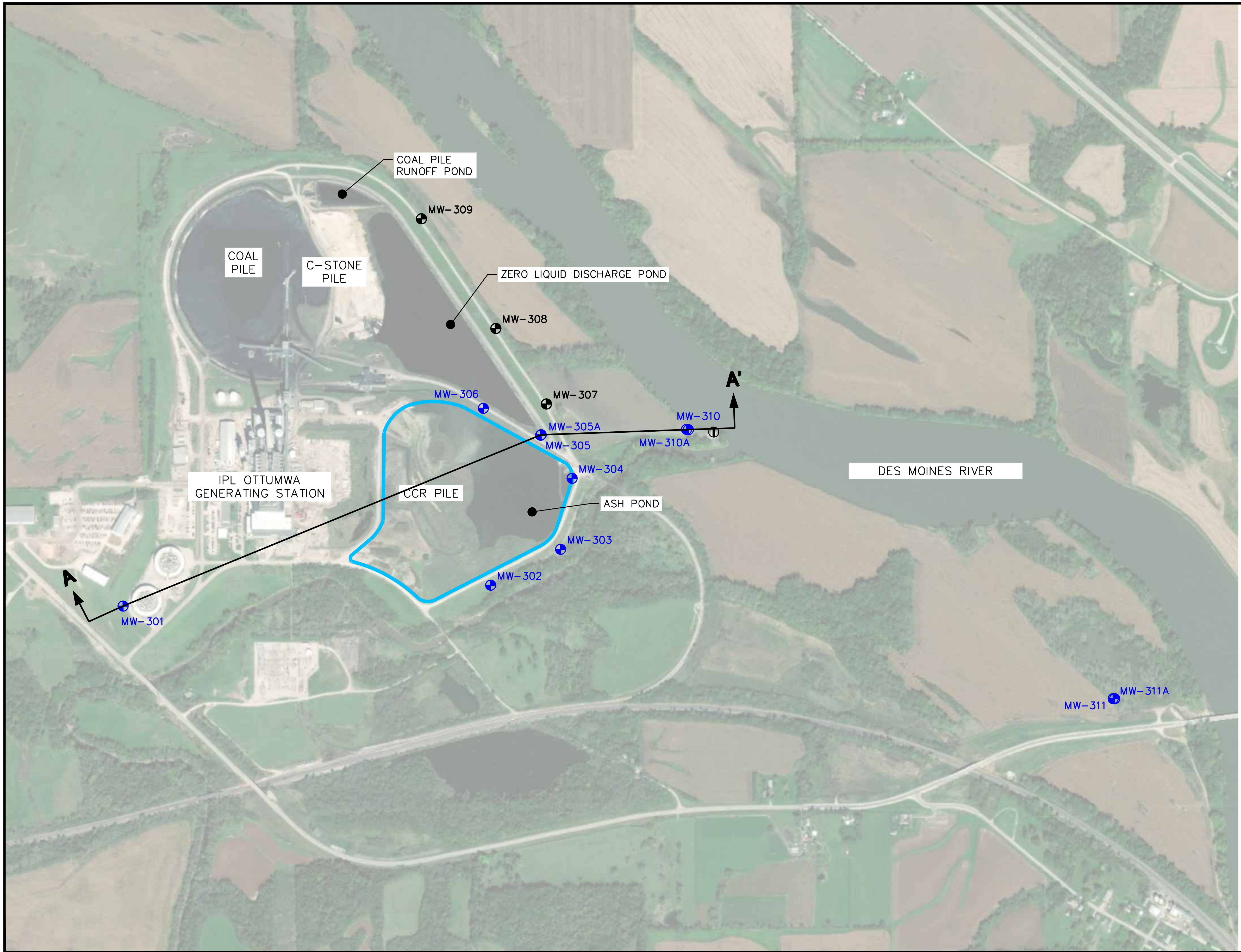

LEGEND

▬	CCR UNIT
⊕	OGS ASH POND CCR MONITORING WELL
⊕	ADDITIONAL CCR MONITORING WELL
◑	RIVER ELEVATION MEASUREMENT LOCATION
↑__↑	GEOLOGIC CROSS SECTION

NOTES:

1. 2014 AERIAL PHOTOGRAPH SOURCES: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA FSA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY.
2. MONITORING WELLS MW-301, MW-302, AND MW-304, WERE INSTALLED BY CASCADE DRILLING, LLP. UNDER THE SUPERVISION OF SCS ENGINEERS FROM NOVEMBER 11-12, 2015.
3. MONITORING WELLS MW-303 AND MW-305 WERE INSTALLED BY CASCADE DRILLING LLP. UNDER THE SUPERVISION OF SCS ENGINEERS ON DECEMBER 7-8, 2015.
4. MONITORING WELLS MW-307, MW-308, AND MW-309 WERE INSTALLED BY CASCADE DRILLING, LLP. UNDER THE SUPERVISION OF SCS ENGINEERS FROM OCTOBER 25-27, 2016.
5. MONITORING WELLS MW-310 AND MW-311 WERE INSTALLED BY ROBERTS ENVIRONMENTAL DRILLING ON AUGUST 27, 2019.
6. MONITORING WELLS MW-305A, MW-310A, AND MW-311A WERE INSTALLED BY ROBERTS ENVIRONMENTAL DRILLING BETWEEN FEBRUARY 27, 2020 AND MARCH 3, 2020.

N

800 0 800

SCALE: 1" = 800'

PROJECT NO.	25220083.00	DRAWN BY:	BSS
DRAWN:	11/15/2019	CHECKED BY:	MDB
REVISED:	11/25/2020	APPROVED BY:	TK 11/25/2020

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OTTUMWA, IA 52501

SITE

ALLIANT ENERGY
OTTUMWA GENERATING STATION
OTTUMWA, IOWA

SITE PLAN
AND MONITORING WELL LOCATIONS

FIGURE
2

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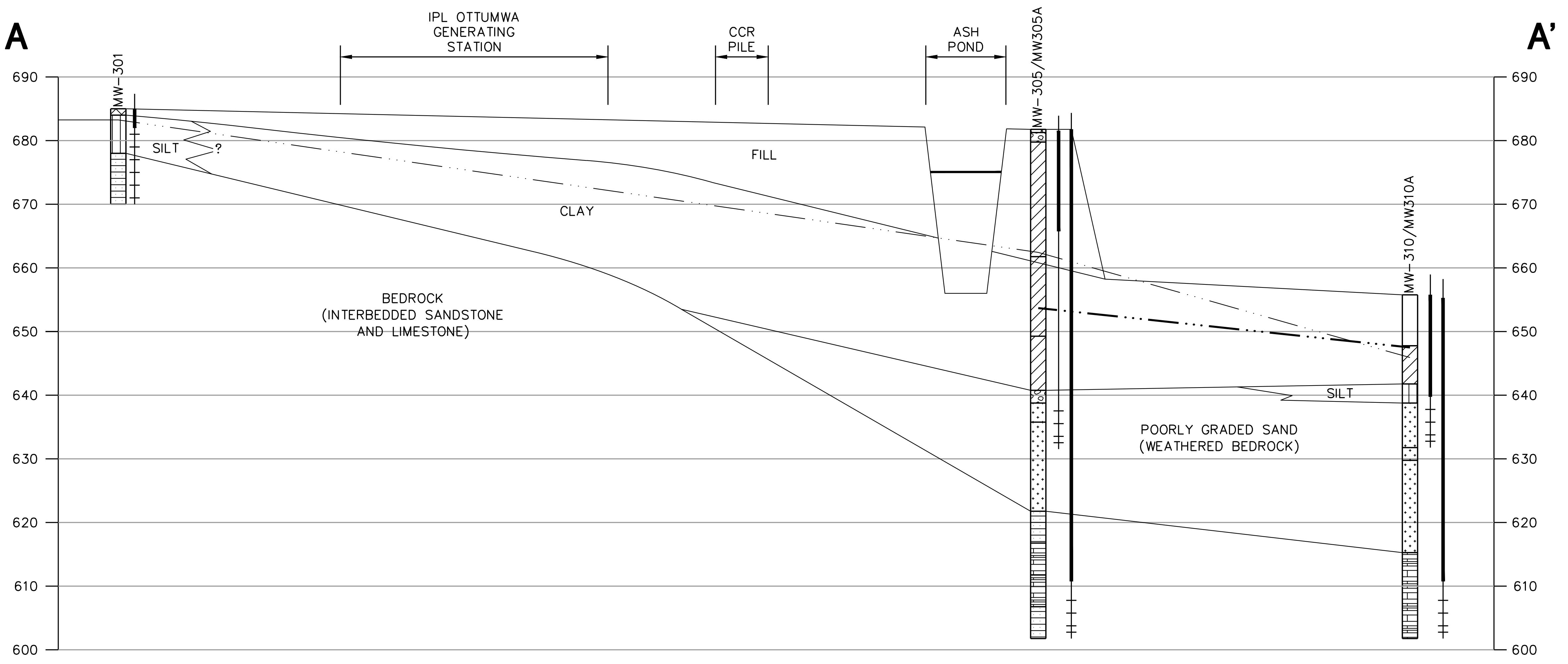


LEGEND

▨ TOPSOIL/FILL

░ SAND, POORLY GRADED (SP)

▥ SILT, WITH SAND AND GRAVEL (ML)

▨ CLAY

░ GRAVEL, POORLY GRADED, LITTLE OR NO FINES (GP)

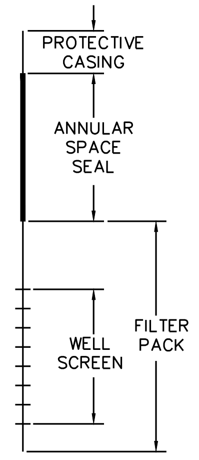
▤ SANDSTONE

▦ LIMESTONE

— · · · — DEEP POTENTIOMETRIC SURFACE MEASURED APRIL 13–14, 2020

— · · · — SHALLOW POTENTIOMETRIC SURFACE MEASURED APRIL 13–14, 2020

—— POND SURFACE ELEVATION MEASURED JUNE 10–11, 2019



WELL DETAIL

HORIZONTAL SCALE: 1" = 500'
VERTICAL SCALE: 1" = 20'
VERTICAL EXAGGERATION = 25X

NOTES:

1. MW–305 AND MW–305A WERE HYDROVACED TO APPROXIMATELY 8.5'. MW–310 AND MW–310A WERE HYDROVACED TO APPROXIMATELY 8.0'. HYDROVACING IS PERFORMED TO DETERMINE IF UNDERGROUND UTILITIES ARE PRESENT. HIGH PRESSURE WATER AND A VACUUM ARE USED TO CLEAR THE BOREHOLE AND GEOLOGIC SAMPLES ARE NOT COLLECTED. NATIVE SOIL IN THE VICINITY OF MW–307 IS CLAY.

2. ASH POND BOTTOM ELEVATION IS BASED ON THE EMBANKMENT CREST ELEVATION (681 FEET) AND INTERNAL STORAGE DEPTH (25 FEET) REPORTED IN THE HISTORY OF CONSTRUCTION REPORT ISSUED SEPTEMBER 29, 2016, BY HARD HAT SERVICES.

PROJECT NO.	25220083.00	DRAWN BY:	BSS/KP
DRAWN:	07/03/2019	CHECKED BY:	NDK/MDB
REVISED:	05/13/2020	APPROVED BY:	EJN 09/11/20

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OTTUMWA, IA 52501

SITE
OTTUMWA GENERATING STATION
20775 POWER PLANT ROAD
OTTUMWA, IOWA

GEOLOGIC CROSS SECTION A–A'

FIGURE
3

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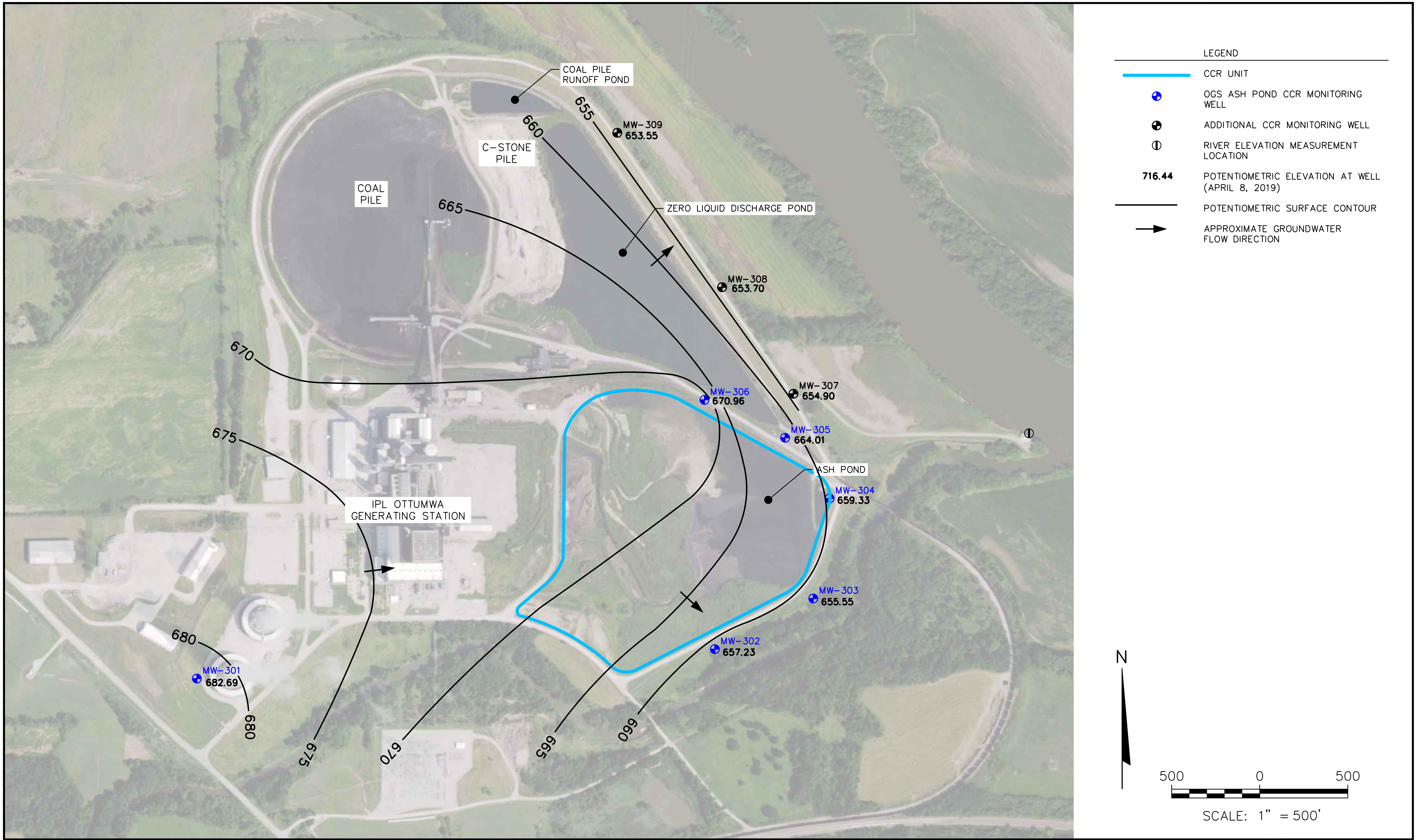

PROJECT NO.	25220083.00	DRAWN BY:	BSS
DRAWN:	07/03/2019	CHECKED BY:	NDK
REVISED:	11/25/2020	APPROVED BY:	TK 11/25/2020

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SITE

OTTUMWA GENERATING STATION
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OTTUMWA, IOWA

POTENTIOMETRIC SURFACE – APRIL 2019

FIGURE
4

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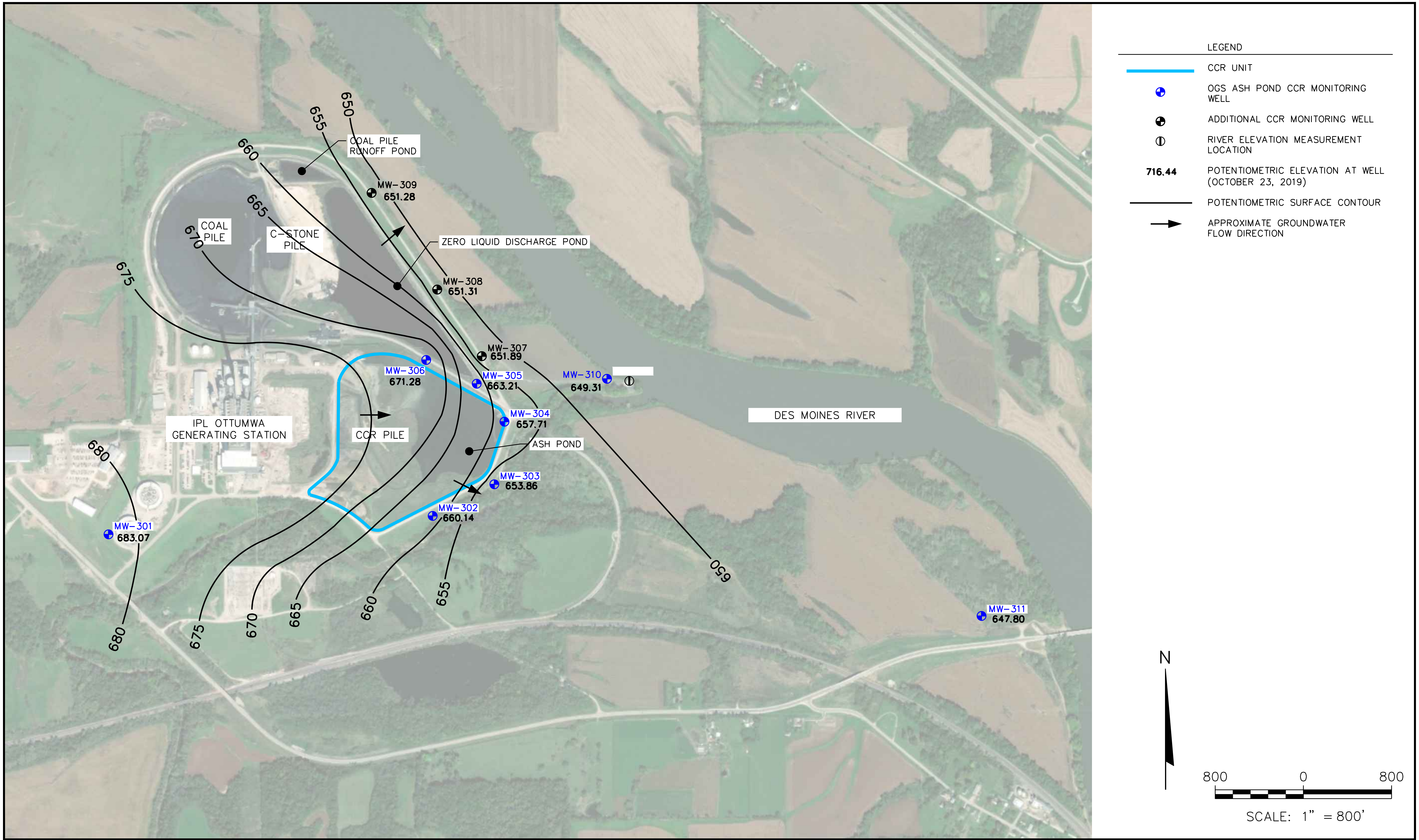

LEGEND

▬	CCR UNIT
⊕	OGS ASH POND CCR MONITORING WELL
⊕	ADDITIONAL CCR MONITORING WELL
⦶	RIVER ELEVATION MEASUREMENT LOCATION
716.44	POTENTIOMETRIC ELEVATION AT WELL (OCTOBER 23, 2019)
—	POTENTIOMETRIC SURFACE CONTOUR
→	APPROXIMATE GROUNDWATER FLOW DIRECTION

PROJECT NO.	25220083.00	DRAWN BY:	BSS
DRAWN:	11/15/2019	CHECKED BY:	NDK/SCC
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OTTUMWA, IA 52501

SITE

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OTTUMWA GENERATING STATION
OTTUMWA, IOWA

POTENTIOMETRIC SURFACE
OCTOBER 2019

FIGURE
5

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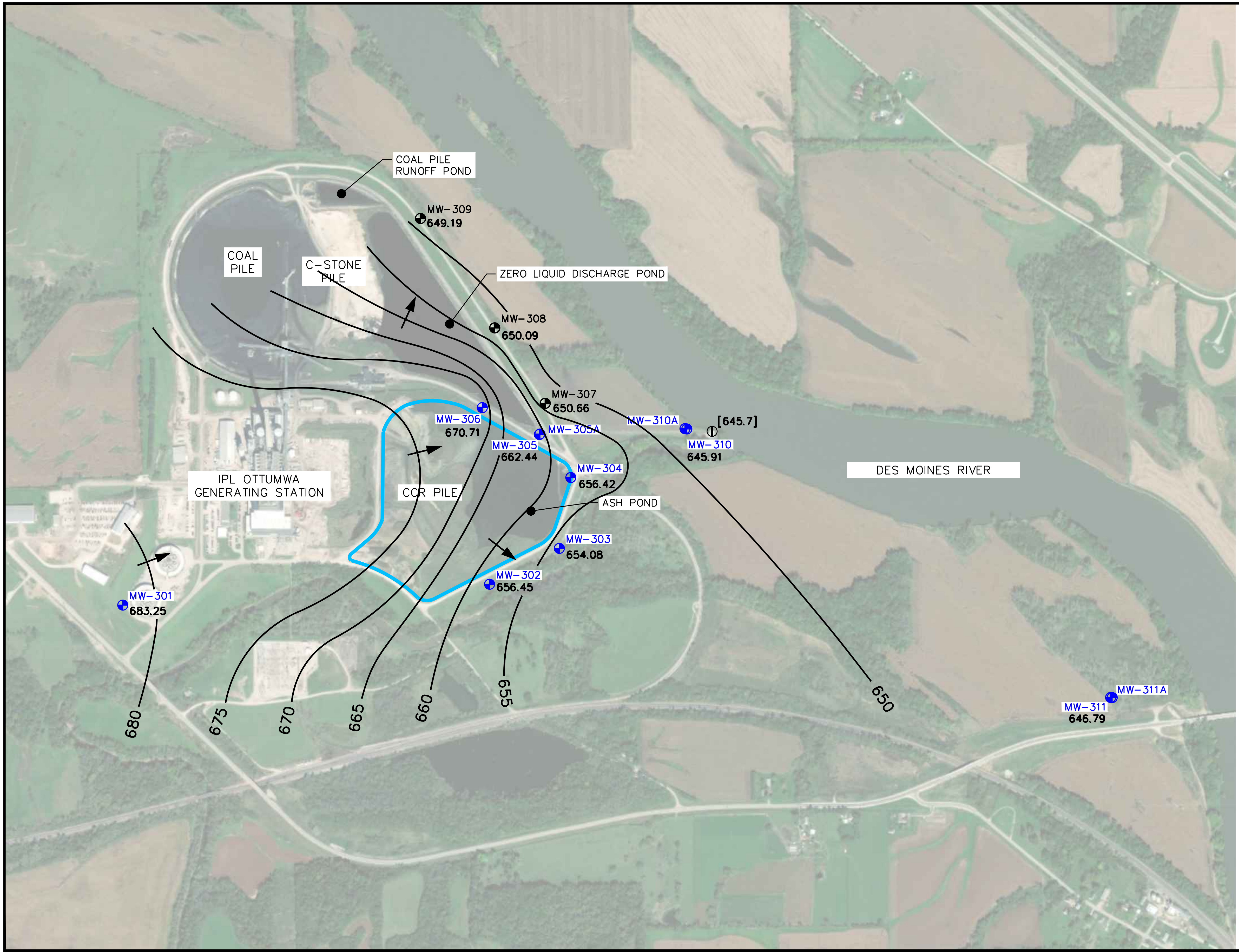

LEGEND

▬	CCR UNIT
⊕	OGS ASH POND CCR MONITORING WELL
⊕	ADDITIONAL CCR MONITORING WELL
⦶	RIVER ELEVATION MEASUREMENT LOCATION
645.91	POTENTIOMETRIC ELEVATION AT WELL (APRIL 13–14, 2020)
[645.7]	SURFACE WATER ELEVATION (APRIL 13, 2020)
—	POTENTIOMETRIC SURFACE CONTOUR
→	APPROXIMATE GROUNDWATER FLOW DIRECTION

N

800 0 800

SCALE: 1" = 800'

PROJECT NO.	25220083.00	DRAWN BY:	KP/BSS/RJG
DRAWN:	04/28/2020	CHECKED BY:	NDK/SCC
REVISED:	07/30/2020	APPROVED BY:	TK 11/25/2020

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CLIENT

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OTTUMWA, IA 52501

SITE

ALLIANT ENERGY
OTTUMWA GENERATING STATION
OTTUMWA, IOWA

SHALLOW POTENTIOMETRIC SURFACE
APRIL 13–14, 2020

FIGURE
6

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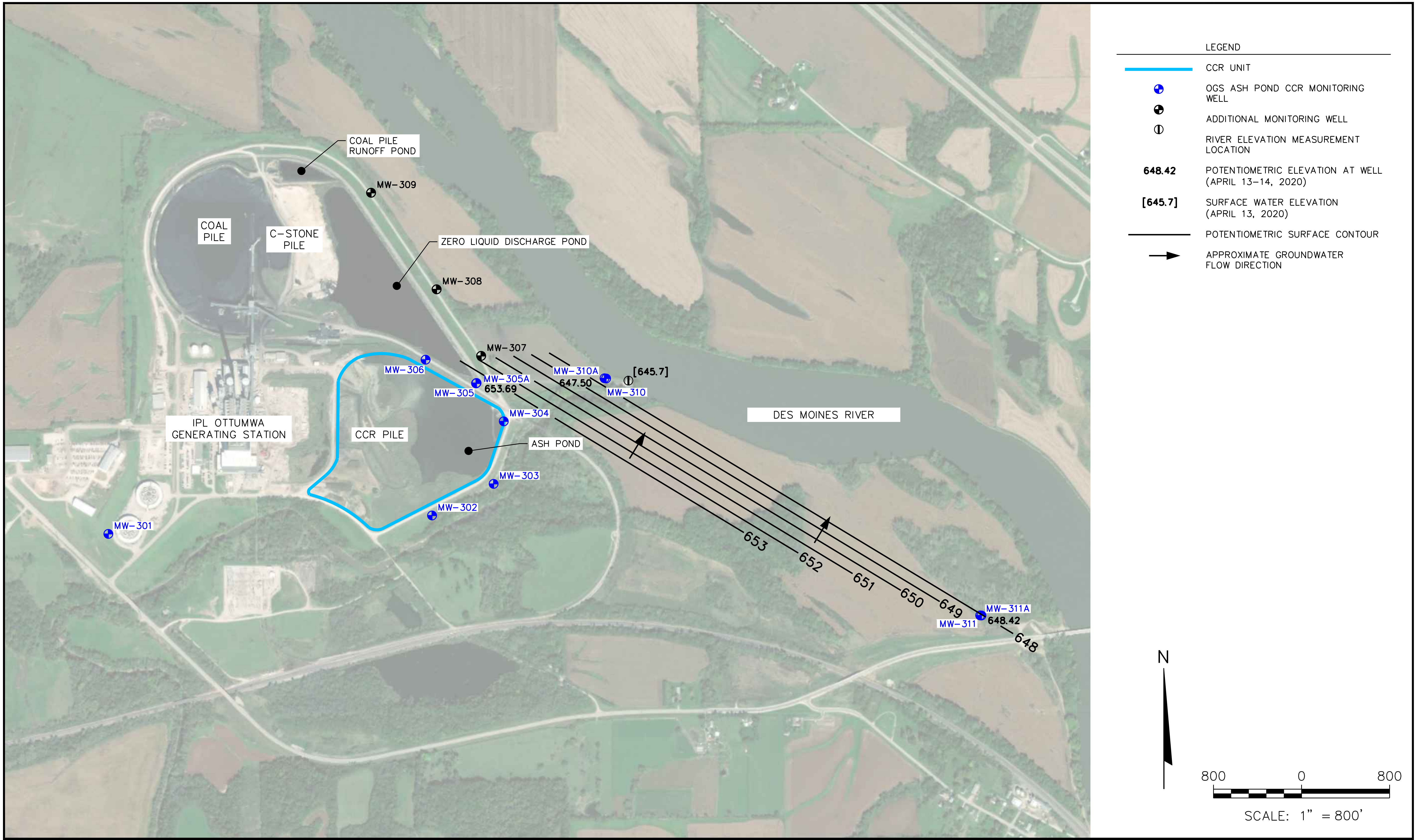

PROJECT NO.	25220083.00	DRAWN BY:	KP/BSS
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OTTUMWA, IA 52501

SITE

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OTTUMWA, IOWA

DEEP POTENTIOMETRIC SURFACE
APRIL 13-14, 2020

FIGURE
7

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Appendix A

Regional Geological and Hydrogeological Information

Regional Hydrogeologic Stratigraphy
Ottumwa Generating Station / SCS Engineers Project #25215053.01

Age of Rocks	Hydrogeologic Unit	General Thickness (feet)	Name of Rock Unit*	Type of Rock
Quaternary (0-1 million years old)	Surficial Aquifers • Alluvial • Buried-Channel • Drift	0 to 320	Undifferentiated	• Sand, gravel, silt, and clay • Sand, gravel, silt, and clay • Till (sandy, pebbly clay), sand, and silt
Pennsylvanian (180 to 310 million years old)	Aquiclude	0 to 370	Undifferentiated	• Shale, sandstone, limestone, and coal
Mississippian (310 to 345 million years old	Mississippian Aquifer • Upper	0 to 600	St. Louis Spergen	• Limestone and sandstone • Limestone
	• Lower		Warsaw Keokuk Burlington Hampton Starrs Cave	• Shale and dolomite • Dolomite, limestone, and shale • Dolomite and limestone • Limestone and dolomite • Limestone
	Aquiclude	0 to 425	Prospect Hill McCraney	• Siltstone • Limestone
Devonian (345 to 400 million years old)			Yellow Spring Lime Creek	• Shale, dolomite, and siltstone • Dolomite and shale
	Devonian Aquifer	110 to 420	Cedar Valley Wapsipinicon	• Limestone and dolomite • Dolomite, limestone, shale, and gypsum
Silurian (400 to 425 million years old)		0 to 105	Undifferentiated	• Dolomite
Ordovician (425 to 500 million years old)	Aquiclude	150 to 600	Maquoketa Galena Decorah Platteville	• Dolomite and shale • Dolomite and chert • Limestone and shale • Limestone, shale, and sandstone
	Cambrian-Ordovician aquifer	750 to 1,110	St. Peter Prairie du Chien	• Sandstone • Dolomite and sandstone
Cambrian (500 to 600 million years old)			Jordan St. Lawrence	• Sandstone • Dolomite
	Not considered an aquifer in southeast Iowa	450 to 750+	Franconia Galesville Eau Claire Mt. Simon	• Shale, siltstone, and sandstone • Sandstone • Sandstone, shale, and dolomite • Sandstone
Precambrian (600 million to 2 billion + years old)				• Sandstone, igneous rocks, and metamorphic rocks

*This nomenclature and classification of rock units in this report are those of the Iowa Geological Survey and do not necessarily coincide with those accepted by the U.S. Geological Survey.

Source: "Water Resources of Southeast Iowa," Iowa Geologic Survey Water Atlas No. 4.

Appendix B

Boring Logs

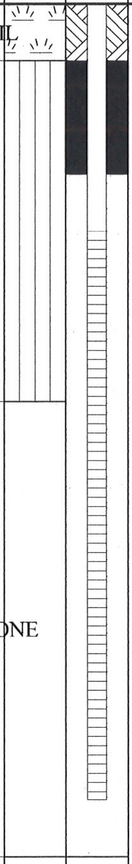
SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

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

Page 1 of 1

Facility/Project Name: IPL- Ottumwa Generating Station SCS#: 25215135.40
License/Permit/Monitoring Number:
Boring Number: MW-301
Boring Drilled By: Name of crew chief (first, last) and Firm: Todd Schmalfeld, Cascade Drilling
Date Drilling Started: 11/10/2015
Date Drilling Completed: 11/10/2015
Drilling Method: 4-1/4 hollow stem auger
Unique Well No.:
DNR Well ID No.:
Common Well Name: MW-301
Final Static Water Level: Feet
Surface Elevation: 684.3 Feet
Borehole Diameter: 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: Feet ☐ N ☐ S Feet ☐ E ☐ W
Facility ID:
County: Wapello
Civil Town/City/ or Village: Ottumwa



Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				TOPSOIL.	TOPSOIL									
			1	SANDY SILT WITH GRAVEL, gray (7.5YR 6/1), gravel is fine.										
			2											
			3											
			4		ML									
			5											
S1	10	woh 1 3 9	6							W				
			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	Endo of Boring at 15 feet bgs.						W				

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 ☐

Page 1 of 2

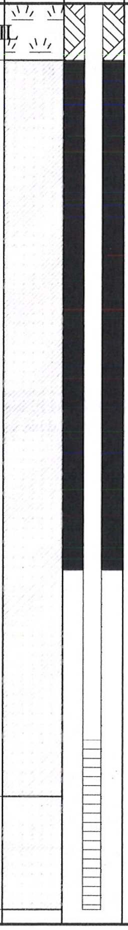
Facility/Project Name IPL- Ottumwa Generating Station SCS#: 25215135.40	License/Permit/Monitoring Number	Boring Number MW-302

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

Unique Well No.	DNR Well ID No.	Common Well Name MW-302	Final Static Water Level Feet	Surface Elevation 671.6 Feet	Borehole Diameter 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
Feet ☐ N ☐ S
Feet ☐ E ☐ W

Facility ID	County Wapello	Civil Town/City/ or Village 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	U S C S	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
				TOPSOIL.	TOPSOIL									
			1	LEAN CLAY WITH SAND, dark gray (10YR 4/1).	CL									
			2											
			3											
			4											
			5											
			6											
			7											
			8											
			9											
			10											
S1	19	1 4 5 7	11							M				
			12											
S2	19	2 4 7 11	13							M				
			14	LEAN CLAY WITH SAND, very dark gray (5Y 3/1).	CL									
			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:

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number MW-302

Page 2 of 2

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

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

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

Page 1 of 1

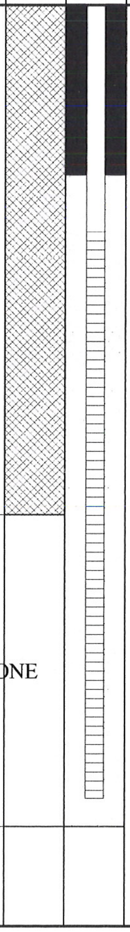
Facility/Project Name IPL- Ottumwa Generating Station SCS#: 25215135.40	License/Permit/Monitoring Number	Boring Number MW-303

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

Unique Well No.	DNR Well ID No.	Common Well Name MW-303	Final Static Water Level Feet	Surface Elevation 659.0 Feet	Borehole Diameter 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
Feet ☐ N ☐ S
Feet ☐ E ☐ W

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

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			0–9	FILL, boring location was cleared to 9' bgs by hydrovac, then back filled.	FILL									
			9	WEATHERED SANDSTONE, medium grained, brown (10YR 5/4).	SANDSTONE									
S1	1	50	11							W				
S2	NR		13.5											
			14.5	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 ☐

Page 1 of 3

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

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

Unique Well No.	DNR Well ID No.	Common Well Name MW-304	Final Static Water Level Feet	Surface Elevation 680.1 Feet	Borehole Diameter 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
Feet ☐ N ☐ S
Feet ☐ E ☐ W

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

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			0–1	TOPSOIL.	TOPSOIL									
			1–12.5	FAT CLAY, black (10YR 2/1).	CH									
S1	23	4 5 4 5	11							M				
S2	19.5	4 4 5 5	12.5–15	FAT CLAY, yellowish brown (10YR 5/4).	CH					M				
			15–16	FAT CLAY, yellowish brown (10YR 3/4).	CH									

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									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	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 22							M				
S6	23	3 4 8 6	23 24							M				
S7	23	5 11 15 11	25 26 27		CH					M				
S8	15	4 4 5 6	28 29							M				
S9	18	4 6 9 9	30 31 32							M				
S10	24	4 6 7 6	33 34							M				
S11	16	2 2 4 6	35 36 37	FAT CLAY, DARK OLIVE BROWN (2.5Y 3/3).						M				
S12	24	4 3 5 5	38 39		CH					M				
S13	18	2 3 3 3	40 41 42							M				

Boring Number MW-304

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

Page 1 of 3

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

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

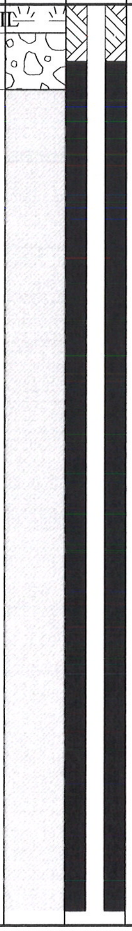
Unique Well No.	DNR Well ID No.	Common Well Name MW-305	Final Static Water Level Feet	Surface Elevation 681.5 Feet	Borehole Diameter 8.5 in

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
Feet ☐ N ☐ S
Feet ☐ E ☐ W

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



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

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number MW-305

Sample		Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties					RQD/ Comments
Number and Type	Length Att. & Recovered (in)								Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	
S3	22	5 15 14 15	17	FAT CLAY *(continued)*										
S4	20	3 5 13 15	18 19		CH									
S5	24	4 5 7 11	20 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	same as above except, very dark grayish brown (10YR 3/2).						W				
S13	6	3 9 11	40 41 42	POORLY GRADED SANDY GRAVEL, fine, brown (10YR 4/3).	GPS					W				water @ 41.0 ft bgs.

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number MW-305

Page 3 of 3

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

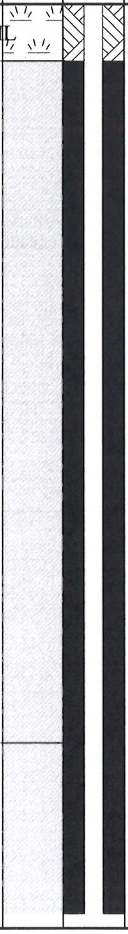
SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

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

Page 1 of 2

Facility/Project Name: IPL- Ottumwa Generating Station SCS#: 25215135.40
License/Permit/Monitoring Number:
Boring Number: MW-306
Boring Drilled By: Name of crew chief (first, last) and Firm: Todd Schmalfeld, Cascade Drilling
Date Drilling Started: 11/12/2015
Date Drilling Completed: 11/12/2015
Drilling Method: 4-1/4 hollow stem auger
Unique Well No.:
DNR Well ID No.:
Common Well Name: MW-306
Final Static Water Level: Feet
Surface Elevation: 681.1 Feet
Borehole Diameter: 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: Feet ☐ N ☐ S Feet ☐ E ☐ W
Facility ID:
County: Wapello
Civil Town/City/ or Village: Ottumwa



Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				TOPSOIL.	TOPSOIL									
			1	FAT CLAY, dark olive brown (2.5Y 3/3).										
			2											
			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

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

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION

Form 4400-122 Rev. 7-98

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

Page 1 of 2

Facility/Project Name IPL - Ottumwa Generating Station SCS#: 25219028.00		**License/Permit/Monitoring Number**		**Boring Number** MW-310	
Boring Drilled By: Name of crew chief (first, last) and Firm Eric Wetzel Roberts Environmental Drilling, Inc.		**Date Drilling Started** 8/27/2019	**Date Drilling Completed** 8/27/2019	**Drilling Method** 4 1/4 hollow stem auger	
WI Unique Well No.	**DNR Well ID No.**	**Common Well Name** MW-310	**Final Static Water Level** Feet MSL	**Surface Elevation** 655.76 Feet MSL	**Borehole Diameter** 8.5 in.

Local Grid Origin ☐ (estimated: ☐) or **Boring Location** ☒
State Plane 401,502 N, 1,904,206 E S/C/N
1/4 of 1/4 of Section , T N, R

Lat ° ' "
Long ° ' "

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

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

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				Hydrovac through clay for utility clearances.										
			8	LEAN CLAY, brown, massive.										
S1	11	WOR 10 3 10	9							M				
				Some reddish brown and grey mottling, some silt.										
S2	15	2 2 3 2	11		CL					M				
S3	20	1 1 1 9	13							M/W				
			14	SILT, brown, with clay.	ML									
			15											

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

Signature

Firm SCS Engineers
2830 Dairy Drive Madison, WI 53718
Tel: 608-224-2830
Fax

This form is authorized by Chapters 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats. Completion of this form is mandatory. Failure to file this form may result in forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on this form is not intended to be be used for any other purpose. NOTE: See instructions for more information, including where the completed form should be sent.

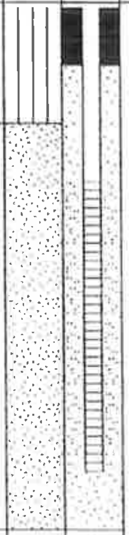
State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION SUPPLEMENT

Form 4400-122A

Boring Number MW-310 Use only as an attachment to Form 4400-122. Page 2 of 2

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
S4	24	WOR								M/W				
			16		ML									
S5	18	1 3 2 3	17	POORLY GRADED SAND, fine to medium, 1/2" coarse sand seam at 17.75'.						W				
			18											
S6	14	WOR WOR 2 3	19							W				
			20											
					SP									
S7	10	WOR 2 4 2	21							W				
			22	Trace small rounded gravel.										
S8	24	6 6 11 20	23							W				
			24	End of boring at 24'										



State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION

Form 4400-122 Rev. 7-98

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

Page 1 of 2

Facility/Project Name: IPL - Ottumwa Generating Station SCS#: 25219028.00
License/Permit/Monitoring Number:
Boring Number: MW-311

Boring Drilled By: Name of crew chief (first, last) and Firm
Eric Wetzel
Roberts Environmental Drilling, Inc.

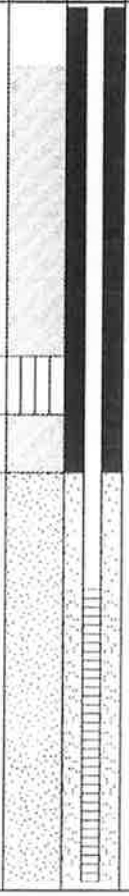
Date Drilling Started: 8/27/2019
Date Drilling Completed: 8/27/2019
Drilling Method: 4 1/4 hollow stem auger

WI Unique Well No.:
DNR Well ID No.:
Common Well Name: MW-311
Final Static Water Level: Feet MSL
Surface Elevation: 651.24 Feet MSL
Borehole Diameter: 8.5 in.

Local Grid Origin ☐ (estimated: ☐) or **Boring Location** ☒
State Plane 399,350 N, 1,907,603 E S/C/N
1/4 of 1/4 of Section , T N, R
Lat ° ' "
Long ° ' "
Local Grid Location
Feet ☐ N ☐ S
Feet ☐ E ☐ W

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

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			1	LEAN CLAY, brown, massive, trace fine to medium sand, roots, 1" sand seam at 1.5'.										
S1	14	2 3 4 6	2							M				
			3											
S2	14	3 3 4 6	4		CL					M				
			5											
S3	6	2 3 4 6	6	SILT, brown, massive.	ML					M				
			7	LEAN CLAY, brown, massive.	CL									
S4	20	2 3 4 3	8	POORLY GRADED SAND, fine to medium, brown, massive.						M/W				
			9											
S5	12	2 3 4 5	10	2" clay seam at 10.5'.						W				
			11		SP									
S6	14	1 2 4 2	12							W				
			13											
S7	14	1 2 3 3	14							W				
			15											



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

Signature
Firm SCS Engineers
2830 Dairy Drive Madison, WI 53718
Tel: 608-224-2830
Fax

This form is authorized by Chapters 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats. Completion of this form is mandatory. Failure to file this form may result in forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on this form is not intended to be be used for any other purpose. NOTE: See instructions for more information, including where the completed form should be sent.

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION SUPPLEMENT

Form 4400-122A

Boring Number MW-311 Use only as an attachment to Form 4400-122. Page 2 of 2

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
					SP	▨	▨							
			16	End of boring at 16'.										

MONITORING WELL / PIEZOMETER CONSTRUCTION DOCUMENTATION FORM

Disposal Site Name IPL - Ottumwa Generating Station
Permit No.
Well or Piezometer No. MW-310
Dates Started 8/27/2019
Date Completed 8/27/2019

A. SURVEYED LOCATION AND ELEVATION OF POINT (+0.5 ft.)

Specify corner of site Middle Avery Creek @ Des Moines River
Distance and direction along boundary 340' NW
Distance and direction from boundary to surface monitoring well 45' SW
Elevation (+0.01 ft. MSL)
Ground Surface 655.76
Top of protective casing 658.97
Top of well casing 658.63
Benchmark elevation
Benchmark description

B. SOIL BORING INFORMATION

Construction Company Name Roberts Environmental Drilling Inc.
Address 1107 South Mulberry Street
City, State, Zip Code Millstadt, IL, 62260
Name of driller Eric Wetzel
Drilling method 4 1/4" HSA
Drilling fluid
Bore Hole diameter 8.5"
Soil sampling method Split Spoon
Depth of boring 24'

C. MONITORING WELL INSTALLATION

Casing material PVC - Sch. 40
Length of casing 20.87
Outside casing diameter 2.4"
Inside casing diameter 2.0"
Casing joint type Threaded
Casing/screen joint type Threaded
Screen material PVC - Sch. 40
Screen opening size 0.01'
Screen length 5'
Depth of Well 23'
Filter Pack:
Material Filter Sand
Grain Size #5
Volume 1.25 cubic feet
Seal (minimum 3 ft. length above filter pack):
Material 3/8" Bentonite Chips

Placement method Gravity
Volume 4 cubic feet
Backfill (if different from seal):
Material
Placement method
Volume
Surface seal design: Concrete
Material of protective casing: Steel
Material of grout between protective casing and well casing: Bentonite/Filter Sand
Protective cap:
Material Steel
Vented?: ☒ Y ☐ N Locking?: ☒ Y ☐ N
Well cap:
Material Plastic
Vented?: ☐ Y ☒ N

D. GROUNDWATER MEASUREMENT (±0.01 foot below top of inner well casing)

Water level 16.67
Stabilization time 5 min
Well development method surge and purge with pump to remove turbidity
Average depth of frost line 3.5'

DRILLER'S CERTIFICATION

I certify under penalty of law I believe the information reported above is true, accurate, and complete.

Signature
Certification # 11509
Date 10.3.19

Attachments: Driller's log. Pipe schedules and grouting schedules. 8 ½ inch x 11 inch map showing locations of all monitoring wells and piezometers.

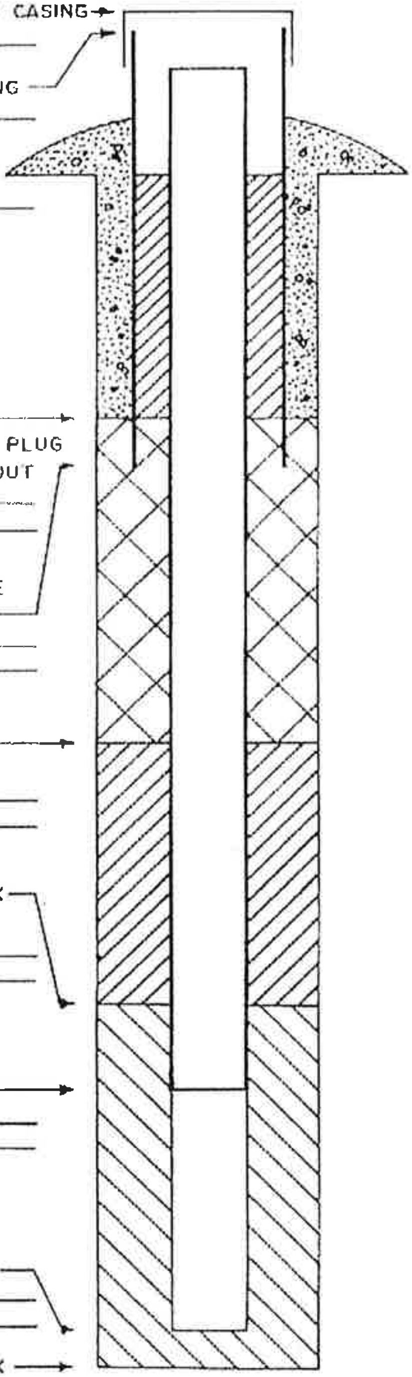
Please mail completed form to: Iowa Department of Natural Resources, Land Quality Bureau, 502 E. 9th St, Des Moines, IA 50319.
Questions? Call or Email: Nina Booker Environmental Engineer Sr., 515-725-8309, nina.booker@dnr.iowa.gov

09/2017 cmc
DNR Form 542-1277

ELEVATIONS: ± 0.01 FT. MSL

DEPTHS: ± 0.1 FT. FROM
GROUND SERFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL).



TOP OF PROTECTIVE CASING
ELEVATION 658.97

TOP OF WELL CASING
ELEVATION 658.63

GROUND SURFACE
ELEVATION 655.76

TOP OF BACKFILL
BASE OF CONCRETE PLUG
AND BENTONITE GROUT
ELEVATION 651.76
DEPTH 4

BASE OF PROTECTIVE
CASING
ELEVATION 651.76
DEPTH 4

BASE OF BACKFILL
TOP OF SEAL
ELEVATION
DEPTH N/A

TOP OF FILTER PACK
BASE OF SEAL
ELEVATION 639.76
DEPTH 16

TOP OF SCREEN
ELEVATION 637.76
DEPTH 18

BOTTOM OF SCREEN
ELEVATION 632.76
DEPTH 23

BASE OF FILTER PACK
ELEVATION 631.76
DEPTH 24

MONITORING WELL / PIEZOMETER CONSTRUCTION DOCUMENTATION FORM

Disposal Site Name: IPL - Ottumwa Generating Station   Permit No.:

Well or Piezometer No.: MW-311   Dates Started: 8/27/2019   Date Completed: 8/27/2019

A. SURVEYED LOCATION AND ELEVATION OF POINT (+0.5 ft.)

Specify corner of site: SE   Distance and direction along boundary: 730' W

Distance and direction from boundary to surface monitoring well: 160' N

Elevation (+0.01 ft. MSL):

Ground Surface: 651.24   Top of protective casing: 654.49

Top of well casing: 654.18   Benchmark elevation:

Benchmark description:

B. SOIL BORING INFORMATION

Construction Company Name: Roberts Environmental Drilling Inc.

Address: 1107 South Mulberry Street   City, State, Zip Code: Millstadt, IL, 62260

Name of driller: Eric Wetzel

Drilling method: 4 1/4" HSA   Drilling fluid: Bore Hole diameter: 8.5"

Soil sampling method: Split Spoon   Depth of boring: 16'

C. MONITORING WELL INSTALLATION

Casing material: PVC - Sch. 40   Placement method: Gravity

Length of casing: 12.94'   Volume: 2 cubic feet

Outside casing diameter: 2.4"   Backfill (if different from seal):

Inside casing diameter: 2.0"   Material:

Casing joint type: Threaded   Placement method:

Casing/screen joint type: Threaded   Volume:

Screen material: PVC - Sch. 40   Surface seal design: Concrete

Screen opening size: 0.01'   Material of protective casing: Steel

Material of grout between protective casing and well casing: Bentonite/Filter Sand

Screen length: 5'

Depth of Well: 15'   Protective cap:

Filter Pack: Material: Steel

Material: Filter Sand   Vented?: ☒ Y ☐ N   Locking?: ☒ Y ☐ N

Grain Size: #5   Well cap:

Volume: 1.5 cubic feet   Material: Plastic

Seal (minimum 3 ft. length above filter pack):   Vented?: ☐ Y ☒ N

Material: 3/8" Bentonite Chips

D. GROUNDWATER MEASUREMENT (+0.01 foot below top of inner well casing)

Water level: 12.04   **Stabilization time**: 5 min

Well development method: surge and purge with pump to remove turbidity

Average depth of frost line: 3.5'

DRILLER'S CERTIFICATION

I certify under penalty of law I believe the information reported above is true, accurate, and complete.

Signature   **Certification #** 11509   **Date** 12.3.19

Attachments: Driller's log. Pipe schedules and grouting schedules. 8 ½ inch x 11 inch map showing locations of all monitoring wells and piezometers.

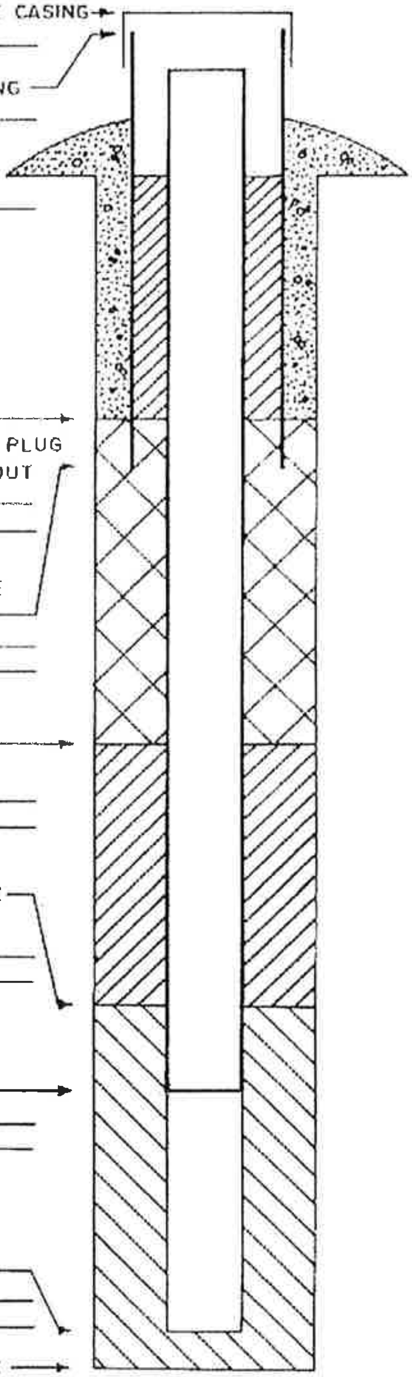
Please mail completed form to: Iowa Department of Natural Resources, Land Quality Bureau, 502 E. 9th St, Des Moines, IA 50319.

Questions? Call or Email: Nina Booker Environmental Engineer Sr., 515-725-8309, nina.booker@dnr.iowa.gov

ELEVATIONS: ± 0.01 FT. MSL

DEPTHS: ± 0.1 FT. FROM
GROUND SERFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL).



TOP OF PROTECTIVE CASING
ELEVATION 654.49

TOP OF WELL CASING
ELEVATION 654.18

GROUND SURFACE
ELEVATION 651.24

TOP OF BACKFILL
BASE OF CONCRETE PLUG
AND BENTONITE GROUT
ELEVATION 647.24
DEPTH 4

BASE OF PROTECTIVE
CASING
ELEVATION 647.24
DEPTH 4

BASE OF BACKFILL
TOP OF SEAL
ELEVATION
DEPTH N/A

TOP OF FILTER PACK
BASE OF SEAL
ELEVATION 643.24
DEPTH 8

TOP OF SCREEN
ELEVATION 641.24
DEPTH 10

BOTTOM OF SCREEN
ELEVATION 636.24
DEPTH 15

BASE OF FILTER PACK
ELEVATION 635.24
DEPTH 16

SOIL BORING LOG INFORMATION

Page 1 of 4

Facility/Project Name IPL-Ottumwa Generating Station SCS#: 25220056.00	License/Permit/Monitoring Number	Boring Number MW-305A

Boring Drilled By: Name of crew chief (first, last) and Firm Jeff Crank Roberts Environmental Services	Date Drilling Started 2/25/2020	Date Drilling Completed 2/27/2020	Drilling Method 6 1/4" HSA and air/mud rotary

	DNR Well ID No.	Common Well Name MW-305A	Final Static Water Level 32.7 Feet	Surface Elevation 681.76 Feet	Borehole Diameter 10" and 6" in.

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒

State Plane 401,461 N, 1,903,028 E S/C/N

SE 1/4 of NE 1/4 of Section 26, T 73 N, R 15 W

Lat ___° ___' ____"

Long ___° ___' ____"

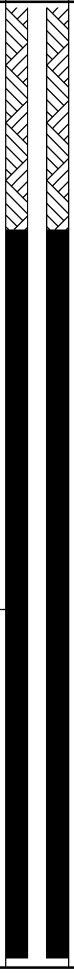
Local Grid Location

Feet ☐ N ☐ S

Feet ☐ E ☐ W

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

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			0–9.5	Hydrovaced to 9.5 feet for utility clearance.										Drilled using hollow stem augers to 55 feet
			9.5–15	Blind drilled to 46 feet. See boring log MW-305 for lithology.										



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

Signature	Firm scs engineers	Tel: Fax:

This form is authorized by Chapters 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats. Completion of this form is mandatory. Failure to file this form may result in forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on this form is not intended to be be used for any other purpose. NOTE: See instructions for more information, including where the completed form should be sent.

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number MW-305A Use only as an attachment to Form 4400-122.

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			16											
			17											
			18											
			19											
			20											
			21											
			22											
			23											
			24											
			25											
			26											
			27											
			28											
			29											
			30											
			31											
			32											
			33											
			34											
			35											
			36											
			37											
			38											
			39											
			40											

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION SUPPLEMENT

Form 4400-122A

Boring Number MW-305A Use only as an attachment to Form 4400-122.

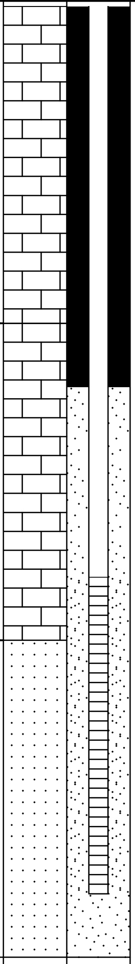
Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
														Bagged auger samples to ~40 feet
			41											
			42											
			43											
			44											
			45											Swithched to mud rotary drilling at 45 feet
S1	5	50/5	46	POORLY GRADED SAND, fine, light brown, (weathered sandstone bedrock).						W				
			47											
			48											
			49											
			50											
			51											
			52											
			53		SP									
			54											
			55	Same as above but very fine, light brown to light gray, with pieces of rock.										Switched to air rotary drilling at 55 feet
			56											
			57											
			58											
			59											Driller noted rock became more compitant at 59' bgs.
			60	SANDSTONE, fine to medium, light brown, trace gravel and light gray to gray limestone, (bedrock).										
			61											
			62											
			63											
			64											
			65											

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION SUPPLEMENT

Form 4400-122A

Boring Number MW-305A Use only as an attachment to Form 4400-122. Page 4 of 4



Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				LIMESTONE, light gray, with fine, light brown sandstone, (bedrock).										
			66											
			67											
			68											At 68 feet, driller noted a fracture in the bedrock.
			69											
			70	LIMESTONE, gray, with dark brownish gray shale, (bedrock).										
			71											
			72											
			73											
			74											
			75	SANDSTONE, fine, light grayish white, with gray limestone, (bedrock).										
			76											
			77											
			78											
			79											
			80	End of boring at 80 feet below ground surface.										

SOIL BORING LOG INFORMATIO

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
IPL-Ottumwa Generating Station SCS#: 25220056.00		MW-310A

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Jeff Crank Roberts Environmental Services	2/27/2020	3/2/2020	6 1/4" HSA & air rotary

	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		MW-310A	12.0 Feet	655.26 Feet	10" and 6" in.

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒

State Plane 401,504 N, 1,904,191 E S/C/N

SW 1/4 of NW 1/4 of Section 25, T 73 N, R 15 W

Lat ___° ___' ___"

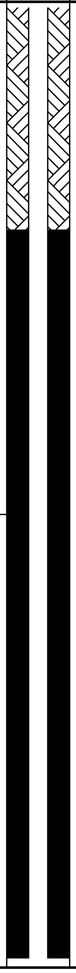
Long ___° ___' ___"

Local Grid Location

Feet ☐ N ☐ S

Feet ☐ E ☐ W

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

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			1 2 3 4 5 6 7	Hydrovaced to 8 feet for utility clearance.										Drilled using hollow stem augers to 40 feet
			8 9 10 11 12 13 14 15	Blind drilled to 24 feet. See boring log MW-310 for lithology.										

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

Signature	Firm scs engineers	Tel: Fax:

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State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION SUPPLEMENT

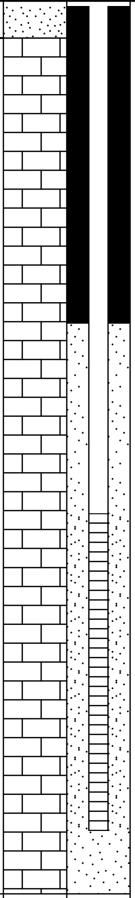
Form 4400-122A

Boring Number MW-310A Use only as an attachment to Form 4400-122. Page 2 of 3

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	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
			16											
			17											
			18											
			19											
			20											
			21											
			22											
			23											
			24	POORLY GRADED SAND, fine to coarse, brown, trace gravel and lenses of lean clay.	SP									
S1	14	7 20 23 21	25							W				Began collecting split spoon samples at 24 feet
				POORLY GRADED SAND, fine, light gray, trace lean clay, (weathered sandstone bedrock).										
			26											
S2	17	9 11 12 13	27							W				
			28	Same as above but brown with small gravel.										
S3	13	14 36 50/5	29							W				
			30	Same as above but fine to medium and brown to light gray.										
S4	5	50/5	31							W				
			32	Same as above but fine and light gray.	SP									
S5	5	50/5	33							W				
			34											
S6	5	50/5	35							W				
			36											
S7	5	50/5	37							W				
			38											
S8	4	50/4	39							W				Auger refusal at 39 fet
			40	Same as above but much more competent.										

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number MW-310A Use only as an attachment to Form 4400-122. Page 3 of 3



Sample		Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties					RQD/ Comments
Number and Type	Length Att. & Recovered (in)								Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	
					SP									
			41	LIMESTONE, light brownish gray, with fine to medium light gray sandstone, (bedrock).										
S9			42							W				Switching to air rotary drilling at 40 feet
			43	Same as above but with gravel and very little sand.										Intermittent gravel between 43 to 54 feet
			44											
			45											
			46											
			47											
			48											
			49											
			50											
			51											
			52											
			53											
			54	End of boring at 54 feet below ground surface.										

SOIL BORING LOG INFORMATIO

Facility/Project Name IPL-Ottumwa Generating Station SCS#: 25220056.00	License/Permit/Monitoring Number	Boring Number MW-311A

Boring Drilled By: Name of crew chief (first, last) and Firm Jeff Crank Roberts Environmental Services	Date Drilling Started 3/2/2020	Date Drilling Completed 3/3/2020	Drilling Method 6 1/4" auger & air rotary

	DNR Well ID No.	Common Well Name MW-311A	Final Static Water Level 8.9 Feet	Surface Elevation 651.16 Feet	Borehole Diameter 10" and 6" in.

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒

State Plane 399,349 N, 1,907,615 E S/C/N

SW 1/4 of SE 1/4 of Section 25, T 73 N, R 15 W

Lat ____° ____' ______"

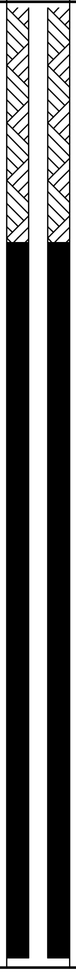
Long ____° ____' ______"

Local Grid Location

Feet ☐ N ☐ S

Feet ☐ E ☐ W

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

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	Blind drilled to 16 feet. See boring log MW-311 for lithology.										Drilled using hollow stem augers to 28 feet

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

Signature	Firm scs engineers	Tel: Fax:

This form is authorized by Chapters 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats. Completion of this form is mandatory. Failure to file this form may result in forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on this form is not intended to be be used for any other purpose. NOTE: See instructions for more information, including where the completed form should be sent.

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION SUPPLEMENT

Form 4400-122A

Boring Number MW-311A Use only as an attachment to Form 4400-122. Page 2 of 3

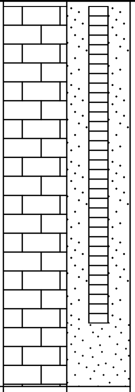
Sample		Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties					RQD/ Comments
Number and Type	Length Att. & Recovered (in)								Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	
				POORLY GRADED SAND, fine to coarse, brown, with trace gravel and silt.										
			16											
S1	2		17							W				Began collecting split spoon samples at 16 feet
			18											
S2	11	4 5 6 7	19							W				
			20											
S3	12	5 5 6 7	21		SP					W				
			22											
S4		7 8 9 8	23							W				No return
			24											
S5		3 3 5 10	25							W				No return
			26											
S6	14	5 9 50/5	27							W				Driller noted bedrock at 27.5 feet
			28	POORLY GRADED SAND, very fine, white, with pieces of competent rock, (weatherd sandstone bedrock).	SP									Switched to air rotary drilling at 28 feet
			29	LIMESTONE, gray with fine, light gray to white sandstone, (bedrock).										
			30											
			31	POORLY GRADED SAND, fine to medium, brown, with trace brown limestone, (bedrock).										
			32											
			33											
			34		SP									
			35											
			36											
			37	LIMESTONE, gray, with fine to medium browinsh gray sandstone, (bedrock).										
			38											
			39											
			40											

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION SUPPLEMENT

Form 4400-122A

Boring Number MW-311A Use only as an attachment to Form 4400-122. Page 3 of 3

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			41 42 43 44 45											
			46	End of boring at 46 feet below ground surface.										

Appendix C

Hydrogeochemical Conceptual Model and Preliminary Summary of Groundwater Contaminant Attenuation

ReSolution Partners, LLC

Subject: Cobalt assessment in response to November 2020 e-mail data update

From: Bernd W. Rehm Date: 25 November 2020

Project: SCS – Alliant OGS Ash pond CCR Evaluations 158-002a

Introduction.

This document focuses the application of monitored natural attenuation with respect to cobalt for the Ottumwa Generating Station Ash Pond. Two of the five shallow monitoring wells on the downgradient perimeter of the Ash Pond consistently exceed one or both of either the cobalt background upper prediction limit (UPL = 4.1 µg/L) or the groundwater protection standard (GPS = 6.0 µg/L):

	MW-305	MW-306
Mean	16.2	5.9
Median	16.0	5.9
Range	14.5 to 17.2	4.8 to 6.9
Number	7	6

One of six observations at MW-302 exceeded the UPL with a concentration of 5.3 µg/L. The final two monitoring wells, MW-303 and MW-304, did not exceed the cobalt UPL.

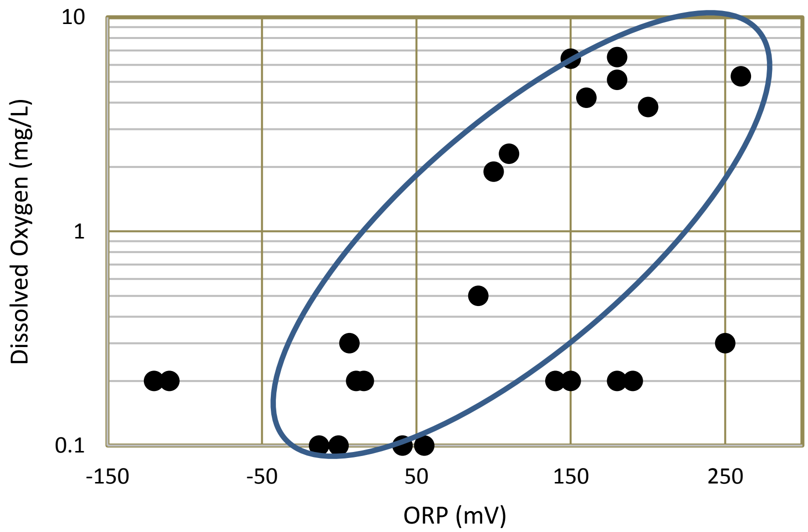
Conceptual Site Model.

Hydrogeology. Four of the five monitoring wells downgradient of the Ash Pond are completed in saturated poorly graded sand (weathered sandstone) between elevations of approximately 655 to 625 feet above mean sea level. The fifth location (MW-303) encountered sandstone at an elevation of about 650 feet. Clay of variable thickness is generally found above the sand. The degree to which clay separates the Ash Pond from the saturated sand in uncertain. The saturated sand forms a permeable pathway from beneath the Ash Pond to well MW-310 and presumably to the Des Moines River immediately east of MW-310. The horizontal hydraulic gradient of ~0.01 beneath the Ash Pond decreases to ~0.006 from the Ash Pond to the river. The hydraulic conductivity of the sand was observed to range from 3.5 E-4 to 3.2 E-3 cm/s (median 2.8 E-3 cm/s, n=5). Assuming a porosity of 0.3 yields estimated groundwater flow rates on the order of 100 ft/yr below the Ash Pond, to on the order of 60 ft/yr from the pond to the river. The groundwater travel time from the pond to the river is estimated on the order of 30 years. The Ash Ponds were first commissioned in 1981, approximately 40 years ago.

Geochemistry. The groundwater chemistry of the cobalt-bearing monitoring wells and the downgradient monitoring well within the potential groundwater flow path as observed in March, April and October 2020 are used to evaluate the site groundwater chemistry. The wells include MW-301 and MW-302. Table 1 summarizes the overall groundwater chemistry and Table 2 summarizes the data used in the preparation of the figures that follow in this memorandum.

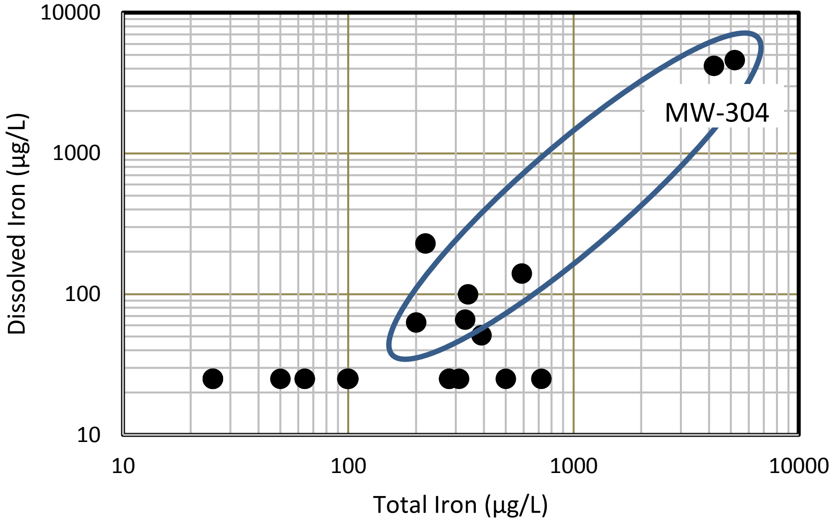
The groundwater has near-neutral pH, with a slight increase east of the Ash Pond with no clear trend over time.

The ORP varies greatly between sampling events. Except for MW-304 and -306, the ORP shows increasing trends to more oxic conditions from March to October. Most samples show a positive correlation between ORP and dissolved oxygen above an ORP of about 0 mV.

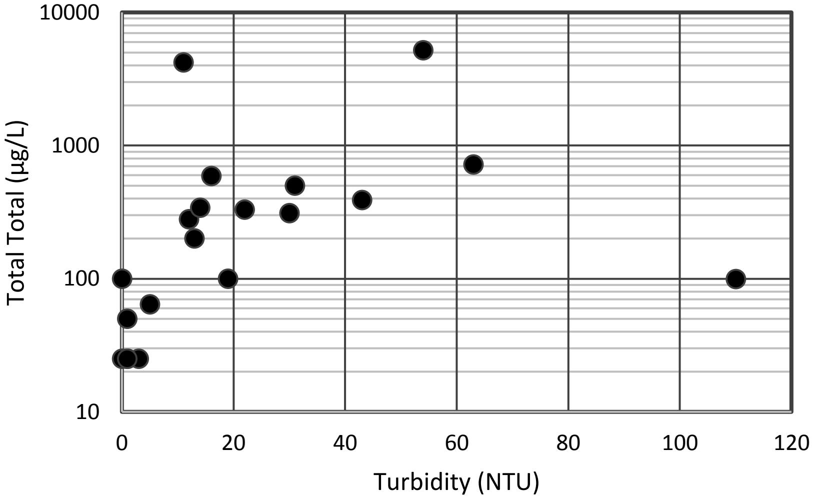


The five possible outliers with high ORP and low dissolved oxygen include all three observations from MW-310 and one from MW-305. The DO measurements indicate the groundwater becomes suboxic as it travels beneath the Ash Pond. The ORP values at the downgradient edge of the Ash Pond range from +55 to -110 mV in the October samples compared to the upgradient value of +160 mV. At the most downgradient location, near the Des Moines River, the October dissolved oxygen increases slightly and the ORP is +90 mV.

There is no measurable total or dissolved iron in the upgradient well consistent with the pH and ORP. At the Ash Pond perimeter, the total iron (including iron associated with suspended sediment) increases to between 64 and 5,200 µg/L. The dissolved iron increases significantly only at MW-304, -305 and -306. At MW-310 the total and dissolved iron return to near or below the laboratory reporting limits.



There is a weak correlation between total and dissolved iron. There is no correlation between the groundwater pH and the total or dissolved iron. Except for MW-304, there is no correlation between total and dissolved iron and ORP. MW-304 reports the lowest ORPs (-110 to -120 mV) and the highest iron concentrations.



As might be expected, the suspended sediment is positively correlated with total iron concentrations (with one outlier from MW-304 and one from MW-310A).

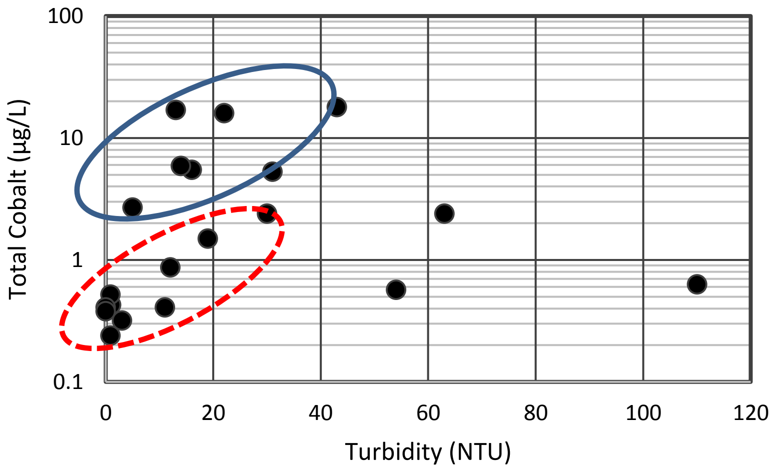
Only dissolved manganese was consistently measured in the groundwater. The lowest concentrations are found at MW-301 and -310 (14 to 53 µg/L). At MW-304, -305 and -306 the concentrations range from 3,100 to 16,000 µg/L. There is a general negative correlation between dissolved manganese and ORP.

Sulfate concentrations increase from MW-301 to MW-306 with the possible seepage from the Ash Pond, and then decreased with continued downgradient migration to MW-305. This may suggest limited sulfate reduction is occurring. The subsequent increase in sulfate at MW-310 is attributed to upward flowing deep groundwater mixing with the shallow groundwater as described elsewhere by SCS. The mixing is supported by the trends in boron and lithium concentrations that show sharp decreases and increases, respectively, as the deeper groundwater mixes with the shallower groundwater.

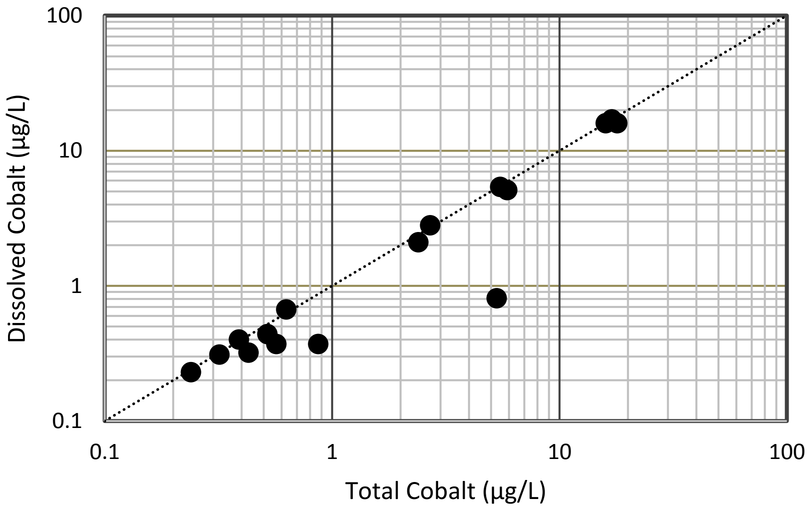
Cobalt Geochemistry. Cobalt is present as a 2+ cation (Co^{2+}) and is the dominant species found in natural environments. Its valance state is not affected by the oxidation reduction potential in which it is found, but the ORP can affect ligands with which cobalt may complex, precipitate or absorb to. Assuming an ORP on the order of -100 to -400 mV (Eh on the order of 100 to -200 mV) and a pH on the order of 6 to 7 SU suggests cobalt could occur as aqueous Co^{2+} or precipitate as CoS. In many settings the aqueous concentrations are a function of adsorption to, or coprecipitation with iron, manganese or aluminum oxyhydroxides. Iron and manganese oxyhydroxide formation are controlled by pH and ORP. Aluminum oxyhydroxide is controlled by pH with maximum precipitation between pH of 6 to 7 SU.

Total and dissolved iron concentrations are less than 1 µg/L at the upgradient well (MW-301) and the downgradient-most wells (MW-310 and -310A). Cobalt concentrations are also less than 1 µg/L at MW-304. Most of the remaining perimeter wells (MW-302, -303, -305A and -306) yield total and dissolved cobalt concentrations between 1 and 6 µg/L while MW-305 produced about 17 µg/L of both total and dissolved cobalt.

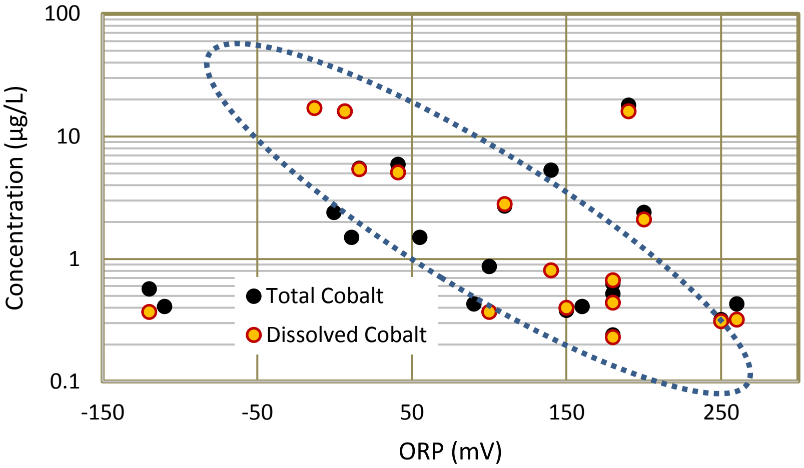
The total cobalt concentrations (which includes cobalt associated with suspended sediment) shows positive correlations with suspended sediment loads as measured by turbidity at the time of sample collection. Three possible outliers on the following chart include one sample each from MW-304, -305 and -310A.



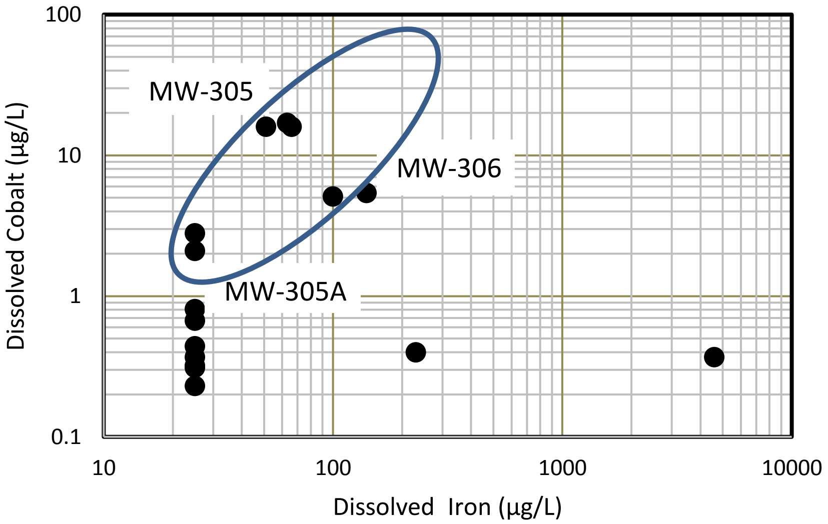
The remaining data appear to fall into two groups. The data from MW-305, -305A and -306 within the solid blue outline suggest the total cobalt concentration increases with the amount of suspended sediment. All the remaining data suggest a similar correlation, but offset by about 10 times lower total cobalt. The correlation between dissolved cobalt and turbidity is nearly identical to the total cobalt plot because dissolved and total cobalt are well correlated.



This suggests the possibility that there is an absorption equilibrium between the aqueous dissolved cobalt and the cobalt associated with the iron-bearing suspended sediment.



While cobalt's valence state would not be affected by ORP, there is a general correlation between ORP and dissolved or total cobalt in the groundwater (except for possible outliers from MW-304 and -305). When reviewing all the data there was no correlation evident between ORP and iron. However, plotting dissolved iron (which is expected to increase with decreasing ORP) against dissolved cobalt there is a positive correlation for MW-305, -305A and -306 where dissolved cobalt is present above 1 µg/L (one sample from each of MW-304 and MW-310A are potential outliers with high iron concentrations).



This suggests the cobalt that passes a 0.45 µm filter may be absorbed to iron that passes a 0.45 µm filter (i.e. "colloidal" particulate iron).

The mass of cobalt in the groundwater where the GPS may be exceeded between MW-305 and MW-310 is estimated at 0.60 kg assuming:

- Approximate plume dimensions of 120 m wide (assuming ~ half the distance between MW-305 and adjacent wells that do not exceed the GPS) by 320 m long and 6 m thick,
- Total porosity of 0.3
- Cobalt concentration of 8.7 ug/L (average of MW-305 and -310)

Potential for Site-Specific Cobalt Natural Attenuation.

Immobilization within the saturated sand is the mechanism that drives natural attenuation of cobalt. If cobalt were not attenuated, the 30-year groundwater travel time from the Ash Pond to MW-310 suggests that cobalt should have arrived at MW-310 in the ~40 years since the Ash Pond was commissioned if it was not attenuated. The cobalt concentration from MW-305 to MW-310 appears to decrease by a factor of ~60. Dilution by mixing with upward flowing deep groundwater at MW-310 may be a factor in the decrease. Assuming lithium is a conservative constituent in the deep groundwater at 270 µg/L, its concentration is reduced to 48 µg/L by mixing with the 3.2 µg/L from MW-305. The potential mixing does not appear to be sufficient to account for the cobalt concentration reduction. Precipitation, coprecipitation or adsorption likely account for the remaining decrease.

The groundwater becomes more oxic from the Ash Pond perimeter to MW-310 at the Des Moines River. As the ORP increases, iron precipitates from the water and provides adsorption sites on iron oxyhydroxides for cobalt which is then also removed from the groundwater.

In addition, the sand at MW-305 is described as yellow-brown suggesting that some of the iron may be in an oxidized form on the surfaces of the sand. The color of the sand at MW-310 was not recorded. The iron oxyhydroxides on the aquifer matrix provide potential adsorption sites for the sequestration of cobalt.

Recommendations for Additional Assessment of Site-Specific Cobalt Monitored Natural Attenuation

Lines of evidence for continued evaluation of cobalt natural attenuation are suggested:

- The redox conditions in the saturated sand are key to understanding potential cobalt fate. The cause(s) of possible recent inconsistent ORP values or potential trends of decreasing ORP measured in the field should be evaluated in order to improve these measurements.

- Two additional monitoring wells should be installed between MW-305 and MW-310 (at ~400-foot spacing) to better define aqueous geochemical trends from the Ash Pond to the Des Moines River. The data will also refine the estimate of cobalt mass in the groundwater downgradient of the Ash Pond. Groundwater sample analyses would include:
    - In-field measurement of pH, ORP, DO, ORP, temperature, specific electrical conductance, turbidity, ferrous iron and sulfide; and laboratory analyses of dissolved (0.45 µm filtered) Ca, Mg, Na, K, Fe, Mn, alkalinity (as $CaCO_3$), Cl, SO_4, and TDS to better define the groundwater chemistry and evolution with flow.
    - Laboratory analyses of dissolved (0.45 µm filtered) cobalt to better define the aqueous or “mobile” plume.
    - Laboratory analyses of 0.20 µm filtered cobalt and iron to assess potential adsorption of cobalt to “colloidal” iron.
    - Filtration of turbid groundwater produced by the monitoring wells and analysis of the solid filtrate for aluminum, iron and cobalt to determine the degree to which the cobalt is associated with suspended solids.

  Additional hydrogeologic data collected from the new well locations would include soil descriptions, hydraulic head and hydraulic conductivity.

- Laboratory analyses of the degree of iron precipitation and cobalt coprecipitation and adsorption from MW-305 groundwater with aeration (i.e. redox increase) to better understand the degree to which cobalt adsorption and coprecipitation contributes to attenuation.

- Continued monitoring of cobalt concentrations over time to determine cobalt migration is completely attenuated or slowed by attenuation.

- Samples of the saturated sand should be collected from the two new well locations and from the area adjacent to MW-305 and MW-310. Analyses of sand would include:
    - iron and manganese concentrations to assess potential for adsorption
    - cobalt concentrations to assess the degree to which cobalt has adsorbed or coprecipitated on to the sand matrix (i.e. defining the "immobile plume")
    - cobalt adsorption isotherms to assess capacity of the sand to absorb cobalt and determine maximum adsorption capacity.

Table 1. Groundwater chemistry summary (April 2020).

Parameter	Units	Location (from up to down gradient)			
		MW-301	MW-306	MW-305	MW-310
pH	SU	6.6	6.7	7.0	7.0
ORP	mV	180	50	7	180
Dissolved Oxygen	mg/L	5.1	0.2	0.3	0.2
Specific Conductance	µS/cm	940	1160	1770	1820
Temperature	ºC	8.7	12	9.1	10
Turbidity	NTU	1	16	22	.9
Cobalt (T)	µg/L	0.42	5.5	16	0.24
Cobalt (D)	µg/L		5.4	16	0.23
Lithium (T)	µg/L	24	<2.3	3.2	48
Calcium (T)	mg/L	84	73	100	200
Magnesium (T)	mg/L	33	26	47	86
Sodium (T)	mg/L	77	160	210	100
Potassium(T)	mg/L	1.5	3.7	7.6	12
Iron (T)	µg/L	50	590	330	<50
Iron (D)	µg/L	<50	140	66	<50
Manganese (D)	µg/L	16	16,000	3400	280
Alkalinity (T, as CaCO3)	mg/L	150	280	460	190
Chloride (T)	mg/L	140	41	270	130
Sulfate (T)	mg/L	140	310	63	590
Total Dissolved Solids	mg/L	550	820	960	1,300

(D) Dissolved concentration filtered at 0.45 µm.

(T) Total concentration, unfiltered.

Ferrous iron measured in the field by Hach colorimetric kit.

NA – not analyzed.

Table 2. Selected groundwater chemistry for March through October 2020.

Parameter	Units	MW-301			MW-302		MW-303		MW-304		MW-305		
		20-Mar	20-Apr	Oct-20	20-Apr	Oct-20	20-Apr	Oct-20	20-Apr	Oct-20	Mar-20	20-Apr	Oct-20
Iron-T	µg/L	<50	50	<50	500	100	280	310	5200	4200	390	330	200
Iron-D		<50	<50	<50	<50	<50	<50	<50	4600	4200	51	66	63
Cobalt-T		0.43	0.52	0.41	5.3	1.5	0.87	2.4	0.57	0.41	18	16	17
Cobalt-D		0.32	0.44	---	0.81	---	0.37	---	0.37	---	16	16	17
Turbidity	NTU	1	0.9	0	31	19	12	30	54	11	43	22	13
pH	SU	6.48	6.58	6.22	6.70	7.00	6.98	8.28	7.12	7.88	7.02	7.00	7.44
ORP	mV	260	180	160	140	55	100	-0.4	-120	-110	190	6.6	-13
Diss. Oxygen	mg/L	5.3	5.1	4.2	0.2	0.1	1.9	0.1	0.2	0.2	0.2	0.3	0.1

Parameter	Units	MW-305A			MW-306		MW-310			MW-310A		
		Mar-20	20-Apr	Oct-20	20-Apr	Oct-20	Mar-20	20-Apr	Oct-20	Mar-20	20-Apr	Oct-20
Iron-T	µg/L	720	64	64	590	340	<50	<50	100	99	220	280
Iron-D		<50	<50	<50	140	100	<50	<50	<50	<50	230	<50
Cobalt-T		2.4	2.7	1.5	5.5	5.9	0.32	0.24	0.38	0.63	0.39	0.43
Cobalt-D		2.1	2.8	---	5.4	5.1	0.31	0.23	---	0.67	0.4	---
Turbidity	NTU	63	5	---	16	14	3	0.9	0	110	---	---
pH	SU	8.09	7.63	7.46	6.68	6.54	6.89	7.00	7.07	7.73	7.85	7.48
ORP	mV	200	110	11	16	41	250	180	150	180	150	90
Diss. Oxygen	mg/L	3.8	2.3	0.2	0.2	0.1	0.3	0.2	0.2	6.5	6.4	0.5

Notes: T – total, result unfiltered with suspended solids. D – Dissolved, result filtered at 0.45 um.
Charts use ½ of the laboratory reporting limits for plotting purposes.

Appendix D

Mann-Kendall Trend Test

Trend Test

Ottumwa Generating Station   Client: SCS Engineers   Data: OGS_CP_Export_201122   Printed 11/25/2020, 8:41 AM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Cobalt (ug/L)	MW-301 (bg)	-0.02007	-6	-23	No	9	0	n/a	n/a	0.02	NP
Cobalt (ug/L)	MW-302	0.869	8	17	No	7	0	n/a	n/a	0.02	NP
Cobalt (ug/L)	MW-303	-0.5549	-3	-17	No	7	0	n/a	n/a	0.02	NP
Cobalt (ug/L)	MW-304	0.008075	3	17	No	7	0	n/a	n/a	0.02	NP
Cobalt (ug/L)	MW-305	0.7573	13	23	No	9	0	n/a	n/a	0.02	NP
Cobalt (ug/L)	MW-305A	-1.564	NaN	NaN	No	3	0	n/a	n/a	NaN	NP
Cobalt (ug/L)	MW-306	0.2686	4	20	No	8	0	n/a	n/a	0.02	NP
Cobalt (ug/L)	MW-310	-0.3127	-3	-10	No	5	0	n/a	n/a	0.02	NP
Cobalt (ug/L)	MW-310A	-0.3427	NaN	NaN	No	3	0	n/a	n/a	NaN	NP
Cobalt (ug/L)	MW-311	-0.1731	-1	-10	No	5	40	n/a	n/a	0.02	NP
Cobalt (ug/L)	MW-311A	-0.1222	NaN	NaN	No	3	0	n/a	n/a	NaN	NP

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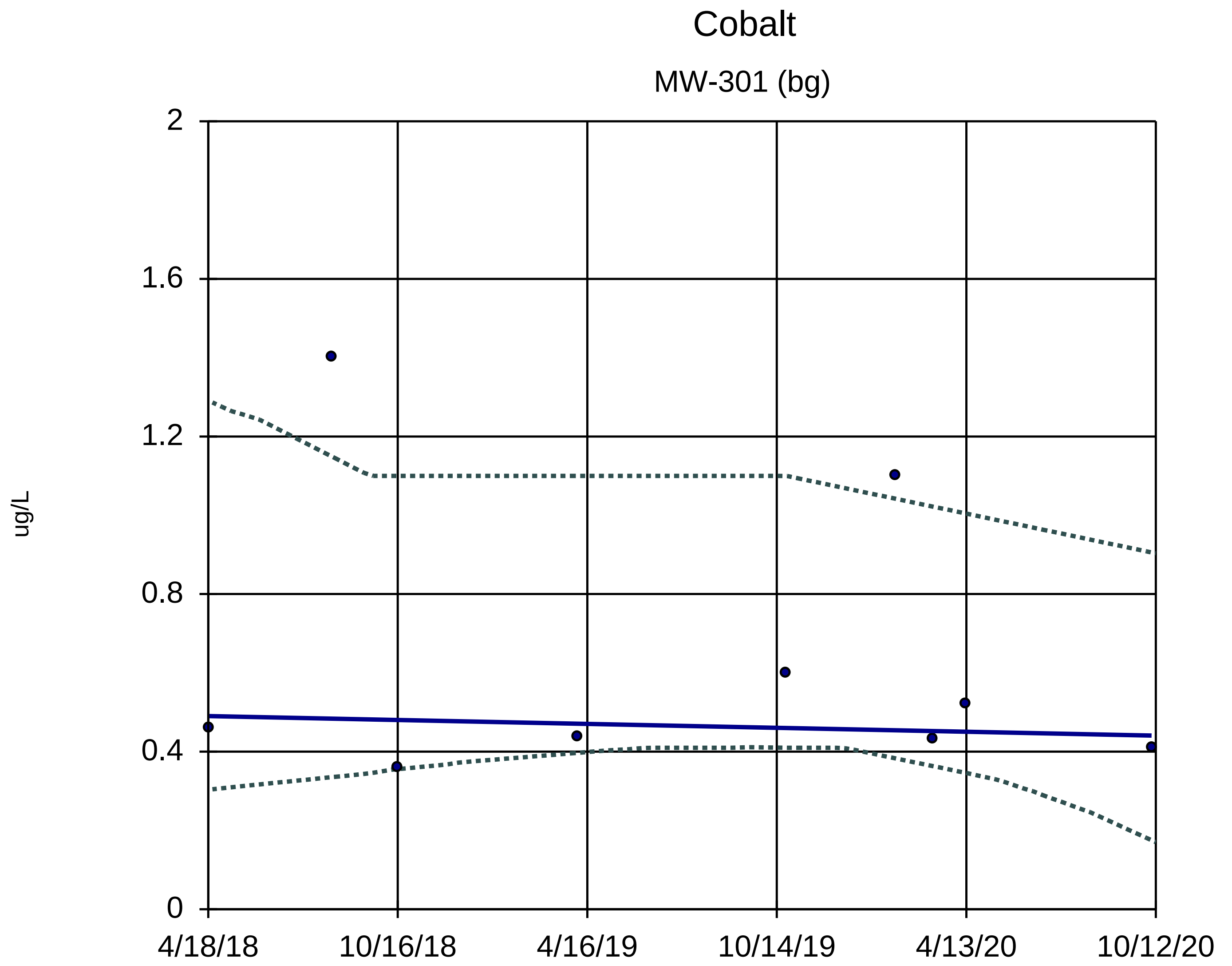


n = 9

Slope = -0.02007
units per year.

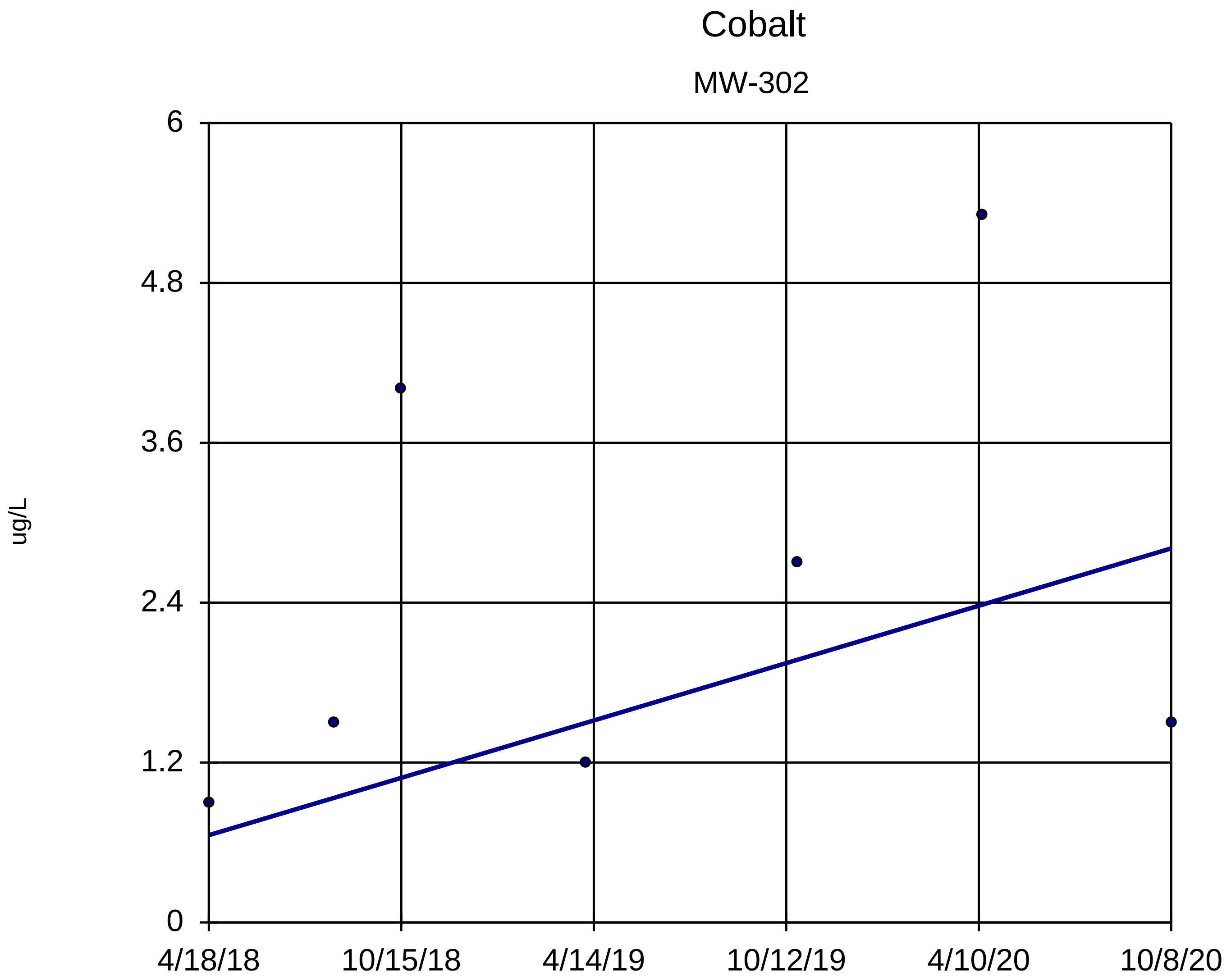
Mann-Kendall
statistic = -6
critical = -23

Trend not significant at 98%
confidence level
(α = 0.01 per
tail).

Sen's Slope and 95% Confidence Band   Analysis Run 11/25/2020 8:40 AM

Ottumwa Generating Station   Client: SCS Engineers   Data: OGS_CP_Export_201122

11/25/2020 - Classification: Internal - ECRM7804236



n = 7

Slope = 0.869
units per year.

Mann-Kendall
statistic = 8
critical = 17

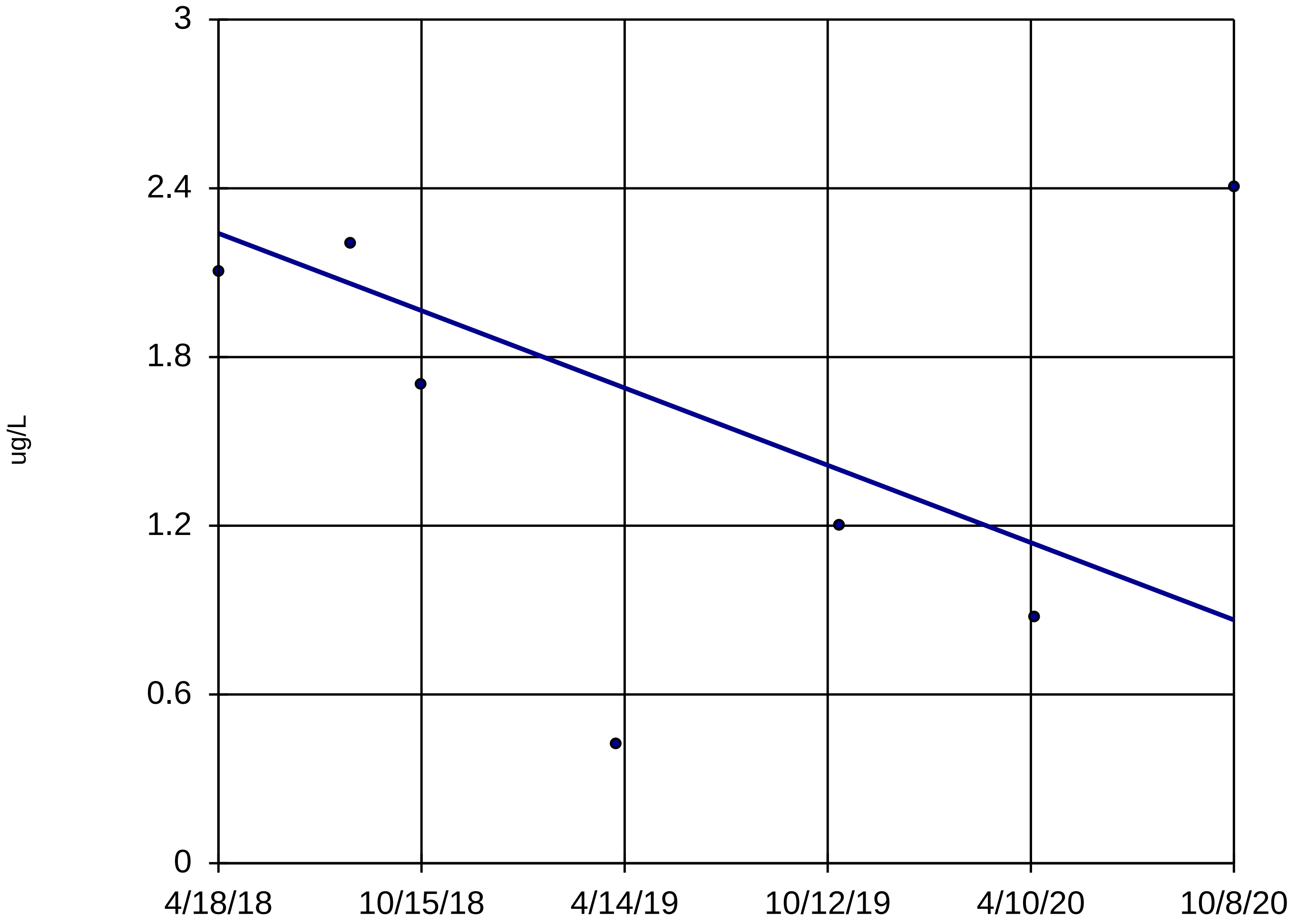
Trend not significant at 98%
confidence level
(α = 0.01 per
tail).

Sen's Slope Estimator Analysis Run 11/25/2020 8:40 AM

Ottumwa Generating Station Client: SCS Engineers Data: OGS_CP_Export_201122

Cobalt

MW-303



n = 7

Slope = -0.5549
units per year.

Mann-Kendall
statistic = -3
critical = -17

Trend not significant at 98%
confidence level
(α = 0.01 per
tail).

Sen's Slope Estimator   Analysis Run 11/25/2020 8:40 AM

Ottumwa Generating Station   Client: SCS Engineers   Data: OGS_CP_Export_201122

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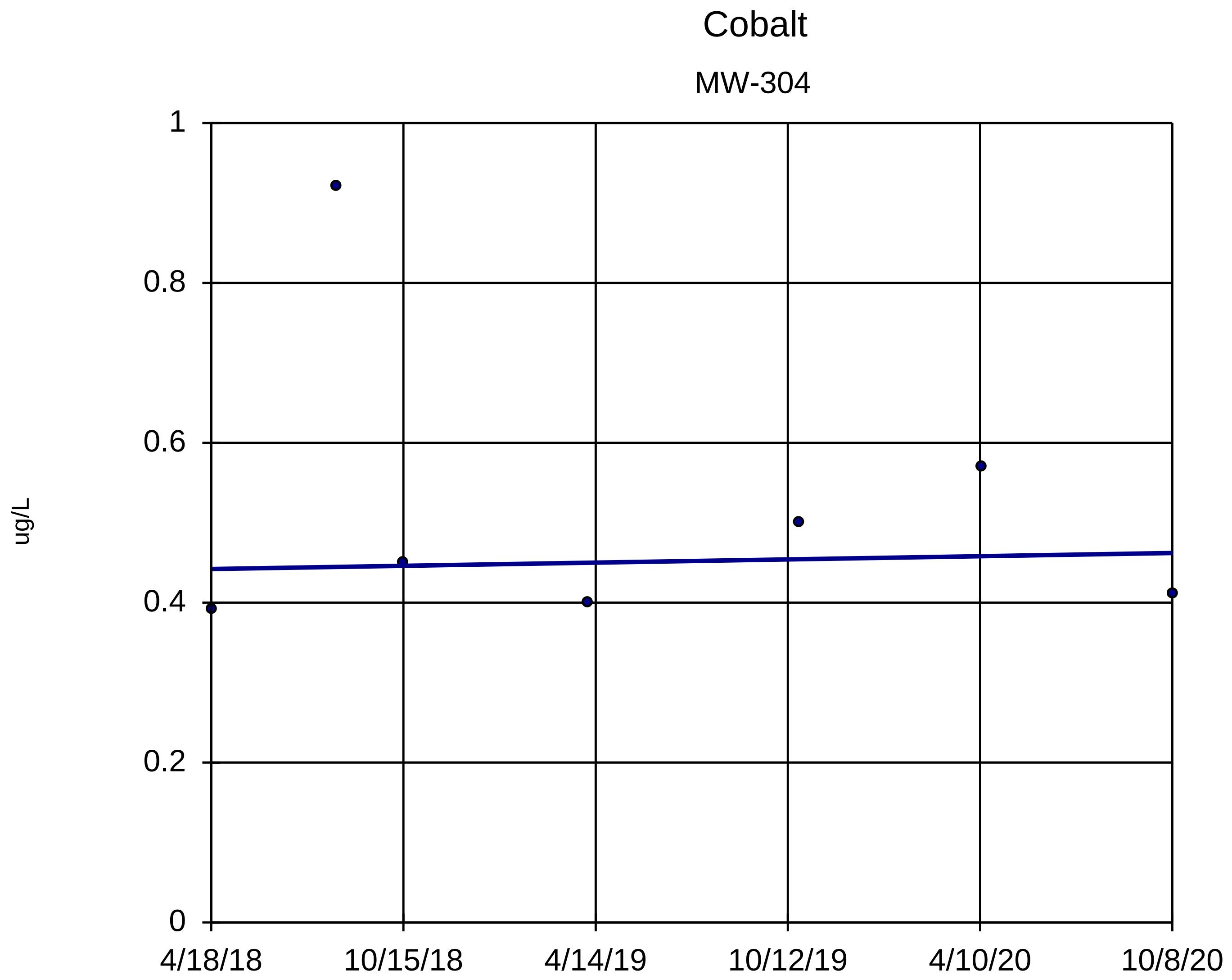


n = 7

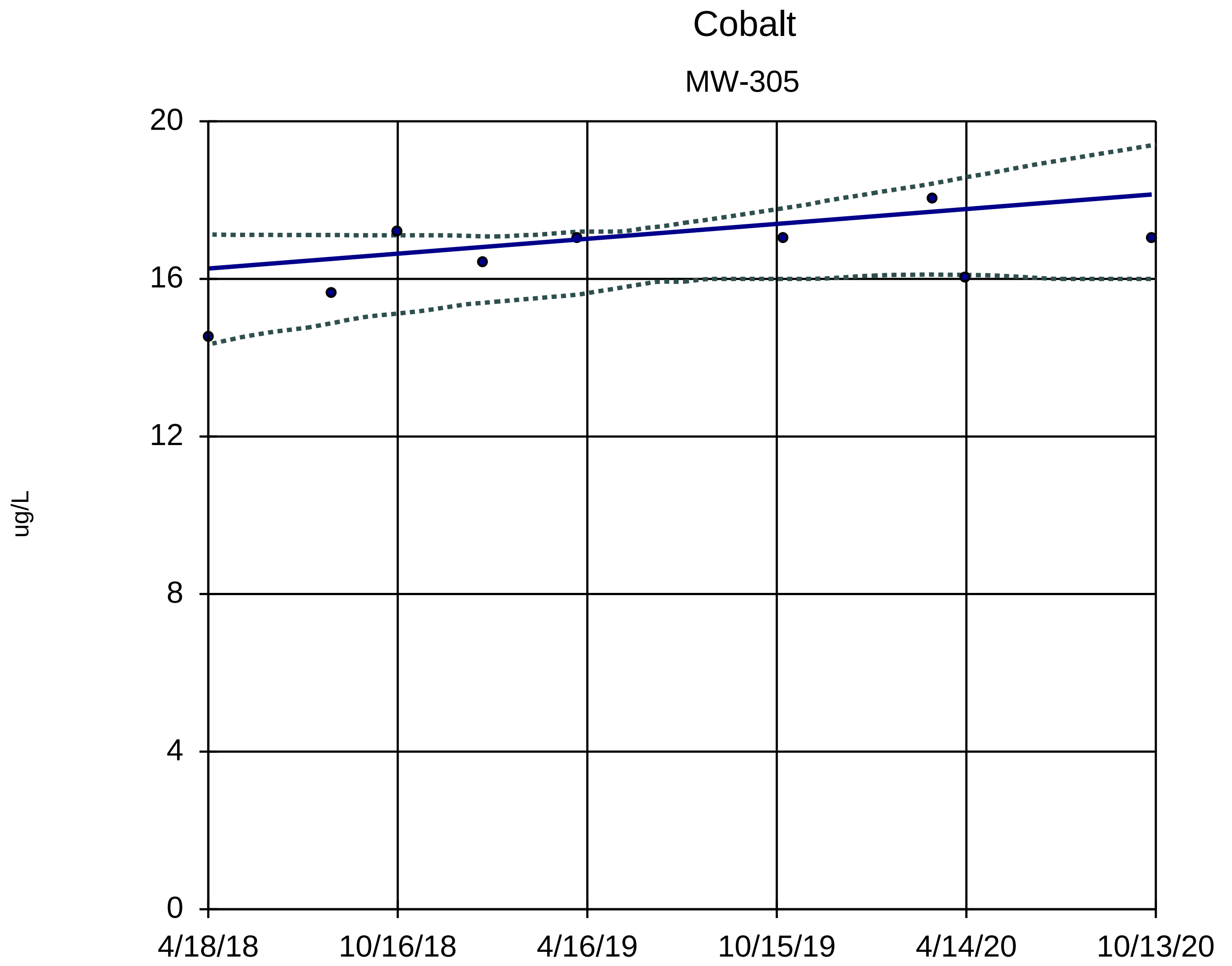
Slope = 0.008075 units per year.

Mann-Kendall statistic = 3 critical = 17

Trend not significant at 98% confidence level (α = 0.01 per tail).

Sen's Slope Estimator   Analysis Run 11/25/2020 8:40 AM

Ottumwa Generating Station   Client: SCS Engineers   Data: OGS_CP_Export_201122



n = 9

Slope = 0.7573
units per year.

Mann-Kendall
statistic = 13
critical = 23

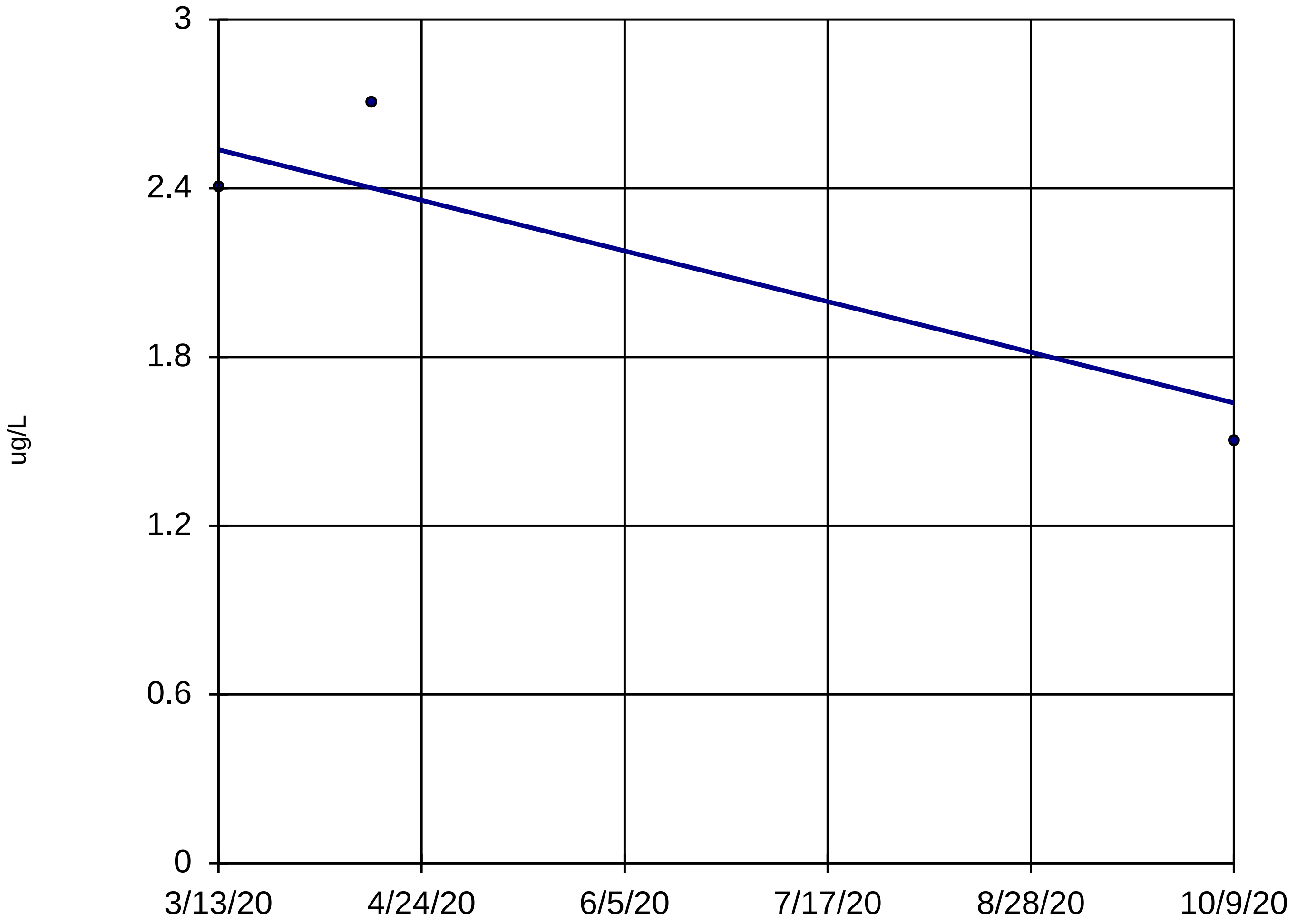
Trend not significant at 98%
confidence level
(α = 0.01 per
tail).

Sen's Slope and 95% Confidence Band   Analysis Run 11/25/2020 8:40 AM

Ottumwa Generating Station   Client: SCS Engineers   Data: OGS_CP_Export_201122

Cobalt

MW-305A



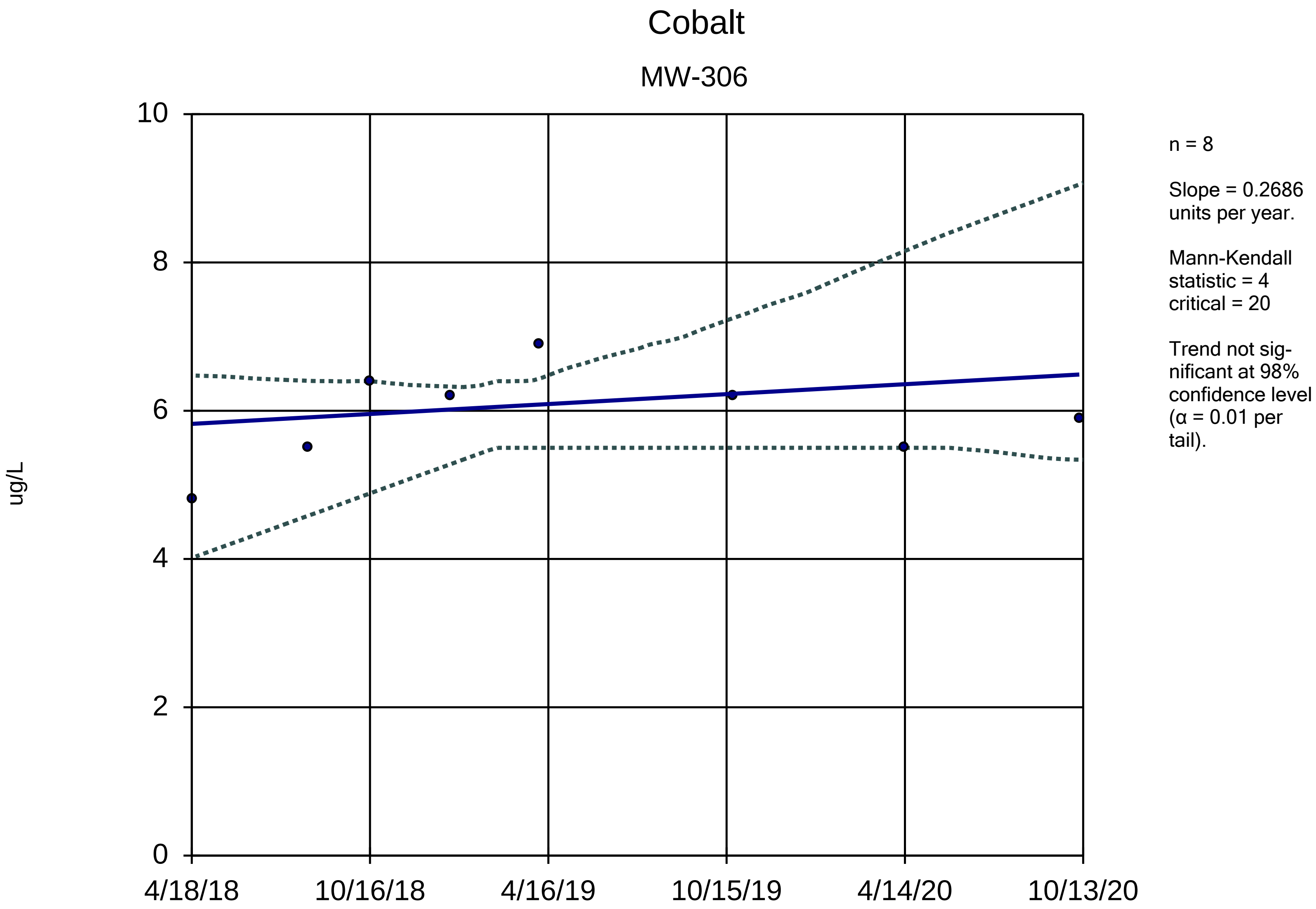
n = 3

Slope = -1.564
units per year.

Minimum n for
Mann-Kendall
is 4.

Sen's Slope Estimator   Analysis Run 11/25/2020 8:40 AM

Ottumwa Generating Station   Client: SCS Engineers   Data: OGS_CP_Export_201122



n = 8

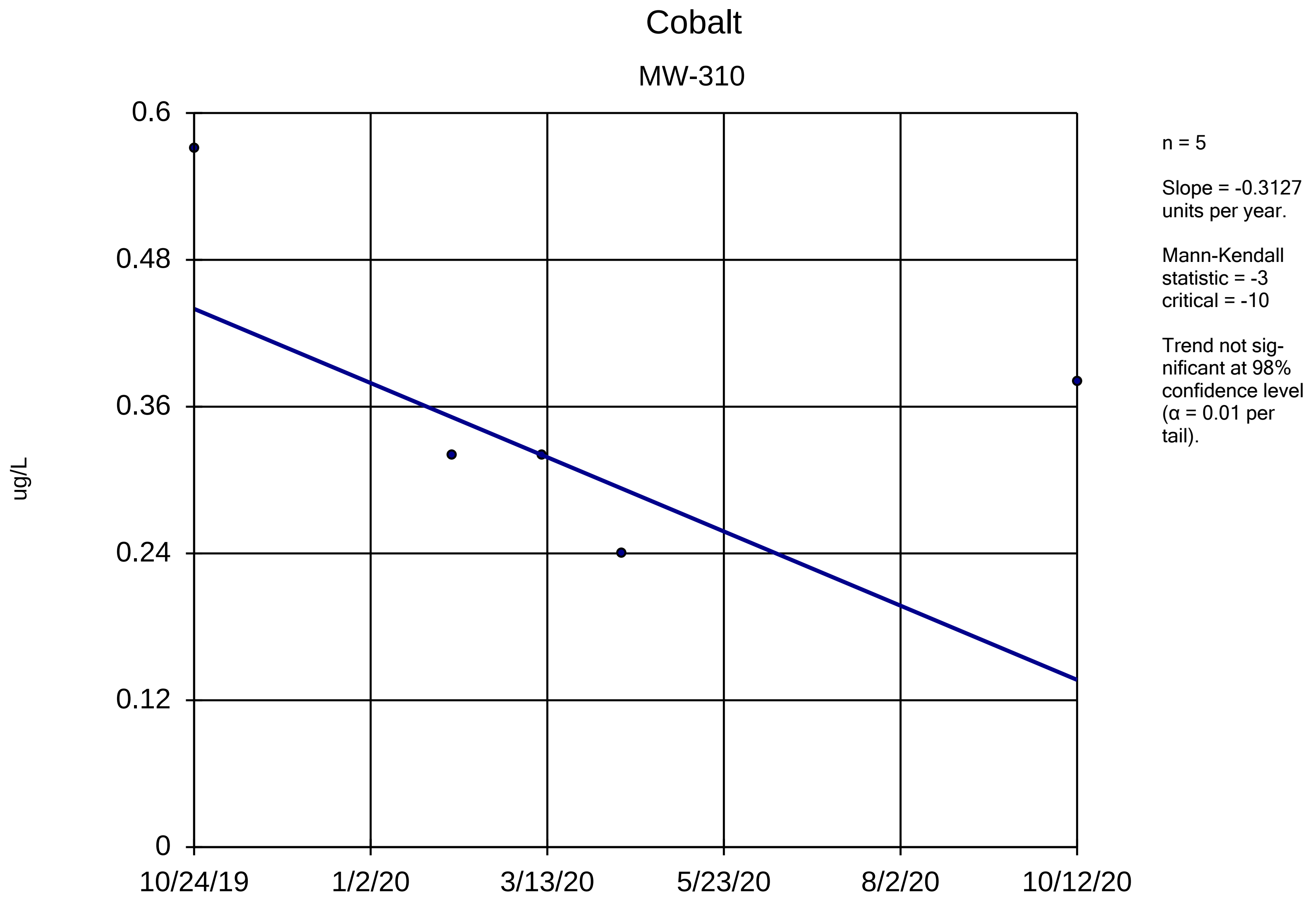
Slope = 0.2686
units per year.

Mann-Kendall
statistic = 4
critical = 20

Trend not significant at 98%
confidence level
(α = 0.01 per
tail).

Sen's Slope and 95% Confidence Band   Analysis Run 11/25/2020 8:40 AM

Ottumwa Generating Station   Client: SCS Engineers   Data: OGS_CP_Export_201122



Sen's Slope Estimator   Analysis Run 11/25/2020 8:40 AM

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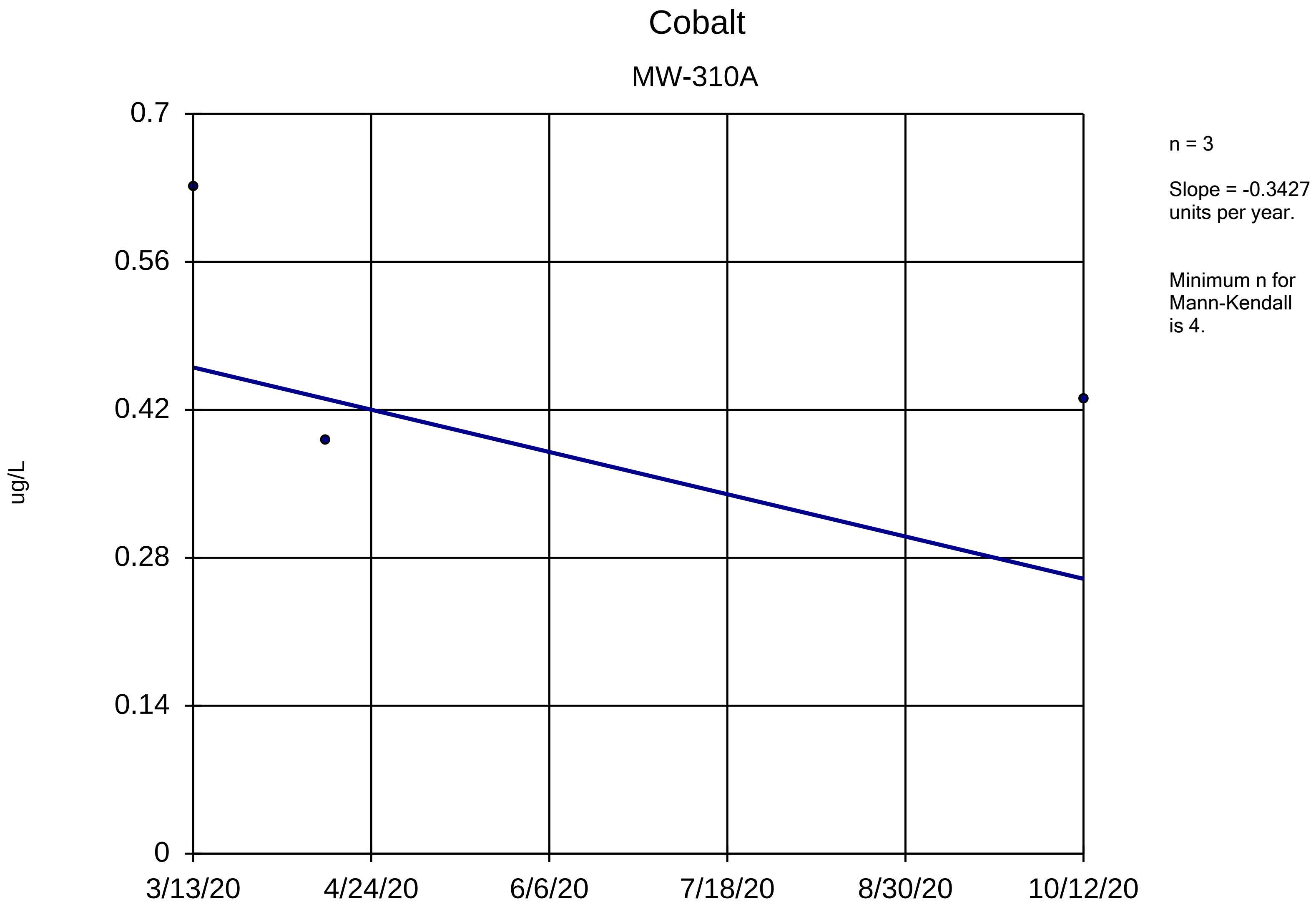

Sen's Slope Estimator Analysis Run 11/25/2020 8:40 AM

Ottumwa Generating Station Client: SCS Engineers Data: OGS_CP_Export_201122

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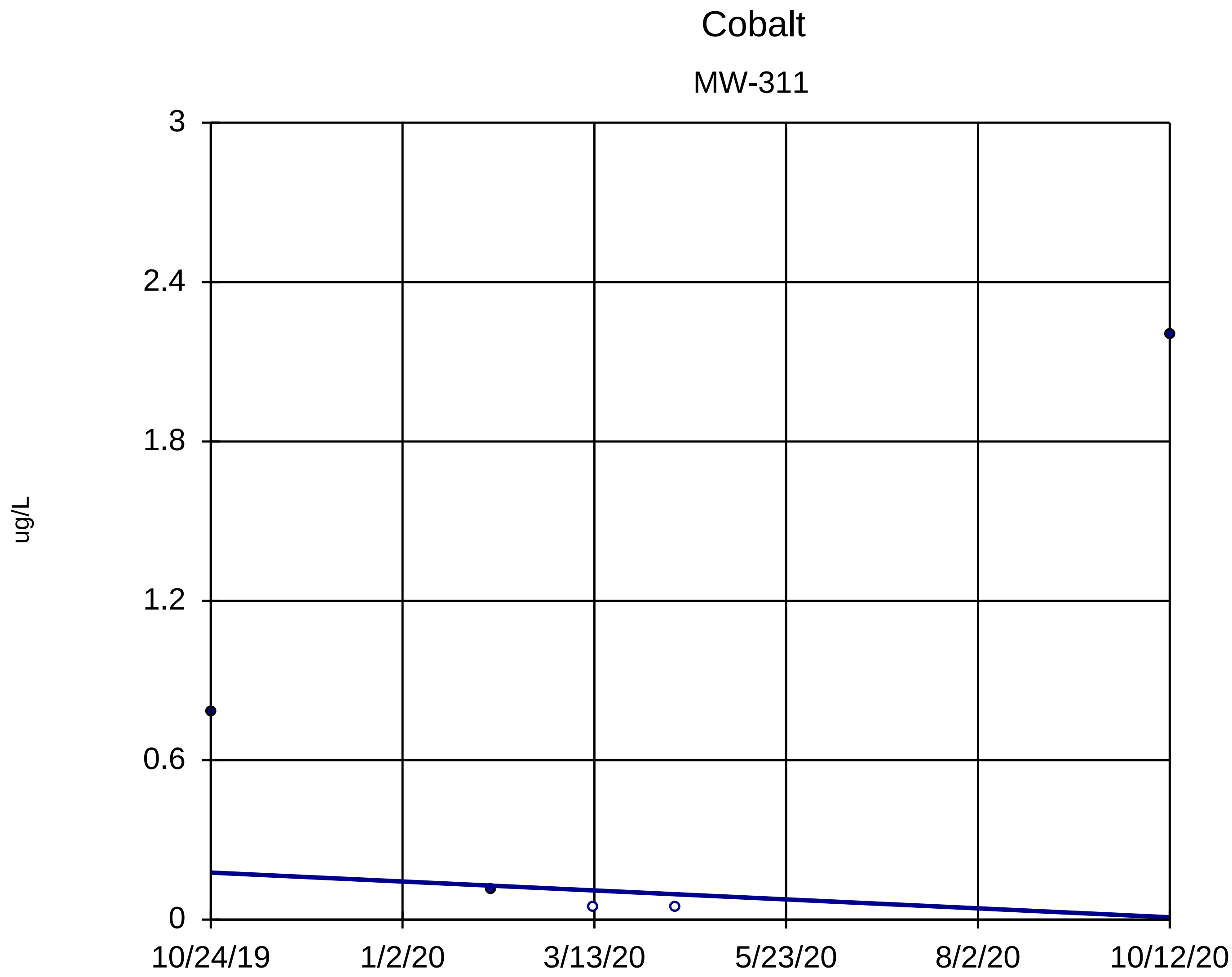
Hollow symbols indicate censored values.



n = 5

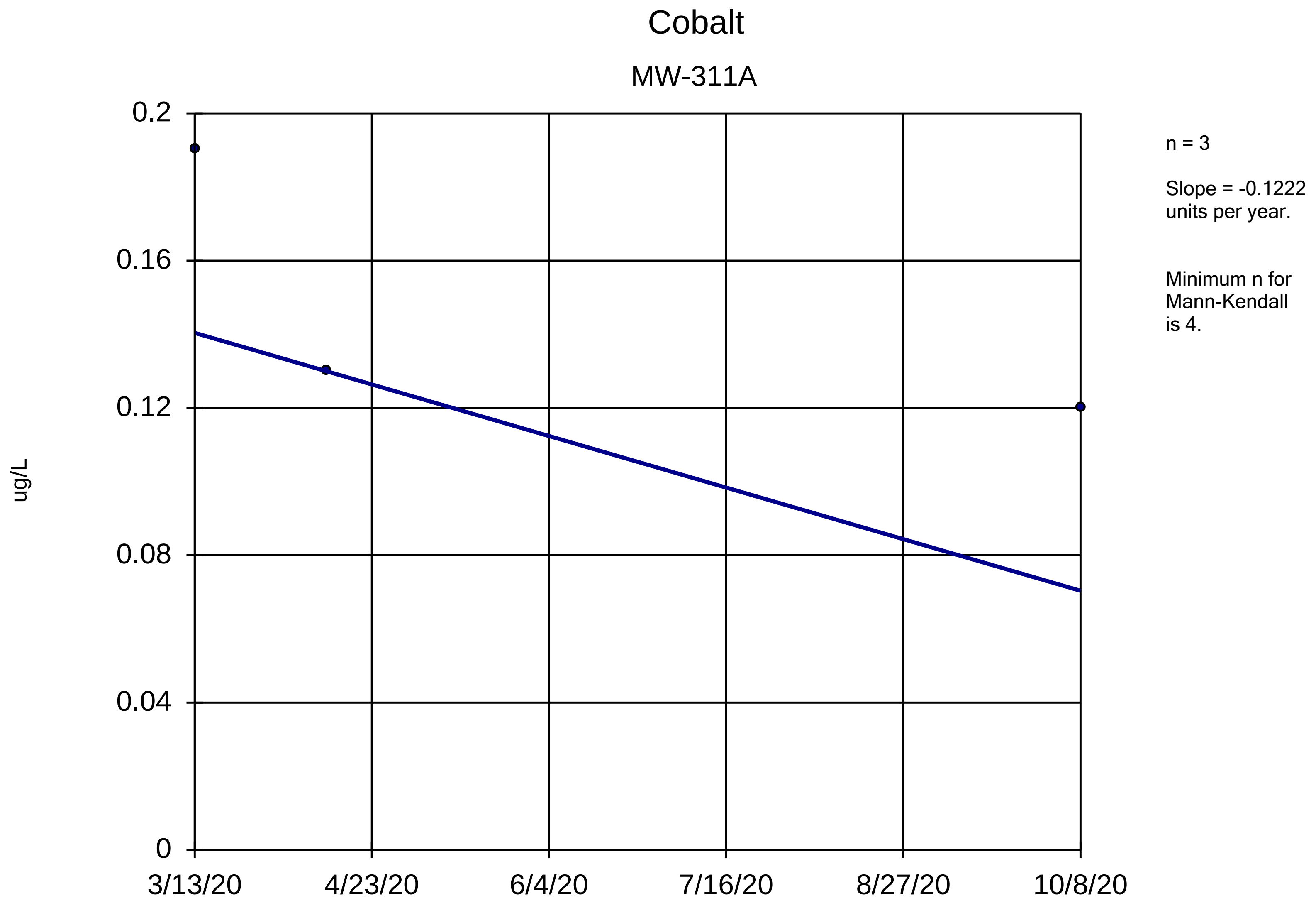
Slope = -0.1731
units per year.

Mann-Kendall
statistic = -1
critical = -10

Trend not significant at 98%
confidence level
(α = 0.01 per
tail).

Sen's Slope Estimator   Analysis Run 11/25/2020 8:40 AM

Ottumwa Generating Station   Client: SCS Engineers   Data: OGS_CP_Export_201122



Sen's Slope Estimator   Analysis Run 11/25/2020 8:40 AM

Ottumwa Generating Station   Client: SCS Engineers   Data: OGS_CP_Export_201122

APPENDIX C7– REMEDY SELECTION PROGRESS REPORT

Semiannual Progress Report
Selection of Remedy – OGS Ash Pond

Ottumwa Generating Station
Ottumwa, Iowa

Prepared for:

Alliant Energy

SCS ENGINEERS

25220083.00 | March 13, 2020

2830 Dairy Drive
Madison, WI 53718-6751
608-224-2830

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1.0 INTRODUCTION AND PURPOSE

The Semiannual Progress Report for remedy selection at the Interstate Power and Light Company (IPL) Ottumwa Generating Station (OGS) was prepared to comply with U.S. Environmental Protection Agency (USEPA) regulations regarding the Disposal of Coal Combustion Residuals (CCR) from Electric Utilities [40 CFR 257.50-107], or the "CCR Rule" (Rule). Specifically, the selection of remedy process was initiated to fulfill the requirements of 40 CFR 257.97.

1.1 BACKGROUND

The Assessment of Corrective Measures (ACM) for the OGS Ash Pond was completed on September 12, 2019. The ACM was completed in response to the detection of cobalt at a statistically significant level above the Groundwater Protection Standard (GPS) in groundwater samples from downgradient monitoring well MW-305.

This Semiannual Progress Report summarizes data collected and remedy evaluation progress made since the ACM was completed in September 2019, and outlines planned future activities to complete the selection of remedy process.

1.2 SITE INFORMATION AND MAPS

OGS is located southwest of the Des Moines River, approximately 8 miles northwest of the City of Ottumwa in Wapello County, Iowa (**Figure 1**). The address of the plant is 20775 Power Plant Road, Ottumwa, Iowa. In addition to the coal-fired generating station, the property also contains the OGS Ash Pond, the OGS Zero Liquid Discharge (ZLD) Pond, a coal stockpile, and a hydrated fly ash stockpile.

The two CCR units at the facility (OGS Ash Pond and OGS ZLD Pond) are each monitored with single-unit groundwater monitoring systems. The OGS Ash Pond is the subject of this Semiannual Progress Report.

The pending closure of the OGS Ash Pond was discussed in the IPL Notification of Intent to Close CCR Surface Impoundment, dated April 3, 2019. A map showing the CCR units and all background (or upgradient) and downgradient monitoring wells with identification numbers for the CCR groundwater monitoring program is provided as **Figure 2**.

Groundwater flow at the site is generally to the east-northeast, and the groundwater flow direction and water levels fluctuate seasonally due to the proximity to the river. Depth to groundwater as measured in the site monitoring wells varies from 1 to 25 feet below ground surface due to topographic variations across the facility and seasonal variations in water levels.

2.0 SUMMARY OF WORK COMPLETED

Work completed to support remedy selection for the OGS Ash Pond is summarized in **Table 1**. Activities completed within the 6-month period covered by this semiannual report are discussed in more detail below.

2.1 MONITORING NETWORK CHANGES

Planning, permitting, and access coordination for the installation of three additional monitoring wells was completed in February 2020. The proposed wells are deeper piezometers, to be located adjacent to existing monitoring wells MW-305, MW-310, and MW-311. The locations of existing monitoring wells at OGS are shown on **Figure 2**.

2.2 GROUNDWATER MONITORING

Groundwater samples were collected in October 2019 and February 2020. The October 2019 monitoring event was part of the routine semiannual assessment monitoring program. The wells sampled included the six wells in the original monitoring system (MW-301 through MW-306) and the two additional wells (MW-310 and MW-311) installed in August 2019. The February 2020 monitoring event included a second round of samples from the two new wells. The background well (MW-301) was also sampled in the February 2020 event. A summary of groundwater samples collected since submittal of the ACM is provided in **Table 2**.

2.3 EVALUATION OF CORRECTIVE MEASURE ALTERNATIVES

A qualitative assessment of potential Corrective Measure Alternatives using the selection criteria in 40 CFR 257.97(b) and (c) was provided in the September 2019 ACM. **Table 3** summarizes the assessment completed for the ACM. No updates or changes to the assessment have been made based on additional information obtained since the issue of the ACM. Additional groundwater data collection and analysis is necessary for the evaluation of the monitored natural attenuation (MNA) option. In addition, IPL has retained an engineer to develop a proposed design for closure of the OGS Ash Pond that will be evaluated against the selection criteria. Updates to the assessment, and development of the quantitative evaluation system discussed in the ACM, will be completed in the future based on updates to the conceptual site model, delineation of the nature and extent of impacts, ash pond closure design activities, and collection of additional data relevant to remedy selection.

3.0 PLANNED ACTIVITIES

Planned activities related to the remedy selection process include the following:

- Install three piezometers nested with existing monitoring wells MW-305, MW-310, and MW-311. The piezometers will provide additional data on vertical groundwater flow and groundwater constituent concentrations.
- Collect groundwater samples at the three new piezometers.
- Continue semiannual assessment monitoring for the existing monitoring well network and new monitoring wells.
- Evaluate MNA feasibility, including additional evaluation of groundwater flow and groundwater quality.
- Update conceptual site model based on findings of nature and extent investigation.
- IPL will continue to develop a closure design for the OGS Ash Pond.
- Continue evaluation of remedial options.
- Conduct public meeting (40 CFR 257.96(e)).

Tables

Table 1. Timeline for Completed Work - Selection of Remedy
Ottumwa Generating Station / SCS Engineers Project #25220083.00

Date	Activity
August 2019	Additional monitoring wells installed to investigate nature and extent (MW-310 and MW-311)
September 2019	Completed ACM
October 2019	Conducted semiannual assessment monitoring event
November 2019	Completed Well Construction Documentation for new monitoring wells
January 2020	Completed Statistical Evaluation of October 2019 groundwater monitoring results
January 2020	Completed 2019 Annual Groundwater Monitoring and Corrective Action Report
August 2019 - February 2020	OGS Ash Pond closure design (ongoing)
December 2019 to February 2020	Planning, permitting, and access for three additional monitoring wells (piezometers) to investigate the vertical extent of impacts
February 2020	Collected second round of groundwater samples from the new monitoring wells (MW-310 and MW-311) and background well

Created by: SCC Date: 2/17/2020
Last revision by: MDB Date: 2/26/2020
Checked by: TK Date: 2/26/2020

I:\25220083.00\Deliverables\2020 Semiannual - Remedy Selection\Tables\[Table 1_Timeline_SOR_OGS.xlsx]Timeline

Table 2. Groundwater Samples Summary - Events Since ACM Submittal
Ottumwa Generating Station / SCS Engineers Project #25220083.00

Sample Dates	**Background Well**	**Downgradient Wells at Waste Boundary**					**Downgradient Wells for Nature and Extent**	
	MW-301	MW-302	MW-303	MW-304	MW-305	MW-306	MW-310	MW-311
10/23-24/2019	A	A	A	A	A	A	A	A
2/5/2020	A	--	--	--	--	--	A	A
Total Samples	2	1	1	1	1	1	2	2

Abbreviations:
A = Samples analyzed for assessment monitoring parameters
-- = Not sampled

Created by: LWJ Date: 11/21/2019
Last revision by: SCC Date: 2/19/2020
Checked by: TK Date: 2/19/2020

I:\25220083.00\Deliverables\2020 Semiannual - Remedy Selection\Tables\[Table 2_GW_Samples_Summary_Table_OGS.xlsx]GW Summary

Table 3. Preliminary Evaluation of Corrective Measure Alternatives
Ottumwa Generating Station / SCS Engineers Project #25220083.00

	Alternative #1 No Action	Alternative #2 Close and Cap in place with MNA	Alternative #3 Consolidate on Site and Cap with MNA	Alternative #4 Excavate and Dispose on site with MNA	Alternative #5 Excavate and Dispose in Off-Site Landfill
CORRECTIVE ACTION ASSESSMENT - 40 CFR 257.97(b)					
257.97(b)(1) Is remedy protective of human health and the environment?	No	Yes	Yes	Yes	Yes
257.97(b)(2) Can the remedy attain the groundwater protection standard?	Unlikely	Yes	Yes	Yes	Yes
257.97(b)(3) Can the remedy control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of constituents in appendix IV to this part into the environment?	No	Yes	Yes	Yes	Yes
257.97(b)(4) Can the remedy remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible?	Not Applicable - No release of CCR	Not Applicable - No release of CCR	Not Applicable - No release of CCR	Not Applicable - No release of CCR	Not Applicable - No release of CCR
257.97(b)(5) Can the remedy comply with standards for management of wastes as specified in §257.98(d)?	Not Applicable	Yes	Yes	Yes	Yes
LONG- AND SHORT-TERM EFFECTIVENESS - 40 CFR 257.97(c)(1)					
257.97(c)(1)(i) Magnitude of reduction of existing risks	No reduction of existing risk	Existing risk reduced by achieving GPS	Same as Alternative #2	Same as Alternative #2	Same as Alternative #2
257.97(c)(1)(ii) Magnitude of residual risks in terms of likelihood of further releases due to CCR remaining following implementation of a remedy	No reduction of existing risk. Residual risk is limited for all alternatives due to limited extent of impacts and lack of receptors.	Magnitude of residual risk of further releases is lower than current conditions due to final cover eliminating infiltration through CCR; Residual risk is limited for all alternatives due to limited extent of impacts and lack of receptors	Same as Alternative #2 with potential further reduction in release risk due to CCR material footprint; However, limited to no overall risk reduction is provided due to lack of current/anticipated future receptors for groundwater impacts	Same as Alternative #3 with potential further reduction in release risk due to composite liner and cover; However, limited to no overall risk reduction is provided due to lack of current/anticipated future receptors for groundwater impacts	Same as Alternative #3 with potential further reduction in release risk due to removal of CCR from site; However, limited to no overall risk reduction is provided due to lack of current/anticipated future receptors for groundwater impacts
257.97(c)(1)(iii) The type and degree of long-term management required, including monitoring, operation, and maintenance	Not Applicable	30-year post-closure groundwater monitoring; Groundwater monitoring network maintenance and as-needed repair/replacement Final cover maintenance (e.g., mowing and as-needed repair); Periodic final cover inspections; Additional corrective action as required based on post-closure groundwater monitoring	Same as Alternative #2	Same as Alternative #2	No on-site long-term management required; Limited on-site post-closure groundwater monitoring until GPS are achieved; Receiving disposal facility will have same/similar long-term monitoring, operation, and maintenance requirements as Alternative #2

Table 3. Preliminary Evaluation of Corrective Measure Alternatives
Ottumwa Generating Station / SCS Engineers Project #25220083.00

	Alternative #1 No Action	Alternative #2 Close and Cap in place with MNA	Alternative #3 Consolidate on Site and Cap with MNA	Alternative #4 Excavate and Dispose on site with MNA	Alternative #5 Excavate and Dispose in Off-Site Landfill
LONG- AND SHORT-TERM EFFECTIVENESS - 40 CFR 257.97(c)(1) (continued)					
257.97(c)(1)(iv) Short-term risks - Implementation					
Excavation	None	Limited risk to community and environment due to limited amount of excavation (likely <100K cy) required to establish final cover subgrades and no off-site excavation	Same as Alternative #2 with increased risk to environment due to increased excavation volumes required for consolidation (likely >100K cy but <463K cy)	Same as Alternative #3 with increased risk to environment due to increased excavation volumes (~463K cy) and temporary CCR storage during disposal site construction required for removal and on-site re-disposal	Same as Alternative #4 with reduced risk to environment from excavation due to limited on-site storage
Transportation	None	No risk to community or environment from off-site CCR transportation; Typical risk due to construction traffic delivering final cover materials to site	Same as Alternative #2 with reduced risk from construction traffic due to reduced final cover material requirements (smaller cap footprint)	Same as Alternative #2 with increased risk from construction traffic due to increased material import requirements (liner and cap construction required)	Highest level of community and environmental risk due to CCR volume export (~463K cy)
Re-Disposal	None	Limited risk to community and environment due to limited volume of CCR re-disposal (likely <100K cy)	Same as Alternative #2 with increased risk to environment due to increased excavation volumes (likely >100K cy but <463K cy) required for consolidation	Same as Alternative #3 with increased risk to environment due to increased excavation volumes (~463K cy) and temporary CCR storage during disposal site construction required for removal and on-site re-disposal	Same as Alternative #4 with increased risk to community and environment due to re-disposal of large CCR volume (~463K cy) at another facility; Re-disposal risks are managed by the receiving disposal facility
257.97(c)(1)(v) Time until full protection is achieved	Unknown	To be evaluated further during remedy selection. Closure and capping anticipated by end of 2022. Groundwater protection timeframe to reach GPS potentially 2 to 10 years following closure construction, achievable within 30-year post-closure monitoring period.	Similar to Alternative #2. Potential for increase in time to reach GPS due to significant source disturbance during construction. Potential for decrease in time to reach GPS due to consolidation of CCR.	Similar to Alternative #2. Potential for increase in time to reach GPS due to significant source disturbance during construction. Potential decrease in time to reach GPS due to source isolation within liner/cover system.	Similar to Alternative #2. Potential for increase in time to reach GPS due to significant source disturbance during construction. Potential decrease in time to reach GPS due to impounded CCR source removal.
257.97(c)(1)(vi) Potential for exposure of humans and environmental receptors to remaining wastes, considering the potential threat to human health and the environment associated with excavation, transportation, re-disposal, or containment	No change in potential exposure	Potential for exposure is low. Remaining waste is capped.	Same as Alternative #2	Same as Alternative #2	No potential for on-site exposure to remaining waste since no waste remains on site; Risk of potential exposure is transferred to receiving disposal facility and is likely similar to Alternative #2
257.97(c)(1)(vii) Long-term reliability of the engineering and institutional controls	Not Applicable	Long-term reliability of cap is good; Significant industry experience with methods/controls; Capping is common practice/industry standard for closure in place for remediation and solid waste management	Same as Alternative #2 with potentially increased reliability due to smaller footprint and reduced maintenance	Same as Alternative #3	Success of remedy at OGS does not rely on long-term reliability of engineering or institutional controls; Overall success relies on reliability of the engineering and institutional controls at the receiving facility
257.97(c)(1)(viii) Potential need for replacement of the remedy	Not Applicable	Limited potential for remedy replacement if maintained; Some potential for remedy enhancement due to residual groundwater impacts following source control	Same as Alternative #2 with reduced potential need for remedy enhancement with consolidated/smaller closure area footprint	Same as Alternative #2 with further reduction in potential need for remedy enhancement composite with liner	No potential for remedy replacement; Limited potential for remedy enhancement due to residual groundwater impacts following source control

Table 3. Preliminary Evaluation of Corrective Measure Alternatives
Ottumwa Generating Station / SCS Engineers Project #25220083.00

	Alternative #1	Alternative #2	Alternative #3	Alternative #4	Alternative #5
	No Action	**Close and Cap in place with MNA**	**Consolidate on Site and Cap with MNA**	**Excavate and Dispose on site with MNA**	**Excavate and Dispose in Off-Site Landfill**
SOURCE CONTROL TO MITIGATE FUTURE RELEASES - 40 CFR 257.97(c)(2)					
257.97(c)(2)(i) The extent to which containment practices will reduce further releases	No reduction in further releases	Cap will reduce further releases by minimizing infiltration through CCR	Same as Alternative #2 with further reduction due to consolidated/smaller closure footprint	Same as Alternative #3 with further reduction due to composite liner and 5-foot groundwater separation required by CCR Rule	Removal of CCR prevents further releases at OGS; Receiving disposal site risk similar to Alternative #3
257.97(c)(2)(ii) The extent to which treatment technologies may be used	Alternative does not rely on treatment technologies	Alternative does not rely on treatment technologies	Alternative does not rely on treatment technologies	Alternative does not rely on treatment technologies	Alternative does not rely on treatment technologies
IMPLEMENTATION - 40 CFR 257.97(c)(3)					
257.97(c)(3)(i) Degree of difficulty associated with constructing the technology	Not Applicable	Low complexity construction; Potentially lowest level of dewatering effort - dewatering required for cap installation only	Low complexity construction; Moderate degree of logistical complexity; Moderate level of dewatering effort - dewatering required for material excavation/placement and capping	Moderately complex construction due to composite liner and cover; High degree of logistical complexity due to excavation and on-site storage of ~463K cy of CCR while new lined disposal area is constructed; High level of dewatering effort - dewatering required for excavation of full CCR volume	Low complexity construction; High degree of logistical complexity including the excavation and off-site transport of ~463K cy of CCR and permitting/development of off-site disposal facility airspace; High level of dewatering effort - dewatering required for excavation of full CCR volume
257.97(c)(3)(ii) Expected operational reliability of the technologies	Not Applicable	High reliability based on historic use of capping as corrective measure	Same as Alternative #2	Same as Alternative #2	Success at OGS does not rely on operational reliability of technologies; Overall success relies on off-site disposal facility, which is likely same/similar to Alternative #2
257.97(c)(3)(iii) Need to coordinate with and obtain necessary approvals and permits from other agencies	Not Applicable	Need is low in comparison to other alternatives; State Closure Permit required	Same as Alternative #2	Need is high in comparison to other alternatives State Closure Permit required; State Landfill Permit may be required	Need is highest in comparison to other alternatives; State Closure Permit required; Approval of off-site disposal site owner required; May require State solid waste comprehensive planning approval; Local road use permits likely required
257.97(c)(3)(iv) Availability of necessary equipment and specialists	Not Applicable	Necessary equipment and specialists are highly available; Highest level of demand for cap construction material	Same as Alternative #2; Lowest level of demand for cap construction material	Same as Alternative #2; Moderate level of demand for liner and cap construction material	Availability of necessary equipment to develop necessary off-site disposal facility airspace and transport ~463K cy of CCR to new disposal facility will be a limiting factor in the schedule for executing this alternative; No liner or cover material demands for on-site implementation of remedy
257.97(c)(3)(v) Available capacity and location of needed treatment, storage, and disposal services	Not Applicable	Capacity and location of treatment, storage, and disposal services is not a factor for this alternative	Capacity and location of treatment, storage, and disposal services is unlikely to be a factor for this alternative	Available temporary on-site storage capacity for ~463K cy of CCR while composite liner is constructed is significant limiting factor	Off-site disposal capacity, facility logistical capacity, or the time required to develop the necessary off-site disposal and logistical capacity is a significant limiting factor.
COMMUNITY ACCEPTANCE - 40 CFR 257.97(c)(4)					
257.97(c)(4) The degree to which community concerns are addressed by a potential remedy (Anticipated)	To be determined based on input obtained through public meetings/outreach to be completed	To be determined based on input obtained through public meetings/outreach to be completed	To be determined based on input obtained through public meetings/outreach to be completed	To be determined based on input obtained through public meetings/outreach to be completed	To be determined based on input obtained through public meetings/outreach to be completed

Created by: LAB/SK Date: 6/20/2019
Last revision by: EJN Date: 8/9/2019
Checked by: TK Date: 9/12/2019

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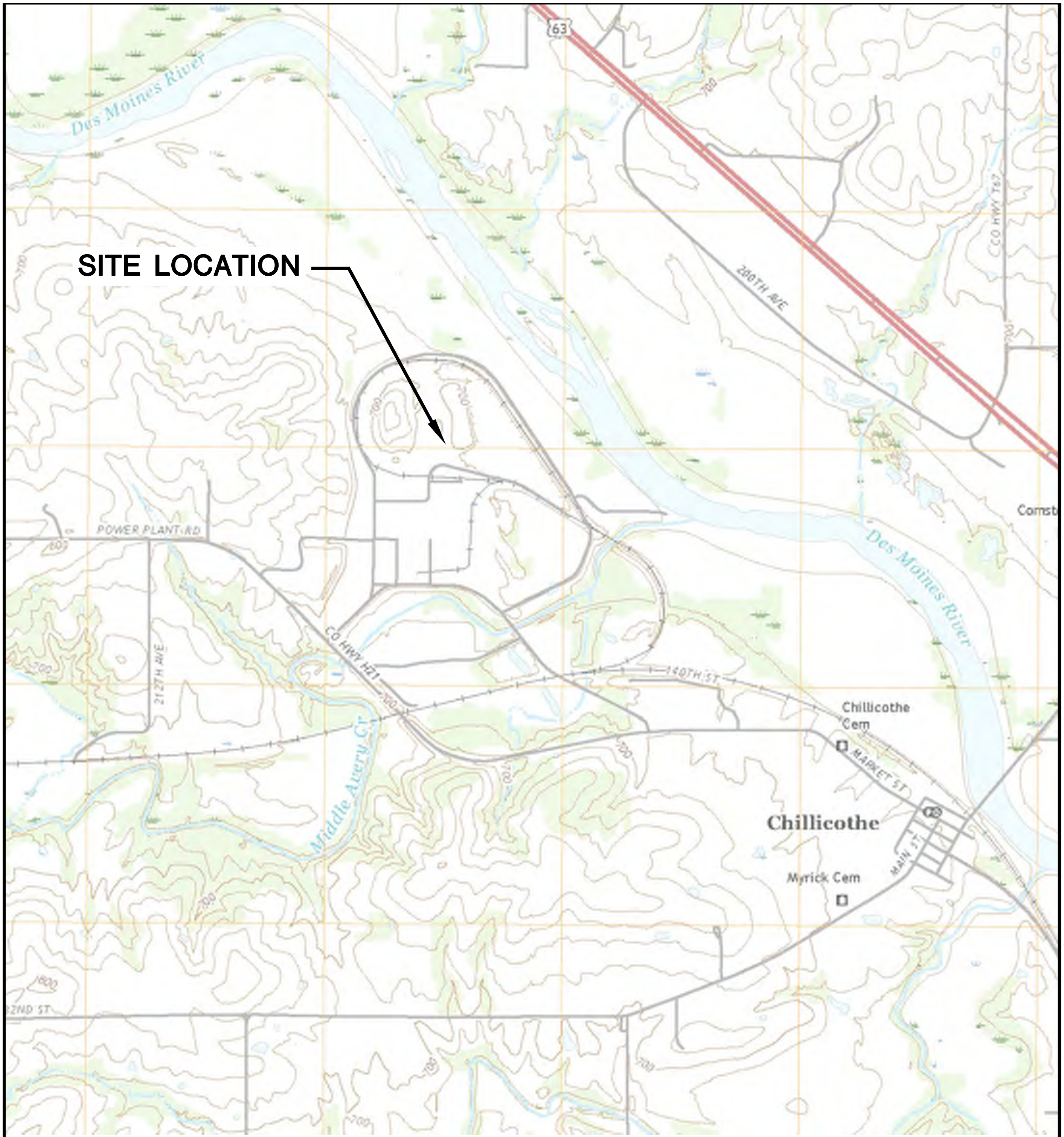
Figures



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IOWA–WAPELLO CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
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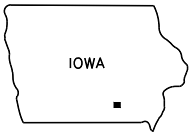

CLIENT	INTERSTATE POWER AND LIGHT CO. 20775 POWER PLANT ROAD OTTUMWA, IA 52501	SITE	ALLIANT ENERGY OTTUMWA GENERATING STATION OTTUMWA, IOWA	SITE LOCATION MAP	

PROJECT NO.	25219072.00	DRAWN BY:	BSS	ENGINEER	SCS ENGINEERS 2830 DAIRY DRIVE MADISON, WI 53718-6751 PHONE: (608) 224-2830	FIGURE
DRAWN:	11/15/2019	CHECKED BY:	MDB			1
REVISED:	03/12/2020	APPROVED BY:	TK 03/12/2020			

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PROJECT NO.	25220072.00	DRAWN BY:	MBH
DRAWN:	10/16/2019	CHECKED BY:	MDB
REVISED:	03/12/2020	APPROVED BY:	TK 03/12/2020

ENGINEER

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

CLIENT

INTERSTATE POWER AND LIGHT CO.
15300 130th STREET
OTTUMWA, IA 52501

SITE

OTTUMWA GENERATING STATION
20775 POWER PLANT ROAD
OTTUMWA, IOWA

MONITORING WELL LOCATIONS MAP

FIGURE
2

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Selection of Remedy
OGS Ash Pond

Ottumwa Generating Station
Ottumwa, Iowa

Prepared for:

Alliant Energy

NOTE: This report describes progress toward remedy selection between March 2020 and September 2020 and was originally prepared as a final report. New information was received following issuance of this report, resulting in an addendum to the ACM (Addendum No. 1) issued in November 2020. The amended ACM includes an update of available site data obtained since the initial ACM was completed and additional Corrective Measures. IPL held a public meeting on June 4, 2020, to discuss the contents of the September 2019 ACM. IPL will hold an additional public meeting with interested and affected parties to discuss the amended ACM and will issue a revised Selection of Remedy report.

SCS ENGINEERS

25220083.00 | September 11, 2020

2830 Dairy Drive
Madison, WI 53718-6751
608-224-2830

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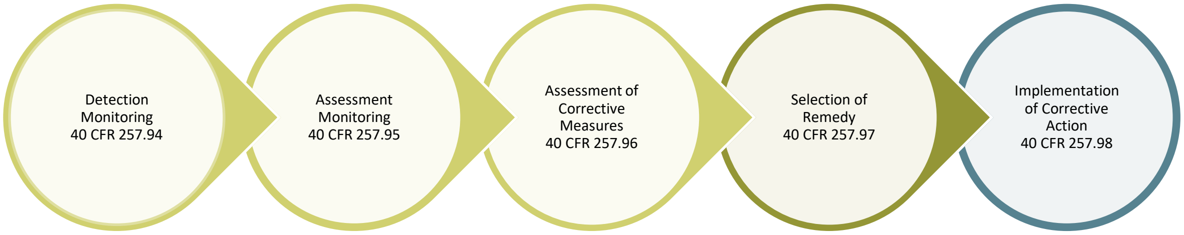
EXECUTIVE SUMMARY

Interstate Power and Light Company (IPL), an Alliant Energy company, operates two ash ponds at the Ottumwa Generating Station (OGS). The ponds are used to manage coal combustion residuals (CCR) and wastewater from the power plant, which burns coal to generate electricity.

IPL samples and tests the groundwater in the area of the ash ponds to comply with U.S. Environmental Protection Agency (USEPA) standards for the Disposal of CCR from Electric Utilities, or the “CCR Rule” (Rule).

Groundwater samples from two of the wells installed to monitor one of the ponds (OGS Ash Pond) contain cobalt at levels higher than the Groundwater Protection Standards (GPS) defined in the Rule. Cobalt occurs naturally and can also be present in coal and CCR.

IPL has prepared this Selection of Remedy Report in accordance with the requirements of the CCR Rule. The information in this report builds on the Assessment of Corrective Measures (ACM) Report issued in September 2019. The ACM was prepared in response to the groundwater sampling results at the OGS facility. The Selection of Remedy process is the next step in a series of steps defined in the Rule and shown below.



The Selection of Remedy Report provides an update to the nature and extent of groundwater impacts discussed in the ACM. Since the ACM was issued, IPL has continued to develop an understanding of the following:

- Types of soil and rock deposits in the area of the OGS facility.
- Depth of groundwater.
- Direction that groundwater is moving.
- Potential sources of the cobalt in groundwater.
- The area where cobalt levels are higher than the USEPA standards.
- The people, plants, and animals that may be affected by levels of cobalt in groundwater that are above the GPS.

IPL has installed new wells to evaluate groundwater concentrations beyond the location of the wells with GPS exceedances. Groundwater monitoring data continue to show cobalt is present in groundwater near the OGS Ash Pond, but the available data indicate that cobalt is present at levels below USEPA standards beyond the immediate area of the waste limits where downgradient compliance monitoring wells are located. Therefore, the available information does not indicate completion of an exposure pathway that would adversely impact people, plants, and animals.

Groundwater monitoring completed since the ACM was issued identified lithium and fluoride in deeper monitoring wells at levels higher than the GPS defined in the Rule. IPL is evaluating the lithium and fluoride detections (see **Appendix B**). An initial review of available information indicates that lithium and fluoride detected in groundwater samples is attributable to natural background conditions in the Mississippian bedrock aquifer, rather than a release from the OGS Ash Pond or other man-made sources.

The Selection of Remedy Report also presents the following:

- A comparison to the minimum criteria set forth in 40 CFR 257.97(b).
- A discussion of the evaluating criteria in 40 CFR 257.97(c) and the remedy selection scoring methodology used to help select an appropriate corrective measure.
- A summary of the selected remedy.

IPL has identified capping CCR in place with monitored natural attenuation (MNA) as the selected remedy for cobalt impacts to groundwater. The selected remedy meets the minimum criteria established in the Rule, and includes:

- Stopping all CCR and wastewater discharges to the OGS Ash Pond.
- Closing the pond with CCR in place according to 40 CFR 257.102(d).
- Implementing enhanced groundwater monitoring via MNA.

In accordance with 40 CFR 257.96(e), IPL held a public meeting with interested and affected parties to discuss the ACM as required by the Rule on June 4, 2020. Within 90 days of this Selection of Remedy Report, IPL will implement the selected remedy as required in 40 CFR 257.98(a). This report describes the status of remedy design and an anticipated construction schedule. Currently, OGS Ash Pond closure construction is anticipated to begin in 2021 and finish in 2023. A corrective action groundwater monitoring program that includes MNA will also be established and is expected to continue into early 2028.

For more information on Alliant Energy, view our 2020 Corporate Responsibility Report at http://www.alliantenergy.com/responsibility.

PE CERTIFICATION

ERIC J. NELSON
23136

9/11/20

I, Eric J. Nelson, hereby certify that the selected groundwater remedy described herein meets the requirements of 40 CFR 257.97. This Selection of Remedy report was prepared by me or under my direct supervision, and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.

9/11/2020
(signature) (date)

Eric J. Nelson
(printed or typed name)

License number 23136

My license renewal date is December 31, 2020.

Pages or sheets covered by this seal:

Selection of Remedy Report dated 9/11/2020 excluding the drawings provided in Appendix C.

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1.0 INTRODUCTION AND PURPOSE

This Selection of Remedy report was prepared to support compliance with the groundwater monitoring requirements of the "Coal Combustion Residuals (CCR) Final Rule" published by the U.S. Environmental Protection Agency (USEPA) in the *Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule*, dated April 17, 2015 (USEPA, 2015), and subsequent amendments. Specifically, this report was prepared to fulfill the requirements of a final report identified in 40 CFR 257.97(a) and identify the remedy selected to address the Groundwater Protection Standard (GPS) exceedances observed in the April, August, and October 2018 sampling events for the OGS Ash Pond, and identified in the Notification of Groundwater Protection Standard Exceedance dated February 13, 2019. This Selection of Remedy report includes a description of the selected remedy and how it meets the requirements of 40 CFR 257.97(b), which are described in **Section 3.1**.

This report also provides a brief summary of the activities completed to further define the nature and extent of the groundwater impacts attributed to the Ottumwa Generating Station (OGS) Ash Pond at OGS since the Assessment of Corrective Measures (ACM) report was issued in September 2019.

2.0 BACKGROUND

2.1 SITE INFORMATION AND MAP

OGS is located southwest of the Des Moines River, approximately 8 miles northwest of the City of Ottumwa in Wapello County, Iowa (**Figure 1**). The address of the plant is 20775 Power Plant Road, Ottumwa, Iowa. In addition to the coal-fired generating station, the property also contains the OGS Ash Pond, the OGS Zero Liquid Discharge (ZLD) Pond, a coal stockpile, and a hydrated fly ash stockpile.

The two CCR units at the facility (OGS Ash Pond and OGS ZLD Pond) are each monitored with single-unit groundwater monitoring systems. The OGS Ash Pond is the subject of this report.

The pending closure of the OGS Ash Pond was discussed in the Interstate Power and Light Company (IPL) Notification of Intent to Close CCR Surface Impoundment, dated April 3, 2019. A map showing the CCR units and all background (or upgradient) and downgradient monitoring wells with identification numbers for the CCR groundwater monitoring program is provided as **Figure 2**.

In accordance with 40 CFR 257.96(a), IPL prepared an ACM in response to the cobalt detected in groundwater samples above the GPS, which was issued in September 2019.

In accordance with 40 CFR 257.96(e), IPL held a public meeting to discuss the ACM on June 4, 2020. The meeting was open to interested and affected parties, and, due to the COVID-19 pandemic, was held virtually using an interactive online meeting platform.

2.2 UPDATED NATURE AND EXTENT OF GROUNDWATER IMPACTS

This section provides an update of the nature and extent of groundwater impacts since the ACM was completed. The additional work completed since the ACM was issued further defined the nature and extent of groundwater impacts and includes:

- Installation of deeper piezometers MW-305A, MW-310A, and MW-311A, which are nested with compliance well MW-305 and downgradient wells MW-310 and MW-311 located along the Des Moines River (see **Figure 2**).

- Establishment of a permanent benchmark for measuring the Des Moines River elevation (see **Figure 2**).

- Collection of several rounds of groundwater elevations from the new and existing monitoring wells. The April 13 and 14 water level measurements were used to create an updated potentiometric surface map for the wells near the top of the bedrock aquifer (see **Table 1** and **Figure 3**).

- Collection of three rounds of groundwater samples from new downgradient monitoring wells MW-310 and MW-311 in October 2019, February 2020, and April 2020 (see **Table 2**).

- Collection of two rounds of groundwater samples from the three new piezometers in March 2020 and April 2020 (see **Table 2**).

- Resample of monitoring well MW-311A for fluoride in June 2020. (see **Table 2**).

- Collection of select additional parameters in March 2020 to assist with the evaluation of monitored natural attenuation (MNA) (see **Table 2**).

- Collection of three rounds of groundwater samples from adjacent OGS ZLD monitoring network wells. Cobalt sample results from OGS ZLD Pond well MW-307 from December 2019, February 2020, and April 2020 exceed the cobalt GPS. Sample results for the ZLD Pond wells are summarized in **Table 3**, and are discussed further in the July 13, 2020, Assessment Groundwater Monitoring – Statistical Evaluation. MW-307 is located downgradient of cobalt impacted wells MW-305 and MW-306. MW-307 is immediately downgradient of the southern portion of the OGS ZLD Pond, which, based on pond geometry, is also downgradient of the OGS Ash Pond (see **Figure 2**). The other compliance wells monitoring the ZLD Pond (MW-308 and MW-309) have cobalt concentrations below the UPL and the GPS. The OGS ZLD Pond is not a suspected source of cobalt.

- Continuation of semiannual assessment monitoring in October 2019 and April 2020 for the original monitoring network, with new wells added as described above (see **Table 2**).

- Calculation of vertical gradients at well nest MW-305/MW-305A and the two downgradient well nests MW-310/MW-310A and MW-311/MW-311A (see **Table 4**).

2.2.1 Potential Sources

Although cobalt is present in shallow groundwater upgradient of the OGS Ash Pond, the OGS Ash Pond is still believed to be the likely source of the cobalt concentrations above the GPS in groundwater samples from the compliance wells. As described in the ACM, potential sources of cobalt or factors that may be contributing the groundwater impacts observed include:

- CCR discharged to and stored in the OGS Ash Pond.

- Storm water runoff into the OGS Ash Pond from surrounding areas.
- Low-volume plant wastewater managed via the OGS Ash Pond.

No additional sources have been identified since the ACM.

2.2.2 Updated Groundwater Assessment

When the ACM was completed in September 2019, monitoring wells MW-310 and MW-311 had been installed in the area between the current downgradient wells and the Des Moines River to fulfill the requirements of 40 CFR 257.95(g)(1). However, no groundwater samples had yet been collected.

Monitoring wells MW-305A, MW-310A, and MW-311A were also installed since the ACM as nested piezometers with monitoring wells MW-305, MW-310, and MW-311. The three additional piezometers were installed on February 25 through March 4, 2020, to provide additional vertical characterization of groundwater impacts and groundwater flow paths in support of the assessment of corrective measures. The wells were monitored as described above. Results of the groundwater sample analysis are located in **Table 2**. The significance of these GPS exceedances are discussed below.

The monitoring wells at the site are screened within the bedrock aquifer and/or alluvial sands that are in contact with bedrock. The groundwater elevations from these wells represent the potentiometric head within the bedrock aquifer and alluvial sands in contact with the bedrock, which are overlain by clay. The piezometers are screened within the bedrock aquifer.

The water table in the vicinity of the CCR unit lies within the clay unit located immediately above the bedrock aquifer. There are no monitoring wells screened within the clay unit since it is not part of the uppermost aquifer.

The depth to groundwater as measured in the site monitoring wells varies from approximately 2 to 28 feet below ground surface (bgs) due to topographic variations across the facility and seasonal variations in water levels (**Table 1**). Groundwater depth at the wells located in the berm around the OGS Ash Pond varies between 9 and 28 feet bgs. These depths represent the potentiometric head in the bedrock and alluvial sands, which lie below approximately 9 to 15 feet of native clay in the area near the pond. Up to 41 feet of total clay thickness was observed at monitoring wells drilled within the berm. Groundwater flow at the site is generally to the east-northeast, and the groundwater flow direction and water levels fluctuate seasonally due to the proximity to the river.

Concentrations of cobalt above the GPS in groundwater samples collected in October 2019, March 2020, and April 2020 are similar to the concentrations reported in the ACM (around 16 to 17 ug/L). The groundwater sample from MW-306 contained cobalt above the GPS (6.2 ug/L) in October 2019. Subsequent samples from MW-306 (April 2020) contained a lower cobalt concentration that was below the GPS (5.5 ug/L). None of the new groundwater samples collected from MW-305 or the other OGS Ash Pond wells contained cobalt at a concentration above the GPS.

Cobalt was not detected above the GPS in samples from the new wells (MW-305A, MW-310/ MW-310A, or MW-311/MW311A).

Lithium was detected above the GPS at new monitoring wells MW-310 (three of four samples collected), MW-310A, and MW-311A (two of two samples collected for both deep piezometers). Fluoride was also detected in the deep piezometer MW-311A at a concentration above the GPS in one of the three sampling events. These exceedances have not yet been determined to be statistically significant. Lithium and fluoride concentrations above the GPSs in these three wells are discussed in the technical memorandum provided in **Appendix B**, and are most likely due to natural background conditions in the Mississippian bedrock aquifer, rather than a release from the ash pond or other man-made source. Lines of evidence supporting this finding include:

- No lithium or fluoride GPS exceedances have been detected at monitoring wells MW-302, MW-304, MW-305, MW-306, or MW-305A, located adjacent to the OGS Ash Pond, as would be expected if the OGS Ash Pond was the source of elevated fluoride and lithium at wells located further downgradient.

- The lithium and fluoride concentrations detected in samples from MW-310A and MW-311A are well within the range of concentrations naturally present in the Mississippian aquifer based on results from background monitoring wells in the same aquifer at the nearby Ottumwa Midland Landfill (OML) located approximately 5 miles to the east-southeast.

- Analysis of major anions and cations indicates that the water quality in deep piezometers MW-310A and MW-311A is similar to regional water quality for the Mississippian aquifer and different from water quality in the shallower on-site wells.

- Vertical gradients at monitoring well pairs MW-310/MW-310A and MW-311/MW-311A during the two water level measurement events in April 2020 indicate that groundwater flow is at least intermittently upward from the Mississippian bedrock into the overlying unconsolidated material.

If the lithium and fluoride exceedances are determined to be statistically significant, IPL will be required to either prepare an alternative source demonstration (ASD) or initiate an Assessment of Corrective Measures for these constituents.

2.2.3 Updated Conceptual Site Model

Based on the additional investigations performed since the September 2019 ACM, the OGS Ash Pond continues to be identified as the likely source of the statistically significant exceedances above the GPS for cobalt. Cobalt remains the only constituent with a statistically significant exceedance of the GPS.

Groundwater samples collected from the piezometer nests installed downgradient of the OGS Ash Pond and adjacent to the Des Moines River did not contain cobalt at a concentration above the GPS. None of the additional information obtained since the ACM was issued suggests that cobalt is reaching the new wells, and our samples indicate that elevated concentrations of cobalt are only present near the pond. Therefore, we have not observed cobalt migrating to a location where it can impact human health or the environment. In other words, there is no pathway for exposure to cobalt.

The ACM listed the surface water/sediment, biota/food, and ecological exposure assessment as ongoing because the extent of groundwater impacts was still being evaluated. Based on the results of the additional investigation work performed since the ACM was prepared, there do not appear to be any remaining potential human or ecological health pathways related to the cobalt concentrations in groundwater related to the OGS Ash Pond that exceed the GPS.

In summary, cobalt is present in groundwater near the OGS Ash Pond but the available data do not indicate completion of an exposure pathway. Therefore, there are no current or expected adverse impacts to human health or ecological receptors.

3.0 CORRECTIVE MEASURES AND REMEDY SELECTION

Several corrective measure options were presented in detail in the Assessment of Corrective Measures OGS Ash Pond report, dated September 2019. This report identified the following corrective measure alternatives for the cobalt impacts to groundwater associated with the OGS Ash Pond:

- Alternative 1 – No Action
- Alternative 2 – Close and Cap in Place with MNA
- Alternative 3 – Consolidate On Site and Cap with MNA
- Alternative 4 – Excavate and Dispose On Site with MNA
- Alternative 5 – Excavate and Dispose Off Site with MNA

The following sections present:

- A comparison to the minimum criteria set forth in 40 CFR 257.97(b).
- A discussion of the evaluating criteria in 40 CFR 257.97(c) and our remedy selection scoring methodology.
- A summary of the selected remedy.

3.1 MINUMUM CRITERIA

The selected remedy must meet the minimum criteria set forth in 40 CFR 257.97(b). These criteria and the ability of the alternatives evaluated to satisfy the criteria is summarized in **Table 5**.

With the exception of the No Action alternative, each of the corrective measure alternatives meet the requirements in 40 CFR 257.97(b)(1) through (5) based on the information available at the current time.

3.2 EVALUATION FACTORS

Each alternative remedy was evaluated based on the criteria in 257.97(c) and assigned a score for each of the criteria. An individual score of “1” through “4” was assigned to each of the criteria. A score of “1” represents “least effective” and a score of “4” represents “most effective.” The scoring is based on each option relative to the other remedies evaluated. This scoring was applied to the following evaluation factors:

- **Long- and Short-Term Effectiveness [257.97(c)(1)]**
  - Magnitude of reduction of existing risks.
  - Magnitude of residual risks in terms of likelihood of further released due to CCR remaining following implementation of a remedy.
  - The type and degree of long-term management required, including monitoring, operation, and maintenance.
  - Short-term risks:
    - Excavation
    - Transportation

        - Re-disposal
    - Potential for exposure for humans and environmental receptors to remaining wastes, considering the potential threat to human health and the environment associated with excavation, transportation, re-disposal, or containment.
    - Long-term reliability of the engineering and institutional controls.
    - Potential need for replacement of the remedy.

- **Source Control to Mitigate Future Releases [257.97(c)(2)]**
    - The extent to which containment practices will reduce further releases.
    - The extent to which treatment technologies may be used.

- **Implementation [257.97(c)(3)]**
    - Degree of difficulty associated with constructing the technology.
    - Expected operation reliability of the technologies.
    - Need to coordinate with and obtain necessary approvals and permits from other agencies.
    - Availability of necessary equipment and specialists.
    - Available capacity and location of needed treatment, storage, and disposal.

- *Community Acceptance*
    - The degree to which community concerns are addressed by a potential remedy.

The scoring is detailed in **Table 5**. An individual score of “1” to “4” was applied to each item above. Individual scores were added to develop a total score for each alternative. There are 18 separate criteria allowing a lowest possible score of 18, and a highest possible score of 72. A high score represents a more favorable option based on the assessment criteria. A summary of the scoring is presented in **Table 6**.

3.3 SELECTED REMEDY

Alternative 2 - Close and Cap in Place with MNA - scored highest in the evaluation of factors defined in 257.97(c) and is presented below as the selected remedy.

3.3.1 Remedy Description

Alternative 2 includes stopping all CCR and wastewater discharges to the OGS Ash Pond and closing the pond with CCR in place. The OGS Ash Pond will be dewatered; existing on-site CCR, sediment, and soil will be placed or graded within the existing pond limits; the CCR materials will be covered with a low-permeability soil or geosynthetic cap; and vegetation, or an appropriate alternative erosion layer, will be established in accordance with the requirements for closure in place in 40 CFR 257.102(d). The closed OGS Ash Pond will be subject to enhanced groundwater monitoring via MNA. A discussion of how this alternative meets the minimum standards in 257.97(b) is provided below. Preliminary drawings showing the proposed closure of the OGS Ash Pond are provided in **Attachment C**.

3.3.2 Satisfying Minimum Criteria

The selected remedy is expected to meet the minimum criteria established in 257.97(b) and described in **Section 3.1**. Each criteria is discussed below.

257.97(b)(1) – Be protective of human health and the environment:

As discussed in the September 2019 ACM and **Section 2.2** above, the available data do not indicate completion of an exposure pathway for cobalt. Alternative 2 sustains or improves the current level of protectiveness by eliminating infiltration of plant wastewater discharges and precipitation.

In addition, the selected remedy minimizes the handling of CCR and therefore the exposure of construction workers and the public to CCR as well as secondary impacts from the remedy implementation such as fine particulates from fugitive dust (e.g., dust generated while travelling local gravel roads, particulate in equipment exhaust, etc.), noise, and traffic.

257.97(b)(2) – Attain the groundwater protection standard as specified pursuant to §257.95(h):

Ceasing wastewater discharges and closing the impoundments by capping is expected to address infiltration, which is likely a key contributor to groundwater impacts. MNA monitoring will identify the natural attenuation processes that reduce mass, toxicity, mobility, volume, or concentrations of the constituents of concern in groundwater. The selected remedy is capable of and expected to attain the GPS for cobalt.

257.97(b)(3) – Control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of constituents in appendix IV to this part into the environment:

The source of the cobalt release to groundwater is attributed to CCR and wastewater discharges to the OGS Ash Pond. The selected remedy eliminates CCR sluicing/plant process water discharges and, with the installation of a cap, will reduce vertical infiltration through the CCR. This is expected to address the major contributor to the observed GPS exceedances, which is exposure of CCR material to precipitation/surface water infiltration. MNA is part of the selected remedy to monitor changes in groundwater impacts and the effectiveness of degradation mechanisms on groundwater concentrations over time.

257.97(b)(4) – Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, taking into account factors such as avoiding inappropriate disturbance of sensitive ecosystems:

No releases of CCR have been identified from the OGS Ash Pond. As described above, addressing infiltration in combination with MNA processes are expected to reduce cobalt impacts to groundwater.

257.97(b)(5) – Comply with standards for management of wastes as specified in §257.98(d):

All CCR or other waste generated during the OGS Ash Pond closure can be managed in accordance with Resource Conservation and Recovery Act (RCRA) requirements. The selected remedy will comply with the standards for management of wastes described in 257.98(d).

4.0 SCHEDULE

The anticipated schedule for implementing and completing the selected remedy includes:

- July 2020 – Complete OGS Ash Pond closure design.
- October 2020 – Establish and implement corrective action groundwater monitoring program, including MNA (within 90 days of selection of remedy).

- January 2021 – Complete procurement for closure construction.
- October 2021 – Complete state and local approvals.
- October 2023 – Complete closure construction.
- October 2028 – Evaluate MNA progress if compliance with GPS not yet achieved.

This schedule is based on the following considerations, as described in 257.97(d) and discussed below.

257.97(d)(1) – Extent and nature of contamination, as determined by the characterization required under §257.95(g):

Investigations of the nature and extent of cobalt in groundwater attributed to the OGS Ash Pond are complete. Groundwater monitoring will continue as the selected remedy is implemented, and, unless significant changes in the nature of the impacts are observed, the schedule described above will not be impacted.

257.97(d)(2) – Reasonable probabilities of remedial technologies in achieving compliance with the groundwater protection standards established under §257.95(h) and other objectives of the remedy:

The cessation of wastewater discharges and capping the OGS Ash Pond is expected to be a reliable method of attaining the groundwater protection standard for cobalt. Capping is a common practice and standard remedial method for site remediation and solid waste management projects. There is significant industry experience with the design and construction of this method. The evaluation of the natural attenuation processes that are active at OGS will continue as the remedy is implemented.

The combination of closure in place with a cap and MNA will require time to evaluate and achieve the GPS. It is reasonable to expect the selected remedy will achieve the GPS. It is also reasonable to expect that cobalt concentrations in groundwater may increase in the near term as CCR is disturbed during remedy implementation. Given the lack of human and ecological receptors, ongoing monitoring should be sufficiently protective of human health and the environment if local cobalt concentrations in groundwater increase during or shortly after closure construction is completed.

257.97(d)(3) – Availability of treatment or disposal capacity for CCR managed during implementation of the remedy:

The availability of treatment or disposal capacity is not a factor for the selected remedy schedule. The capacity to manage CCR from the OGS Ash Pond is available on site within the current footprint of the pond.

257.97(d)(4) – Potential risks to human health and the environment from exposure to contamination prior to completion of the remedy:

There are no operational changes planned at OGS that would lead to a potential risk to human health and the environment from cobalt-impacted groundwater attributed to the OGS Ash Pond prior to the implementation of the selected remedy. Operational changes at OGS prior to implementation of the remedy are expected to reduce infiltration potential, further limiting the potential to complete an exposure pathway.

257.97(d)(5) – Resource value of the aquifer:

The aquifer in the area of cobalt impacts attributed to the OGS ash pond is not currently used as a water supply for human or animal consumption or irrigation. Surface waters, including the Des Moines River, are the source of most water supply in the area due to the low quality of groundwater supplies. As discussed in **Section 2.2**, the Des Moines River is not affected by cobalt attributable to the OGS Ash Pond.

257.97(d)(6) – Other relevant factors:

The schedule above reflects an initial 5-year post-closure period of enhanced groundwater monitoring for the ongoing evaluation of MNA. During this time, groundwater monitoring will be used to document and evaluate the natural attenuation processes active at OGS, and progress toward achieving the GPS. Groundwater monitoring, including ongoing MNA described in **Section 2.2**, will continue throughout implementation of the selected remedy, which will allow IPL to assess groundwater quality and human and ecological risk throughout the implementation period and implement other methods or techniques in accordance with 257.98(b).

5.0 REFERENCES

SCS Engineers, Assessment of Corrective Measures, OGS Ash Pond, September 2019.

ASTM International, ASTM E2616-09 - Standard Guide for Remedy Selection Integrating Risk-Based Corrective Action and Non-Risk Considerations, Reapproved 2014

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Tables

Table 1. Water Level Summary
IPL - Ottumwa Generating Station / SCS Engineers Project #25220083.00

Depth to Water in feet below top of well casing/reference elevation															
Raw Data	**MW-301**	**MW-302**	**MW-303**	**MW-304**	**MW-305**	**MW-305A**	**MW-306**	**MW-307**	**MW-308**	**MW-309**	**MW-310**	**MW-310A**	**MW-311**	**MW-311A**	**River at Intake**
Measurement Date															
April 26, 2016	3.83	18.27	8.65	27.47	22.24	NI	12.61				NI	NI	NI	NI	NI
June 23, 2016	4.05	18.25	8.18	26.31	21.55	NI	12.83				NI	NI	NI	NI	NI
August 9, 2016	4.36	18.38	9.31	29.05	23.13	NI	13.12				NI	NI	NI	NI	NI
October 26-27, 2016	4.59	18.23	8.90	27.81	22.54	NI	13.26				NI	NI	NI	NI	NI
January 18-19, 2017	4.96	18.44	9.33	28.34	23.04	NI	13.58	8.75	7.97	8.28	NI	NI	NI	NI	NI
April 19-20, 2017	4.48	17.55	6.50	25.36	20.64	NI	12.78	3.94	4.30	4.78	NI	NI	NI	NI	NI
June 20-21, 2017	4.72	18.25	8.65	28.09	22.65	NI	13.53	7.71	7.13	7.34	NI	NI	NI	NI	NI
August 21-23, 2017	5.35	18.77	10.49	30.45	24.91	NI	14.70	11.78	12.27	13.12	NI	NI	NI	NI	NI
November 8, 2017	5.09	18.50	9.73	29.81	24.15	NI	14.43	10.19	10.40	10.74	NI	NI	NI	NI	NI
April 18, 2018	5.10	18.19	8.60	27.29	22.92	NI	14.55	7.90	7.48	7.29	NI	NI	NI	NI	NI
May 30, 2018	NM	NM	NM	NM	NM	NI	NM	5.11	4.34	3.96	NI	NI	NI	NI	NI
June 28, 2018	NM	NM	NM	NM	NM	NI	NM	4.69	3.96	3.47	NI	NI	NI	NI	NI
July 18, 2018	NM	NM	NM	NM	NM	NI	NM	5.29	4.72	4.25	NI	NI	NI	NI	NI
August 14-15, 2018	5.72	17.85	8.50	26.49	22.35	NI	14.81	NM	NM	NM	NI	NI	NI	NI	NI
August 29, 2018	5.54	18.01	6.00	25.02	NM	NI	NM	NM	NM	NM	NI	NI	NI	NI	NI
October 16, 2018	4.13	16.99	4.90	24.64	20.54	NI	13.23	3.43	NM	3.33	NI	NI	NI	NI	NI
January 8, 2019	4.41	17.87	6.42	26.56	21.78	NI	13.63	NM	NM	NM	NI	NI	NI	NI	NI
April 8, 2019	3.94	16.67	5.52	23.51	19.90	NI	12.51	2.66	1.69	1.39	NI	NI	NI	NI	NI
August 28, 2019	NM	NM	NM	NM	NM	NI	NM	NM	NM	NM	17.65	NI	12.08	NI	NI
October 23-24, 2019	3.56	13.76	7.21	25.13	20.70	NI	12.19	5.67	4.08	3.66	9.32	NI	6.38	NI	NI
December 11, 2019	NM	NM	NM	NM	NM	NI	NM	7.97	8.00	7.70	NM	NI	NM	NI	NI
February 5, 2020	3.33	NM	NM	NM	NM	NI	NM	7.68	5.27	6.60	13.92	NI	9.18	NI	NI
March 12-13, 2020	3.81	NM	NM	NM	22.50	32.39	NM	NM	NM	NM	13.18	40.09	10.00	29.43	NI
April 1, 2020	3.36	16.9	5.18	24.27	23.32	28.98	12.34	3.8	3.51	3.71	7.54	8.77	4.83	5.27	6.6
April 13-14, 2020	3.38	17.45	6.99	26.42	21.47	30.34	12.76	6.90	5.30	5.75	12.72	10.43	7.39	5.12	10.6
June 30, 2020	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	5.81	NM

Ground Water or Surface Water Elevation in feet above mean sea level (amsl)															
Well Number	**MW-301**	**MW-302**	**MW-303**	**MW-304**	**MW-305**	**MW-305A**	**MW-306**	**MW-307**	**MW-308**	**MW-309**	**MW-310**	**MW-310A**	**MW-311**	**MW-311A**	**River at Intake**
Top of Well Casing Elevation / Surface Water Reference Elevation (feet amsl)	686.63	673.90	661.07	682.84	683.91	684.03	683.47	657.56	655.39	654.94	658.63	657.93	654.18	653.54	656.31
Screen Length (ft)	10.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	NA
Total Depth (ft from top of casing)	17.0	25.8	17.5	52.3	51.5	81.91	36.6	28.0	25.0	27.5	25.9	55.55	17.9	47.68	NA
Top of Well Screen Elevation (ft)	679.63	653.10	648.57	635.54	637.41	607.12	651.87	634.56	635.39	632.44	637.76	607.38	641.24	610.86	NA
Measurement Date															
April 26, 2016	682.80	655.63	652.42	655.37	661.67	NI	670.86				NI	NI	NI	NI	NI
June 23, 2016	682.58	655.65	652.89	656.53	662.36	NI	670.64				NI	NI	NI	NI	NI
August 9, 2016	682.27	655.52	651.76	653.79	660.78	NI	670.35				NI	NI	NI	NI	NI
October 26-27, 2016	682.04	655.67	652.17	655.03	661.37	NI	670.21				NI	NI	NI	NI	NI
January 18-19, 2017	681.67	655.46	651.74	654.50	660.87	NI	669.89	648.81	647.42	646.66	NI	NI	NI	NI	NI
April 19-20, 2017	682.15	656.35	654.57	657.48	663.27	NI	670.69	653.62	651.09	650.16	NI	NI	NI	NI	NI
June 20-21, 2017	681.91	655.65	652.42	654.75	661.26	NI	669.94	649.85	648.26	647.60	NI	NI	NI	NI	NI
August 21-23, 2017	681.28	655.13	650.58	652.39	659.00	NI	668.77	645.78	643.12	641.82	NI	NI	NI	NI	NI
November 8, 2017	681.54	655.40	651.34	653.03	659.76	NI	669.04	647.37	644.99	644.20	NI	NI	NI	NI	NI
April 18, 2018	681.53	655.71	652.47	655.55	660.99	NI	668.92	649.66	647.91	647.65	NI	NI	NI	NI	NI
May 30, 2018	NM	NM	NM	NM	NM	NI	NM	652.45	651.05	650.98	NI	NI	NI	NI	NI
June 28, 2018	NM	NM	NM	NM	NM	NI	NM	652.87	651.43	651.47	NI	NI	NI	NI	NI
July 18, 2018	NM	NM	NM	NM	NM	NI	NM	652.27	650.67	650.69	NI	NI	NI	NI	NI
August 14-15, 2018	680.91	656.05	652.57	656.35	661.56	NI	668.66	NM	NM	NM	NI	NI	NI	NI	NI
August 29, 2018	681.09	655.89	655.07	657.82	NM	NI	NM	NM	NM	NM	NI	NI	NI	NI	NI
October 16, 2018	682.50	656.91	656.17	658.20	663.37	NI	670.24	654.13	NM	651.61	NI	NI	NI	NI	NI
January 8, 2019	682.22	656.03	654.65	656.28	662.13	NI	669.84	NM	NM	NM	NI	NI	NI	NI	NI
April 8, 2019	682.69	657.23	655.55	659.33	664.01	NI	670.96	654.90	653.70	653.55	NI	NI	NI	NI	NI
August 28, 2019	NM	NM	NM	NM	NM	NI	NM	NM	NM	NM	640.98	NI	642.10	NI	NI
October 23-24, 2019	683.07	660.14	653.86	657.71	663.21	NI	671.28	651.89	651.31	651.28	649.31	NI	647.80	NI	NI
December 11, 2019	NM	NM	NM	NM	NM	NI	NM	649.59	647.39	647.24	NM	NI	NM	NI	NI
February 5, 2020	683.30	NM	NM	NM	NM	NI	NM	649.88	650.12	648.34	644.71	NI	645.00	NI	NI
March 12-13, 2020	682.82	NM	NM	NM	661.41	651.64	NM	NM	NM	NM	645.45	617.84	644.18	624.11	NI
April 1, 2020	683.27	657.00	655.89	658.57	660.59	655.05	671.13	653.76	651.88	651.23	651.09	649.16	649.35	648.27	649.71
April 13-14, 2020	683.25	656.45	654.08	656.42	662.44	653.69	670.71	650.66	650.09	649.19	645.91	647.50	646.79	648.42	645.71
June 30, 2020	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	647.73	NM
Bottom of Well Elevation (ft)	669.63	648.10	643.57	630.54	632.41	602.12	646.87	629.56	630.39	627.44	632.76	602.38	636.24	605.86	--

Notes:
NM = not measured
NI= not installed

Created by: KAK Date: 5/1/2017
Last rev. by: NDK Date: 7/22/2020
Checked by: AJR Date: 7/22/2020
Proj Mgr QA/QC: EJN Date: 9/11/2020

I:\25220083.00\Data and Calculations\Tables\[wlstat_OGS.xls]levels

Table 2. Groundwater Analytical Results Summary
Ottumwa Generating Station Ash Pond / SCS Engineers Project #25220083.00

				Background Well				Compliance Wells												
				MW-301				MW-302		MW-303		MW-304		MW-305			MW-305A		MW-306	
Parameter Name	UPL Method	UPL	GPS	10/24/2019	2/5/2020	3/12/2020	4/14/2020	10/24/2019	4/14/2020	10/24/2019	4/14/2020	10/23/2019	4/13/2020	#######	3/13/2020	4/13/2020	3/13/2020	4/14/2020	10/23/2019	4/14/2020
Appendix III																				
Boron, ug/L	P	820		680	540	--	700	1,200	1,200	440	420	970	1,000	880	--	920	250	280	980	1,000
Calcium, mg/L	P	78.7		78	68	--	84	180	180	170	170	120	130	100	--	100	100	130	77	73
Chloride, mg/L	P	86.8		110	120	--	140	220	220	35	47	280	250	280	--	270	40	89	47	41
Fluoride, mg/L	P	0.484		<0.23	--	--	<0.23	<0.23	<0.23	<0.23	<0.23	0.74	1.1	<0.23	--	0.35 J	0.77	0.73	<0.23	<0.23
Field pH, Std. Units	P	6.87		6.33	6.39	6.48	6.58	6.55	6.7	6.83	6.98	7.05	7.12	6.91	7.02	7.0	8.09	7.63	6.74	6.68
Sulfate, mg/L	P	199		130	130	--	140	810	790	180	180	190	220	76	--	63	40	93	280	310
Total Dissolved Solids, mg/L	P	628		510	570	--	550	1,600	1,500	810	810	1100	1,000	1000	--	960	400	570	870	820
Appendix IV		UPL	GPS																	
Antimony, ug/L	P*	0.22	6	<0.53	--	--	<0.58	<0.53	<0.58	<0.53	<0.58	<0.53	<0.58	<0.53	--	<0.58	1.3	0.88 J	<0.53	<0.58
Arsenic, ug/L	P*	0.53	10	<0.75	<0.88	--	<0.88	<0.75	<0.88	<0.75	<0.88	0.83 J	0.96 J	<0.75	--	<0.88	<0.88	<0.88	0.78 J	<0.88
Barium, ug/L	P	68.8	2,000	56	43	--	54	21	23	77	64	80	80	110	--	110	70	80	51	48
Beryllium, ug/L	DQ	DQ	4	<0.27	--	--	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	--	<0.27	<0.27	<0.27	<0.27	<0.27
Cadmium, ug/L	NP*	0.12	5	0.040	<0.039	--	<0.039	0.20	0.23	0.21	0.18	<0.039	<0.039	0.087 J	--	0.14	<0.039	<0.039	0.89	0.83
Chromium, ug/L	P	1.07	100	<0.98	<1.1	--	<1.1	<0.98	1.4 J	<0.98	<1.1	2 J	3.5 J	<0.98	--	<1.1	<1.1	<1.1	1.0 J	<1.1
Cobalt, ug/L	NP	4.1	6	0.60	1.1	0.43 J	0.52	2.7	5.3	1.2	0.87	0.5	0.57	**17**	**18**	**16**	2.4	2.7	6.2	5.5
Fluoride, mg/L	P	0.48	4	<0.23	--	--	<0.23	<0.23	<0.23		<0.23	0.74	1.1	<0.23	--	0.35 J	0.77	0.73	<0.23	<0.23
Lead, ug/L	NP*	0.10	15	<0.27	<0.27	--	<0.27	0.29 J	1.0	<0.27	<0.27	0.27 J	0.5	<0.27	-	0.27 J	0.68	<0.27	0.34 J	0.37 J
Lithium, ug/L	P	34.2	40	24	17	21	24	10	11	<2.7	4.7 J	2.8 J	4.8 J	<2.7	2.3 J	3.2 J	14	16	<2.7	<2.3
Mercury, ug/L	DQ	DQ	2	<0.10	--	--	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	--	<0.10	<0.10	<0.10	<0.10	<0.10
Molybdenum, ug/L	P	1.74	100	1.1	--	--	1.2 J	<1.1	<1.1	5.2	3.6	2.3	2	7.2	--	6.9	9	17	4.9	4.4
Selenium, ug/L	P	8.55	50	6.2	--	--	6.8	<1.0	<1.0	<1.0	5.0	<1.0	<1.0	<1.0	--	<1.0	2.3 J	1.7 J	<1.0	<1.0
Thallium, ug/L	NP*	0.14	2	<0.27	--	--	<0.26	<0.27	<0.26	<0.27	<0.26	<0.27	<0.26	0.38 J	--	0.35 J	<0.26	<0.26	<0.27	<0.26
Radium 226/228 Combined, pCI/L	P	2.15	5	0.956	0.228	--	0.315	0.79	1.26	0.336	0.229	3.03	2.46	0.46	--	0.909	1.97	1.26	0.624	0.0738
Additonal Parameters - Selection of Remedy																				
Cobalt - dissolved,$^{\#}$	UPL or GPS not applicable			--	--	0.32 J	0.44 J	--	0.81	--	0.37 J	--	0.37 J	--	16	16	2.1	2.8	--	5.4
Lithium - dissolved,$^{\#}$				--	--	22	--	--	--	--	--	--	--	--	<2.3	--	15	--	--	--
Iron, dissolved,$^{\#}$ ug/L				--	--	<50	<50	--	<50	--	<50	--	4,600	--	51 J	66 J	<50	<50	--	140
Iron, ug/L				--	--	<50	50 J	--	500	--	280	--	5,200	--	390	330	720	64 J	--	590
Magnesium						--	33,000		50,000		23,000		43,000			47,000	--	28,000		26,000
Manganese, dissolved,$^{\#}$ ug/L				--	--	17	16	--	110	--	220	--	3,700	--	3,100	3,400	150	240	--	16,000
Manganese, ug/L				--	--	16	19	--	200	--	260	--	3,700	--	3,200	3,300	180	260	--	16,000
Potassium, ug/L				--	--	--	1,500	--	1,500	--	960	--	7,700	--	--	7,600	--	3,800	--	3,700
Sodium, ug/L				--	--	--	77,000	--	250,000	--	100,000	--	210,000	--	--	210,000	--	46,000	--	160,000
Total Alkalinity, mg/L				--	--	--	150	--	61	--	440	--	370	--	--	460	--	270	--	280
Cabonate Alkalinity, mg/L				--	--	--	<1.9	--	<1.9	--	<1.9	--	<1.9	--	--	<1.9	--	<1.9	--	<1.9
Bicarbonate Alkalinity, mg/L				--	--	--	150	--	61	--	440	--	370	--	--	460	--	270	--	280

4.4	Blue highlighted cell indicates the compliance well result exceeds the UPL (background) and the LOQ.
30.8	Yellow highlighted cell indicates the compliance well result exceeds the GPS.
17	Yellow highlighted cell with bold text indicates the compliance well result exceeds the GPS and the result was determined to be statistically significant$^{(1)}$.
17	Grayscale indicates Additional Parameters sampled for selection of remedy and evaluation of MNA.

Blue highlighted cell indic
Yellow highlighted cell inc
Yellow highlighted cell wi
Grayscale indicates Addit

Table 2. Groundwater Analytical Results Summary
Ottumwa Generating Station Ash Pond / SCS Engineers Project #25220083.00

Parameter Name	UPL Method	UPL	GPS	Compliance Wells												
				MW-310				MW-310A		MW-311				MW-311A		
				10/24/2019	2/5/2020	3/13/2020	4/13/2020	3/13/2020	4/14/2020	10/24/2019	2/5/2020	3/13/2020	4/13/2020	3/13/2020	4/13/2020	6/30/2020
Appendix III																
Boron, ug/L	P	820		720	620	--	550	1500	1,600	<110	<100	--	<100	1400	1,500	NA
Calcium, mg/L	P	78.7		230	160	--	200	82	87	170	130	--	170	44	48	NA
Chloride, mg/L	P	86.8		150	120	--	130	140	130	13	14	--	13	130	140	NA
Fluoride, mg/L	P	0.484		0.31 J	0.85	--	1.1	1.7	1.8	<0.23	<0.23	--	<0.23	3.4	4.1	3.7
Field pH, Std. Units	P	6.87		7.15	7.08	6.89	7	7.73	7.85	6.95	6.72	7.11	6.86	7.85	8.4	7.64
Sulfate, mg/L	P	199		610	530	--	590	1200	1,100	47	54	--	54	1200	1,200	NA
Total Dissolved Solids, mg/L	P	628		260	1200	--	1,300	2300	2,300	530	520	--	570	2300	2,400	NA
Appendix IV		**UPL**	**GPS**													
Antimony, ug/L	P*	0.22	6	<0.53	<0.58	--	<0.58	<0.58	<0.58	<0.53	<0.58	--	<0.58	<0.58	<0.58	NA
Arsenic, ug/L	P*	0.53	10	0.78 J	<0.88	--	<0.88	<0.88	<0.88	<0.75	<0.88	--	<0.88	<0.88	<0.88	NA
Barium, ug/L	P	68.8	2,000	76	53	--	62	16	16	200	160	--	180	20	20	NA
Beryllium, ug/L	DQ	DQ	4	<0.27	<0.27	--	<0.27	<0.27	<0.27	<0.27	<0.27	--	<0.27	<0.27	<0.27	NA
Cadmium, ug/L	NP*	0.12	5	0.22	0.12	--	0.16	<0.039	<0.039	0.04 J	<0.039	--	<0.039	<0.039	<0.039	NA
Chromium, ug/L	P	1.07	100	<0.98	<1.1	--	<1.1	<1.1	<1.1	<0.98	<1.1	--	<1.1	<1.1	<1.1	NA
Cobalt, ug/L	NP	4.1	6	0.57	0.32 J	0.32 J	0.24 J	0.63	0.39 J	0.78	0.11 J	<0.091	<0.091	0.19 J	0.13 J	NA
Fluoride, mg/L	P	0.48	4	0.31 J	0.85	--	1.1	1.7	1.8	<0.23	<0.23	--	<0.23	3.4	4.1	3.7
Lead, ug/L	NP*	0.10	15	<0.27	<0.27	--	<0.27	<0.27	<0.27	<0.27	<0.27	--	<0.27	<0.27	<0.27	NA
Lithium, ug/L	P	34.2	40	35	42	46	48	250	290	4.7 J	2.9 J	4.7 J	6.2 J	260	310	NA
Mercury, ug/L	DQ	DQ	2	<0.10	<0.10	--	<.10	<0.10	<0.10	<0.10 F1	<0.10	--	<0.10	<0.10	<0.10	NA
Molybdenum, ug/L	P	1.74	100	26	29	--	31	2.6	2.7	<1.1	<1.1	--	<1.1	1.2 J	2.8	NA
Selenium, ug/L	P	8.55	50	5	3.3 J	--	4.5 J	<1.0	<1.0	<1.0	1.2 J	--	<1.0	<1.0	<1.0	NA
Thallium, ug/L	NP*	0.14	2	<0.27	<0.26	--	<0.26	<0.26	<0.26	<0.27	<0.26	--	<0.26	<0.26	<0.26	NA
Radium 226/228 Combined, pCI/L	P	2.15	5	0.411	0.0344	--	0.271	3.43	3.9	0.411	0.108	--	0.17	1.47	2.31	NA
Additonal Parameters - Selection of Remedy																
Cobalt - dissolved,$^{\#}$	UPL or GPS not applicable			--	--	0.31 J	0.23 J	0.67	0.40 J	--	--	0.11 J	<0.091	0.36 J	0.12 J	--
Lithium - dissolved,$^{\#}$				--	--	45	--	250	--	--	--	8.0 J	--	250	--	--
Iron, dissolved,$^{\#}$ ug/L				--	--	<50	<50	<50	220	--	--	<50	<50	<50	<50	--
Iron, ug/L				--	--	<50	<50	99 J	230	--	--	<50	<50	<50	<50	--
Magnesium							86,000	--	41,000			--	40,000	--	23,000	--
Manganese, dissolved,$^{\#}$ ug/L				--	--	250	280	53	39	--	--	21	39	20	22	--
Manganese, ug/L				--	--	260	280	51	38	--	--	20	41	20	13	--
Potassium, ug/L				--	--	--	12,000	--	9,900	--	--	--	620	--	9,000	--
Sodium, ug/L				--	--	--	100,000	--	630,000	--	--	--	5,000	--	710,000	--
Total Alkalinity, mg/L				--	--	--	190	--	320	--	--	--	460	--	360	--
Cabonate Alkalinity, mg/L				--	--	--	<1.9	--	<1.9	--	--	--	<1.9	--	<1.9	--
Bicarbonate Alkalinity, mg/L				--	--	--	190	--	320	--	--	--	460	--	360	--

4.4	ates the compliance well result exceeds the UPL (background) and the LOQ.
30.8	dicates the compliance well result exceeds the GPS.
17	th bold text indicates the compliance well result exceeds the GPS and the result was determined to be statistically significant$^{(1)}$.
17	tional Parameters sampled for selection of remedy and evaluation of MNA.

Table 2. Groundwater Analytical Results Summary
Ottumwa Generating Station Ash Pond / SCS Engineers Project #25220083.00

Abbreviations:

-- = Not Analyzed
mg/L = milligrams per liter
ug/L = micrograms per liter
J = Estimated concentration at or above the LOD and below the LOQ.
B = Analyte was detected in the associated Method Blank.
F1 = MS and/or MSD Recovery is outside acceptance limits.
[#] = Dissolved parameter samples collected for MNA data review
* = UPL is below the LOQ for background sampling. For compliance wells, only results confirmed above the LOQ are evaluated as potential SSIs above background.

LOD = Limit of Detection
LOQ = Limit of Quantitation
GPS = Groundwater Protection Standard
UPL = Upper Prediction Limit

P = Parametric UPL with 1-of-2 retesting
DQ = Double Quantification Rule (not detected in background)
NP = Nonparametric UPL (highest background value)

Notes:

1. An individual result above the UPL or GPS does not constitute a statistically significant increase (SSI) above background or statistically significant level above the GPS. The cobalt GPS exceedances at MW-305 have been determined to be statistically significant. The cobalt GPS exceedance at MW-306 has been determined not to be statistically significant. Lithium and fluoride GPS exceedances have either been determined not to be statistically significant or the determination is ongoing. See the accompanying reporttext for additional information regarding determinations of statistical significance.
2. GPS is the United States Environmental Protection Agency (US EPA) Maximum Contamination Level (MCL), if established; otherwise, the values are from 40 CFR 257.95(h)(2).
3. Interwell UPLs calculated based on results from background well MW-301.

Created by: NDK Date: 5/1/2018
Last revision by: NDK Date: 7/30/2020
Checked by: MDB Date: 7/30/2020
Proj Mgr QA/QC: TK Date: 7/30/2020

Table 3. Groundwater Analytical Results Summary

Ottumwa Generating Station - Zero Liquid Discharge Pond (ZLDP) / SCS Engineers Project #25220083.00

			Background Well			Compliance Wells												
Parameter Name	**UPL**		**MW-301**			**MW-307**				**MW-308**				**MW-309**			
			10/24/2019	2/5/2020	4/14/2020	10/23/2019	12/11/2019	2/5/2020	4/14/2020	10/23/2019	12/11/2019	2/5/2020	4/14/2020	10/23/2019	12/11/2019	2/5/2020	4/14/2020
Appendix III		**UPL only**															
Boron, ug/L	820		680	540	700	200	190 J	200	240	220	160 J	220	210	1,300	1,100	1300	1400
Calcium, mg/L	78.7		78	68	84	230	230	210	240	240	220	210	240	150	150	130	150
Chloride, mg/L	86.8		110	120	140	220	200	220	230	160	150	160	170	74	66	68	69
Fluoride, mg/L	0.484		<0.23	--	<0.23	<0.23	<0.23	NA	<0.23	<0.23	<0.23	NA	<0.23	<0.23	<0.23	NA	0.36 J
Field pH, Std. Units	6.87		6.33	6.39	6.58	6.68	6.37	6.67	6.76	6.78	6.55	6.78	6.90	6.98	6.67	7.09	7.21
Sulfate, mg/L	199		130	130	140	95	92	100	99	300	280	300	290	400	370	370	390
Total Dissolved Solids, mg/L	628		510	570	550	1,000	1,000	970	980	1,100	1,100	1100	1,000	1,100	980	990	1000
Appendix IV	**UPL**	**GPS**															
Antimony, ug/L	0.22	6	<0.53	--	<0.58	NA	<0.53	NA	<0.58	NA	<0.53	NA	<0.58	NA	<0.53	NA	<0.58
Arsenic, ug/L	0.53	10	<0.75	<0.88	<0.88	--	<0.75	<0.88	<0.88	--	<0.75	<0.88	<0.88	--	1.1 J	<0.88	0.88 J
Barium, ug/L	68.8	2,000	56	43	54	--	140	130	140	--	130	130	140	--	54	46	50
Beryllium, ug/L	DQ	4	<0.27	--	<0.27	--	<0.27	--	<0.27	--	<0.27	--	<0.27	--	<0.27	--	<0.27
Cadmium, ug/L	0.12	5	0.040 J	<0.039	<0.039	--	<0.039	<0.039	<0.039	--	<0.039	<0.039	<0.039	--	0.090 J	<0.039	<0.039
Chromium, ug/L	1.07	100	<0.98	<1.1	<1.1	--	<0.98	<1.1	<1.1	--	5.9	<1.1	<1.1	--	1.7 J	<1.1	1.3 J
Cobalt, ug/L	4.1	6	0.60	1.1	0.52	--	11	13	20	--	0.26 J	0.14 J	0.14 J	--	3.7	2.3	3.2
Fluoride, mg/L	0.484	4	<0.23	--	<0.23	<0.23	<0.23	--	<0.23	<0.23	<0.23	--	<0.23	<0.23	<0.23	--	0.36 J
Lead, ug/L	0.1	15	<0.27	<0.27	<0.27	--	0.71	<0.27	0.31 J	--	0.52	<0.27	<0.27	--	2.8	0.63	1.6
Lithium, ug/L	34.2	40	24	17	24	--	12	9.1 J	13	--	16	12	17	--	8.2 J	6.3 J	9.6 J
Mercury, ug/L	DQ	2	<0.10	--	<0.10	--	<0.10	--	<0.10	--	<0.10	--	<0.10	--	<0.10	--	<0.10
Molybdenum, ug/L	1.74	100	1.1 J	--	1.2 J	--	<1.1	--	<1.1	--	<1.1	--	<1.1	--	<1.1	--	<1.1
Selenium, ug/L	8.55	50	6.2	--	6.8	--	<1.0	--	<1.0	--	<1.0	--	<1.0	--	<1.0	--	<1.0
Thallium, ug/L	0.14	2	<0.27	--	<0.26	--	<0.27	--	<0.26	--	<0.27	--	<0.26	--	<0.27	--	<0.26
Radium 226/228 Combined, pCl/L	2.15	5	0.956	0.228	0.315	--	2.46	2.23	2.06	--	2.73	2.13	1.69	--	1.77	1.02	0.957
Additonal Parameters - Selection of Remedy																	
Cobalt - dissolved,$^{\#}$ ug/L	UPL or GPS not applicable		--	--	0.44 J	--	--	--	19	--	--	--	0.11 J	--	--	--	2.2
Iron, dissolved,$^{\#}$ ug/L			--	--	<50	--	--	--	3,100	--	--	--	4,400	--	--	--	590
Iron, ug/L			--	--	50 J	--	--	--	3,800	--	--	--	5,100	--	--	--	1,900
Magnesium, ug/L			--	--	33,000	--	--	--	28,000	--	--	--	25,000	--	--	--	19,000
Manganese, dissolved,$^{\#}$ ug/L			--	--	16	--	--	--	290	--	--	--	770	--	--	--	660
Manganese, ug/L			--	--	19	--	--	--	310	--	--	--	800	--	--	--	740
Potassium, total, ug/L			--	--	1,500	--	--	--	1,900	--	--	--	3,900	--	--	--	670
Sodium, total, ug/L			--	--	77,000	--	--	--	97,000	--	--	--	110,000	--	--	--	170,000
Total Alkalinity as CaCO3			--	--	150	--	--	--	520	--	--	--	380	--	--	--	290
Carbonate Alkalinity as CaCO3			--	--	<1.9	--	--	--	<1.9	--	--	--	<1.9	--	--	--	<1.9
Bicarbonate Alkalinity as CaCO3			--	--	150	--	--	--	520	--	--	--	380	--	--	--	290

🟦	Blue highlighted cell indicates the compliance well result exceeds the UPL and the LOQ.
🟨	Yellow highlighted cell indicates the compliance well result exceeds the GPS.
⬜	Grayscale indicates Additional Parameters sampled for selection of remedy and evaluation of MNA.

Table 3. Groundwater Analytical Results Summary
Ottumwa Generating Station - Zero Liquid Discharge Pond (ZLDP) / SCS Engineers Project #25220083.00

Abbreviations:

-- = Not Analyzed
mg/L = milligrams per liter
ug/L = micrograms per liter

J = Estimated concentration at or above the LOD and below the LOQ.
DQ = Double Quantification Rule (not detected in background)
UPL = Upper Prediction Limit

GPS = Groundwater Protection Standard
LOD = Limit of Detection
LOQ = Limit of Quantitation

[#] = Dissolved parameter samples collected for MNA data review

* = UPL is below the LOQ for background sampling. For compliance wells, only results confirmed above the LOQ are evaluated as potential SSIs above background.

Notes:

1. An individual result above the UPL or GPS does not constitute a statistically significant increase (SSI) above background or statistically significant level above the GPS. See the accompanying letter text for identification of statistically significant results.
2. GPS is the United States Environmental Protection Agency (US EPA) Maximum Contamination Level (MCL), if established; otherwise, the values are from 40 CFR 257.95(h)(2).
3. Interwell UPLs calculated based on results from background well MW-301.

Created by: NDK Date: 6/12/2019
Last revision by: MDB Date: 6/16/2020
Checked by: NDK Date: 6/16/2020
Proj Mgr QA/QC: EJN Date: 9/11/2020

Table 4. Vertical Hydraulic Gradients at Well Clusters
Ottumwa Generating Station / SCS Engineers Project #25220083.00

Well Pair		Vertical Hydraulic Gradient (feet/foot)$^{(1,2)}$	
Shallower Well	**Deeper Well**	**April 1, 2020**	**April 13-14, 2020**
MW-305	MW-305A	-0.183	-0.289
MW-310	MW-310A	-0.064	0.052
MW-311	MW-311A	-0.036	0.054

Notes:

(1) A negative value indicates a downward gradient; a positive value indicates an upward gradient.

Created by: MDB Date: 5/14/2020
Last rev. by: MDB Date: 5/14/2020
Checked by: LMH Date: 5/14/2020
Proj Mgr QA/QC: TK Date: 5/15/2020

I:\25220083.00\Data and Calculations\Tables\[4_Vertical Gradients_OGS.xls]Gradients

Table 5. Evaluation of Corrective Measure Alternatives
Ottumwa Generating Station / SCS Engineers Project #25220083.00

	Alternative #1 No Action		Alternative #2 Close and Cap in Place with MNA		Alternative #3 Consolidate On Site and Cap with MNA		Alternative #4 Excavate and Dispose On Site with MNA		Alternative #5 Excavate and Dispose in Off-site Landfill	
CORRECTIVE ACTION ASSESSMENT - 40 CFR 257.97(b)										
Threshold Criteria	**Score**	**Able to Meet Criteria?**	**Score**	**Able to Meet Criteria?**	**Score**	**Able to Meet Criteria?**	**Score**	**Able to Meet Criteria?**	**Score**	**Able to Meet Criteria?**
257.97(b)(1) Is remedy protective of human health and the environment?	0	No	1	Yes	1	Yes	1	Yes	1	Yes
257.97(b)(2) Can the remedy attain the groundwater protection standard?	0	Unlikely	1	Yes	1	Yes	1	Yes	1	Yes
257.97(b)(3) Can the remedy control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of constituents in appendix IV to this part into the environment?	0	No	1	Yes	1	Yes	1	Yes	1	Yes
257.97(b)(4) Can the remedy remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible?	N/A	Not Applicable - No release of CCR	N/A	Not Applicable - No release of CCR	N/A	Not Applicable - No release of CCR	N/A	Not Applicable - No release of CCR	N/A	Not Applicable - No release of CCR
257.97(b)(5) Can the remedy comply with standards for management of wastes as specified in §257.98(d)?	0	Not Applicable	1	Yes	1	Yes	1	Yes	1	Yes
COMPOSITE SCORE	**0**		**1**		**1**		**1**		**1**	
DETERMINATION	**This alternative is eliminated from further consideration due to the inability to achieve threshold criteria.**		**This alternative is retained and assessed in further detail.**		**This alternative is retained and assessed in further detail.**		**This alternative is retained and assessed in further detail.**		**This alternative is retained and assessed in further detail.**	

NOTES:

1) Scoring for the CORRECTIVE ACTION ASSESSMENT - 40 CFR 257.97(b) is binary based on a score of "1" indicating that the threshold criteria is met, and a score of "0" indicating that the threshold criteria is not met. A composite (average) score of "1" is required for the Alternative to be retained for further consideration and evaluation.

Table 5. Evaluation of Corrective Measure Alternatives
Ottumwa Generating Station / SCS Engineers Project #25220083.00

	Alternative #1 No Action		Alternative #2 Close and Cap in Place with MNA		Alternative #3 Consolidate On Site and Cap with MNA		Alternative #4 Excavate and Dispose On Site with MNA		Alternative #5 Excavate and Dispose in Off-site Landfill	
LONG- AND SHORT-TERM EFFECTIVENESS - 40 CFR 257.97(c)(1)										
Criteria	**Score**	**Assessment**	**Score**	**Assessment**	**Score**	**Assessment**	**Score**	**Assessment**	**Score**	**Assessment**
257.97(c)(1)(i) Magnitude of reduction of existing risks	–	No reduction of existing risk	4	Existing risk reduced by achieving GPS	4	Same as Alternative #2	4	Same as Alternative #2	4	Same as Alternative #2
257.97(c)(1)(ii) Magnitude of residual risks in terms of likelihood of further releases due to CCR remaining following implementation of a remedy	–	No reduction of existing risk. Residual risk is limited for all alternatives due to limited extent of impacts and lack of receptors.	1	Magnitude of residual risk of further releases is lower than current conditions due to final cover eliminating infiltration through CCR; Residual risk is limited for all alternatives due to limited extent of impacts and lack of receptors	2	Same as Alternative #2 with potential further reduction in release risk due to CCR material footprint; However, limited to no overall risk reduction is provided due to lack of current/anticipated future receptors for groundwater impacts	3	Same as Alternative #3 with potential further reduction in release risk due to composite liner and cover; However, limited to no overall risk reduction is provided due to lack of current/anticipated future receptors for groundwater impacts	4	Same as Alternative #3 with potential further reduction in release risk due to removal of CCR from site; However, limited to no overall risk reduction is provided due to lack of current/anticipated future receptors for groundwater impacts
257.97(c)(1)(iii) The type and degree of long-term management required, including monitoring, operation, and maintenance	–	Not Applicable	3	30-year post-closure groundwater monitoring; Groundwater monitoring network maintenance and as needed repair/replacement Final cover maintenance (e.g., mowing and as-needed repair); Periodic final cover inspections; Additional corrective action as required based on post closure groundwater monitoring	3	Same as Alternative #2	3	Same as Alternative #2	4	No on-site long-term management required; Limited on-site post-closure groundwater monitoring until GPS are achieved; Receiving disposal facility will have same/similar long-term monitoring, operation, and maintenance requirements as Alternative #2
257.97(c)(1)(iv) Short-term risks - Implementation	–		11	Total of Below Criteria (Excavation / Transportation / Redisposal)	10	Total of Below Criteria (Excavation / Transportation / Redisposal)	5	Total of Below Criteria (Excavation / Transportation / Redisposal)	4	Total of Below Criteria (Excavation / Transportation / Redisposal)
Excavation	_	*None*	*4*	*Limited risk to community and environment due to limited amount of excavation (likely <200K cy) required to establish final cover subgrades and no off-site excavation*	*3*	*Same as Alternative #2 with increased risk to environment due to increased excavation volumes required for consolidation (likely >200K cy but <463K cy)*	*1*	*Same as Alternative #3 with increased risk to environment due to increased excavation volumes (~463K cy) and temporary CCR storage during disposal site construction required for removal and on-site re-disposal*	*2*	*Same as Alternative #4 with reduced risk to environment from excavation due to limited on-site storage*
Transportation	_	*None*	*3*	*No risk to community or environment from off-site CCR transportation;* *Typical risk due to construction traffic delivering final cover materials to site*	*4*	*Same as Alternative #2 with reduced risk from construction traffic due to reduced final cover material requirements (smaller cap footprint)*	*2*	*Same as Alternative #2 with increased risk from construction traffic due to increased material import requirements (liner and cap construction required)*	*1*	*Highest level of community and environmental risk due to CCR volume export (~463K cy)*
Re-Disposal	_	*None*	*4*	*Limited risk to community and environment due to limited volume of CCR re-disposal (likely <200K cy)*	*3*	*Same as Alternative #2 with increased risk to environment due to increased excavation volumes (likely >200K cy but <463K cy) required for consolidation*	*2*	*Same as Alternative #3 with increased risk to environment due to increased excavation volumes (~463K cy) and temporary CCR storage during disposal site construction required for removal and on-site re-disposal*	*1*	*Same as Alternative #4 with increased risk to community and environment due to re-disposal of large CCR volume (~463K cy) at another facility;* *Re-disposal risks are managed by the receiving disposal facility*
257.97(c)(1)(v) Time until full protection is achieved	–	Unknown	4	Closure and capping can be completed by end of 2023. Groundwater protection timeframe to reach GPS potentially 2 to 10 years following closure construction, achievable within 30-year post-closure monitoring period.	4	Similar to Alternative #2. Potential for increase in time to reach GPS due to significant source disturbance during construction. Potential for decrease in time to reach GPS due to consolidation of CCR. Scoring is based on balance between potential increase or decrease due to factors listed.	2	Increased time required to implement remedy in comparison to Alternative #2. Anticipated increase in time required to identify, site and develop onsite disposal capacity if located outside of existing impoundment footprint. Increased time required for closure construction due CCR excavation, temporary storage, liner construction, and redisposal if completed within impoundment footprint. Potential for increase in time to reach GPS due to significant source disturbance during construction. Potential decrease in time to reach GPS due to source isolation within liner/cover system.	1	Increased time required to implement remedy in comparison to Alternative #2, and potentially the longest required time to implement closure. Implementation schedule extends the time required to achieve full protection. Extended implementation timeframe is driven by the time required to identifying and secure off-site disposal capacity, or develop the capacity at an existing Alliant-owned facility. If landfill capacity is not owned by Alliant, additional time may be required to permit and develop the necessary disposal capacity. Increased construction time likely required due to the capacity of the receiving site to unload and place material. Potential for increase in time to reach GPS due to significant source disturbance during construction. Potential decrease in time to reach GPS due to impounded CCR source removal.
257.97(c)(1)(vi) Potential for exposure of humans and environmental receptors to remaining wastes, considering the potential threat to human health and the environment associated with excavation, transportation, re-disposal, or containment	–	No change in potential exposure	4	Potential for exposure is low. Remaining waste is capped.	3	Similar to Alternative #2 with increased risk to construction workers during consolidation of CCR.	2	Similar to Alternative #2 with increased risk to construction workers during excavation and re-disposal. Increased risk over Alternative #3 due to higher material management volumes.	1	No potential for on-site exposure to remaining waste since no waste remains on site; Risk of potential exposure is transferred to receiving disposal facility and is likely similar to Alternative #2 Highest level of risk due to excavation, transportation, and re-disposal for construction workers removing CCR and solid waste workers at receiving facility.
257.97(c)(1)(vii) Long-term reliability of the engineering and institutional controls	–	Not Applicable	2	Long-term reliability of cap is good; Significant industry experience with methods/controls; Capping is common practice/industry standard for closure in place for remediation and solid waste management	3	Same as Alternative #2 with potentially increased reliability due to smaller footprint and reduced maintenance	3	Same as Alternative #3	4	Success of remedy at OGS does not rely on long-term reliability of engineering or institutional controls; Overall success relies on reliability of the engineering and institutional controls at the receiving facility
257.97(c)(1)(viii) Potential need for replacement of the remedy	–	Not Applicable	1	Limited potential for remedy replacement if maintained; Some potential for remedy enhancement due to residual groundwater impacts following source control	2	Same as Alternative #2 with reduced potential need for remedy enhancement with consolidated/smaller closure area footprint	3	Same as Alternative #2 with further reduction in potential need for remedy enhancement composite with liner	4	No potential for remedy replacement; Limited potential for remedy enhancement due to residual groundwater impacts following source control
LONG- AND SHORT-TERM EFFECTIVENESS SCORE	_		**30**		**31**		**25**		**26**	

Table 5. Evaluation of Corrective Measure Alternatives
Ottumwa Generating Station / SCS Engineers Project #25220083.00

	Alternative #1 No Action		Alternative #2 Close and Cap in Place with MNA		Alternative #3 Consolidate On Site and Cap with MNA		Alternative #4 Excavate and Dispose On Site with MNA		Alternative #5 Excavate and Dispose in Off-site Landfill	
SOURCE CONTROL TO MITIGATE FUTURE RELEASES - 40 CFR 257.97(c)(2)										
257.97(c)(2)(i) The extent to which containment practices will reduce further releases	_	No reduction in further releases	1	Cap will reduce further releases by minimizing infiltration through CCR	2	Same as Alternative #2 with further reduction due to consolidated/smaller closure footprint	3	Same as Alternative #3 with further reduction due to composite liner and 5-foot groundwater separation required by CCR Rule	4	Removal of CCR prevents further releases at OGS; Receiving disposal site risk similar to Alternative #3
257.97(c)(2)(ii) The extent to which treatment technologies may be used	_	Alternative does not rely on treatment technologies	4	Alternative does not rely on treatment technologies	4	Alternative does not rely on treatment technologies	4	Alternative does not rely on treatment technologies	4	Alternative does not rely on treatment technologies
SOURCE CONTROL SCORE	_		**5**		**6**		**7**		**8**	
IMPLEMENTATION - 40 CFR 257.97(c)(3)										
257.97(c)(3)(i) Degree of difficulty associated with constructing the technology	_	Not Applicable	4	Low complexity construction; Potentially lowest level of dewatering effort - dewatering required for cap installation only	3	Low complexity construction; Moderate degree of logistical complexity; Moderate level of dewatering effort - dewatering required for material excavation/placement and capping	2	Moderately complex construction due to composite liner and cover; High degree of logistical complexity due to excavation and on-site storage of ~463K cy of CCR while new lined disposal area is constructed; High level of dewatering effort - dewatering required for excavation of full CCR volume	1	Low complexity construction; High degree of logistical complexity including the excavation and off-site transport of ~463K cy of CCR and permitting/development of off-site disposal facility airspace; High level of dewatering effort - dewatering required for excavation o full CCR volume
257.97(c)(3)(ii) Expected operational reliability of the technologies	_	Not Applicable	4	High reliability based on historic use of capping as corrective measure	4	Same as Alternative #2	4	Same as Alternative #2	3	Success at OGS does not rely on operational reliability of technologies; Overall success relies on off-site disposal facility, which is likely same/similar to Alternative #2, but may not be controlled by the Owner.
257.97(c)(3)(iii) Need to coordinate with and obtain necessary approvals and permits from other agencies	_	Not Applicable	4	Need is low in comparison to other alternatives; State Closure Permit required	4	Same as Alternative #2	2	Need is high in comparison to other alternatives State Closure Permit required; State Landfill Permit may be required	1	Need is highest in comparison to other alternatives; State Closure Permit required; Approval of off-site disposal site owner required; May require State solid waste comprehensive planning approval; Local road use permits likely required
257.97(c)(3)(iv) Availability of necessary equipment and specialists	_	Not Applicable	4	Necessary equipment and specialists are highly available; Highest level of demand for cap construction material, which are readily available and accessible in the area.	3	Same as Alternative #2; Lowest level of demand for cap construction material. Potentially increased demand for dewatering, treatment and conditioning of CCR.	2	Same as Alternative #2; Moderate level of demand for liner and cap construction material. Increase in demand for specialty materials and services due to composite liner construction.	1	Availability of necessary equipment to develop necessary off-site disposal facility airspace and transport ~463K cy of CCR to new disposal facility will be a limiting factor in the schedule for executing this alternative; No liner or cover material demands for on-site implementation of remedy
257.97(c)(3)(v) Available capacity and location of needed treatment, storage, and disposal services	_	Not Applicable	4	Capacity and location of treatment, storage, and disposal services is not a factor for this alternative	3	Capacity and location of treatment, storage, and disposal services is unlikely to be a factor for this alternative	2	Available temporary on-site storage capacity for ~463K cy of CCR while composite liner is constructed is significant limiting factor	1	Off-site disposal capacity, facility logistical capacity, or the time required to develop the necessary off-site disposal and logistical capacity is a significant limiting factor.
IMPLEMENTATION SCORE	_		**20**		**17**		**12**		**7**	
COMMUNITY ACCEPTANCE - 40 CFR 257.97(c)(4)										
257.97(c)(4) The degree to which community concerns are addressed by a potential remedy	_	To be determined based on input obtained through public meetings/outreach to be completed	4	No comments were received during the public meeting held on June 4, 2020. Assume all alternatives are acceptable to interested/affected parties.	4	No comments were received during the public meeting held on June 4, 2020. Assume all alternatives are acceptable to interested/affected parties.	4	No comments were received during the public meeting held on June 4, 2020. Assume all alternatives are acceptable to interested/affected parties.	4	No comments were received during the public meeting held on June 4, 2020. Assume all alternatives are acceptable to interested/affected parties.
COMMUNITY ACCEPTANCE SCORE	_		**4**		**4**		**4**		**4**	

NOTES:

1) Scoring between "1" and "4" is used to evaluate each remedy with respect to the others. A lower score "1" indicates that the remedy was assessed as less effective when compared to a remedy considered more effective "4". This scoring evaluation is relative to the remedies presented.

Created by: SK	Date: 4/29/2020
Last revision by: EJN	Date: 7/22/2020
Checked by: TK	Date: 7/22/2020

I:\25220083.00\Deliverables\2020 Selection of Remedy Report\[Table 5-6_Evaluation of Assessment of Corrective Measure_OGS.xlsx]Table 5 - OGS_Evaluation Matrix

Table 6. Summary of Corrective Measure Alternative Scoring
Ottumwa Generating Station / SCS Engineers Project #25220083.00

		Alternative #1	Alternative #2	Alternative #3	Alternative #4	Alternative #5
Evaluation Factors	**Potential Points**	**No Action**	**Close and Cap in Place with MNA**	**Consolidate On Site and Cap with MNA**	**Excavate and Dispose On Site with MNA**	**Excavate and Dispose in Off-site Landfill**
LONG- AND SHORT-TERM EFFECTIVENESS 40 CFR 257.97(c)(1)	40	Not Evaluated, Failed Minimum Criteria	30	31	25	26
SOURCE CONTROL TO MITIGATE FUTURE RELEASES 40 CFR 257.97(c)(2)	8	_	5	6	7	8
IMPLEMENTATION 40 CFR 257.97(c)(3)	20	_	20	17	12	7
COMMUNITY ACCEPTANCE 40 CFR 257.97(c)(4)	4	_	4	4	4	4
TOTAL SCORE	**72**	_	**59**	**58**	**48**	**45**

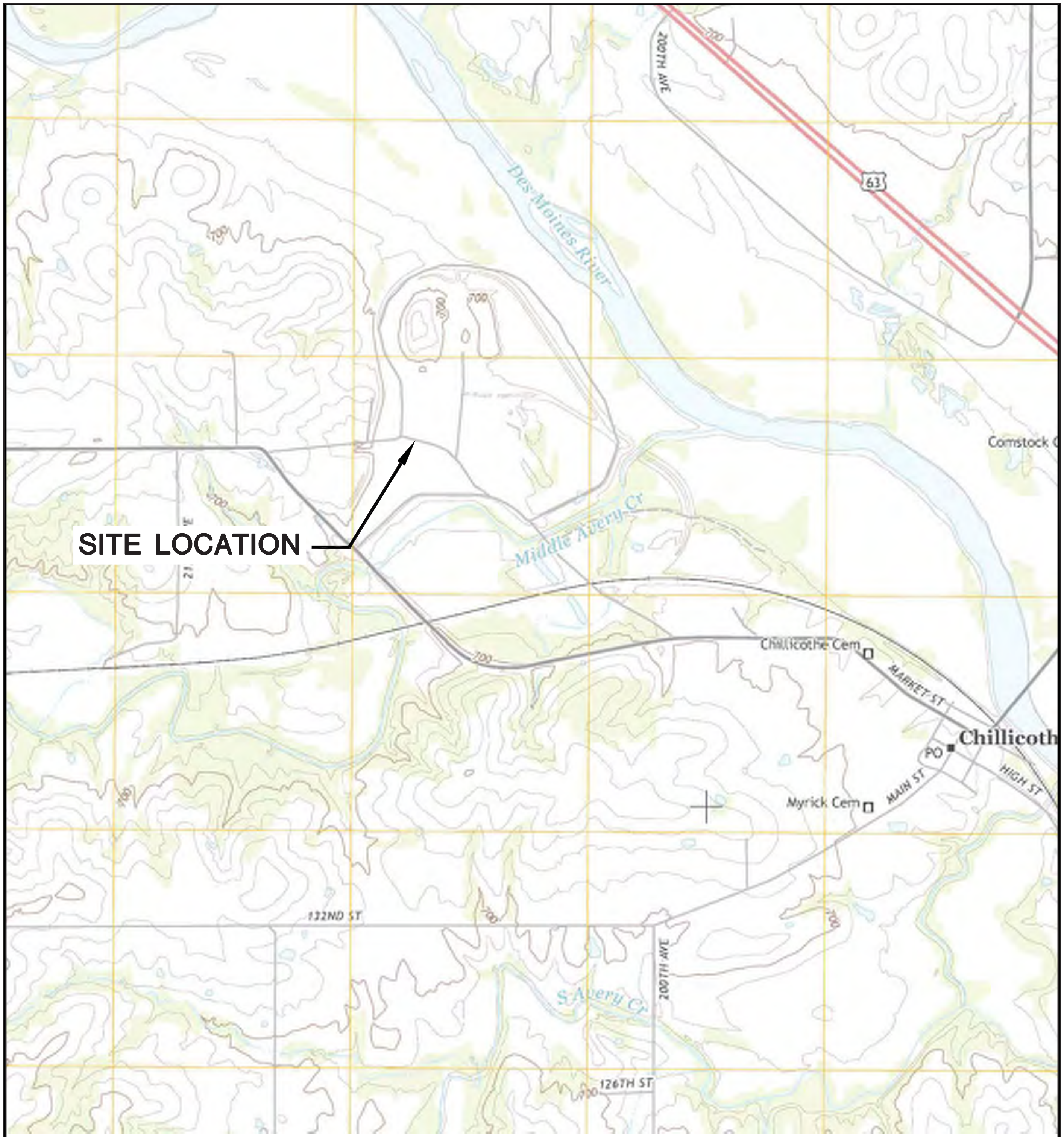
NOTES:

1) Scoring between "1" and "4" is used to evaluate each remedy with respect to the others. A lower score "1" indicates that the remedy was assessed as less effective when compared to a remedy considered more effective "4". This scoring evaluation is relative to the remedies presented.

Created by: SK Date: 4/29/2020
Last revision by: EJN Date: 7/22/2020
Checked by: TK Date: 7/22/2020

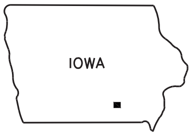
I:\25220083.00\Deliverables\2020 Selection of Remedy Report\[Table 5-6_Evaluation of Assessment of Corrective Measure_OGS.xlsx]Table 6 - Summary of Scores

Figures



N

CHILLICOTHE QUADRANGLE
IOWA–WAPELLO CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
2013
SCALE: 1" = 2,000'



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

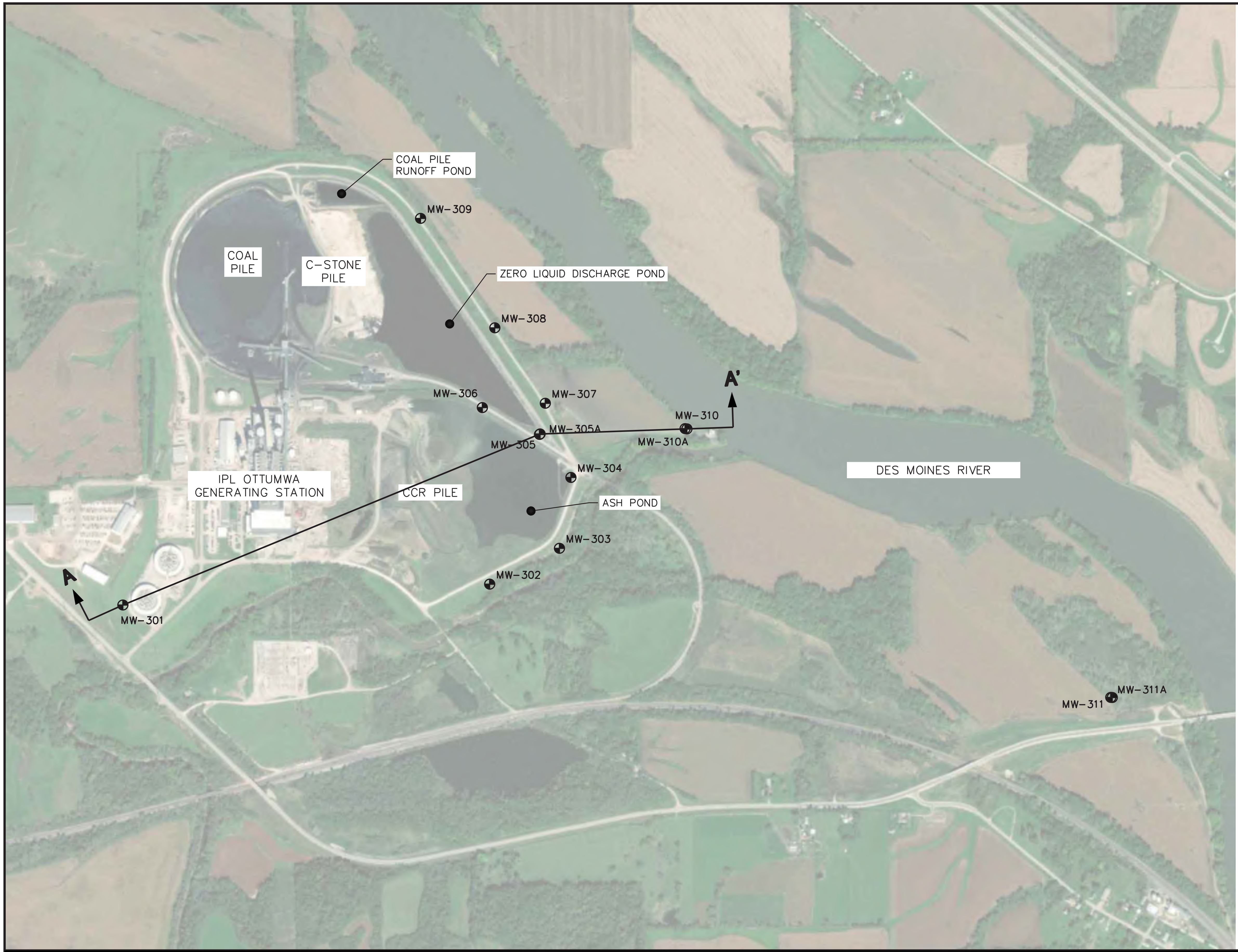
SITE
OTTUMWA GENERATING STATION
OTTUMWA, IOWA

SITE LOCATION MAP

PROJECT NO.	25218201.00	DRAWN BY:	AHB
DRAWN:	05/29/15	CHECKED BY:	KAK
REVISED:	03/08/16	APPROVED BY:	TJK 09/10/19

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

FIGURE
1



LEGEND

⊕ MONITORING WELL

GEOLOGIC CROSS SECTION

NOTES:

1. 2014 AERIAL PHOTOGRAPH SOURCES: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA FSA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY.
2. MONITORING WELLS MW-301, MW-302, AND MW-304, WERE INSTALLED BY CASCADE DRILLING, LLP. UNDER THE SUPERVISION OF SCS ENGINEERS FROM NOVEMBER 11-12, 2015.
3. MONITORING WELLS MW-303 AND MW-305 WERE INSTALLED BY CASCADE DRILLING LLP. UNDER THE SUPERVISION OF SCS ENGINEERS ON DECEMBER 7-8, 2015.
4. MONITORING WELLS MW-307, MW-308, AND MW-309 WERE INSTALLED BY CASCADE DRILLING, LLP. UNDER THE SUPERVISION OF SCS ENGINEERS FROM OCTOBER 25-27, 2016.
5. MONITORING WELLS MW-310 AND MW-311 WERE INSTALLED BY ROBERTS ENVIRONMENTAL DRILLING ON AUGUST 27, 2019.
6. MONITORING WELLS MW-305A, MW-310A, AND MW-311A WERE INSTALLED BY ROBERTS ENVIRONMENTAL DRILLING BETWEEN FEBRUARY 27, 2020 AND MARCH 3, 2020.

N

800 0 800

SCALE: 1" = 800'

PROJECT NO.	25220083.00	DRAWN BY:	BSS
DRAWN:	11/15/2019	CHECKED BY:	MDB
REVISED:	05/11/2020	APPROVED BY:	EJN 9/11/2020

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SCS ENGINEERS
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PHONE: (608) 224-2830

CLIENT

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

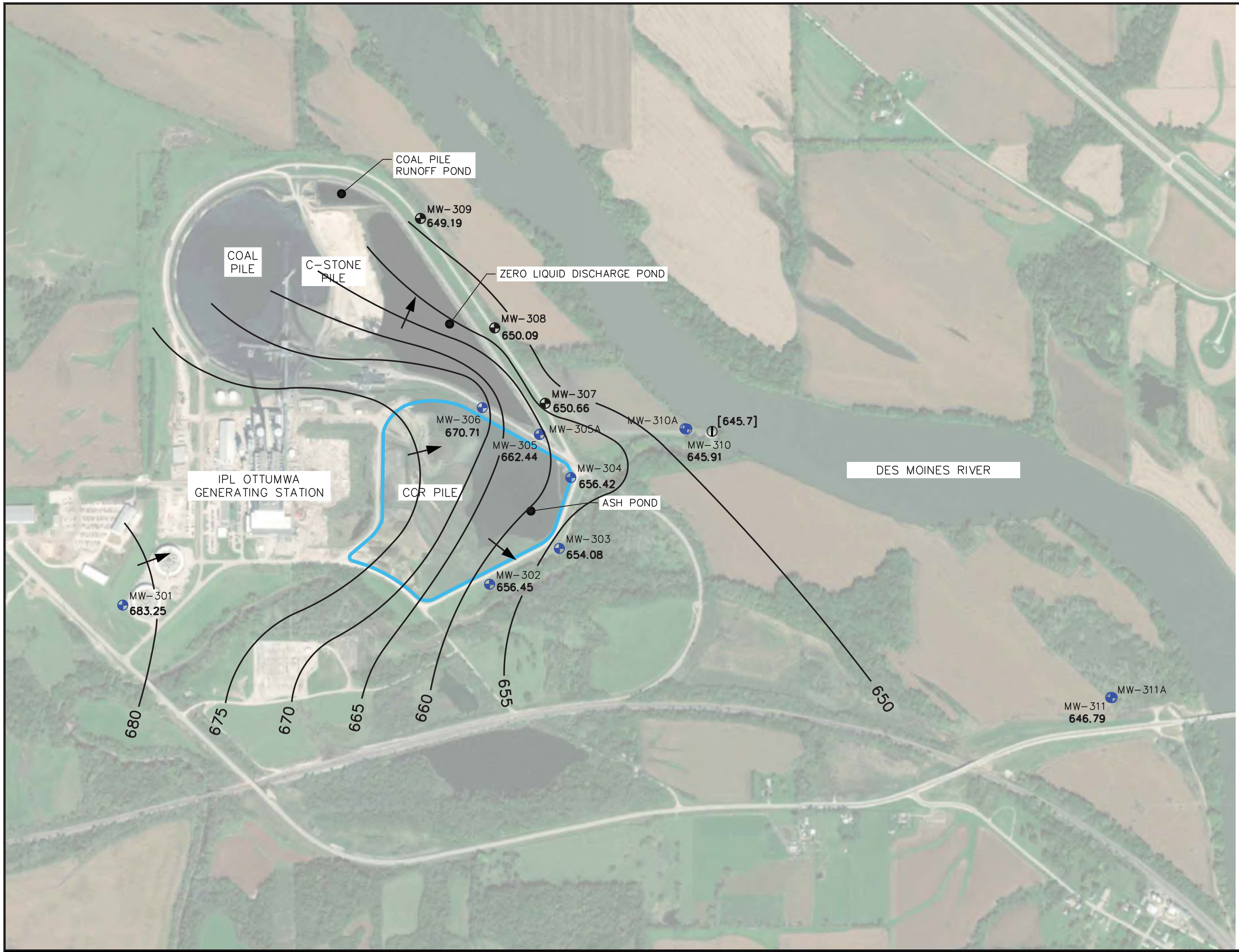
SITE

ALLIANT ENERGY
OTTUMWA GENERATING STATION
OTTUMWA, IOWA

SITE PLAN
AND MONITORING WELL LOCATIONS

FIGURE
2

I:\25220083.00\Drawings\Site Plan and Monitoring Well Locations.dwg, 5/11/2020 7:55:48 AM



LEGEND

▬	CCR UNIT
⊕	OGS ASH POND CCR MONITORING WELL
⊕	ADDITIONAL CCR MONITORING WELL
⦶	RIVER ELEVATION MEASUREMENT LOCATION
645.91	POTENTIOMETRIC ELEVATION AT WELL (APRIL 13–14, 2020)
[645.7]	SURFACE WATER ELEVATION (APRIL 13, 2020)
—	POTENTIOMETRIC SURFACE CONTOUR
→	APPROXIMATE GROUNDWATER FLOW DIRECTION

N

800 0 800

SCALE: 1" = 800'

PROJECT NO.	25220072.00	DRAWN BY:	KP/BSS/RJG
DRAWN:	04/28/2020	CHECKED BY:	NDK/SCC
REVISED:	07/30/2020	APPROVED BY:	EJN 9/11/2020

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CLIENT

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

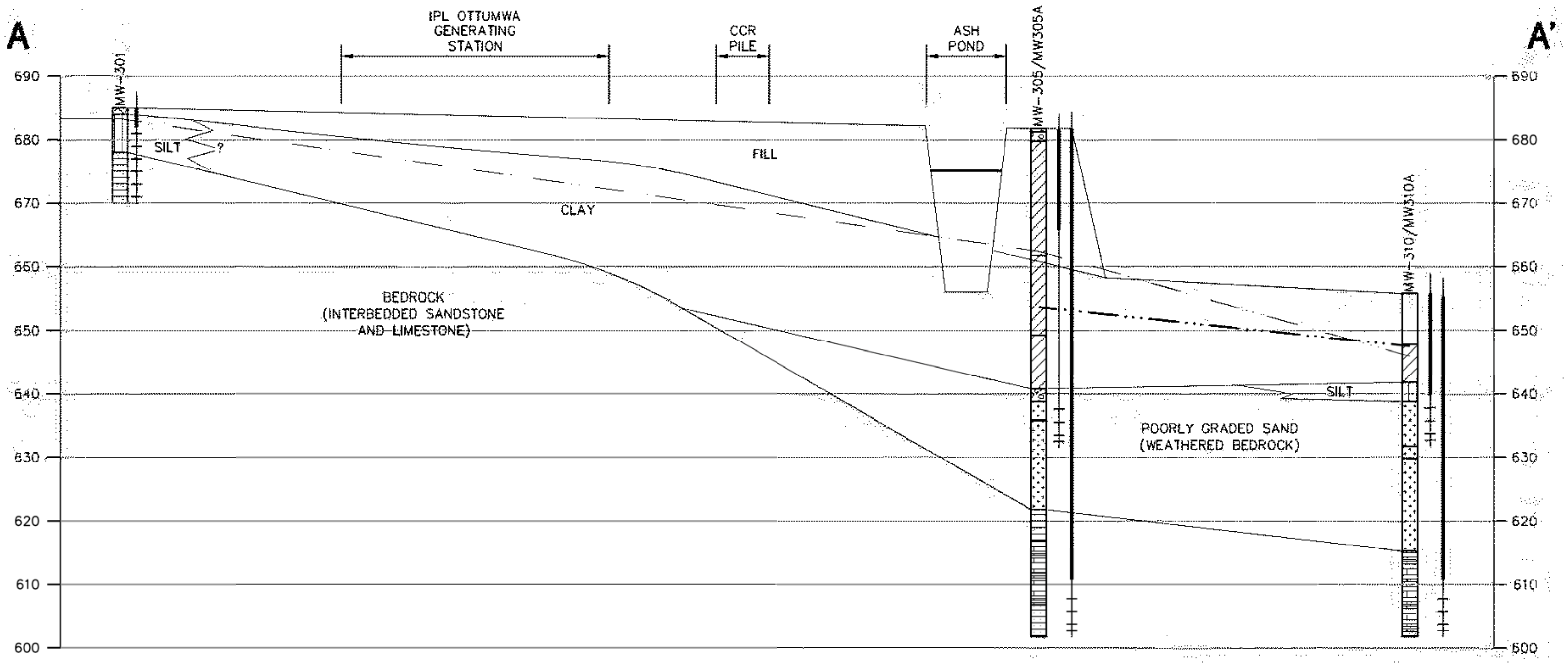
SITE

ALLIANT ENERGY
OTTUMWA GENERATING STATION
OTTUMWA, IOWA

SHALLOW POTENTIOMETRIC SURFACE
APRIL 13–14, 2020

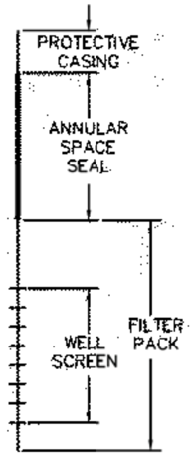
FIGURE
5

I:\25220072.00\Drawings\ otentiometric Sur ace 2020.dwg, 7/ 0/2020 2:12: 6 M



LEGEND

- ▩ TOPSOIL/FILL
- ░ SAND, POORLY GRADED (SP)
- ▥ SILT, WITH SAND AND GRAVEL (ML)
- ▨ CLAY
- ░ GRAVEL, POORLY GRADED, LITTLE OR NO FINES (GP)
- ▤ SANDSTONE
- ▦ LIMESTONE
- —··— DEEP POTENTIOMETRIC SURFACE MEASURED APRIL 13–14, 2020
- —·—· SHALLOW POTENTIOMETRIC SURFACE MEASURED APRIL 13–14, 2020
- —— POND SURFACE ELEVATION MEASURED JUNE 10–11, 2019



WELL DETAIL

0 500

HORIZONTAL SCALE: 1" = 500'
VERTICAL SCALE: 1" = 20'
VERTICAL EXAGGERATION = 25X

NOTES:

1. MW-305 AND MW-305A WERE HYDROVACED TO APPROXIMATELY 8.5'. MW-310 AND MW-310A WERE HYDROVACED TO APPROXIMATELY 8.0'. HYDROVACING IS PERFORMED TO DETERMINE IF UNDERGROUND UTILITIES ARE PRESENT. HIGH PRESSURE WATER AND A VACUUM ARE USED TO CLEAR THE BOREHOLE AND GEOLOGIC SAMPLES ARE NOT COLLECTED. NATIVE SOIL IN THE VICINITY OF MW-307 IS CLAY.
2. ASH POND BOTTOM ELEVATION IS BASED ON THE EMBANKMENT CREST ELEVATION (681 FEET) AND INTERNAL STORAGE DEPTH (25 FEET) REPORTED IN THE HISTORY OF CONSTRUCTION REPORT ISSUED SEPTEMBER 29, 2016, BY HARD HAT SERVICES.

PROJECT NO.	25220083.00	DRAWN BY:	BSS/KP
DRAWN:	07/03/2019	CHECKED BY:	NDK/MDB
REVISED:	05/13/2020	APPROVED BY:	EJN 9/11/2020

ENGINEER
SCS ENGINEERS
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CLIENT
INTERSTATE POWER AND LIGHT CO.
15300 130th STREET
OTTUMWA, IA 52501

SITE
OTTUMWA GENERATING STATION
20775 POWER PLANT ROAD
OTTUMWA, IOWA

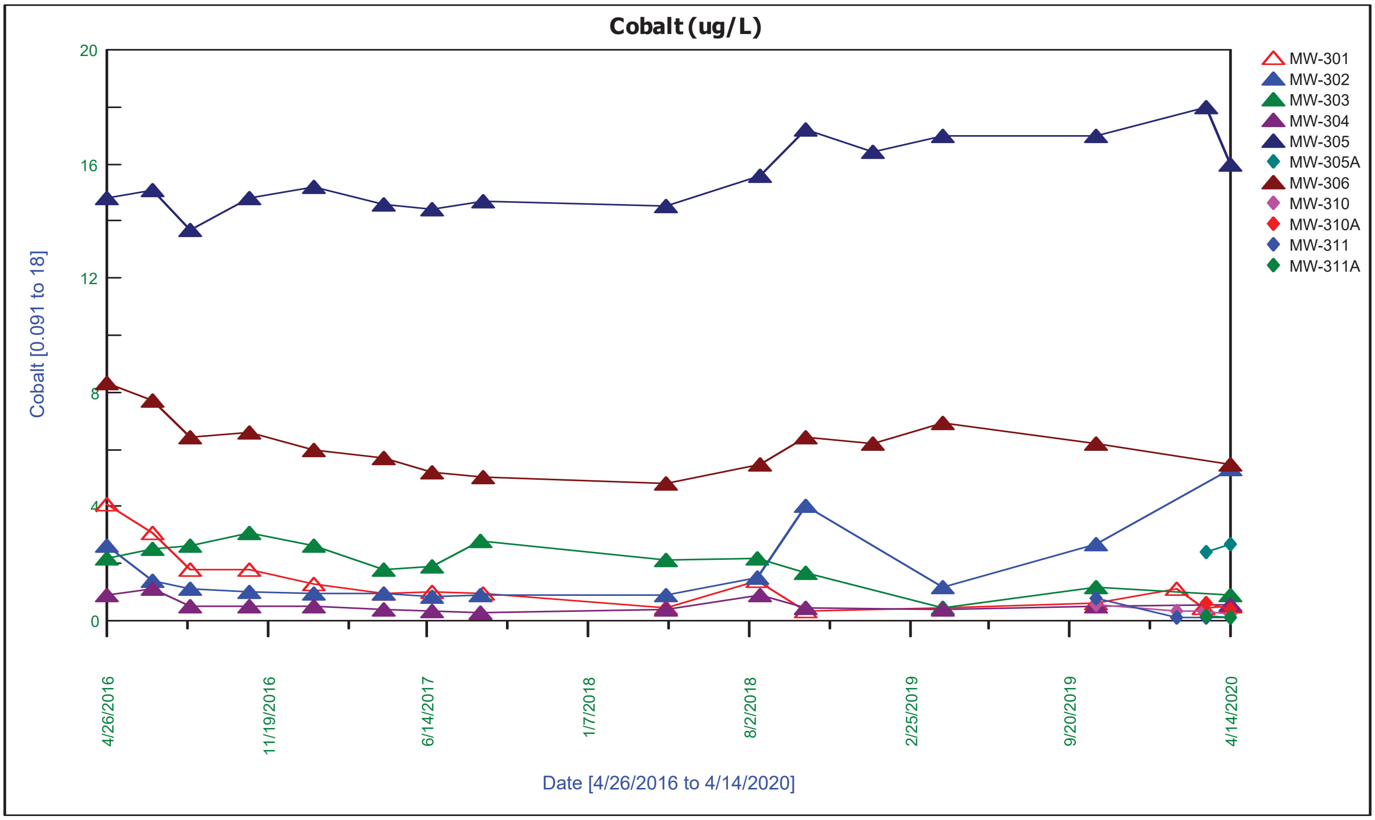
GEOLOGIC CROSS SECTION A–A'

FIGURE
4

I:\25220083.00\Drawings\Geologic Cross Section.dwg, 5/13/2020 8:26:34 AM

Appendix A

Time Series Plots


Cobalt (ug/L)
Cobalt [0.091 to 18]
20
16
12
8
4
0
4/26/2016
11/19/2016
6/14/2017
1/7/2018
8/2/2018
2/25/2019
9/20/2019
4/14/2020
Date [4/26/2016 to 4/14/2020]
MW-301
MW-302
MW-303
MW-304
MW-305
MW-305A
MW-306
MW-310
MW-310A
MW-311
MW-311A

Appendix B

Technical Memorandum – Lithium and Fluoride Detections

SCS ENGINEERS Environmental Consultants & Contractors

September 11, 2020
File No. 25220083.00

TECHNICAL MEMORANDUM

TO: Eric Nelson, PE

FROM: Meg Blodgett and Sherren Clark

SUBJECT: Alternative Source Evaluation for Lithium and Fluoride

This Technical Memorandum provides an evaluation of the source of lithium and fluoride concentrations above the Groundwater Protection Standards (GPSs) in groundwater sampling performed for the Selection of Remedy (SOR) process for the Ottumwa Generating Station (OGS) Ash Pond. These exceedances have not yet been determined to be statistically significant; therefore, a formal Alternative Source Demonstration in accordance with §257.95(g)(3) is not required at this time. Nonetheless, evaluation of the source of these constituents is relevant to the selection of a remedy for the site. The source evaluation and supporting technical data are provided in this memorandum for inclusion in the Selection of Remedy Report.

BACKGROUND

Background information regarding the OGS Ash Pond site history, geology, hydrogeology, and monitoring results is provided in the text, tables, and figures of the SOR report.

The monitoring well locations are shown on **SOR Figure 2**. A potentiometric surface map for April 13-14, 2020, is provided on **SOR Figure 3**, and a geologic cross section is provided on **SOR Figure 4.**

LITHIUM AND FLUORIDE RESULTS ABOVE THE GPS

Lithium was detected above the GPS at new monitoring wells MW-310 (three of four samples collected), MW-310A, and MW-311A (two of two samples collected for both deep piezometers). Fluoride was also detected in the deep piezometer MW-311A at a concentration above the GPS in one of the three sampling events. Monitoring results are summarized in **SOR Table 2**. These exceedances have not yet been determined to be statistically significant.

POTENTIAL ALTERNATIVE SOURCE EVALUATION

To evaluate the potential that the lithium and fluoride detections above the GPSs were due to a source other than the OGS Ash Pond, we used a two-step evaluation process. First, the sample collection and laboratory analysis methods and quality control data were reviewed to identify any potential error or issue that led to the exceedances. Second, potential alternative sources, including natural variation and man-made sources other than the Ash Pond, were evaluated.

Sampling and Field Analysis Review

Based on a review of the field notes and results, we did not identify any evidence that the lithium and fluoride GPS exceedances were due to a sampling error.

Based on a review of the laboratory reports, we did not identify any evidence that the GPS exceedances were due to a laboratory analysis error. There were no laboratory quality control flags or issues identified in the laboratory report that affect the usability of the data for detection monitoring.

Potential Alternative Source Review

Man-made alternative sources that could potentially contribute to the reported fluoride and lithium concentrations could include the inactive OGS ZLDP CCR unit, c-stone pile, coal pile runoff pond, coal storage area, impacts associated with roads or rail lines, or other on-site or off-site sources. Based on the groundwater flow directions and available groundwater quality data, none of these sources currently appears likely to be the primary cause of the observed GPS exceedances.

Fluoride and lithium are naturally present in the aquifer based on results from the nearby Ottumwa-Midland Landfill (OML) site. Based on regional and local information, discussed below, variation in natural background appears to be a likely source of the fluoride and lithium results above the GPSs.

LINES OF EVIDENCE FOR NATURAL SOURCE

Based on the regional and local information discussed below, lithium and fluoride concentrations above the GPSs in wells MW-310, MW-310A, and MW-311A are most likely due to natural background conditions in the Mississippian bedrock aquifer, rather than a release from the OGS Ash Pond or other man-made source. Lines of evidence supporting this conclusion include the following:

1. No lithium or fluoride GPS exceedances have been detected at monitoring wells located adjacent to the OGS Ash Pond, as would be expected if the OGS Ash Pond was the source of elevated fluoride and lithium at wells located further downgradient.

2. The lithium and fluoride concentrations detected in samples from MW-310A and MW-311A are well within the range of concentrations naturally present in the Mississippian aquifer based on results from background monitoring wells in the same aquifer at nearby OML.

3. Analysis of major anions and cations indicates that the water quality in deep piezometers MW-310A and MW-311A is similar to regional water quality for the Mississippian aquifer and different from water quality in the shallower on-site wells.

4. Vertical gradients at monitoring well pairs MW-310/MW-310A and MW-311/MW-311A during the two water level measurement events in April 2020 indicate that groundwater flow is at least intermittently upward from the Mississippian bedrock into the overlying unconsolidated material.

Distribution in Groundwater at OGS

No lithium or fluoride GPS exceedances have been detected at monitoring wells MW-302, MW-304, MW-305, MW-306, or MW-305A, located adjacent to the OGS Ash Pond, as would be expected if the OGS Ash Pond was the source of elevated fluoride and lithium. Lithium and fluoride have only been detected at concentrations above the GPSs in bedrock wells installed closer to the river. Fluoride and lithium results for all site monitoring wells, including background monitoring results, are shown on the times series plots in **Attachment A.** The detected concentrations of fluoride at piezometer MW-310A and of lithium at piezometers MW-310A and MW-311A are well above current and historical concentrations at the wells immediately downgradient of both the Ash Pond and the ZLDP.

Natural Background Concentrations in Bedrock Aquifer

The lithium and fluoride concentrations detected above the GPS at OGS are within the range of concentrations naturally present in the Mississippian aquifer, based on results from background monitoring wells in the same aquifer at OML. CCR Rule background monitoring wells at OML, located approximately 5 miles east of OGS, are screened in the upper portion of the Mississippian bedrock aquifer, which is the same formation as the wells at OGS. The fluoride concentrations detected in samples from MW-311A and lithium concentrations detected in samples from MW-310A and MW-311A are within the range of concentrations observed in background wells at OML that are unaffected by CCR. This indicates that lithium and fluoride are naturally present in the aquifer. Fluoride and lithium concentrations detected in the background monitoring wells at OML are summarized in **Table 1.**

Correlation with Regional Bedrock Water Quality

Analysis of major anions and cations indicates that the water quality in deep piezometers MW-310A and MW-311A is similar to regional water quality for the Mississippian aquifer and different from water quality in the shallower on-site wells.

Regional water quality data for the Mississippian aquifer is available from U.S. Geological Survey (USGS) Open File Report 82-1014, Hydrology of Area 38, Western Region, Interior Coal Province, Iowa and Missouri. An excerpt from this report is included in **Attachment C.** The report indicates that sulfate and sodium are the dominant ionic species, total dissolved solids concentrations are relatively high (370 to 8220 mg/l), and the water is generally not potable. Large concentration ranges were reported for several parameters within the Mississippian aquifer in the study area, including:

- Chloride concentrations ranging from 0.5 to 3,570 milligrams per liter (mg/L), with an average of 137 mg/L
- Sulfate concentrations ranging from 22 to 4,500 mg/L, with an average of 1,697 mg/L
- Sodium concentrations ranging from 6.8 to 2,660 mg/L, with an average of 584 mg/L

The Piper and Stiff diagrams in **Attachment B** show major cations and anions in groundwater samples from shallow and deep monitoring wells, and also show the average cation and anion concentrations in the Mississippian aquifer as reported in USGS Open File Report 82-1014. These plots show that the dominant ions detected in samples from MW-310A and MW-311A are more similar to those in the regional aquifer than to those at the shallower wells.

In the Piper diagram, MW-310A and MW-311A plot near the average for the Mississippian aquifer, near the lower right corner of the cation ternary plot (high sodium) and near the top of the anion ternary plot (high sulfate). Comparing the deep downgradient piezometers (MW-310A and MW-311A) to the shallower wells, the Piper diagram illustrates differences in the general water chemistry. The dominant cations in deep monitoring wells MW-310A and MW-311A are sodium and potassium, while the dominant cations in samples from the shallower wells are calcium and magnesium. The dominant anion in deep monitoring wells MW-310A and MW-311A is sulfate, while the samples from the shallower wells show a mix of carbonate/bicarbonate, chloride, and sulfate. This difference is less pronounced at MW-310/MW-310A, consistent with the effects of mixing due to intermittent upward groundwater flow discussed below.

In the Stiff diagrams, the sodium-sulfate dominance for MW-310A, MW-311A, and for the Mississippian aquifer average, is shown by the sodium vertex extending on the lower left side of the Stiff diagram and the sulfate vertex extending on the upper right side. The shape of the Stiff diagram for these three samples is distinctly different than the shapes for the other monitoring wells. This indicates that the groundwater sampled at MW-310A and MW-311A is likely representative of natural background conditions in the regional flow system in the Mississippian aquifer.

Vertical Groundwater Flow Patterns

Vertical gradients at monitoring well pairs MW-310/MW-310A and MW-311/MW-311A during the two water level measurement events in April 2020 indicate that groundwater flow is at least intermittently upward from the Mississippian bedrock into the overlying unconsolidated material (**SOR Table 4**). This flow pattern further supports the idea that groundwater quality at deeper wells MW-310A and MW-311A reflects regional groundwater flow discharging to the river, and the lithium and fluoride levels above the GPS are due to natural background.

The upward flow is also consistent with the pattern of lithium concentrations detected at MW-310/MW-310A. Concentrations detected at MW-310 are higher than at other shallow monitoring wells on site, but lower than concentrations detected at MW-310A. This indicates that the elevated concentrations at MW-310 are likely due to mixing between shallow groundwater with lower lithium concentrations and groundwater with higher lithium concentrations intermittently flowing upward from the Mississippian bedrock.

CONCLUSION

The lines of evidence discussed above regarding the source of the fluoride concentration above the GPS in downgradient monitoring well MW-311A and the lithium concentrations above the GPS in downgradient monitoring wells MW-310A and MW-311A demonstrate that these results are likely due to naturally occurring fluoride and lithium in the Mississippian aquifer at the OGS site. Therefore, these constituents do not need to be addressed in the selection of a remedy for the Ash Pond CCR unit.

MDB/jsn/SCC

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Table

1 Analytical Results - CCR Detection Monitoring Program, IPL - Ottumwa Midland Landfill

Table 1. Analytical Results - CCR Detection Monitoring Program
IPL - Ottumwa Midland Landfill
Ottumwa, Iowa

Well Group	Well	Collection Date	Fluoride (mg/L)	Lithium (µg/L)
Background	MW-102M	5/4/2016	4.2	46.7
		6/22/2016	4.2	80.7
		8/10/2016	4.4	52.3
		10/26/2016	4.6	75.4
		1/18/2017	4.1	71.8
		4/20/2017	4.0	73.6
		6/21/2017	4.6	52.7
		8/22/2017	4.5	54
		11/8/2017	4.6	--
		4/17/2018	4.5	--
		10/16/2018	4.7	--
		4/18/2019	5.7	--
		10/15/2019	4.5	--
	MW-122M	5/5/2016	1.1	450
		6/23/2016	0.89	332
		8/10/2016	0.74	601
		10/26/2016	0.48	544
		1/18/2017	<0.027	679
		4/20/2017	0.88	643
		6/21/2017	1.1	640
		8/22/2017	0.6	667
		11/8/2017	0.5	--
		4/17/2018	<0.063	--
		10/16/2018	<0.19	--
		4/17/2019	0.7	--
		10/15/2019	<0.23	--

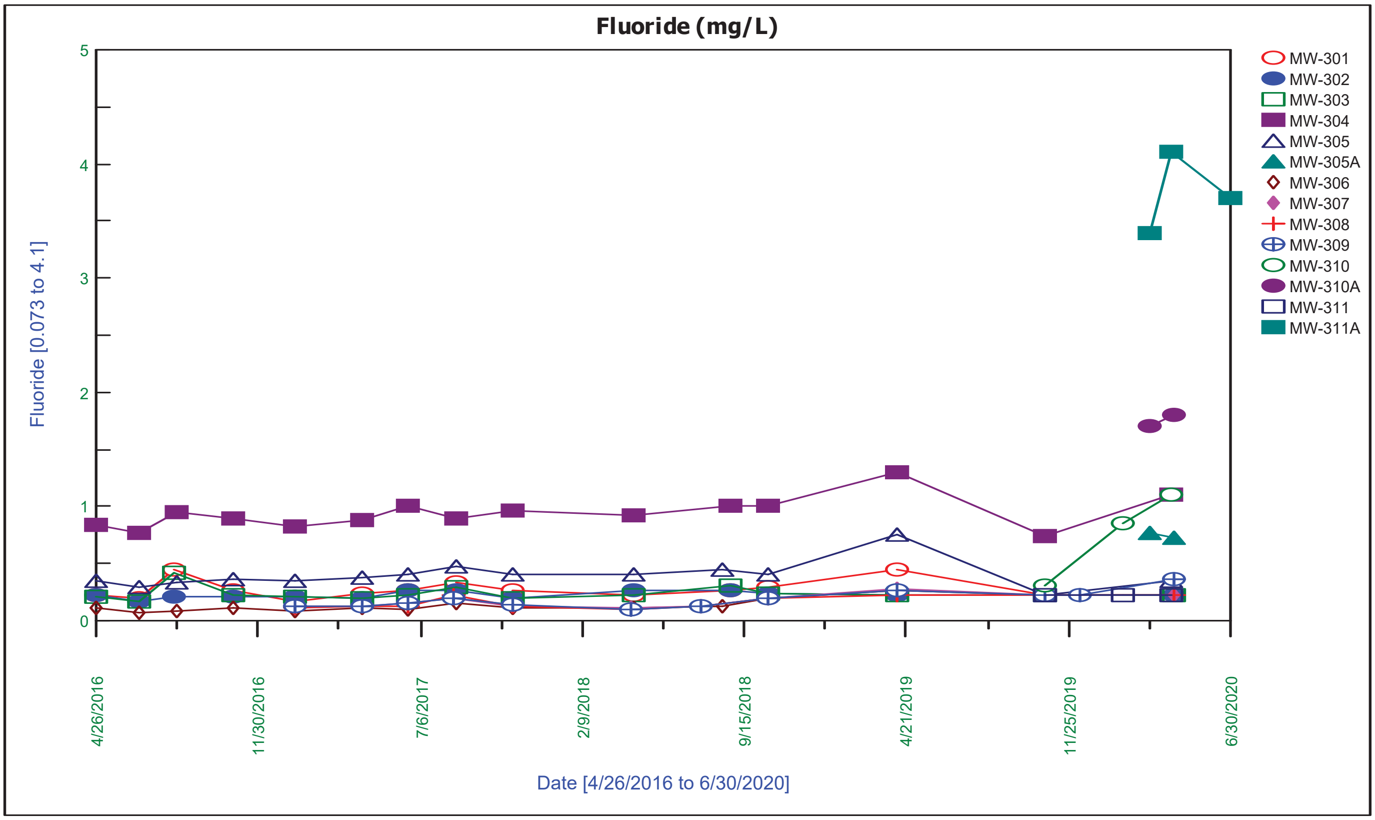
Abbreviations:
µg/L = micrograms per liter or parts per billion (ppb)
mg/L = milligrams per liter or parts per million (ppm)
-- = not analyzed

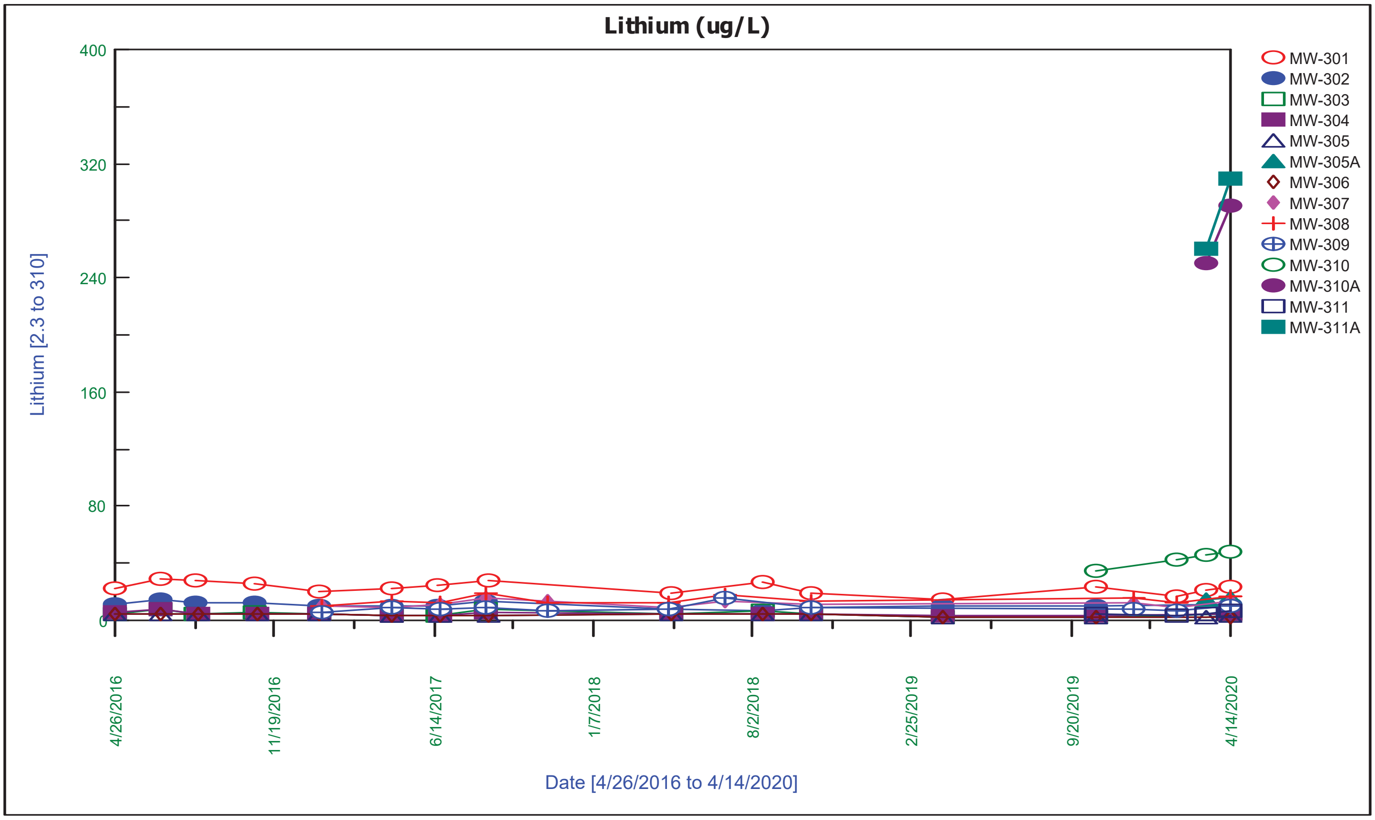
Created by: MDB Date: 5/26/2020
Last revision by: MDB Date: 5/26/2020
Checked by: NDK Date: 5/28/2020

I:\25220072.00\Deliverables\2020 OGS Li and F ASD -draft\[Tables 2 3 and 5_OGS ASD Tables.xlsx]Table 5 OML Background

Attachment A

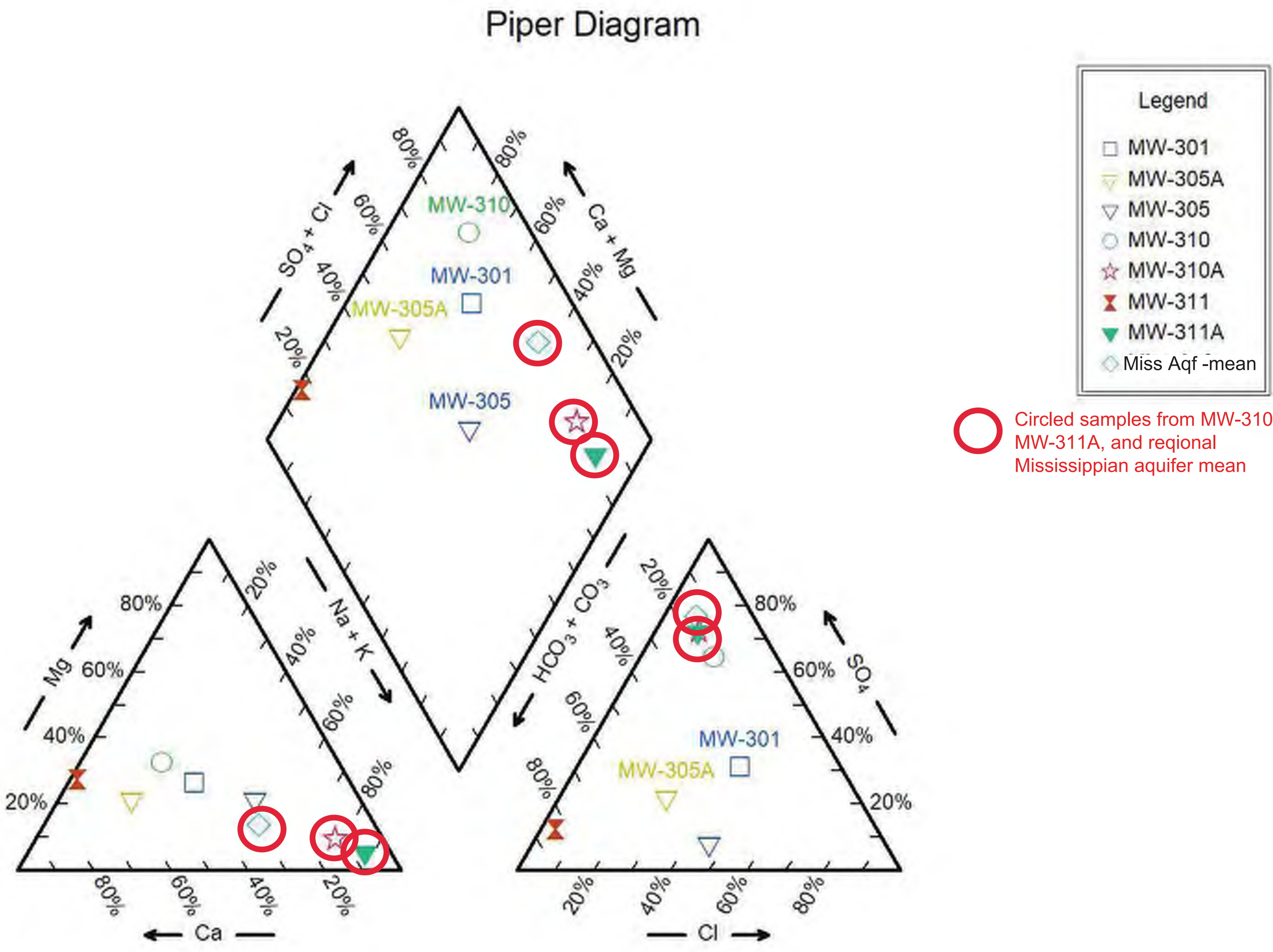
Time Series Plots


Fluoride (mg/L)
Fluoride [0.073 to 4.1]
0
1
2
3
4
5
4/26/2016
11/30/2016
7/6/2017
2/9/2018
9/15/2018
4/21/2019
11/25/2019
6/30/2020
Date [4/26/2016 to 6/30/2020]
MW-301
MW-302
MW-303
MW-304
MW-305
MW-305A
MW-306
MW-307
MW-308
MW-309
MW-310
MW-310A
MW-311
MW-311A


Lithium (ug/L)
Lithium [2.3 to 310]
0
80
160
240
320
400
4/26/2016
11/19/2016
6/14/2017
1/7/2018
8/2/2018
2/25/2019
9/20/2019
4/14/2020
Date [4/26/2016 to 4/14/2020]
MW-301
MW-302
MW-303
MW-304
MW-305
MW-305A
MW-306
MW-307
MW-308
MW-309
MW-310
MW-310A
MW-311
MW-311A

Attachment B

Piper and Stiff Diagrams

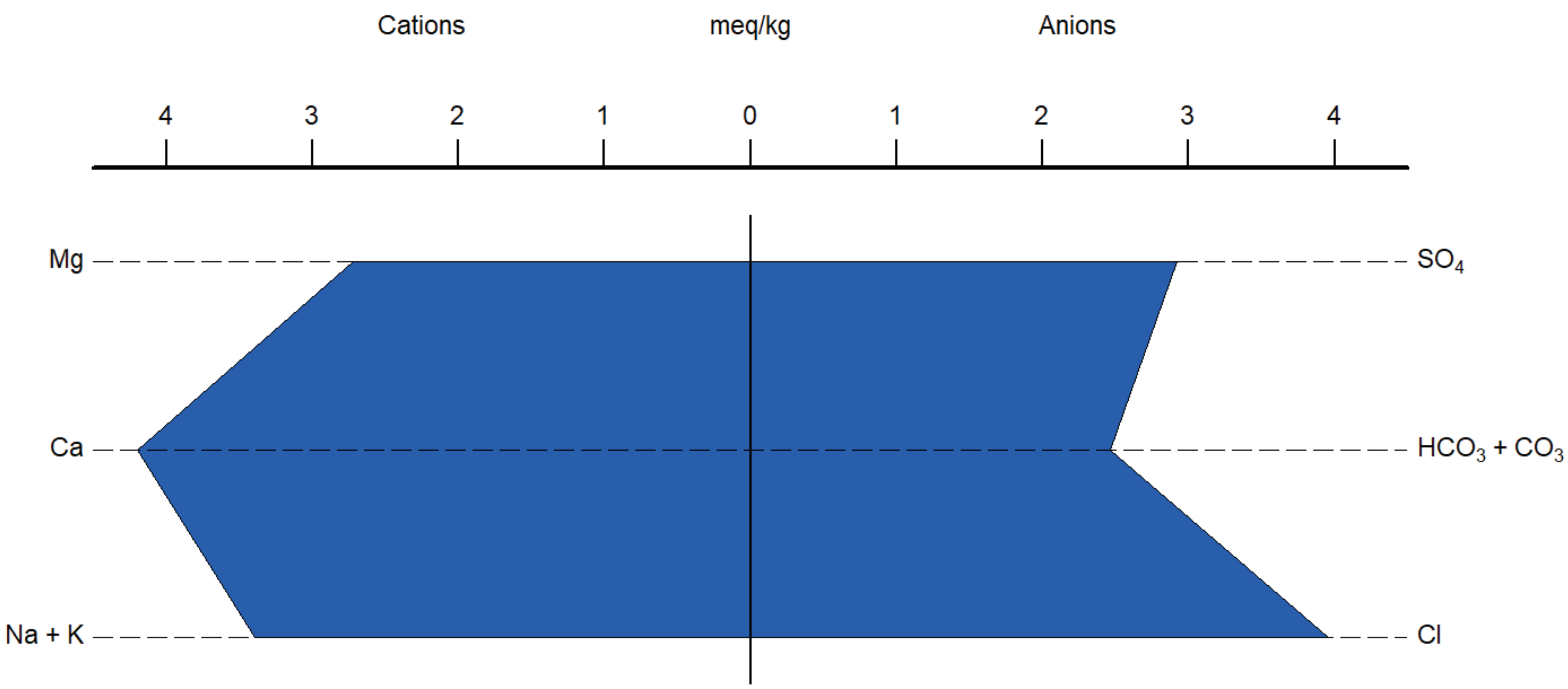


Circled samples from MW-310A, MW-311A, and reqional Mississippian aquifer mean

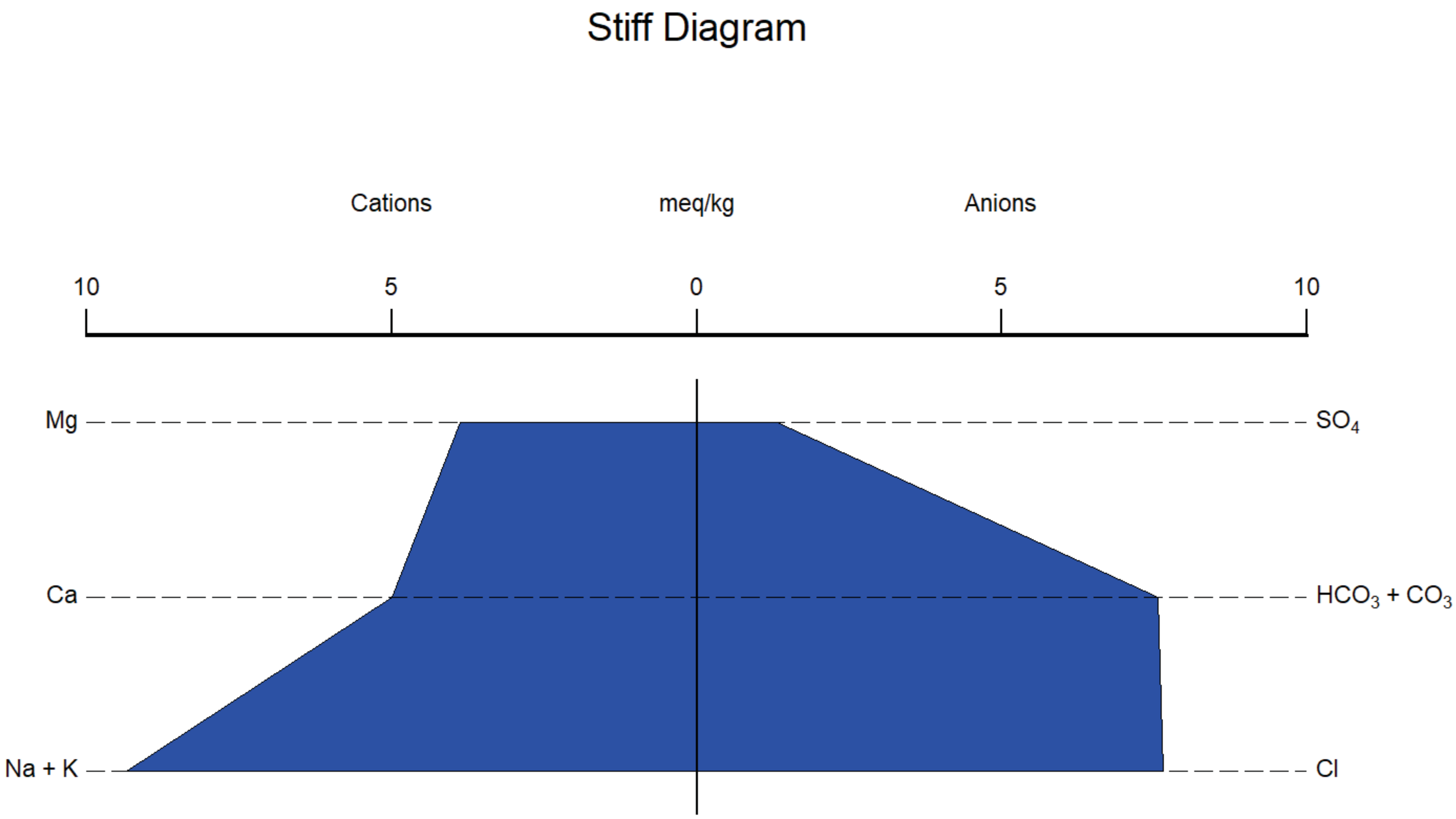
Data Sources: MW-301, MW-305, MW-305A, MW-310, MW-310A, MW-311, MW-311A - April 2020 groundwater sampling results Mississippian Aquifer data - USGS Open File Report 82-1014

MW-301 - Background well

Stiff Diagram

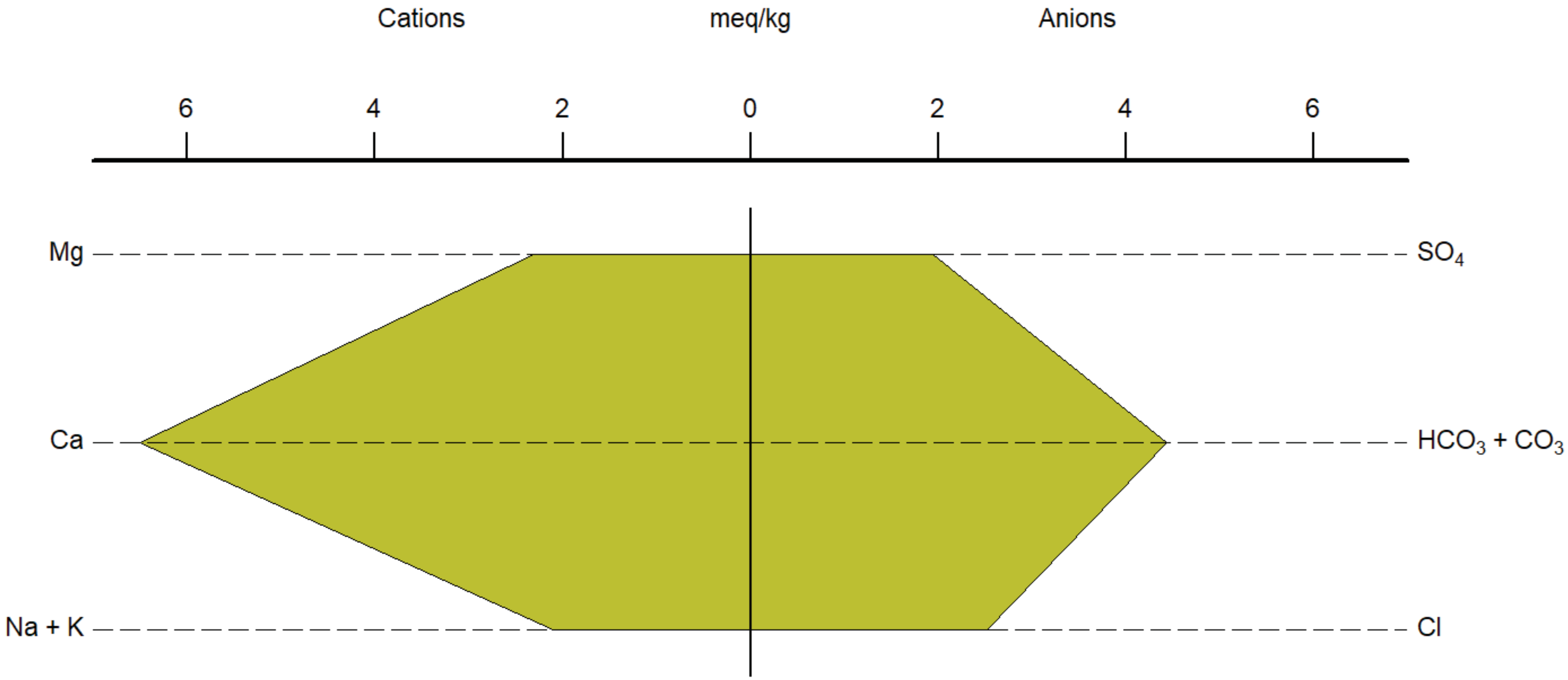


MW-305

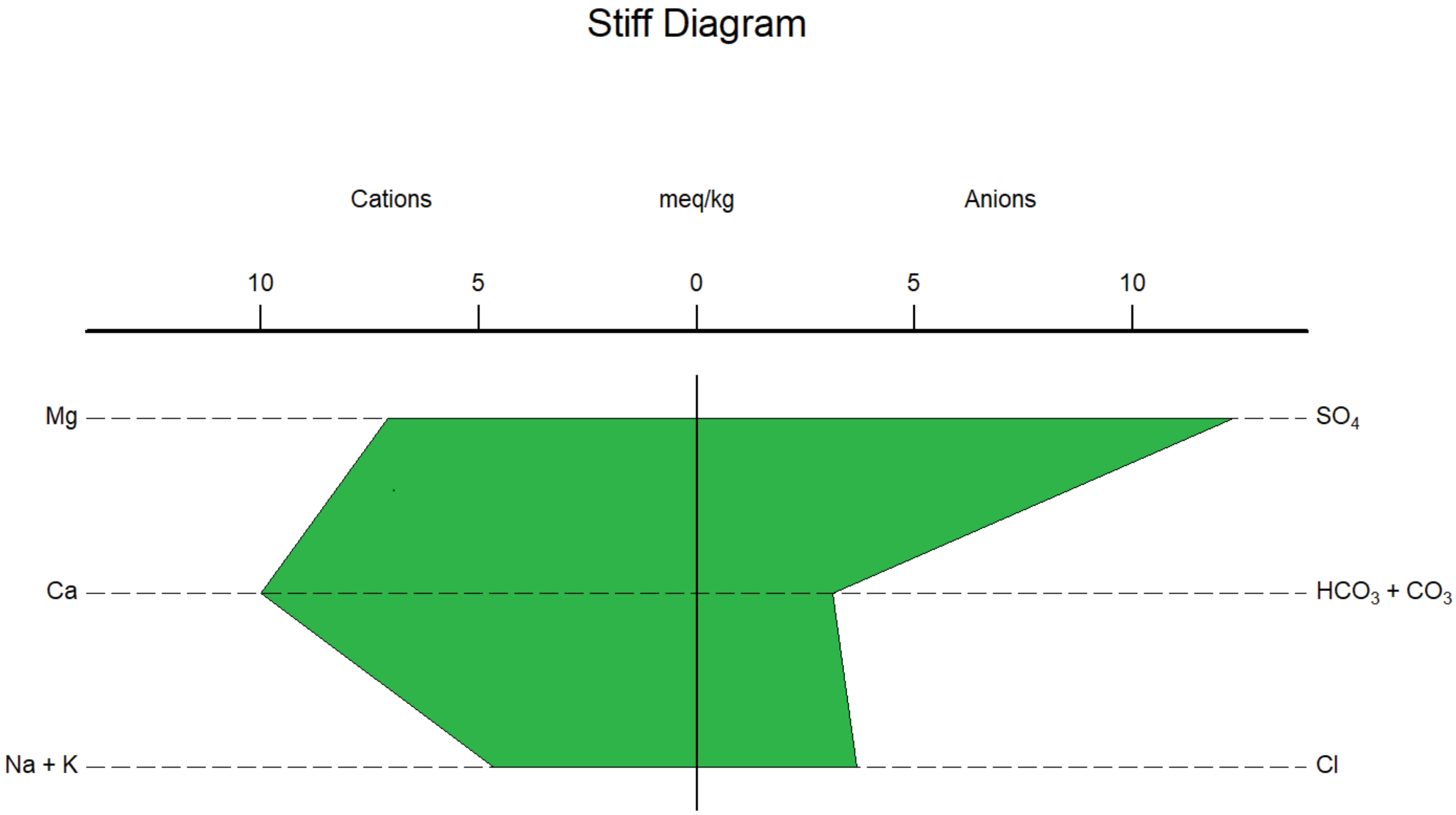

Stiff Diagram
Cations
meq/kg
Anions
10
5
0
5
10
Mg
Ca
Na + K
SO4
HCO3 + CO3
Cl

MW-305A

Stiff Diagram

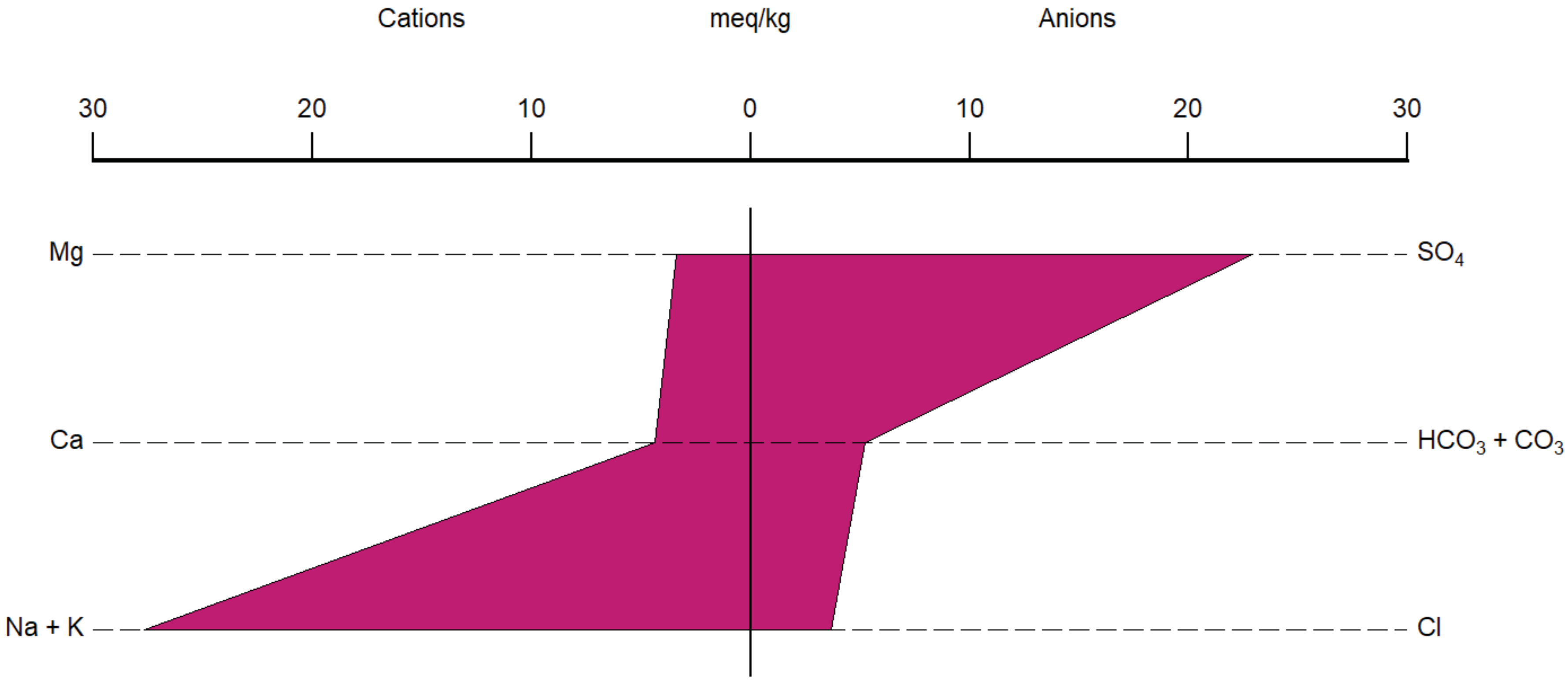


MW-310


Stiff Diagram
Cations
meq/kg
Anions
10
5
0
5
10
Mg
Ca
Na + K
SO4
HCO3 + CO3
Cl

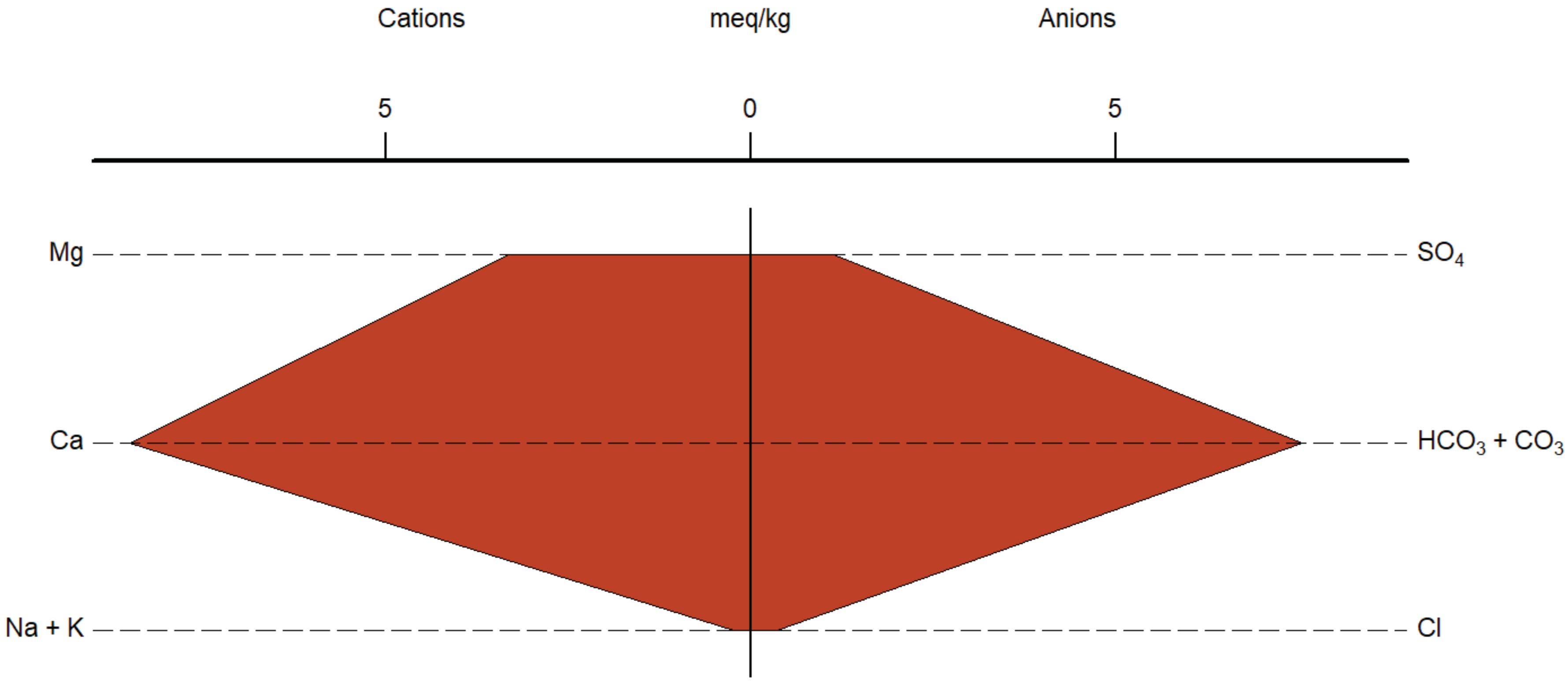
MW-310A

Stiff Diagram

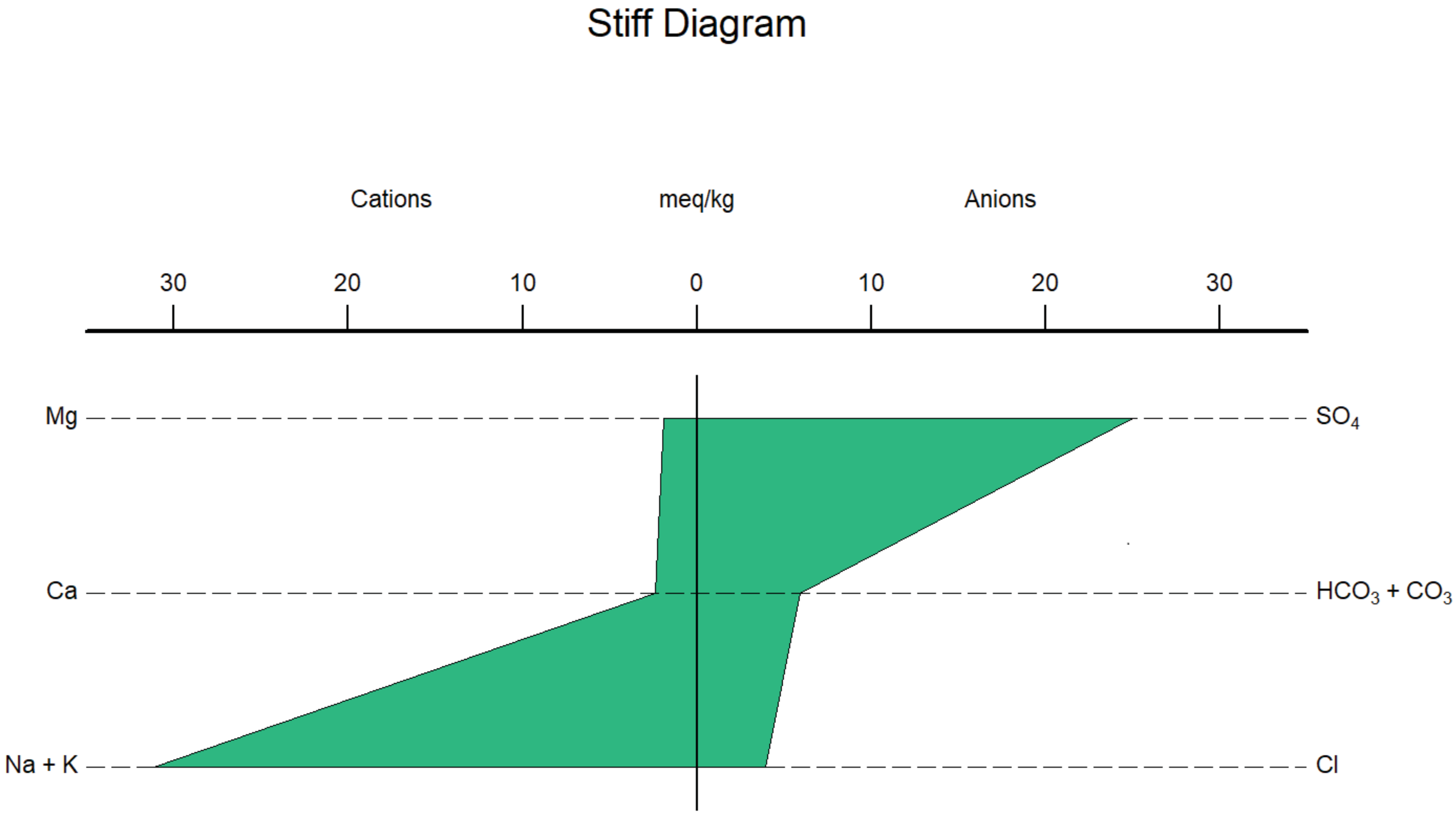


MW-311

Stiff Diagram

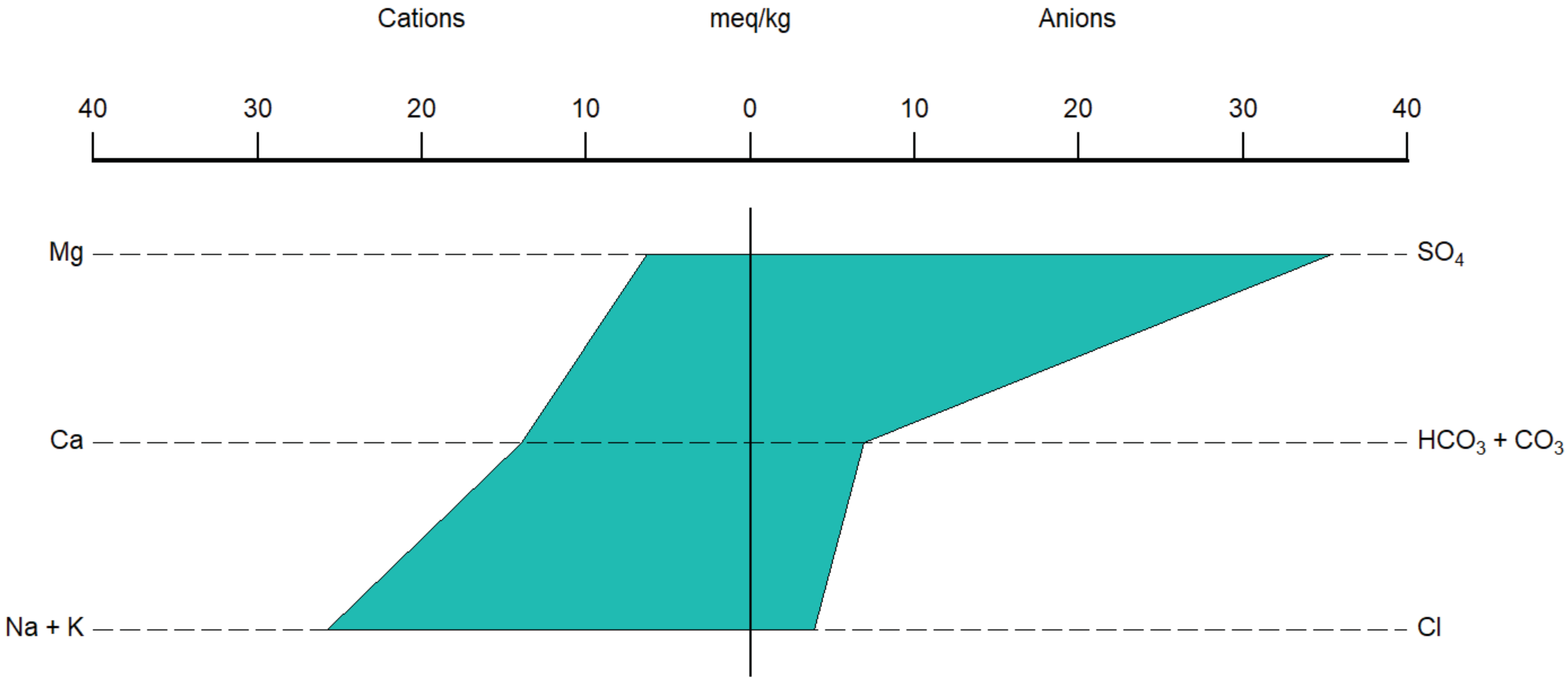


MW-311A


Stiff Diagram
Cations
meq/kg
Anions
30
20
10
0
10
20
30
Mg
Ca
Na + K
SO$_4$
HCO$_3$ + CO$_3$
Cl

Stiff Diagram

Mississippian Aquifer Regional Average

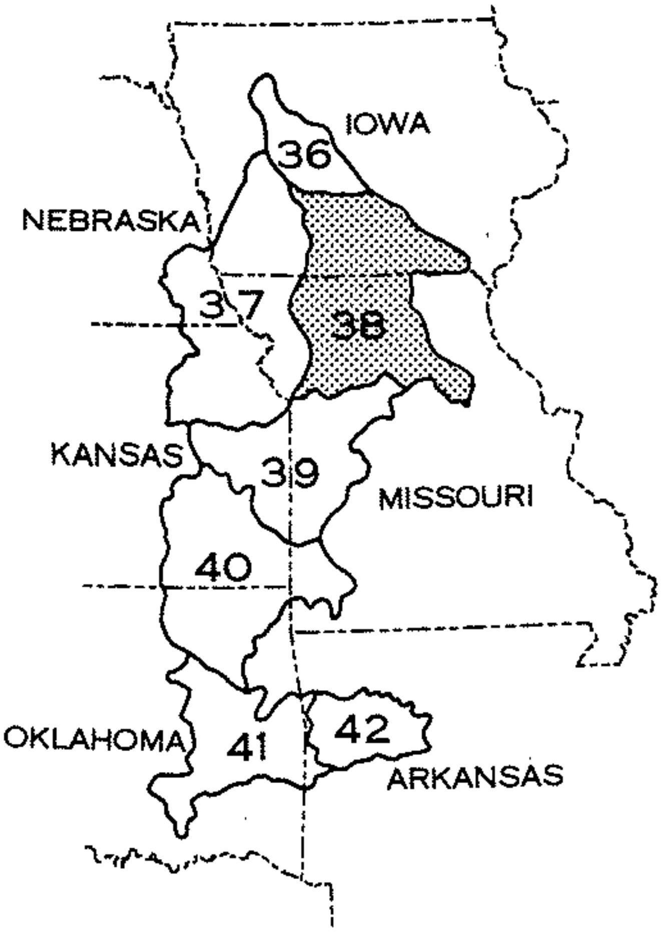


Data Source: USS Open File Report 82-1014. Note that carbonate concentrations were not included in this report, so HCO_3 + CO_3 represents HCO_3 concentrations only.

Attachment C

Excerpt from U.S. Geological Survey (USGS) Open File Report 82-1014, Hydrology of Area 38, Western Region, Interior Coal Province, Iowa and Missouri

HYDROLOGY OF AREA 38, WESTERN REGION, INTERIOR COAL PROVINCE IOWA AND MISSOURI



- CHARITON RIVER
- DES MOINES RIVER
- THOMPSON RIVER
- GRAND RIVER
- ELK FORK SALT RIVER

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

WATER-RESOURCES INVESTIGATIONS
OPEN-FILE REPORT 82-1014

Chemical Quality of Water from Mississippian and Pennsylvanian Aquifers is Variable and Generally Not Potable

Dissolved-solids concentrations in water from the Mississippian aquifer ranged from 370 to 8,220 milligrams per liter and in water from the Pennsylvanian aquifer dissolved-solids concentrations ranged from 250 to 6,790 milligrams per liter; sulfate and sodium are the dominant ionic species in water from both aquifers.

The quality of water in the Mississippian and Pennsylvanian aquifers is variable from place to place, but the water generally is not potable. The areal extent of Mississippian and Pennsylvanian bedrock throughout Area 38 is significant (figure 7.3-1). Neither the Pennsylvanian nor the Mississippian aquifer is a significant source of potable water in Area 38. Limited data for bedrock wells make it difficult to adequately define the characteristics of bedrock water throughout Area 38; however a general data analysis has been provided.

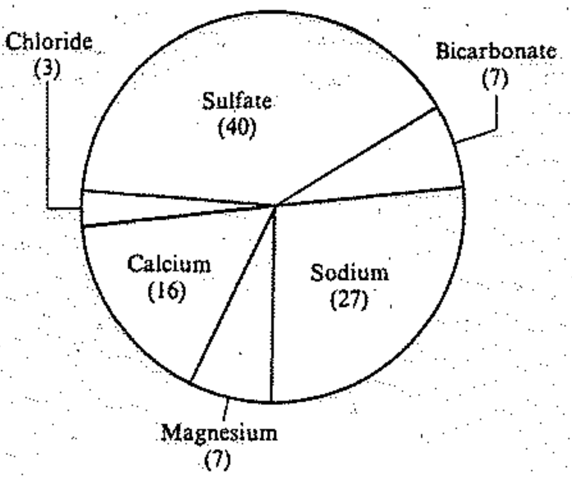
Minimum, maximum and average values for major chemical constituents in water from the Mississippian and Pennsylvanian aquifers are shown in tables 7.3-1 and 7.3-2. Ion-distribution diagrams are shown in figures 7.3-2 and 7.3-3 for both bedrock aquifers. These diagrams are designed to represent simultaneously the total solute concentration and the proportions assigned to each ionic species for a group of analyses.

Concentrations of dissolved solids averaged 3,140 mg/L (milligrams per liter) in water from wells completed in the Mississippian aquifer. The median pH was 7.2, and the average alkalinity was 345 mg/L. Sulfate concentrations ranged from 22 to 4,500 mg/L and sodium concentrations ranged from 6.8 to 2,660 mg/L. Sulfate and sodium are the dominant ionic species as they comprise 40 and 27 percent of the total solute concentration (93 milliequivalents per liter) in water from a typical well. Results of 70 chemical analyses of water from wells completed in the Mississippian aquifer in Iowa were used to compile figure 7.3-2.

The Mississippian aquifer is composed principally of carbonate rocks (limestone and dolomite). In Iowa, the aquifer can be divided into upper and lower units. The upper unit contains some gypsum and anhydrite beds that significantly affect the chemical quality of water (Cagle and Heinitz, 1978).

Concentrations of dissolved solids averaged 2,340 mg/L in water from wells completed in the Pennsylvanian aquifer. The median pH was 7.5 and the average alkalinity was 360 mg/L. Sulfate concentrations ranged from 1 to 4,000 mg/L and sodium concentrations ranged from 5.5 to 2,400 mg/L. Sodium and sulfate are the dominant ionic species as they comprise 35 and 31 percent of the total solute concentration (72 milliequivalents per liter) in water from a typical well. Results of 98 chemical analyses of water from wells completed in the Pennsylvanian aquifer, 76 in Iowa and 22 in Missouri, were used to compile figure 7.3-3.

The Pennsylvanian bedrock in Area 38 is composed predominately of impermeable shale beds, which are a regional confining bed that separates the surficial aquifer from underlying aquifers. However, limestone and sandstone beds are aquifers of local and subregional extent in parts of south-central Iowa (Cagle and Heinitz, 1978). Sources of the sodium and sulfate ions are ion exchange for sodium and pyrite for sulfate. Wells that penetrate clay and shale generally obtain water with excessive dissolved solids directly from the shale layers, which have large cation-exchange capabilities (Hem, 1970). Pyrite is commonly associated with biogenic deposits such as coal, which were deposited under extreme reducing conditions.



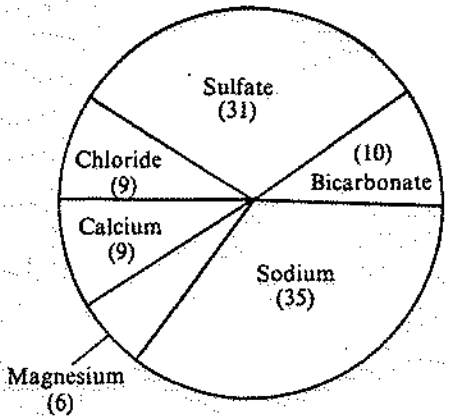
VALUES, IN PERCENTAGE OF TOTAL MILLEQUIVALENTS PER LITER

Figure 7.3-2 Average chemical composition for water from wells in the Mississippian aquifer.

Table 7.3-1. Summary of water-quality data available for the Mississippian aquifer.

[Concentrations in milligrams per liter unless otherwise specified; < = less than]

Constituent	Range	Average	Number of samples
Iron (Fe)	0.02 - 50	6.3	70
Manganese (Mn)	0.01 - 1.4	0.17	70
Calcium (Ca)	10 - 642	279	70
Magnesium (Mg)	3.1 - 340	77	70
Sodium (Na)	6.8 - 2,660	584	70
Potassium (K)	0.2 - 45	14	68
Bicarbonate (HCO_3)	168 - 1,350	420	70
Sulfate (SO_4)	22 - 4,500	1,697	70
Chloride (Cl)	0.5 - 3,570	137	70
Nitrate (NO_3)	<0.1 - 150	4.5	70
pH	6.3 - 8.0	(median)7.2	66
Hardness ($CaCO_3$)	38 - 2,950	1,029	69
Alkalinity ($CaCO_3$)	138 - 1,100	345	70
Dissolved solids	370 - 8,220	3,138	66
Specific conductance (micromhos per centimeter at 25° Celsius)	370 - 9,000	3,850	63



VALUES, IN PERCENTAGE OF TOTAL MILLEQUIVALENTS PER LITER

Figure 7.3-3 Average chemical composition for water from wells in the Pennsylvanian aquifer.

Table 7.3-2 Summary of water-quality data available for the Pennsylvanian aquifer.

[Concentrations in milligrams per liter unless otherwise specified; < = less than]

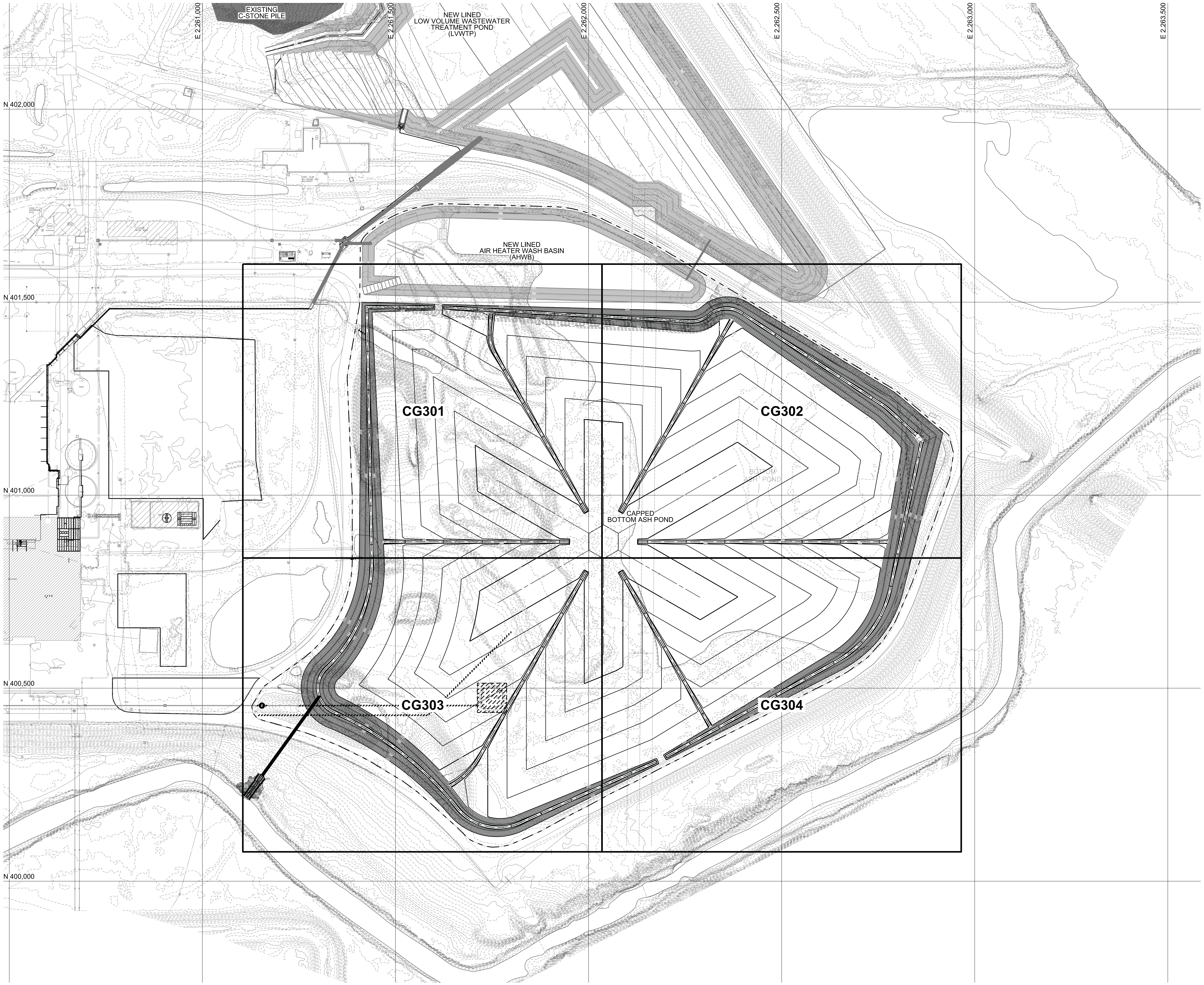
Constituent	Range	Average	Number of samples
Iron (Fe)	0.01 - 22	2.5	96
Manganese (Mn)	0.01 - 2.3	0.16	95
Calcium (Ca)	2.4 - 460	133	97
Magnesium (Mg)	1.5 - 394	48	97
Sodium (Na)	5.5 - 2,400	574	96
Potassium (K)	0.9 - 38	8.5	84
Bicarbonate (HCO_3)	120 - 1,240	437	94
Sulfate (SO_4)	1 - 4,000	1,046	97
Chloride (Cl)	0.5 - 3,060	222	98
Nitrate (NO_3)	<0.1 - 200	4.3	97
pH	6.5 - 8.3	(median)7.5	95
Hardness ($CaCO_3$)	29 - 2,000	528	96
Alkalinity ($CaCO_3$)	98 - 1,080	360	98
Dissolved solids	250 - 6,790	2,339	98
Specific conductance (micromhos per centimeter at 25° Celsius)	350 - 7,700	3,075	75

Appendix C

Preliminary OGS Ash Pond Closure Drawings

NOTES:

1. DESIGN CONTOURS SHOWN ARE TO GRADE TO NEAR ORIGINAL POND BOTTOM ELEVATIONS MINUS 1-FOOT OF OVEREXCAVATION.



FOR BID - NOT FOR CONSTRUCTION

no.	date	by	ckd	description	no.	date	by	ckd	description
0	07/17/20	RNO	ETT	ISSUED FOR BID					

BURNS McDONNELL
9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
Burns & McDonnell Engineering Co, Inc.

designed: A. MUCKENTHALER
detailed: J. RIDDER

Alliant Energy.
INTERSTATE POWER & LIGHT
OTTUMWA GENERATING STATION
POND CLOSURE AND
WASTEWATER TREATMENT PROJECT

OTTUMWA, IA

BOTTOM ASH POND CAP AND CLOSURE
FINISH GRADING PLAN - KEY PLAN

project: 110321
contract: 8120
drawing: **CG300**
rev.: — 0
sheet of sheets
file 110321CG300.DGN

7/13/2020

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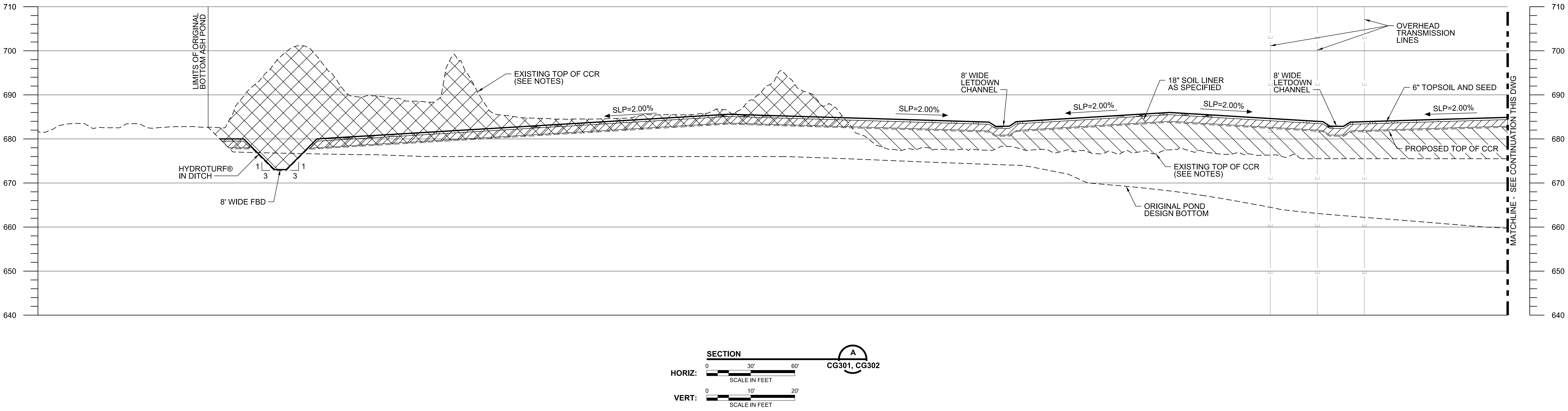

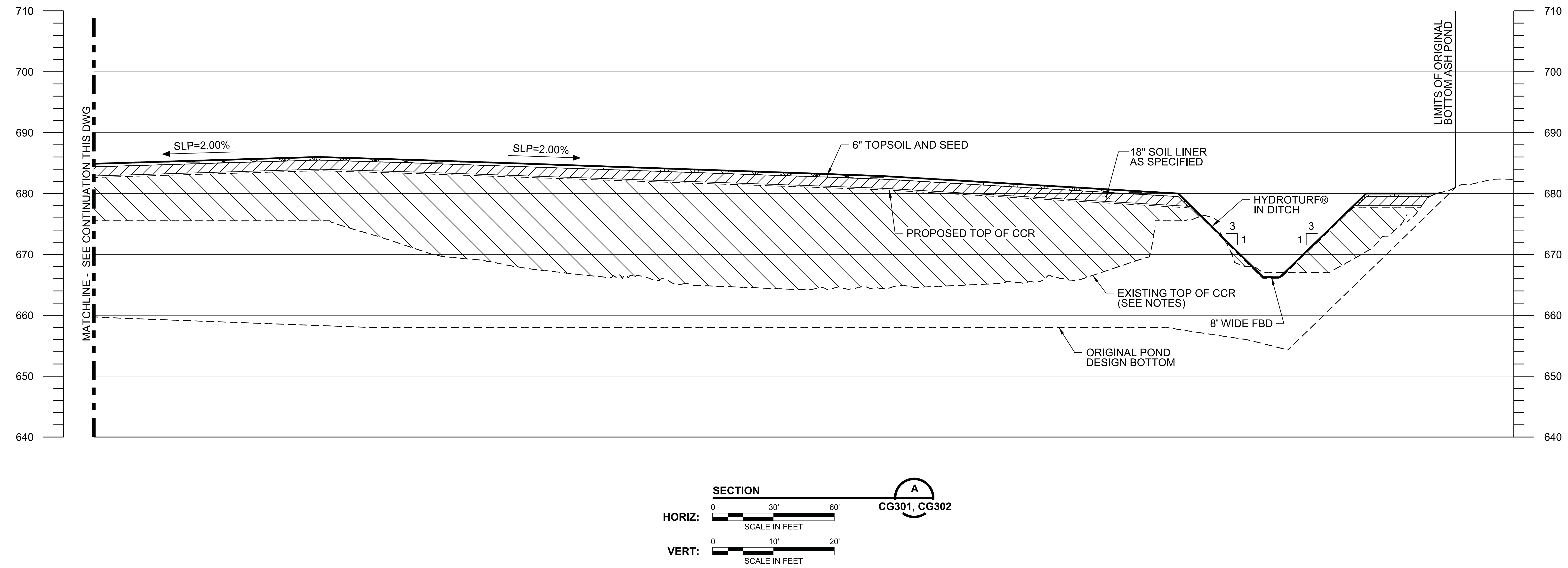

NOTES: △1

1. VOLUME OF CCR TO BE MOVED FROM ZLD POND = 97,300 CU YD; PLUS 49,800 CU YD ACCOUNTING FOR ASSUMED 1' OF OVER EXCAVATION
2. VOLUME OF CCR TO BE MOVED FROM WEST SIDE OF BOTTOM ASH POND TO EAST SIDE OF BOTTOM ASH POND = 175,000 CU YD ▩
3. TOTAL VOLUME OF MATERIAL TO BE MOVED = 322,100 CU YD BULK; ASSUMING A 10% SHRINGAKE FACTOR 289,900 CU YD INPLACE
4. THE CURRENT DESIGN VOLUME BETWEEN EXISTING TOP OF CCR AND PROPOSED TOP OF CCR = 227,000 CU YD ▨
5. VOLUME OF 18" CAP = 77,200 CU YD
6. VOLUMES ARE ESTIMATES FROM LIDAR SURVEYS (DATED JUNE 6, 2019) AND BATHYMETRIC SURVEYS (DATED JULY 17, 2019). THESE VALUES MAY DEVIATE FROM THE ACTUAL FIELD CONDITIONS AT THE TIME OF CLOSURE. PER THE CONSTRUCTION SPECIFICATIONS, CONTRACTOR SHALL PERFORM FIELD VERIFICATION SURVEYS PRIOR TO AND FOLLOWING MOVEMENT OF MATERIAL. ONCE THE VOLUMES ARE CONFIRMED, ENGINEER WILL EVALUATE THE NEED TO MODIFY THE GRADING PLAN TO ACCOMMODATE ANY DISCREPANCIES.
7. SEE REFERENCE DRAWINGS 1-2035-1-D-C1018, 1-2035-1-D-C1019, 1-2035-1-D-C1020, AND 1-2035-1-D-C1021 FOR THE ORIGINAL POND DESIGN TO ESTIMATE POND BOTTOM.

FOR BID - NOT FOR CONSTRUCTION

no.	date	by	ckd	description	no.	date	by	ckd	description
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0	07/17/20	RNO	ETT	ISSUED FOR BID					

BURNS McDONNELL
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Burns & McDonnell Engineering Co, Inc.

designed: A. MUCKENTHALER
detailed: J. RIDDER

Alliant Energy.
INTERSTATE POWER & LIGHT
OTTUMWA GENERATING STATION
POND CLOSURE AND
WASTEWATER TREATMENT PROJECT

OTTUMWA, IA

BOTTOM ASH POND CAP AND CLOSURE
FINISH GRADING SECTIONS - SHEET 1

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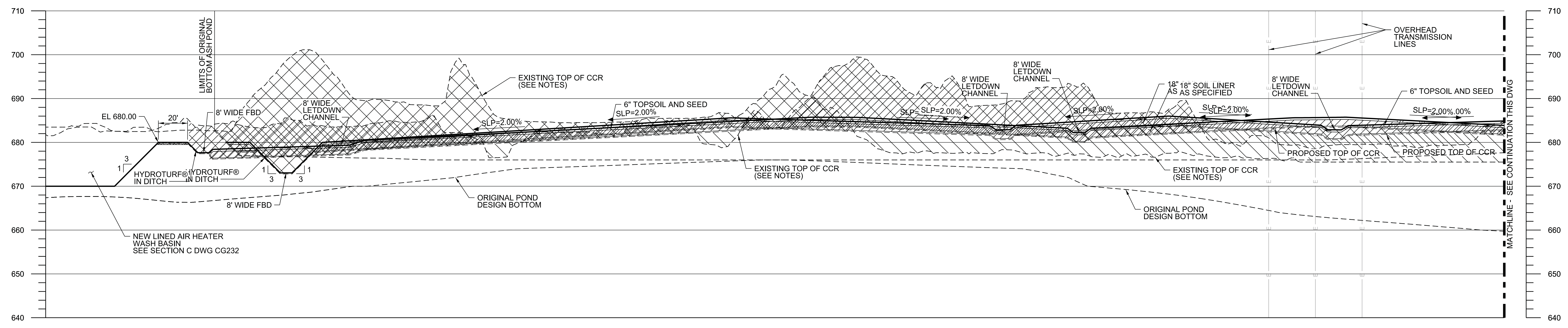
contract: 8120
drawing: CG331
rev.: — 1
sheet of sheets
file 110321CG331.DGN

8/21/2020

11/25/2020 Classification: Internal ECRM7804236



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CG301, CG303

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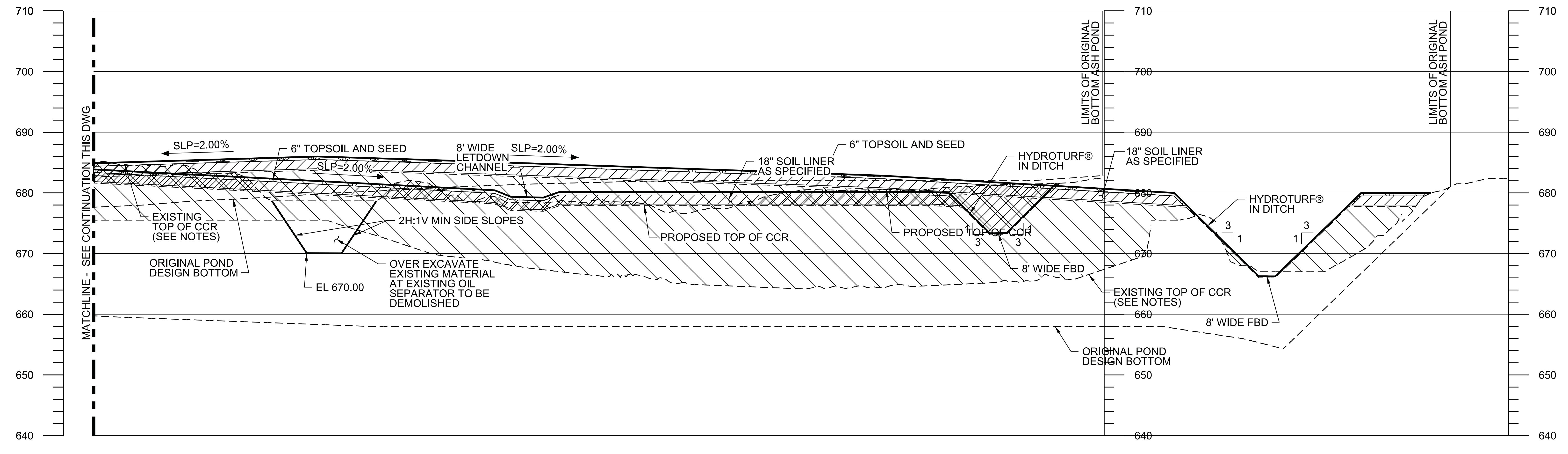
VERT: 0 10' 20' SCALE IN FEET



SECTION B
CG301, CG303

HORIZ: 0 30' 60' SCALE IN FEET

VERT: 0 10' 20' SCALE IN FEET

SECTION A
CG301, CG302

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VERT: 0 10' 20' SCALE IN FEET

NOTES: △1

1. VOLUME OF CCR TO BE MOVED FROM ZLD POND = 97,300 CU YD; PLUS 49,800 CU YD ACCOUNTING FOR ASSUMED 1' OF OVER EXCAVATION
2. VOLUME OF CCR TO BE MOVED FROM WEST SIDE OF BOTTOM ASH POND TO EAST SIDE OF BOTTOM ASH POND = 175,000 CU YD ▩
3. TOTAL VOLUME OF MATERIAL TO BE MOVED = 322,100 CU YD BULK; ASSUMING A 10% SHRINGAKE FACTOR 289,900 CU YD INPLACE
4. THE CURRENT DESIGN VOLUME BETWEEN EXISTING TOP OF CCR AND PROPOSED TOP OF CCR = 227,000 CU YD ▧
5. VOLUME OF 18" CAP = 77,200 CU YD
6. VOLUMES ARE ESTIMATES FROM LIDAR SURVEYS (DATED JUNE 6, 2019) AND BATHYMETRIC SURVEYS (DATED JULY 17, 2019). THESE VALUES MAY DEVIATE FROM THE ACTUAL FIELD CONDITIONS AT THE TIME OF CLOSURE. PER THE CONSTRUCTION SPECIFICATIONS, CONTRACTOR SHALL PERFORM FIELD VERIFICATION SURVEYS PRIOR TO AND FOLLOWING MOVEMENT OF MATERIAL. ONCE THE VOLUMES ARE CONFIRMED, ENGINEER WILL EVALUATE THE NEED TO MODIFY THE GRADING PLAN TO ACCOMMODATE ANY DISCREPANCIES.
7. SEE REFERENCE DRAWINGS 1-2035-1-D-C1018, 1-2035-1-D-C1019, 1-2035-1-D-C1020, AND 1-2035-1-D-C1021 FOR THE ORIGINAL POND DESIGN TO ESTIMATE POND BOTTOM.

FOR BID - NOT FOR CONSTRUCTION

no.	date	by	ckd	description
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0	07/17/20	RNO	ETT	ISSUED FOR BID

no.	date	by	ckd	description

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detailed J. RIDDER

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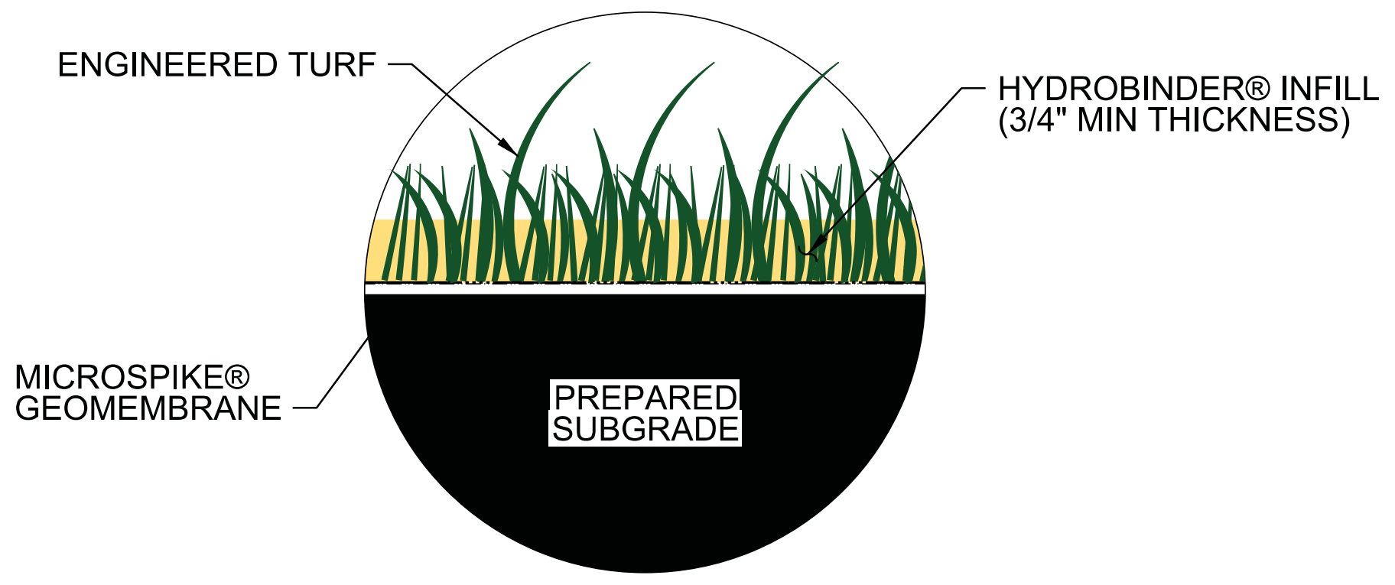
POND CLOSURE AND
WASTEWATER TREATMENT PROJECT

OTTUMWA, IA

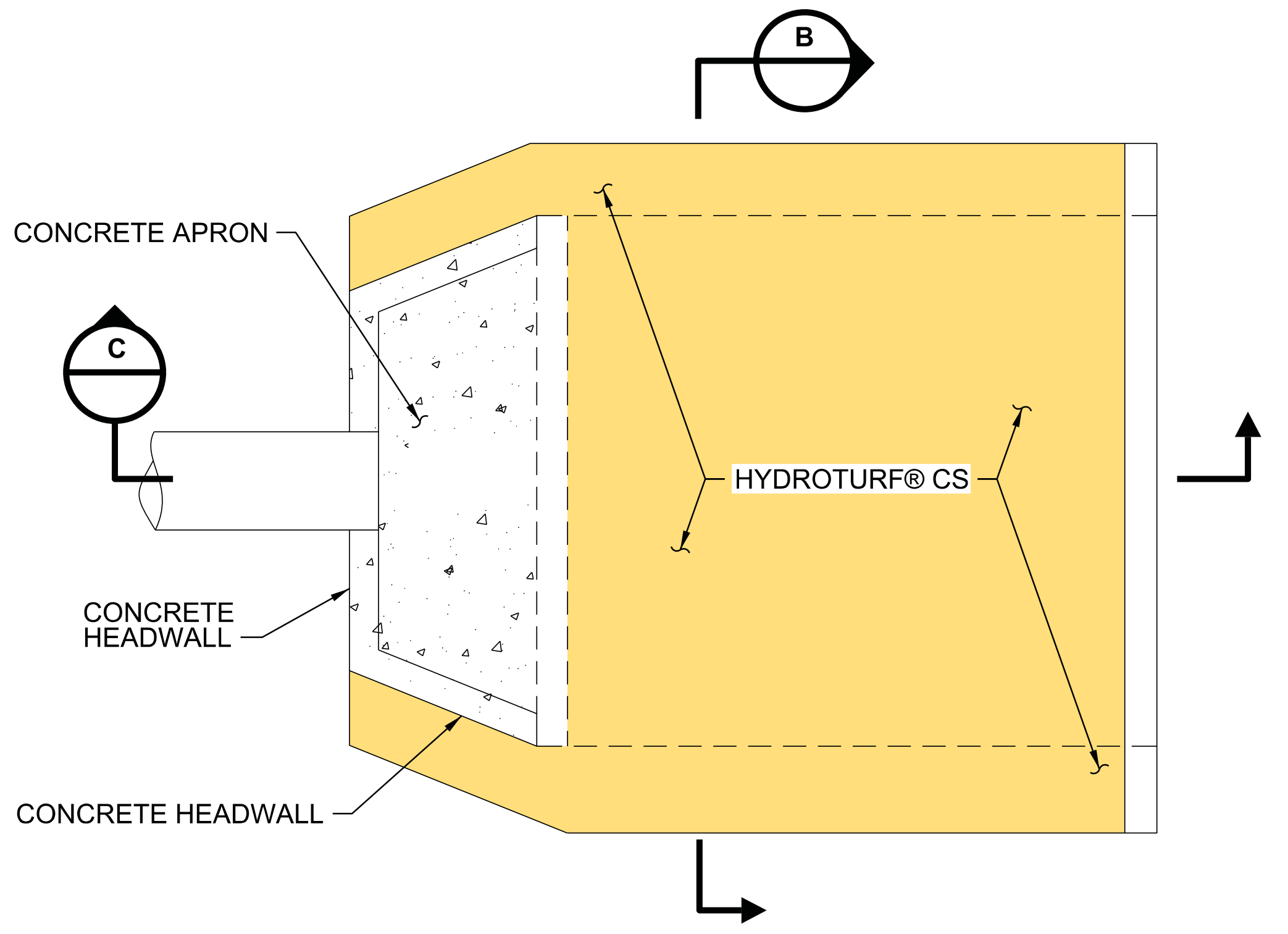
BOTTOM ASH POND CAP AND CLOSURE
FINISH GRADING SECTIONS - SHEET 2

project 110321
contract 8120
drawing CG332 — rev. 1
sheet of sheets
file 110321CG332.DGN

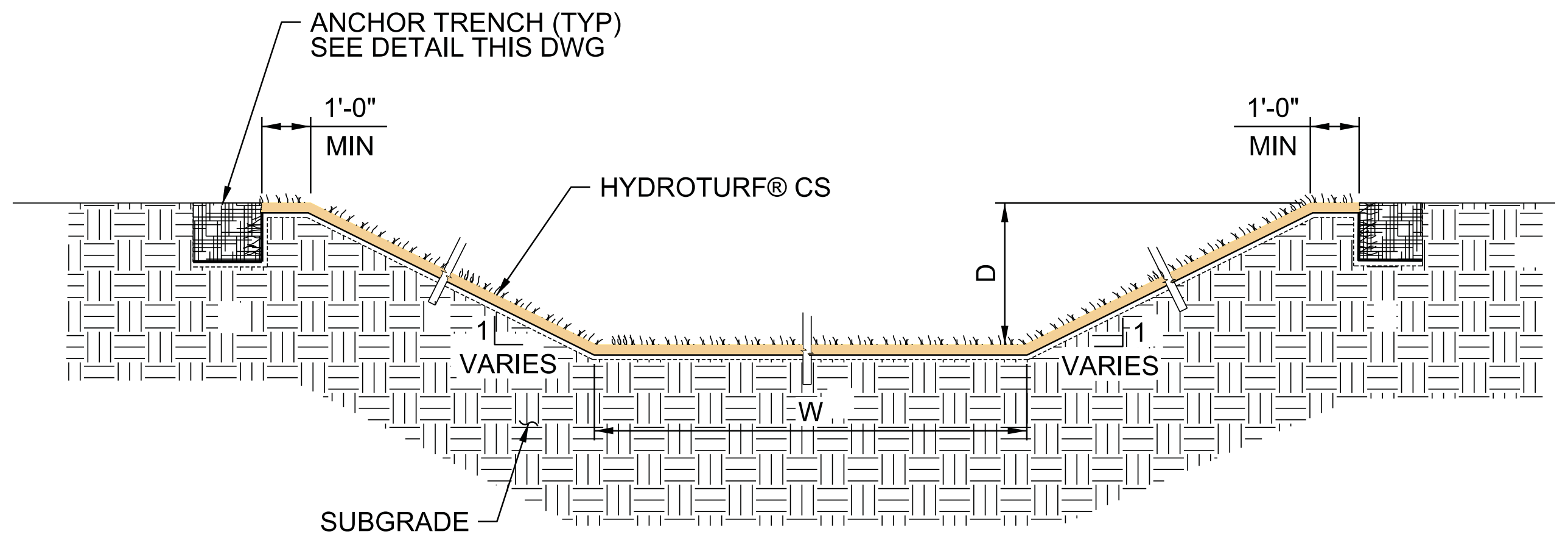
8/21/2020



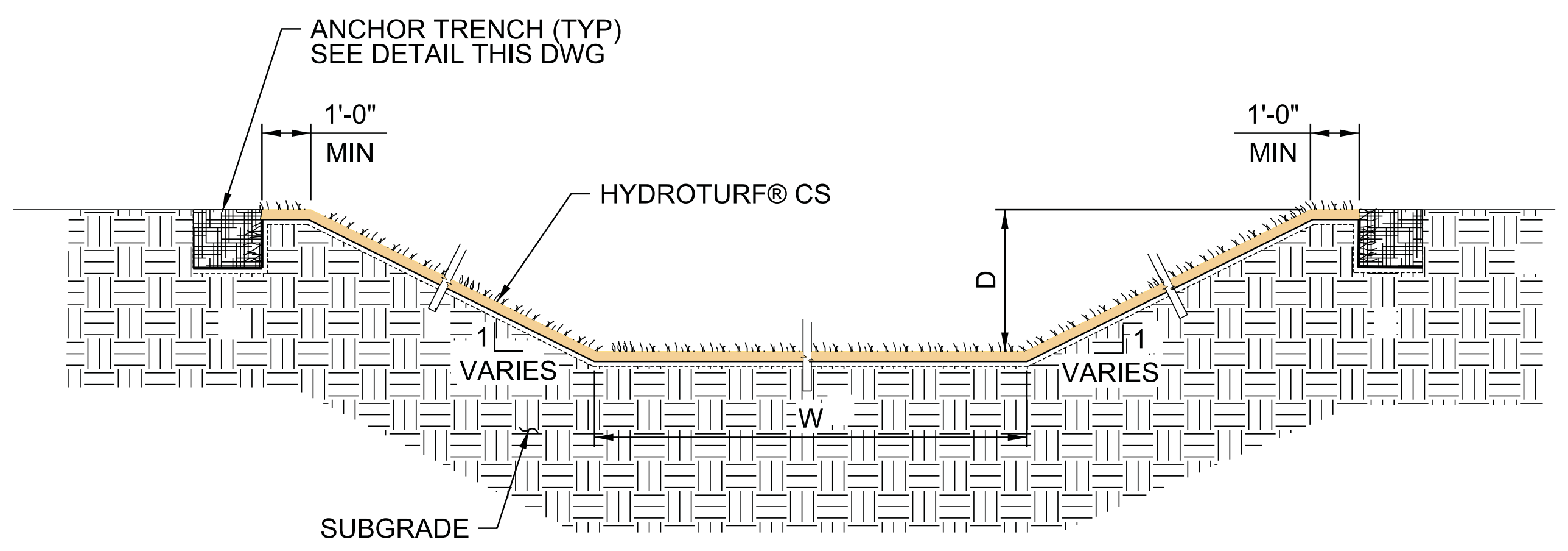
HYDROTURF® CS TYPICAL SECTION
WITH MICROSPIKE GEOMEMBRANE
NOT TO SCALE



PLAN
NOT TO SCALE



HYDROTURF® CHANNEL REVETMENT
TYPICAL SECTION
NOT TO SCALE



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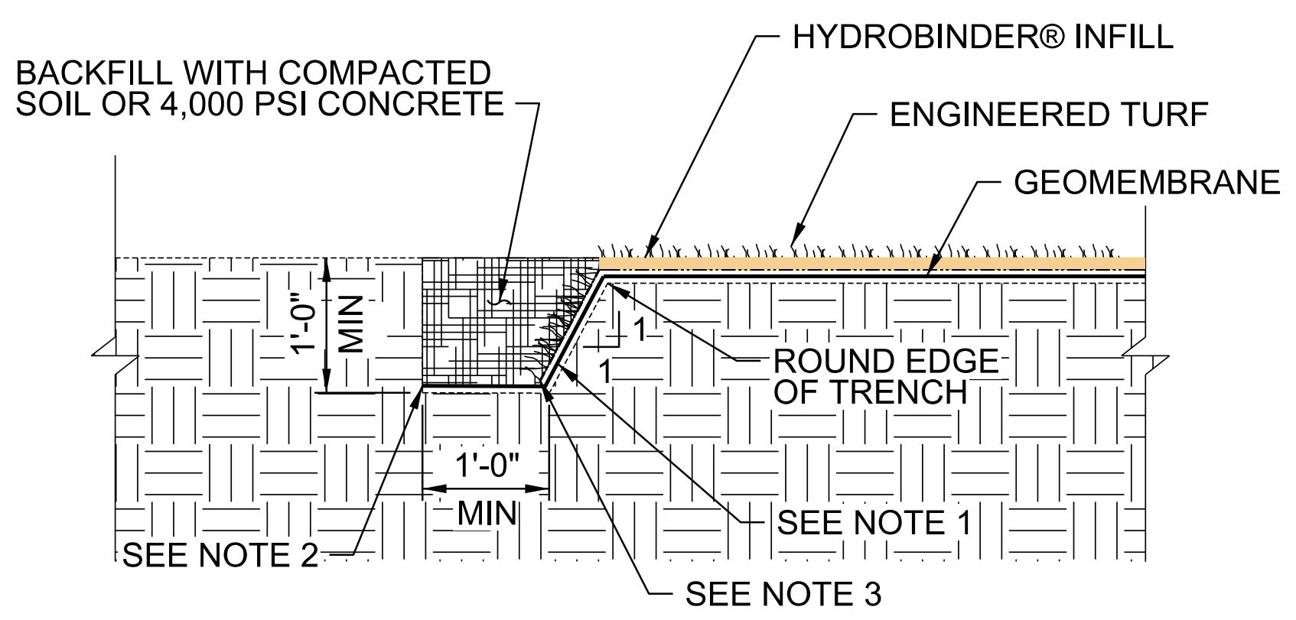
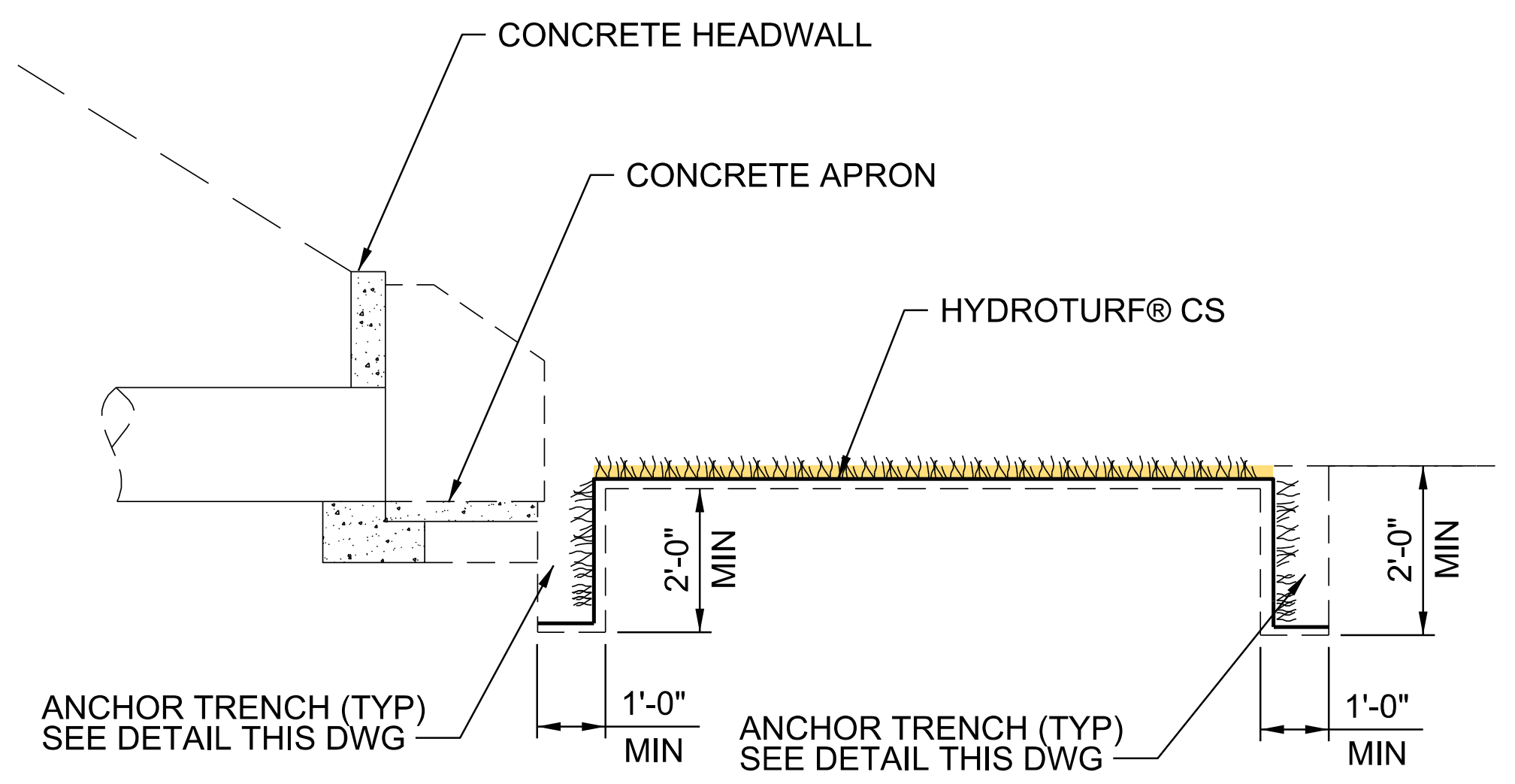




SECTION C
NOT TO SCALE

HYDROTURF REVETMENT SYSTEM
OUTFALL STRUCTURE WITH HEADWALL
NOT TO SCALE

NOTES:

1. THE GEOMEMBRANE COMPONENT OF HYDROTURF® CS SHALL BE IN INTIMATE CONTACT WITH THE ANCHOR TRENCH INSIDE WALL AND BOTTOM. WRINKLES, RIPPLES, FISH MOUTHS, AND / OR BUNCHING SHALL BE REMOVED AND PROPERLY PATCHED. DURING FILLING OF THE ANCHOR TRENCH WITH THE COMPACTED SOIL OR CONCRETE BACKFILL, THE CONTRACTOR SHALL MAINTAIN THAT THE GEOMEMBRANE IS IN INTIMATE CONTACT WITH THE TRENCH WALL AND BOTTOM. CONCRETE BACKFILL SHALL BE VIBRATED IN PLACE IN ACCORDANCE WITH STANDARD INDUSTRY TECHNIQUES.

2. THE GEOMEMBRANE SHALL NOT EXTEND UP THE OUTSIDE WALL OF THE ANCHOR TRENCH. IT SHALL BE TRIMMED SHORT OF THE OUTSIDE WALL AND SHALL EXTEND A MINIMUM OF 3/4 OF THE WIDTH OF THE ANCHOR TRENCH.

3. THE ENGINEERED TURF COMPONENT OF HYDROTURF® CS SHALL BE IN INTIMATE CONTACT WITH THE GEOMEMBRANE. WRINKLES, RIPPLES, FISH MOUTHS, AND / OR BUNCHING SHALL BE REMOVED AND PROPERLY PATCHED. THE ENGINEERED SYNTHETIC TURF SHALL BE TRIMMED SO THAT IT DOES NOT EXTEND ONTO THE BOTTOM OF THE ANCHOR TRENCH. IT SHALL BE TRIMMED JUST SHORT OF THE BOTTOM AND SHALL EXTEND A MINIMUM OF 3/4 OF THE DEPTH OF THE ANCHOR TRENCH.

HYDROTURF® CS TYPICAL
ANCHOR TRENCH TERMINATION
NOT TO SCALE

FOR BID - NOT
FOR CONSTRUCTION

no.	date	by	ckd	description
0	07/17/20	RNO	ETT	ISSUED FOR BID

no.	date	by	ckd	description

BURNS McDONNELL
9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
Burns & McDonnell Engineering Co, Inc.

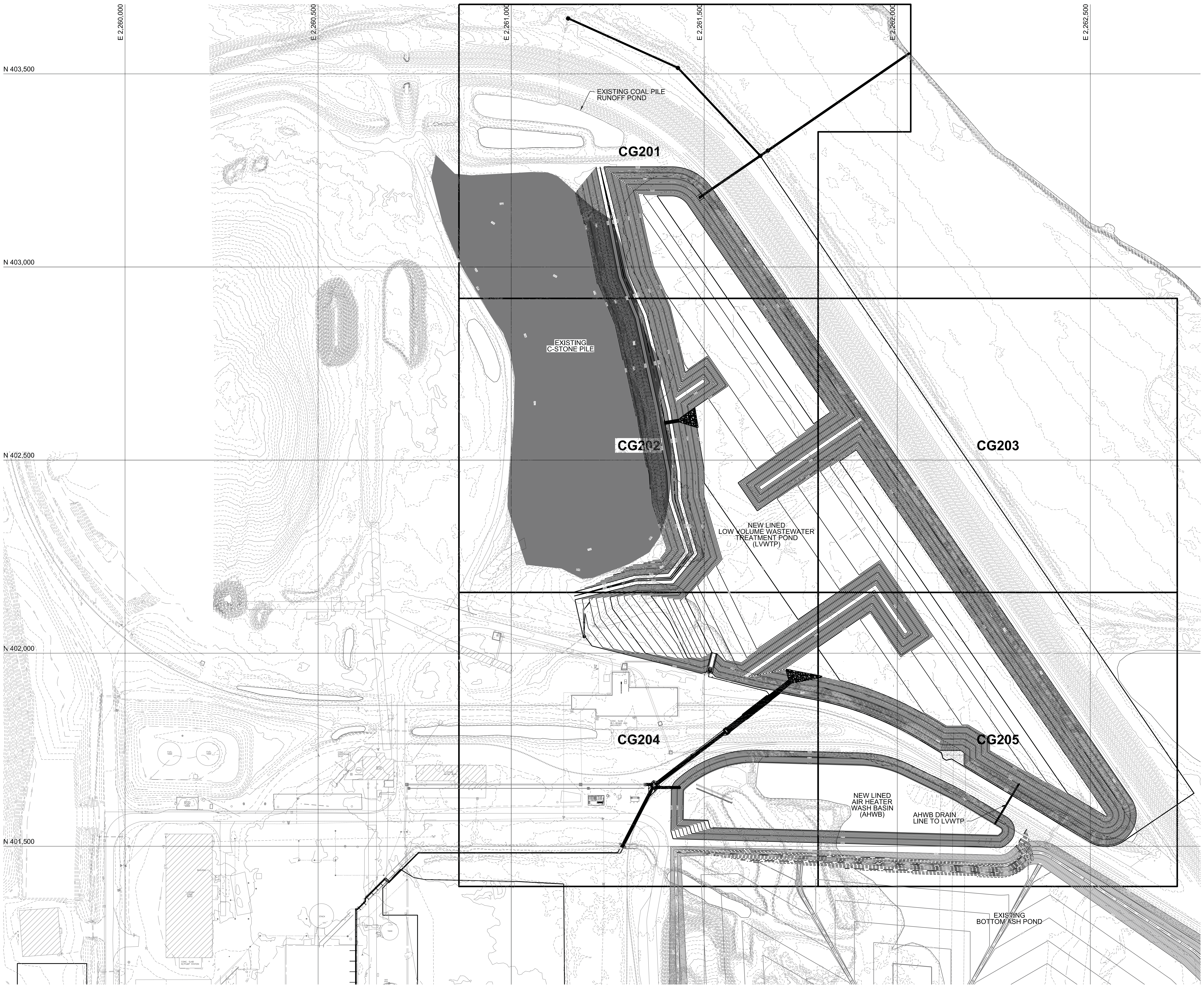
designed A. MUCKENTHALER
detailed J. RIDDER

Alliant Energy.
INTERSTATE POWER & LIGHT
OTTUMWA GENERATING STATION
POND CLOSURE AND
WASTEWATER TREATMENT PROJECT

OTTUMWA, IA

BOTTOM ASH POND CAP AND CLOSURE
FINISH GRADING DETAILS - SHEET 2

project 110321
contract 8120
drawing **CG342** — rev. **0**
sheet of sheets
file 110321CG342.DGN



NOTES:

1. SHADED AREA SHOWS LIMITS OF EXISTING C-STONE MATERIAL. C-STONE MATERIAL IS ASSUMED TO BE REMOVED BY OTHERS. CCR MATERIAL UNDER THIS C-STONE TO BE REMOVED AND PLACED IN BOTTOM ASH POND. THIS QUANTITY IS INCLUDED IN VOLUME CALCULATIONS.
2. CONTOURS SHOWN REPRESENT EXCAVATION GRADE, AND ARE APPROXIMATE. EXCAVATION SHALL REMOVE ALL CCR MATERIAL. EXCAVATION GRADE IS DEFINED AS THE ORIGINAL POND BOTTOM MINUS 1-FOOT OF OVEREXCAVATION.

CONSTRUCTION SEQUENCING:

1. DEWATER ENTIRE ZLD POND. OWNER HAS APPROVED WATER CAN PUMPED TO TO MAIN ASH POND.
2. INSTALL DEWATERING SYSTEM FOR ZLD POND IF NECESSARY TO DEWATER CCR MATERIAL IN POND LIMITS. OWNER HAS APPROVED WATER CAN PUMPED TO MAIN ASH POND.
3. SURVEY ZLD POND LIMITS ON 100' GRID ONCE TO DETERMINE BASELINE FOR CCR REMOVAL.
4. BEGIN EXCAVATING MATERIAL FROM ZLD POND. OWNER HAS APPROVED THE MAIN ASH POND LIMITS TO STOCKPILE MATERIAL AND FOR FINAL GRADING OF THE CCR MATERIAL LOCATED WITHIN THE MAIN ASH POND. DO NOT BLOCK FLOW FROM EXISTING BOTTOM ASH SLUICING OPERATION UNTIL NEW DRY BOTTOM ASH SYSTEM IS OPERATIONAL.
5. OWNER'S REPRESENTATIVE TO PERFORM VISUAL INSPECTION OF CCR REMOVAL TO DETERMINE NO CCR MATERIAL REMAINS IN ZLD POND BOTTOM.
6. NOTIFY OWNER/ENGINEER IF THERE IS A MAJOR DESCREPENCY FROM THE ORGINAL POND BOTTOM DESIGN PROVIDED IN REFERENCE FILES 1-2035-1-D-C1018, C1019, C1020 AND C1021.
7. SURVEY BASIN ON 100' GRID ONCE CCR MATERIAL HAS BEEN REMOVED FOR PAYMENT PURPOSES FOR AMOUNT OF CCR MATERIAL MOVED TO MAIN ASH POND.
8. ONCE IT IS DETERMINED CCR MATERIAL IS REMOVED, OVEREXCAVATE 1-FOOT OF MATERIAL TO BE STOCKPILED IN MAIN ASH POND LIMITS.

FOR BID - NOT FOR CONSTRUCTION

no.	date	by	ckd	description
0	07/17/20	RNO	ETT	ISSUED FOR BID

no.	date	by	ckd	description

BURNS McDONNELL
9400 WARD PARKWAY
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Burns & McDonnell Engineering Co, Inc.

designed: A. MUCKENTHALER
detailed: J. RIDDER

Alliant Energy.
INTERSTATE POWER & LIGHT
OTTUMWA GENERATING STATION
POND CLOSURE AND
WASTEWATER TREATMENT PROJECT

OTTUMWA, IA

LVWTP AND AHWB CONSTRUCTION
FINISH GRADING PLAN - KEY PLAN

project	contract
110321	8120

drawing: CG200 — rev. 0
sheet of sheets
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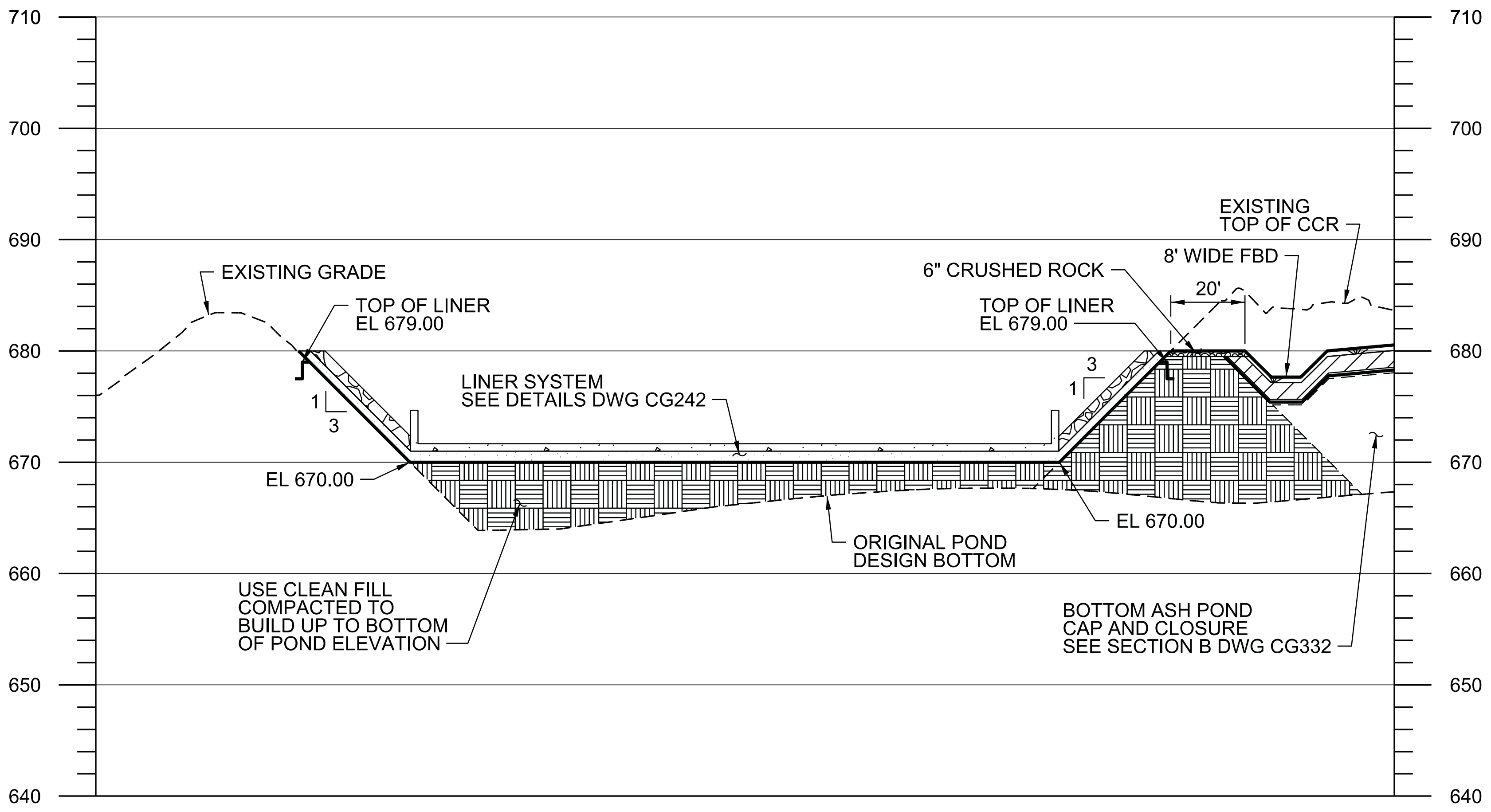
7/13/2020



SECTION C
CG204

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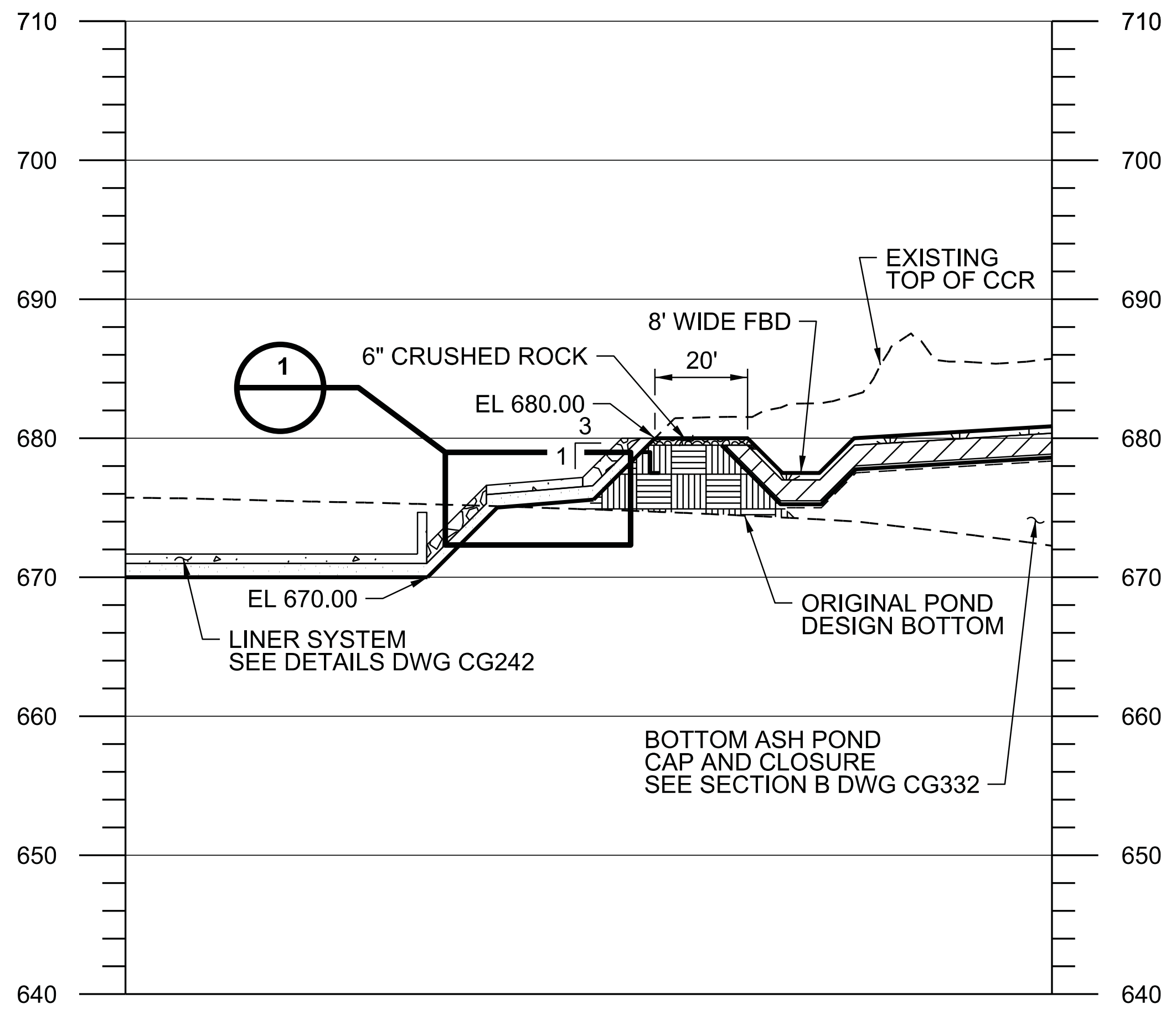

SECTION D
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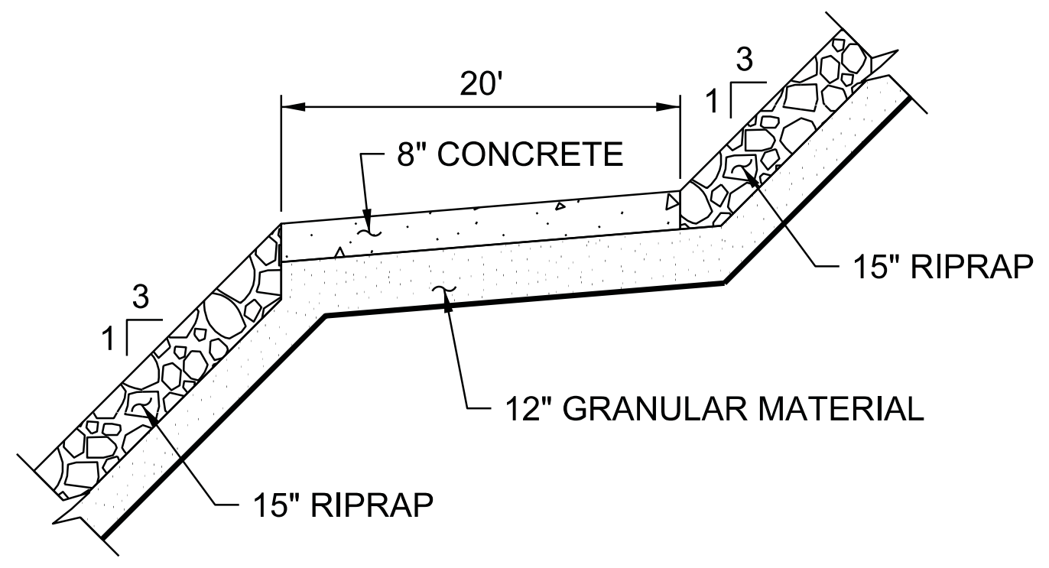
VERT: 0 10' 20' SCALE IN FEET



DETAIL 1
NOT TO SCALE

NOTES:

1. SEE REFERENCE DRAWINGS 1-2035-1-D-C1018, 1-2035-1-D-C1019, 1-2035-1-D-C1020, AND 1-2035-1-D-C1021 FOR THE ORIGINAL POND DESIGN TO ESTIMATE POND BOTTOM FOR EXTENT OF CCR MATERIAL TO BE REMOVED FOR THE CLEAN CLOSURE OF THE AIR HEATER WASH BASIN. CCR MATERIAL AND 1-FOOT OF OVEREXCAVATION MUST BE REMOVED TO THE EXTENT TO CONSTRUCT THE NEW BERM FOR THE SOUTH AND EAST SIDES OF THE BASIN WITH CLEAN BACKFILL MATERIAL FROM THE 1-FOOT OVEREXCAVATION TO THE TOP OF THE NEW BERM WITH 3H:1V SIDE SLOPES.

FOR BID - NOT FOR CONSTRUCTION

no.	date	by	ckd	description
0	07/17/20	RNO	ETT	ISSUED FOR BID

no.	date	by	ckd	description

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POND CLOSURE AND
WASTEWATER TREATMENT PROJECT

OTTUMWA, IA

LVWTP AND AHWB CONSTRUCTION
FINISH GRADING SECTIONS - SHEET 2

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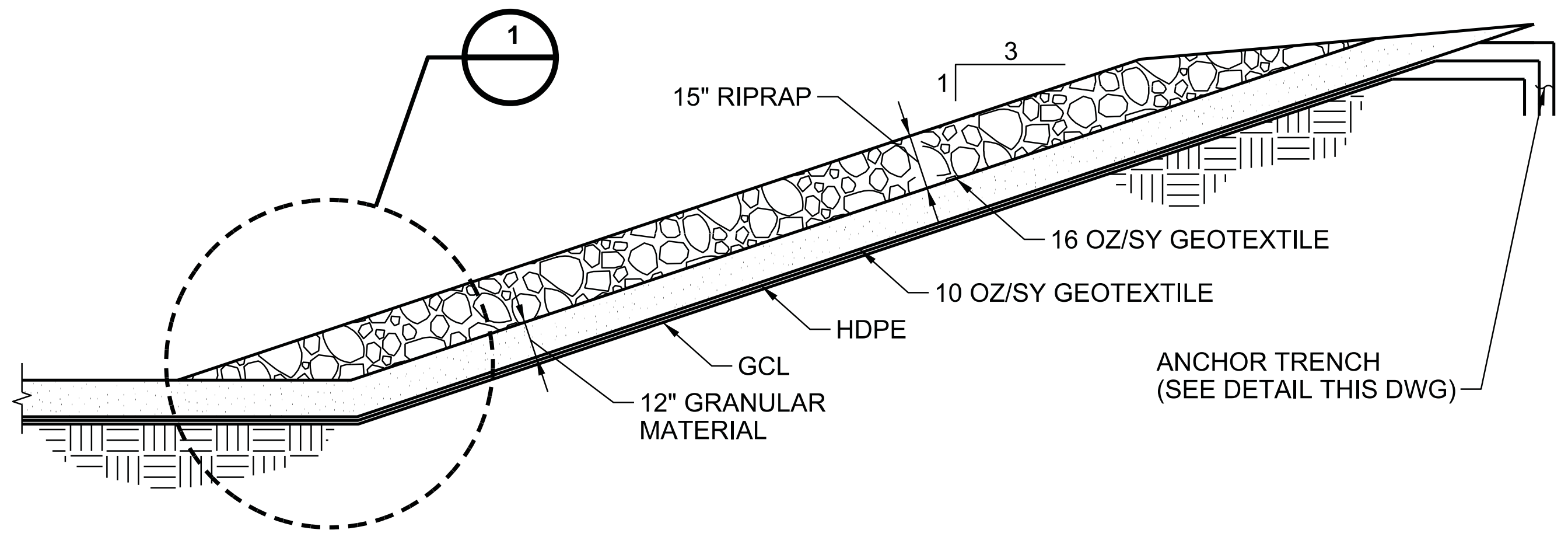
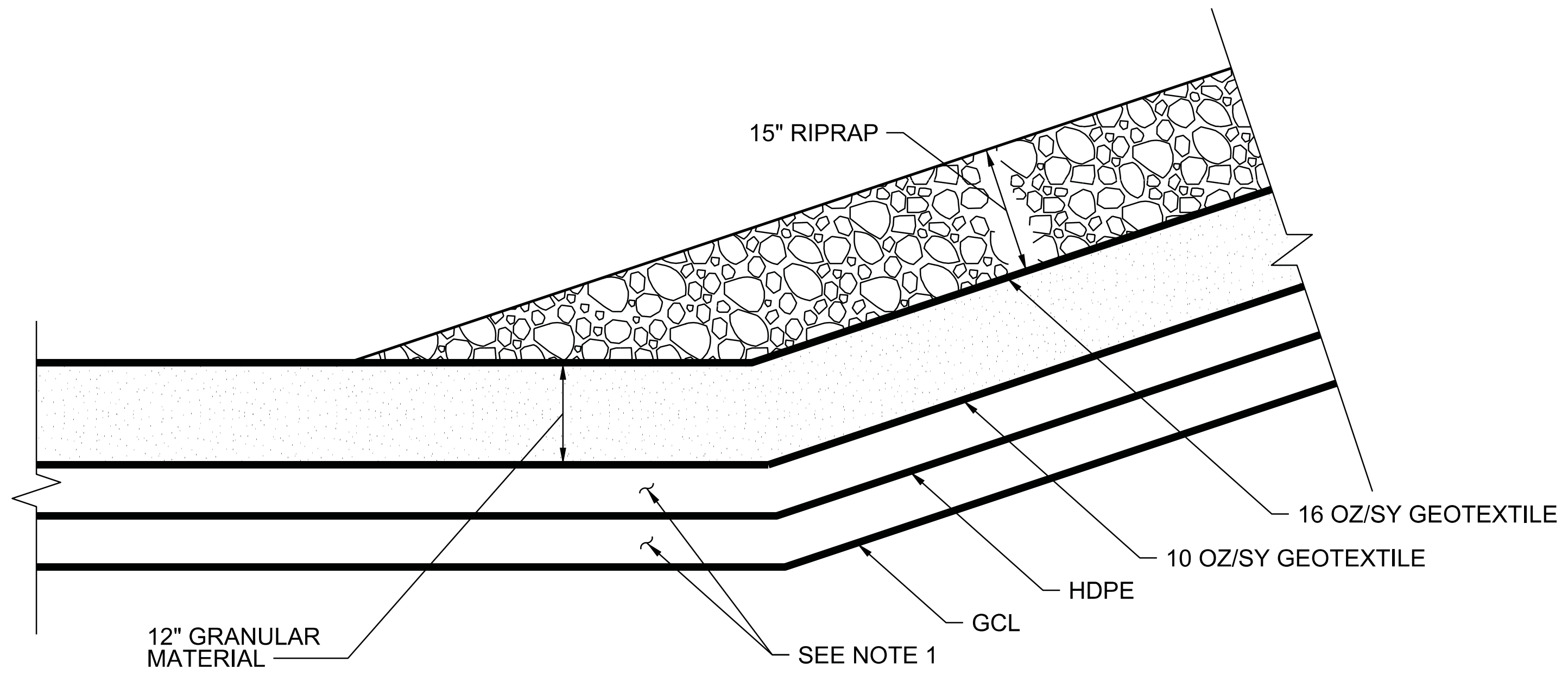
file 110321CG232.DGN

7/13/2020



LOW VOLUME WASTEWATER TREATMENT POND LINING SYSTEM
NOT TO SCALE



NOTES: (DETAIL 1)

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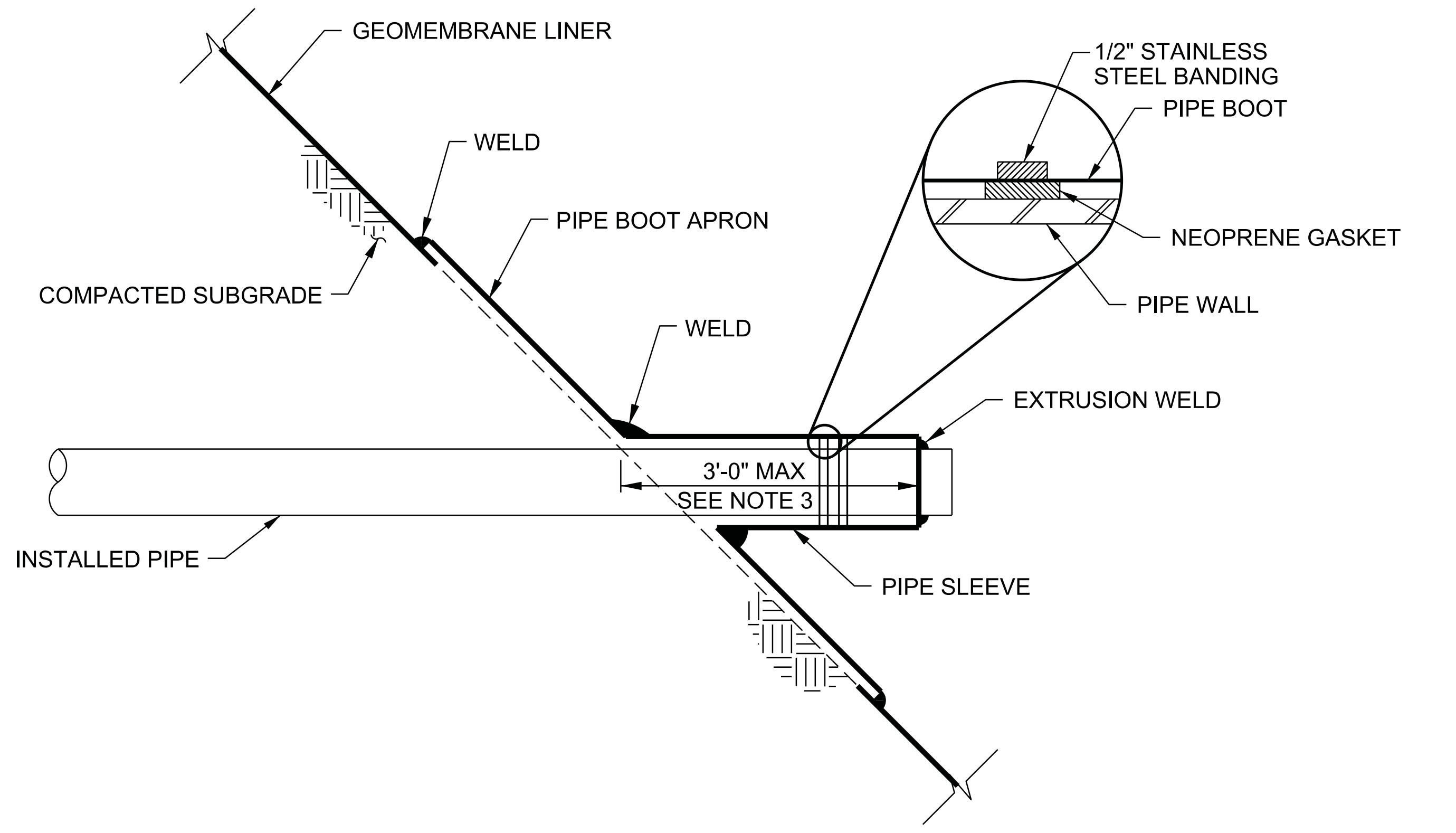
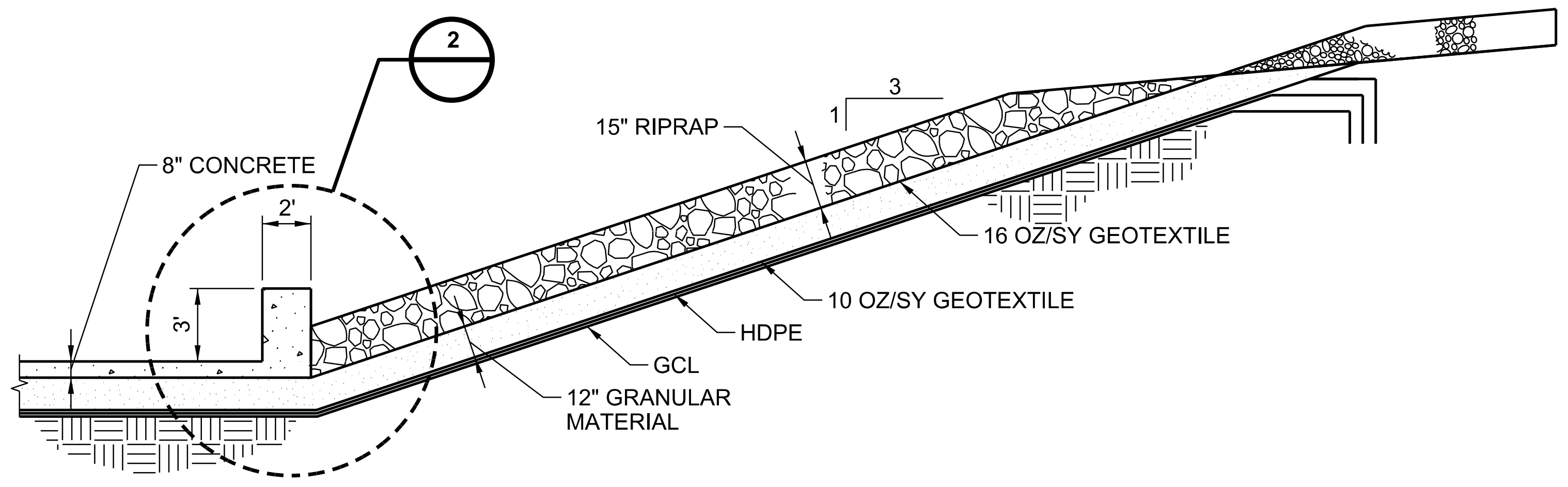
DETAIL ①
NOT TO SCALE



NOTES: (PIPE PENETRATION DETAIL)

1. SEE PIPE PENETRATION ISOMETRIC THIS DWG FOR LIMITS OF PIPE BOOT APRON.
2. BOOT SHALL BE OF SAME MATERIAL AND THICKNESS AS MAIN GEOMEMBRANE LINER.
3. LINER COVER MATERIAL NOT SHOWN FOR THE SAKE OF CLARITY.
SEE PLANS, SECTIONS, AND DETAILS FOR LINER COVER REQUIREMENTS.
NO LINER MATERIAL SHALL BE EXPOSED ON THE SLOPE.

PIPE PENETRATION DETAIL
NOT TO SCALE



AIR HEATER WASH BASIN SECTION
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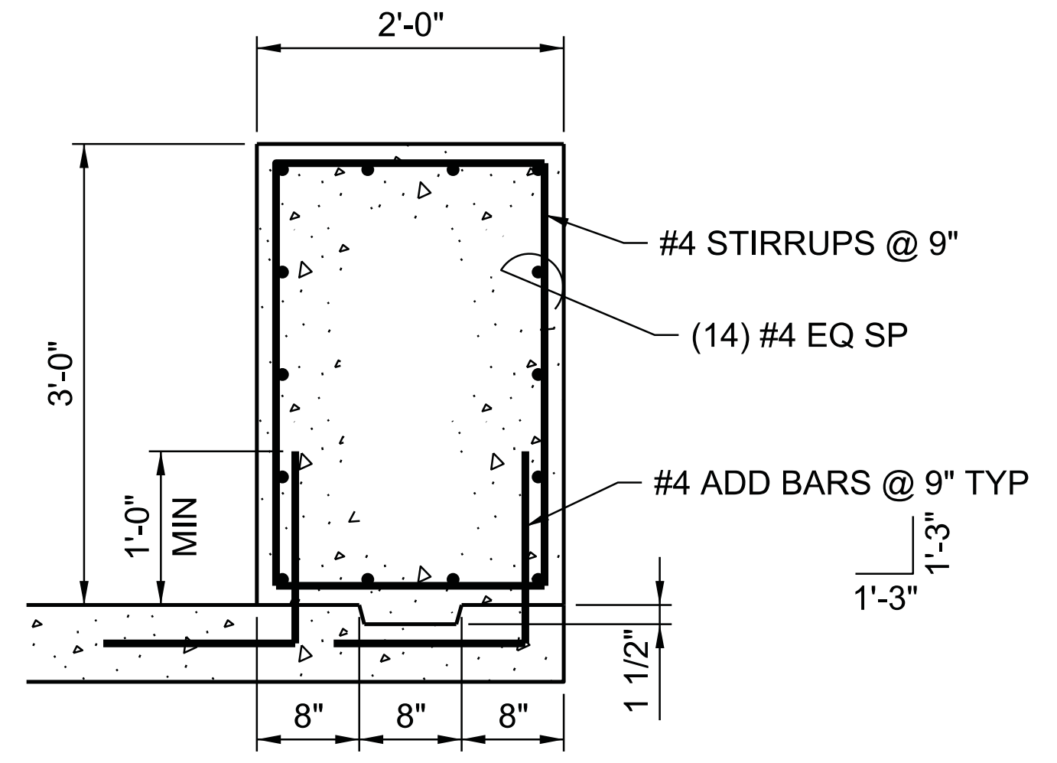
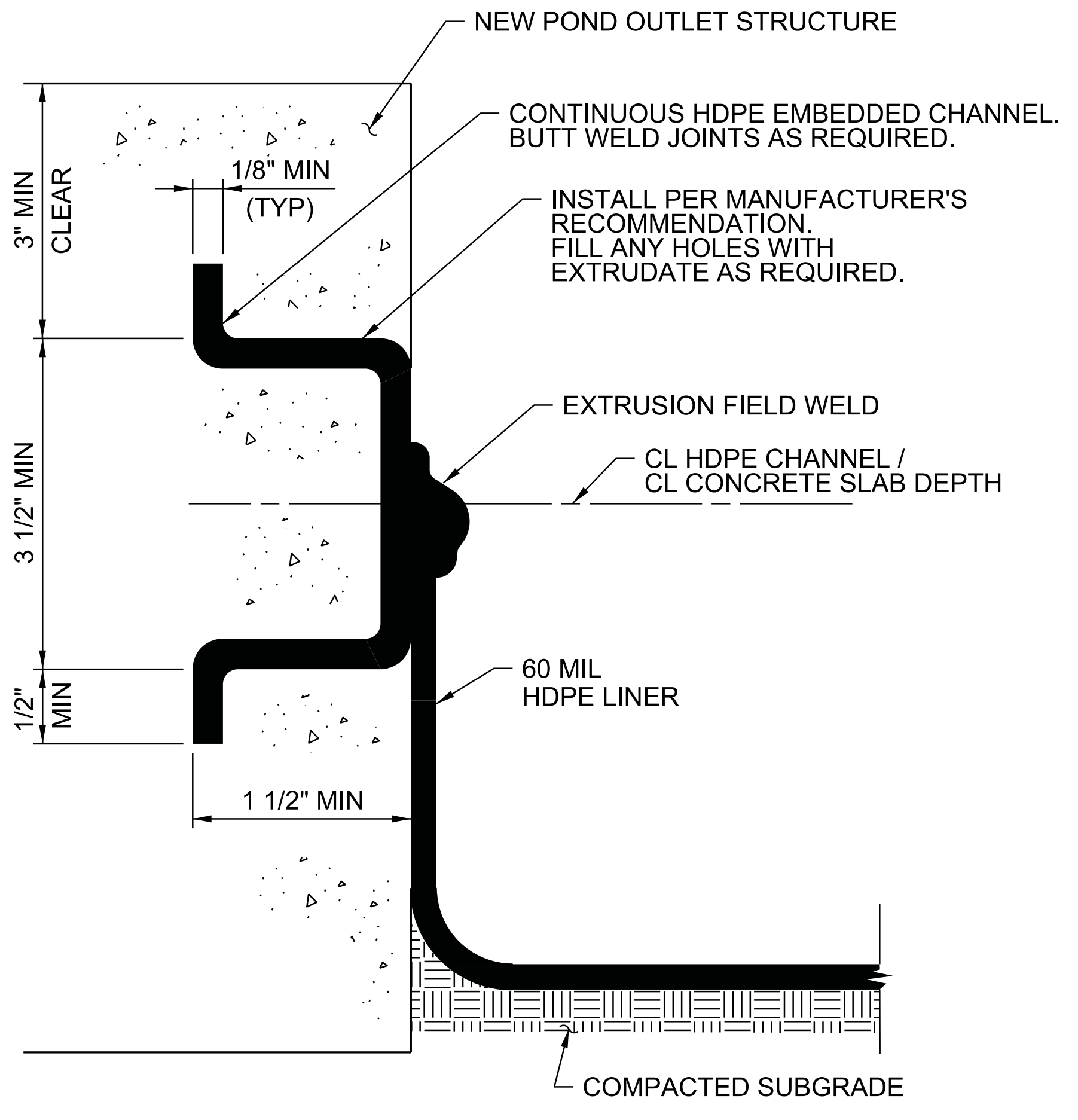


NOTES: (AIR HEATER WASH POND CURB REINFORCING)

1. INSTALL EXPANSION JOINT IN CURB AT ALL LOCATIONS WHERE THE CONCRETE PAVEMENT HAS A DOWELED CONTRACTION JOINT. MATCH THICKNESS AND TYPE OF COMPRESSIBLE MATERIAL AND JOINT SEALER.

AIR HEATER WASH BASIN CURB REINFORCING

DETAIL ②
NOT TO SCALE



LINER ANCHOR TO NEW CONCRETE STRUCTURE
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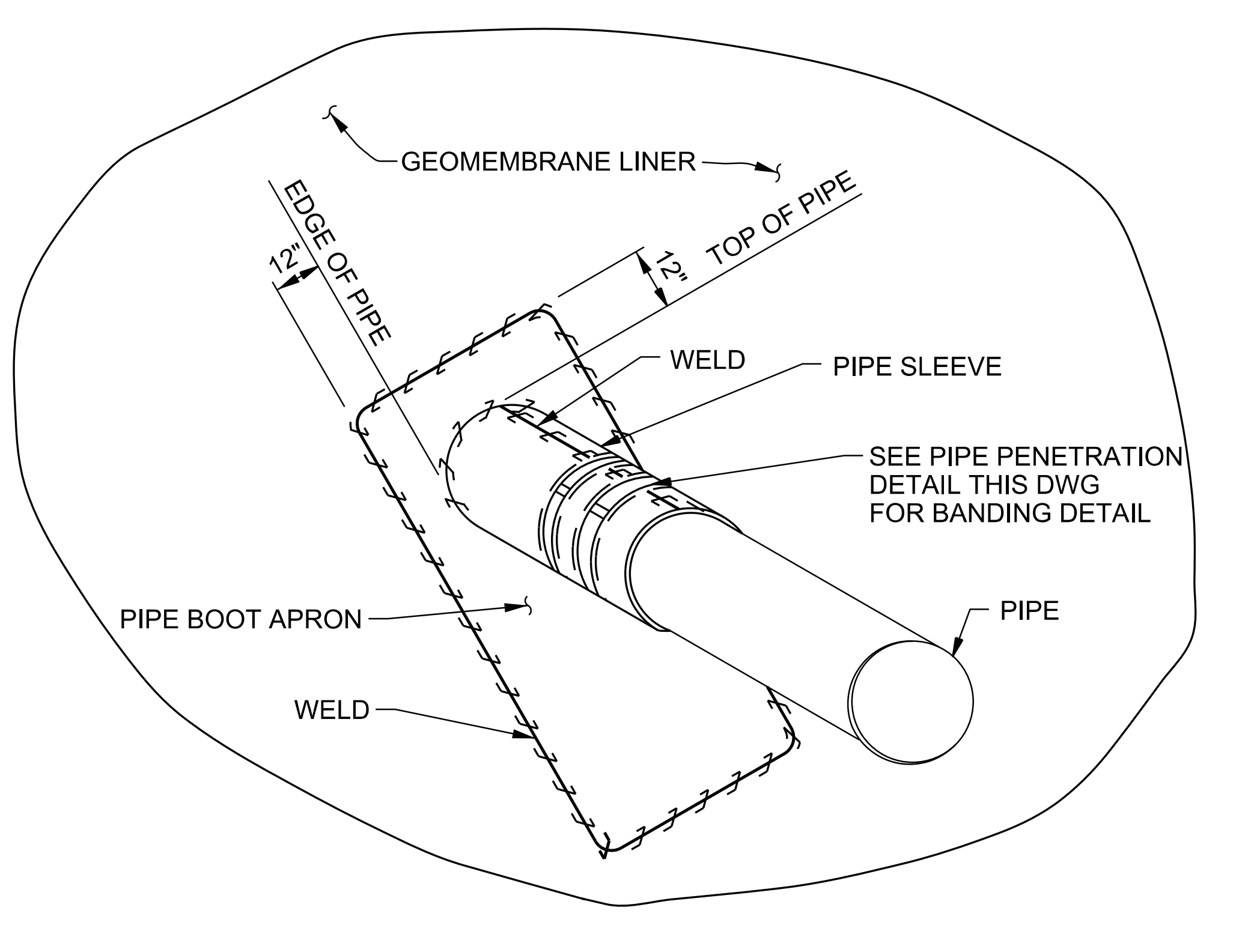
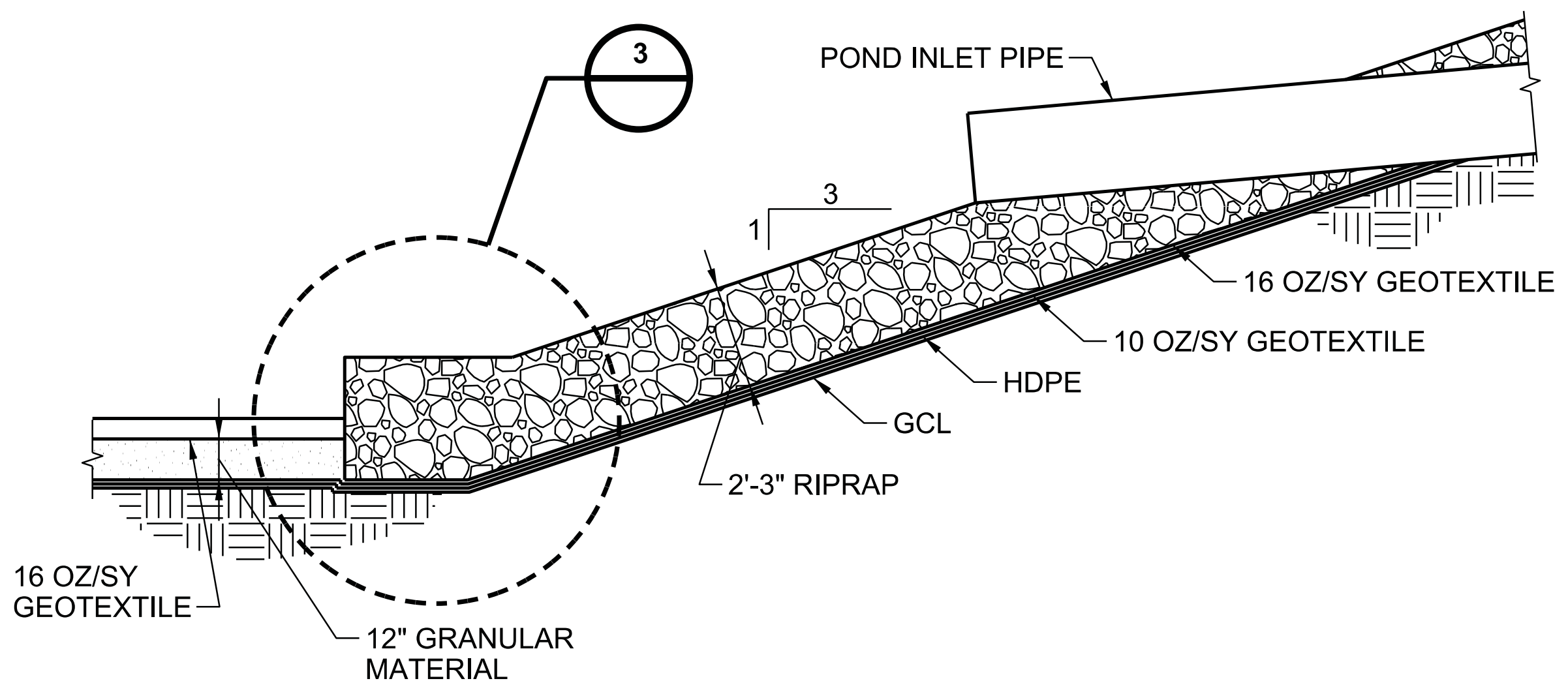


NOTES: (PIPE PENETRATION ISOMETRIC)

1. SEE PIPE PENETRATION DETAIL THIS DWG FOR LIMITS OF PIPE SLEEVE.
2. BOOT SHALL BE OF SAME MATERIAL AND THICKNESS AS MAIN GEOMEMBRANE LINER.
3. LINER COVER MATERIAL NOT SHOWN FOR THE SAKE OF CLARITY.
SEE PLANS, SECTIONS, AND DETAILS FOR LINER COVER REQUIREMENTS.
NO LINER MATERIAL SHALL BE EXPOSED ON THE SLOPE.

PIPE PENETRATION ISOMETRIC
NOT TO SCALE



POND INLET RIPRAPPED SLOPE
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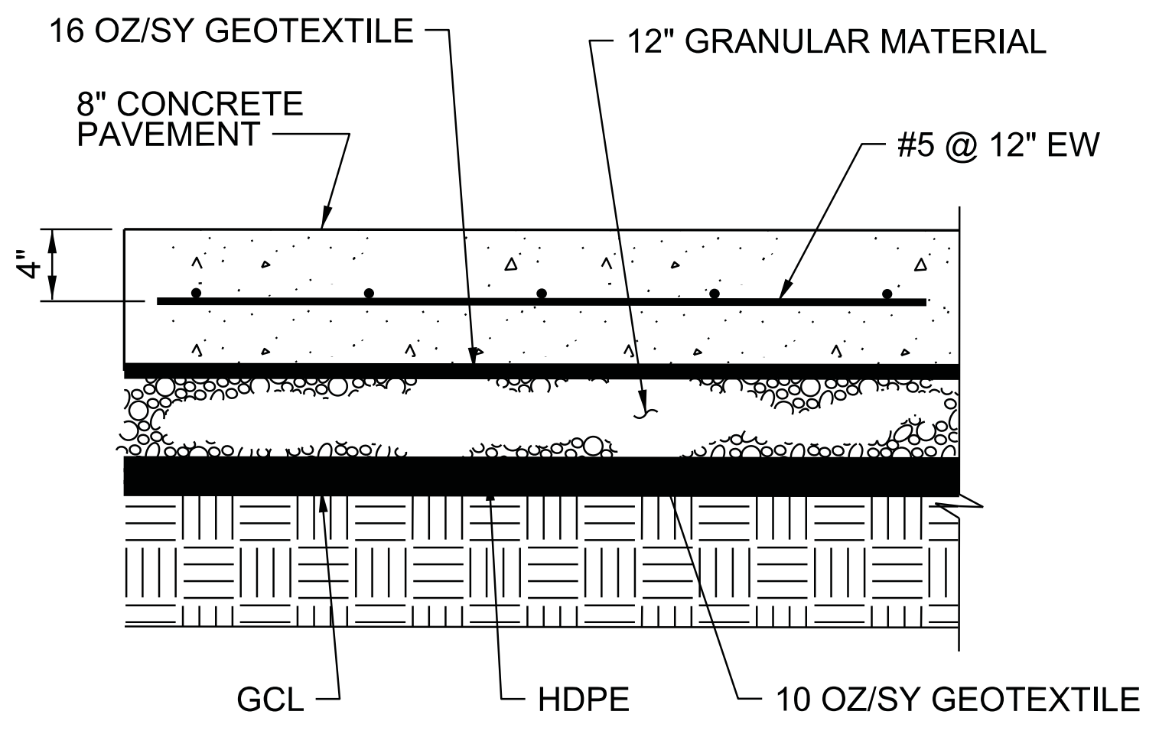

AIR HEATER WASH BASIN CONCRETE PAVEMENT DETAIL
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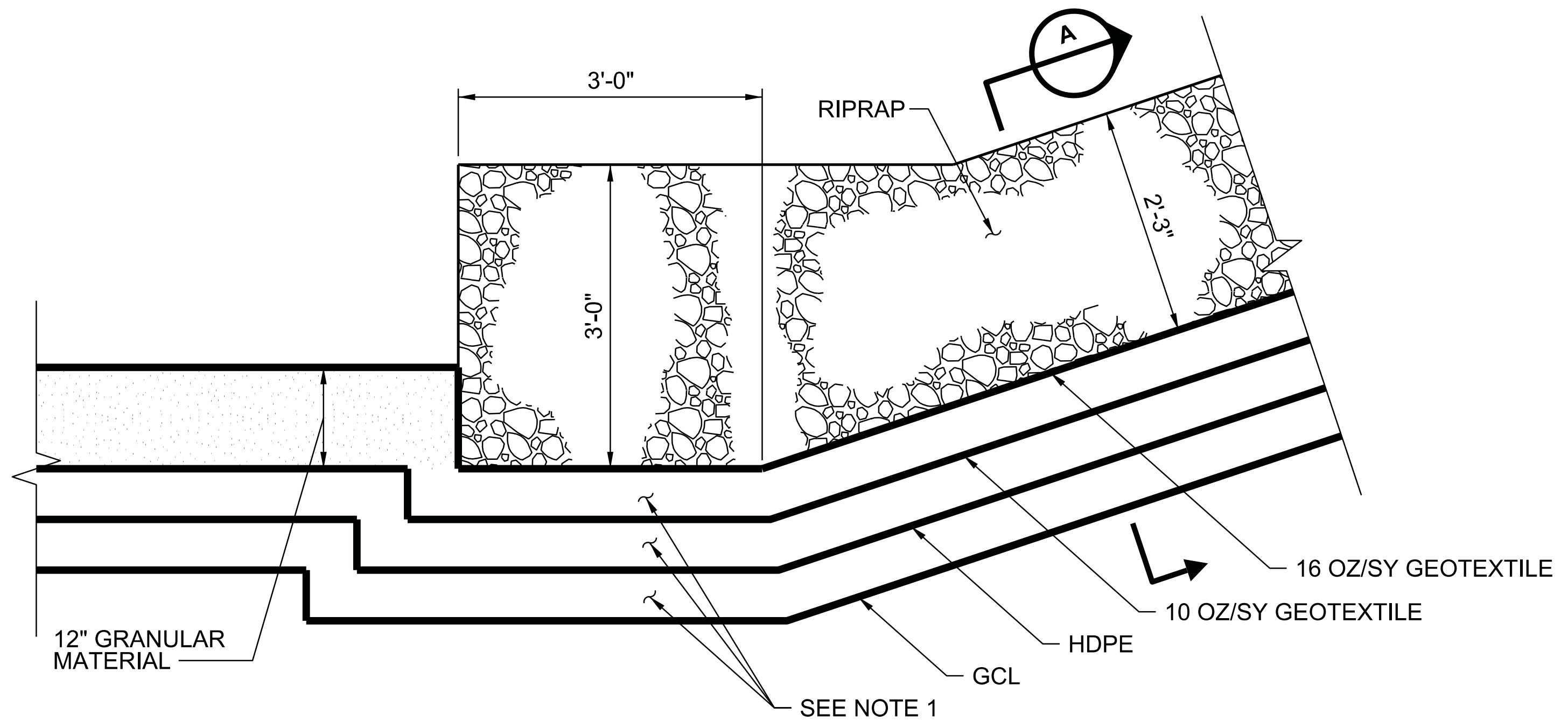

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DETAIL ③
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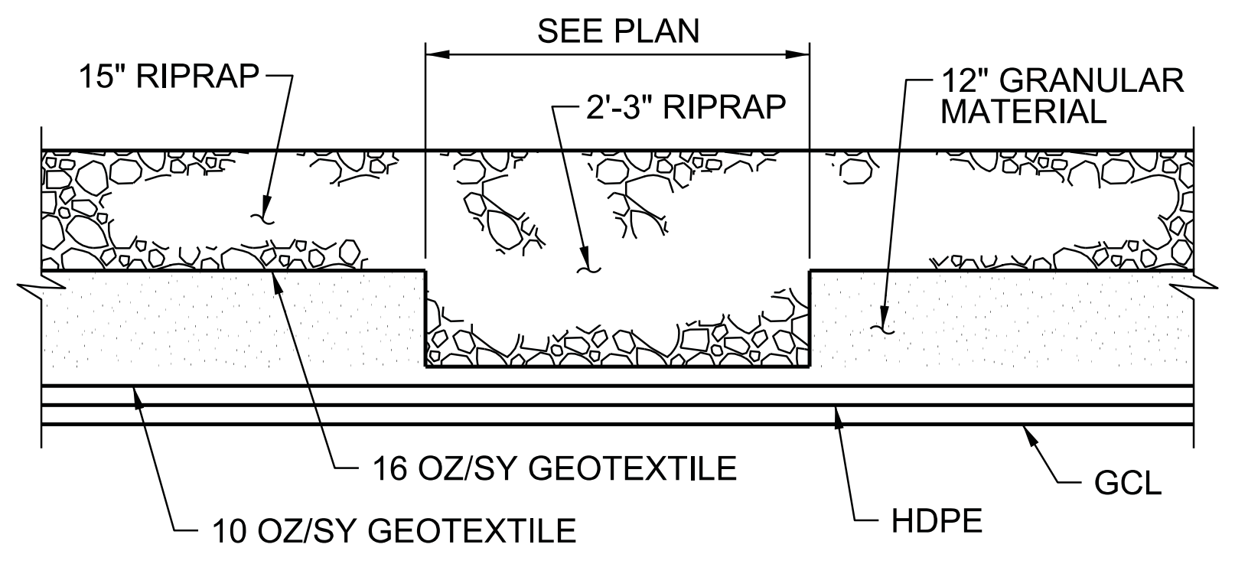

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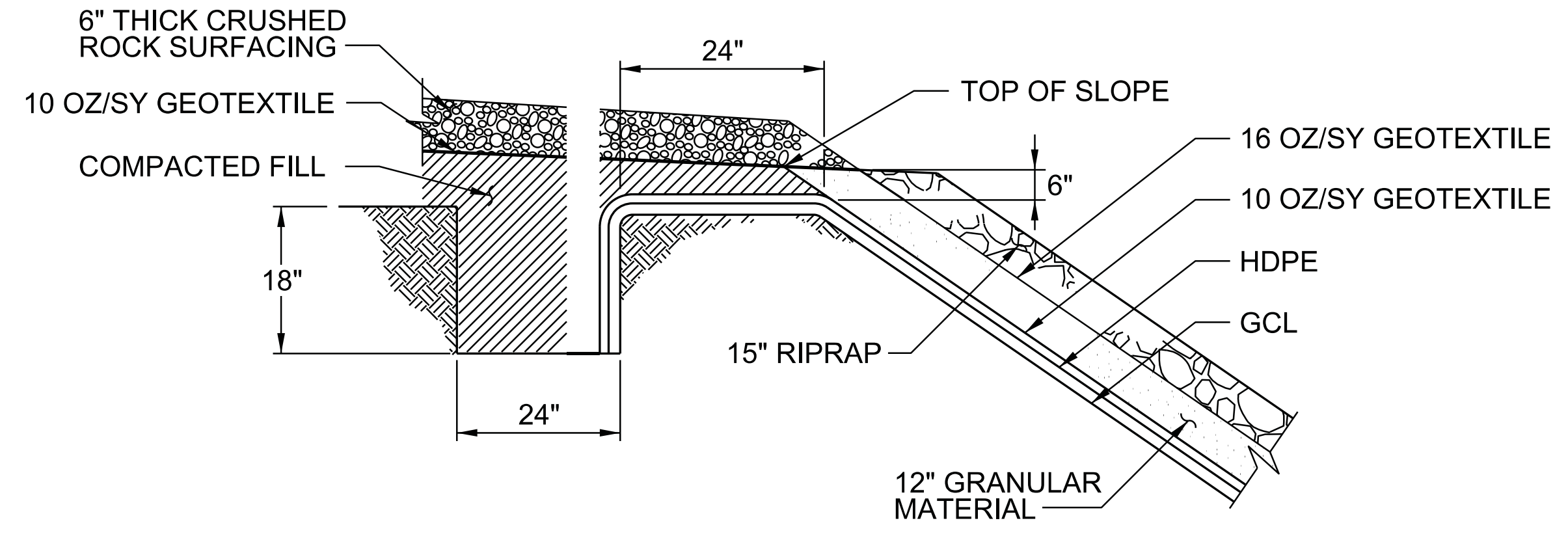

TYPICAL ANCHOR TRENCH DETAIL
NOT TO SCALE

FOR BID - NOT FOR CONSTRUCTION

no.	date	by	ckd	description	no.	date	by	ckd	description
0	07/17/20	RNO	ETT	ISSUED FOR BID					

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OTTUMWA, IA

LVWTP AND AHWB CONSTRUCTION
FINISH GRADING DETAILS - SHEET 2

project: 110321
contract: 8120
drawing: CG242
rev.: — 0
sheet of sheets
file 110321CG242.DGN

7/13/2020

Millimeters
Scale For Microfilming
Inches

11/25/2020 Classification: Internal - ECRM7804236
Z:\Clients\...Site Preparation\110321CG242.dgn

APPENDIX C8– STRUCTURAL STABILITY ASSESSMENT

ALLIANT ENERGY
Interstate Power and Light Company
Ottumwa Generating Station

CCR SURFACE IMPOUNDMENT

STRUCTURAL STABILITY ASSESSMENT

Report Issued: October 5, 2020
Revision 1

HARD HAT SERVICES™
Engineering, Construction and Management Solutions

EXECUTIVE SUMMARY

This Structural Stability Assessment (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 from Electric Utilities (40 CFR Parts 257 and 261, also known as the CCR Rule) published on April 17, 2015 (effective October 19, 2015) and subsequent amendments.

This Report serves as the first periodic review since the initial report dated September 29, 2016. It assesses the structural stability of each CCR unit at Ottumwa Generating Station in Ottumwa, Iowa in accordance with §257.73(b) and §257.73(d) of the CCR Rule. For purposes of this Report, "CCR unit" refers to an existing or inactive CCR surface impoundment.

Primarily, this Report is focused on documenting whether the design, construction, operation, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater which can be impounded within each CCR unit.

Table of Contents

Figures

Appendices

1 Introduction

The owner or operator of the Coal Combustion Residual (CCR) unit must conduct an initial and periodic structural stability assessments and document whether the design, construction, operation, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater which can be impounded therein. This Report serves as the first periodic review from the initial dates September 29, 2016 and has been prepared in accordance with the requirements of §257.73(b) and §257.73(d) of the CCR Rule.

1.1 CCR Rule Applicability

The CCR Rule requires a periodic structural stability assessment by a qualified professional engineer (PE) for existing CCR surface impoundments with a height of 5 feet or more and a storage volume of 20 acre-feet or more; or the existing CCR surface impoundment has a height of 20 feet or more (§257.73(b)).

1.2 Structural Stability Assessment Applicability

The Ottumwa Generating Station (OGS) in Ottumwa, Iowa (Figure 1) has one existing and one inactive CCR surface impoundments that meet the requirements of §257.73(b)(1) or §257.73(b)(2) of the CCR Rule, which are identified as follows:

- OGS Ash Pond (existing)
- OGS Zero Liquid Discharge Pond (inactive)

2 FACILITY DESCRIPTION

OGS is located approximately ten miles northwest of Ottumwa, Iowa on the western shore of the Des Moines River in Wapello County, at 20775 Power Plant Road, Ottumwa, Iowa (Figure 1). The McNeese Wildlife Area is located to the southeast of OGS. Middle Avery Creek, which flows to the northeast into the Des Moines River, is located to the south and east of OGS.

OGS is a fossil-fueled electric generating station consisting of one steam electric generating unit. Sub-bituminous coal is the primary fuel for producing steam. The burning of coal produces a by-product of CCR. The CCR at OGS is categorized into three types; bottom ash, fly ash, and flue gas desulfurization (scrubber) byproducts. The fly ash also can be subdivided into two types, economizer fly ash and precipitator fly ash.

The majority of precipitator fly ash is collected by the electrostatic precipitators and sent to the on-site storage silo located on the west side of the generating plant. Historically, the precipitator fly ash has then either been transported off-site for beneficial reuse or was placed in the fly ash reclamation processing area adjacent to the coal pile storage area for the purposes of producing hydrated fly ash. In the fly ash reclamation processing area, the fly ash was rolled out, compacted, hydrated, and allowed to dry into a very hard, cement-like material that was stored in this area until transported off-site. Although this fly ash hydrating process has occurred in the past, this process ceased prior to October 19, 2015.

The precipitator fly ash that is not collected by the electrostatic precipitators becomes part of the flue gas desulfurization pollution control process at OGS. Activated carbon is injected into the flue gas stream and binds with mercury. This flue gas stream travels to the spray dry desulfurization towers. From there, a water-based slurry of hydrated (slaked) lime is injected into the spray dry desulfurization towers. The hydrated lime reacts with the sulfur compounds in the flue gas and the water evaporates. A precipitate is left that consists of activated carbon bound to mercury, calcium sulfate, calcium sulfite, unreacted slaked lime, and some unreacted fly ash. This flue gas stream is directed to the bag house where the particulate matter is removed. A portion of the solids are recycled back to the process and the rest of the scrubber byproducts are sent to the air quality control system byproduct silo. The material from the byproduct silo is mixed with water in a pin mixer to reduce dust, loaded into trucks, and transported to the off-site Ottumwa-Midland CCR landfill for disposal.

The bottom ash and economizer fly ash at OGS were sluiced to a surface impoundment identified as the OGS Ash Pond (Figure 2) until September 2020 when OGS initiated an outage to install a new dry ash handling system. The OGS Ash Pond is located east of the generating plant and is presently the only existing CCR surface impoundment at OGS.

In addition to the OGS Ash Pond, OGS has one inactive CCR surface impoundment identified as the OGS Zero Liquid Discharge (ZLD) Pond. The OGS ZLD Pond is located northeast of the generating plant and north of the OGS Ash Pond. The OGS ZLD Pond, presently, only receives surface water runoff from the surrounding area.

General Facility Information:

• Date of Initial Facility Operations:	1981	
• NPDES Permit Number:	IA90-001-01	
• Latitude / Longitude:	41°5′53″N	92°33′17″W
• Nameplate Ratings:	Unit 1 (1981)	725 MW

2.1 OGS Ash Pond

The OGS Ash Pond is located east of the generating plant on the eastern portion of the site. The OGS Ash Pond receives influent flows from the generating plant floor drains, oil/water separator, boiler blow down water, solid contact unit sludge, recirculating media sanitary treatment plant, and surface water runoff from the generating site proper.

Sluiced CCR was discharged into the west end of the OGS Ash Pond until September 2020. The sluiced CCR was discharged into a collection pad area where the majority of CCR was recovered. As of September 2020, a dozer continues to be used to scrape the collection pad and push the CCR into a stockpile for dewatering. Once dewatered, the CCR is then loaded into over-the-road haul trucks for transporting off-site. The sluiced water from the CCR previously drained into a narrow channel that flows into the southwest portion of the OGS Ash Pond. Routine maintenance dredging of the narrow channel occurred as the CCR settled out in the channel. Process water from the OGS Ash Pond is recirculated back into OGS for reuse or discharged as described below.

The water in the OGS Ash Pond from other sources flows to the east and discharges through the facility's National Pollution Discharge Elimination System (NPDES) Outfall 001, located in the northeast corner of the OGS Ash Pond. NPDES Outfall 001 consists of a concrete discharge structure with a six-foot-wide overflow weir and includes a Parshall flume and instrumentation to measure the flow of the discharged water. The water flows through the NPDES Outfall 001 and discharges into an unnamed creek at an average rate of 1.54 MGD. The water flows through the NPDES Outfall 001 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.

The surface area of the OGS Ash Pond is approximately 18 acres and has an embankment height of approximately 25 feet from the crest to the toe of the downstream slope. The interior storage depth of the OGS Ash Pond is approximately 20 feet. Currently, the total volume of impounded CCR and water within the OGS Ash Pond is approximately 556,000 cubic yards.

2.2 OGS Zero Liquid Discharge Pond

The OGS Zero Liquid Discharge (ZLD) Pond is located northeast of the generating plant on the eastern portion of the site and north of the OGS Ash Pond. The OGS ZLD Pond historically received influent flows from the generating plant that consisted of boiler wash water, air heater wash, turbine chemical cleaning water, and boiler chemical cleaning water. Presently, the OGS ZLD Pond only receives storm water runoff from the surrounding area, which includes the inactive hydrated fly ash area located west of the surface impoundment, as well as occasional excess storm water runoff from the coal pile storage area. One 24-inch diameter high-density polyethylene culvert connects the coal pile runoff pond to the OGS ZLD Pond. The culvert is used as an emergency overflow to route storm water from the coal pile runoff pond into the OGS ZLD Pond.

The OGS ZLD Pond does not currently discharge. Two 48-inch diameter concrete culverts, located along the south embankment, previously connected the OGS ZLD Pond to the OGS Ash Pond prior to being permanently sealed off with concrete.

The OGS ZLD Pond covers a surface area of approximately 19 acres and has an embankment height of approximately 29 feet from crest to toe of the downstream slope. The interior storage depth of the OGS ZLD Pond is approximately 25 feet. Based on readily available information, the OGS ZLD Pond has a total storage capacity of approximately 515,000 cubic yards.

3 STRUCTURAL STABILITY ASSESSMENT- §257.73(d)

This Report documents whether the design, construction, operation, and maintenance of each CCR unit is consistent with recognized and generally accepted good engineering practices for maximum volume of CCR and CCR wastewater which can be impounded.

3.1 OGS Ash Pond

The OGS Ash Pond was constructed as part of the initial plant sometime between 1977 and 1981 using native clay from onsite for construction of embankments for the impoundment. The embankments were constructed on the native clay. The impoundment is subject to water loss mainly from evaporation and the discharge of water that is not reused for sluicing.

Borings for the installation of monitoring wells were installed through the embankment in April of 2016 and form the current understanding of embankment and foundation soils for the OGS Ash Pond, Appendix A.

The outfall structure for the OGS Ash Pond is a concrete weir box with six-foot-wide overflow weir and a Parshall flume for flow monitoring. The weir box discharges under the embankment through two 66-inch diameter reinforced concrete pipes, Appendix B.

Based on the annual inspections conducted by Hard Hat Services since Revision 0 of this Report, there have been no significant changes regarding settlement, instability, or reconfiguration of the OGS Ash Pond.

3.1.1 CCR Unit Foundation and Abutments - §257.73(d)(1)(i)

The foundation soil is a medium stiff to stiff low plasticity clay (CL) with an unconfined compressive strength of 2,000 psf. The clay is underlain by a deposit of very dense sand (SP) over rock at an elevation of approximately 625 feet. The foundation soils are adequate for the support of the approximately 24-foot-high embankment with acceptable safety factors as shown in the OGS Safety Factor Assessment Report, Revision 1.

3.1.2 Slope Protection - §257.73(d)(1)(ii)

The impoundment is incised on the portions of the north side and all the west side. The crest of the embankments is approximately 20 feet wide and the downstream slope of the embankment is approximately a 3:1 vegetated slope. The east and portion of the north sides also have an embankment crest of 20 feet and consist of a 3:1 vegetated slope.

Well established and managed vegetation will minimize surface erosion on both the upstream and downstream slopes. Additionally, storm water runoff is limited to the crest and downstream slope of the embankment, which limits the erosive force. Therefore, the impoundment configuration protects against surface erosion. Additionally, erosion due to wave action will have minimal impacts to the embankments.

Sudden drawdown is addressed in Section 3.1.7.

3.1.3 CCR Embankment Density- §257.73(d)(1)(iii)

The embankment is constructed of compacted low plasticity clay. The borings shown in Appendix A indicate an unconfined compressive strength of 3,200 psf. The strength of the clay indicates that the clay was compacted at optimum moisture during construction of the embankments and that the density of the embankments are adequate. Analysis of the slope safety factor in the OGS Safety Factor Assessment Report, Revision 1 indicate the foundation soils control the minimum safety factors for the slope.

3.1.4 Vegetation Management - §257.73(d)(1)(iv)

Historically, vegetation management has been conducted on a periodic basis. Annual inspections have been completed since the Revision 0 of this Report. Based on those inspections, the facility has continued to routinely manage vegetation, minimizing animal activity and deep rooting vegetation. The vegetation management has been maintained with recognized and generally accepted good engineering practices.

3.1.5 Spillway Management - §257.73(d)(1)(v)

The OGS Ash Pond is equipped with two side-by-side 66-inch diameter reinforced concrete pipes to drain process water and storm water from the concrete box structure in east corner of the impoundment, Figure 2. The culverts and drainage structure are constructed of non-erodible material and designed to carry sustained flows.

The culverts are checked for malfunction (e.g., blockages, deformations) during the weekly inspections by the facility personnel and have been inspected during the annual inspections.

This impoundment currently has a hazard potential classification of "Low," which in turn requires an evaluation of the impacts of a 100-year rainfall event. The Inflow Flood Control Plan, which is a separate document developed to comply with §257.82, shows that the precipitation from this event will drain through the culverts without overtopping the embankments of the impoundment.

3.1.6 Hydraulic Structures - §257.73(d)(1)(vi)

The two 66-inch diameter outlet pipes under the embankment provide adequate discharge capacity that is independent of the flood stage in Middle Avery Creek. On June 20, 2016, the pipes were inspected using remote camera video inspection. The inspection showed that there was minimal deterioration, deformation, distortion, sedimentation, debris, and no bedding deficiencies were observed. Additionally, the pipes were visually inspected on September 24, 2020 by Hard Hat Services and found no changes since the 2016 remote camera video inspection.

3.1.7 Sudden Drawdown - §257.73(d)(1)(vii)

The toe of the embankment could be flooded if the Des Moines River exceeds flood elevation of 656 feet. The embankments and the foundation soils are clay and there will be no sudden drawdown seepage pressure from the short-term impacts from floodwaters receding.

3.2 OGS Zero Liquid Discharge Pond

The OGS ZLD Pond was constructed as part of the initial plant sometime between 1977 and 1981 using native clay from the site for construction of embankments for the impoundment. The embankments were constructed on the native clay and the impoundment is subject to water loss from evaporation. The impoundment presently does not discharge water and the former discharge pipes to the OGS Ash Pond are permanently sealed. The OGS ZLD Pond could accept water from the coal pile runoff pond under certain severe storm events.

Borings for the installation of monitoring wells were installed through the embankment in April of 2016 and form the current understanding of embankment and foundation soils for the impoundment, Appendix A.

Based on the annual inspections conducted by Hard Hat Services since Revision 0 of this Report, there have been no significant changes regarding settlement, instability, or reconfiguration of the OGS ZLD Pond.

3.2.1 CCR Unit Foundation and Abutments - §257.73(d)(1)(i)

The foundation soil is a medium stiff to stiff low plasticity clay (CL) with an unconfined compressive strength of 2,000 psf. The clay is underlain by a deposit of very dense sand (SP) over rock at an elevation of approximately 625 feet. The foundation soils are adequate for the support of the approximately 30-foot-high embankment with acceptable safety factors as shown in the OGS Safety Factor Assessment Report, Revision 1.

3.2.2 Slope Protection - §257.73(d)(1)(ii)

The impoundment is incised on the west side. The south, east and north crest of the embankments is approximately 20 feet wide and the downstream slope of the embankment is approximately a 3:1 vegetated slope.

Well established and managed vegetation will minimize surface erosion on both the upstream and downstream slopes. Additionally, storm water runoff is limited to the crest and downstream slope of the embankment, which limits the erosive force. Therefore, the impoundment configuration protects against surface erosion. Additionally, erosion due to wave action will have minimal impacts to the embankments.

Sudden drawdown is addressed in Section 3.2.7.

3.2.3 CCR Embankment Density- §257.73(d)(1)(iii)

The embankment is constructed of compacted low plasticity clay. The borings shown in Appendix A indicate an unconfined compressive strength of 3,200 psf. The strength of the clay indicates that the clay was compacted at optimum moisture during construction of the embankments and that the density of the embankments are adequate. Analysis of the slope safety factor in the OGS Safety Factor Assessment Report, Revision 1 indicate the foundation soils control the minimum safety factors for the slope.

3.2.4 Vegetation Management - §257.73(d)(1)(iv)

Historically, vegetation management has been conducted on a periodic basis. Annual inspections have been completed since the Revision 0 of this Report. Based on those inspections, the facility has continued to routinely manage vegetation, minimizing animal activity and deep rooting vegetation. The vegetation management has been maintained with recognized and generally accepted good engineering practices.

3.2.5 Spillway Management - §257.73(d)(1)(v)

The OGS ZLD Pond is a zero liquid discharge impoundment. The former spillway, which consisted of two 48-inch RCP pipes are permanently sealed. The storm water that collects within the OGS ZLD Pond exfiltrates and evaporates, Figure 2.

This impoundment currently has a hazard potential classification of "Low," which in turn requires an evaluation of the impacts of a 100-year rainfall event. The Inflow Flood Control Plan, which is a separate document developed to comply with §257.82, shows that the precipitation from this event will be contained within the limits of the impoundment without overtopping the embankments.

3.2.6 Hydraulic Structures - §257.73(d)(1)(vi)

No active hydraulic structures are associated with this OGS ZLD Pond. The abandoned discharge pipes are filled with concrete. The pipes were visually inspected on September 24, 2020 by Hard Hat Services and found no changes since the 2016 remote camera video inspection.

3.2.7 Sudden Drawdown - §257.73(d)(1)(vii)

The toe of the embankment could be flooded if the Des Moines River exceeds flood elevation of 652 feet. The embankments and the foundation soils are both clay and there will be no sudden drawdown seepage pressure from the short-term impacts of toe flooding.

4 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

To meet the requirements of 40 CFR 257.73(d)(3), I Mark W. Loerop hereby certify that I am a licensed professional engineer in the State of Iowa; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in 40 CFR 257.73(b) and 40 CFR 257.73(d).

MARK W. LOEROP
22197

By:

Name: Mark Loerop

Date: October 5, 2020

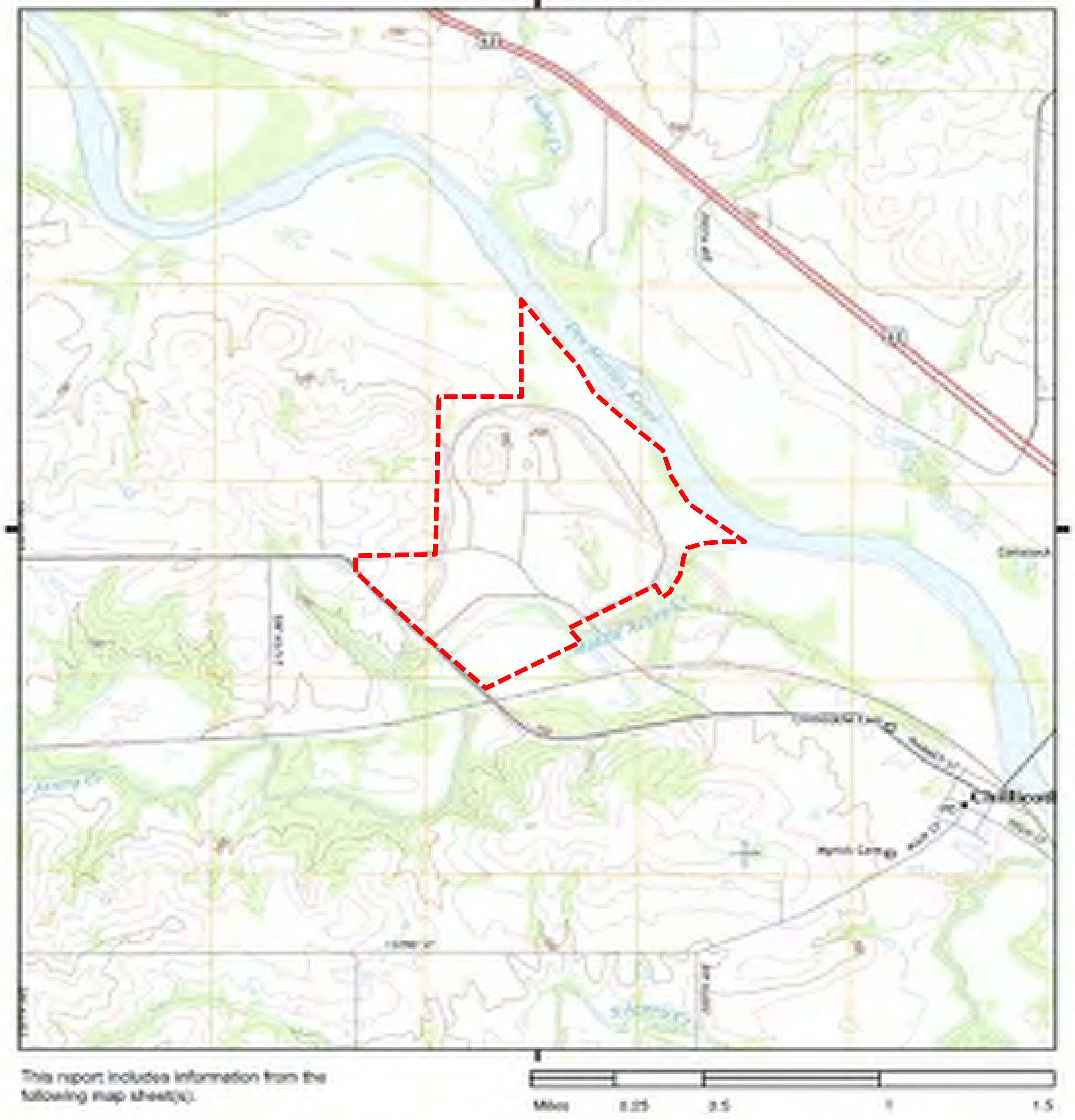
FIGURES

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

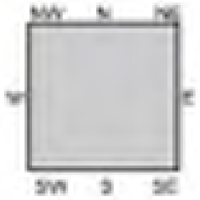
Structural Stability Assessment

Historical Topo Map

2013



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

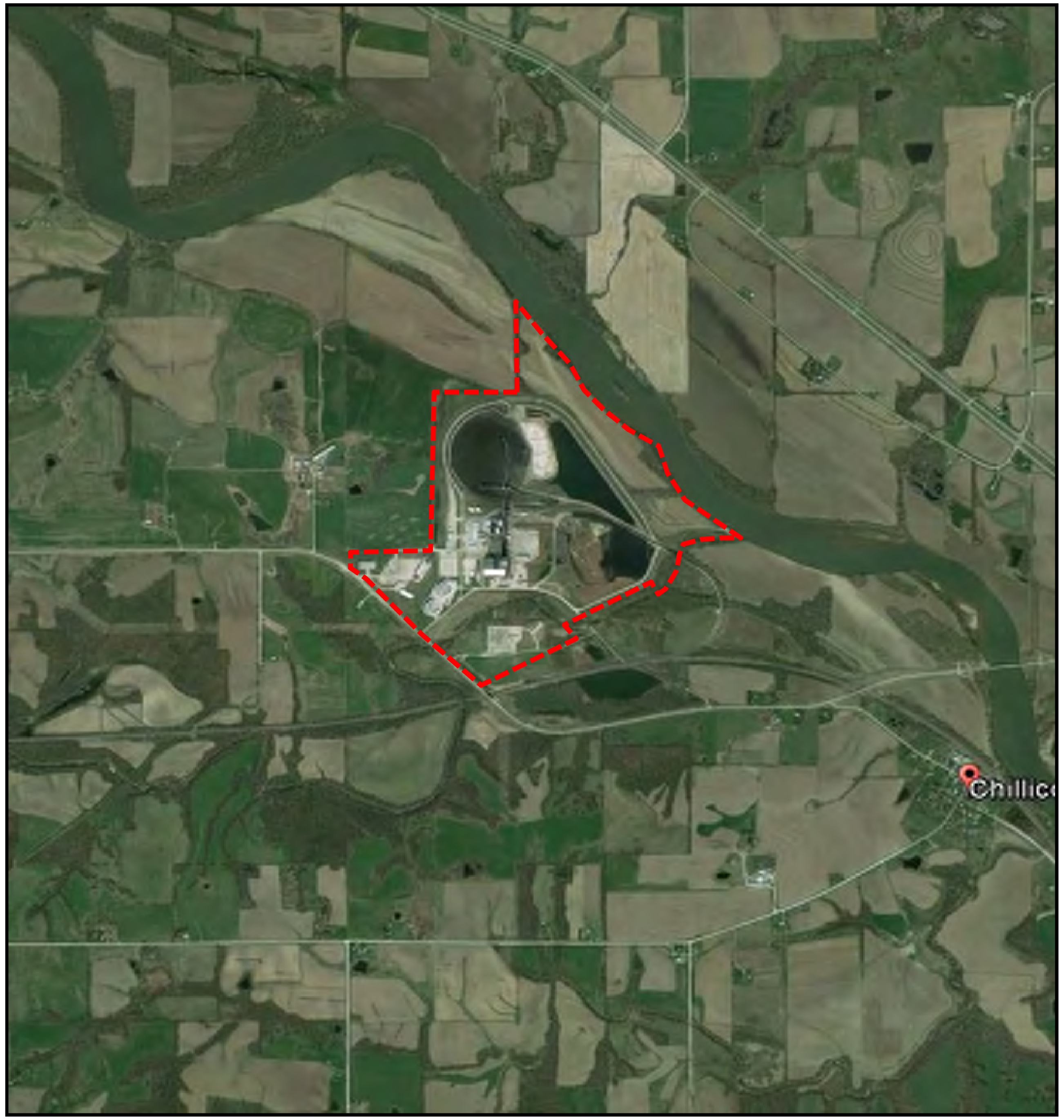


TP, Chillicothe, 2013, 7.5-minute

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

4666679 - 5 page 4

Historical Aerial Photo 4/13/2016

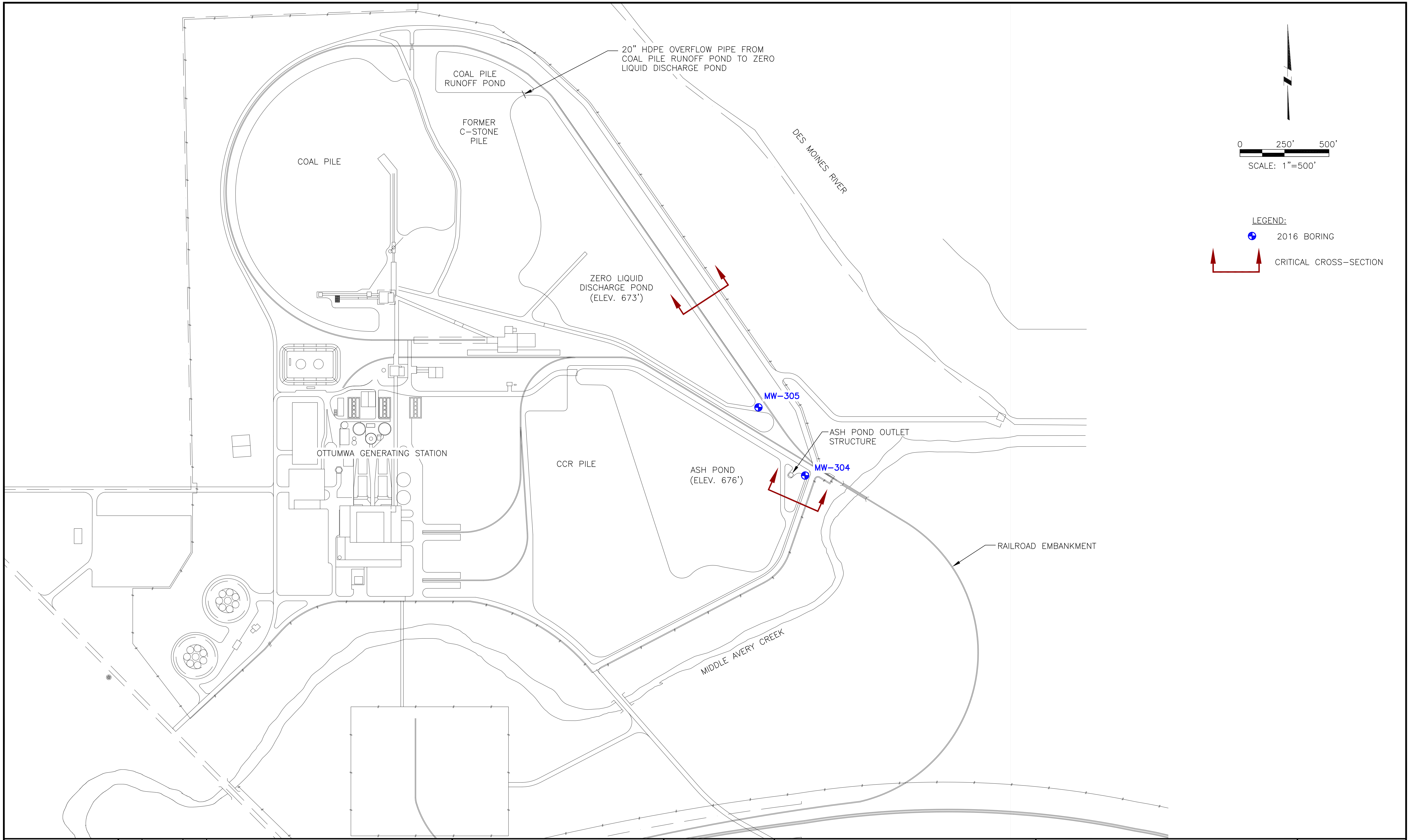


- - - - - Approximate Property Boundary

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



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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
SAFETY FACTOR ASSESSMENT
CRITICAL CROSS–SECTION LOCATION

JOB 154.018.002.003
SHT. FIGURE 2
DWG. 154.018.002.003–D2

APPENDIX A – 2016 Boring Logs

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

Structural Stability Assessment

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

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

Page 1 of 3

Facility/Project Name IPL- Ottumwa Generating Station SCS#: 25215135.40		License/Permit/Monitoring Number		Boring Number MW-304	
Boring Drilled By: Name of crew chief (first, last) and Firm Todd Schmalfeld Cascade Drilling		Date Drilling Started 11/11/2015	Date Drilling Completed 11/11/2015		Drilling Method 4-1/4 hollow stem auger
Unique Well No.	DNR Well ID No.	Common Well Name MW-304	Final Static Water Level Feet	Surface Elevation 680.1 Feet	Borehole Diameter 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
Feet ☐ N ☐ S
Feet ☐ E ☐ 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	U S C S	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
				TOPSOIL.	TOPSOIL									
			1 2 3 4 5 6 7 8 9 10	FAT CLAY, black (10YR 2/1).	CH									
S1	23	4 5 4 5	11 12							M				
S2	19.5	4 4 5 5	13 14	FAT CLAY, yellowish brown (10YR 5/4).	CH					M				
			15 16	FAT CLAY, yellowish brown (10YR 3/4).	CH									

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:

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number **MW-304**

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

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number MW-304

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

Page 1 of 3

Facility/Project Name IPL- Ottumwa Generating Station SCS#: 25215135.40	License/Permit/Monitoring Number	Boring Number MW-305	
Boring Drilled By: Name of crew chief (first, last) and Firm Todd Schmalfeld Cascade Drilling	Date Drilling Started 12/7/2015	Date Drilling Completed 12/8/2015	Drilling Method 4-1/4 hollow stem auger

Unique Well No.	DNR Well ID No.	Common Well Name MW-305	Final Static Water Level Feet	Surface Elevation 681.5 Feet	Borehole Diameter 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
Feet ☐ N ☐ S Feet ☐ E ☐ W

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

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				TOPSOIL	TOPSOIL									
			1	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:

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number MW-305

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	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		CH									
S5	24	4 5 7 11	20 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 30							M				
S9	13	4 4 7 12	31 32							M				
S10	24	5 6 9	33 34 35	LEAN CLAY, very dark brown (10YR 2/2).						W				
S11	24	4 4 5 7	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

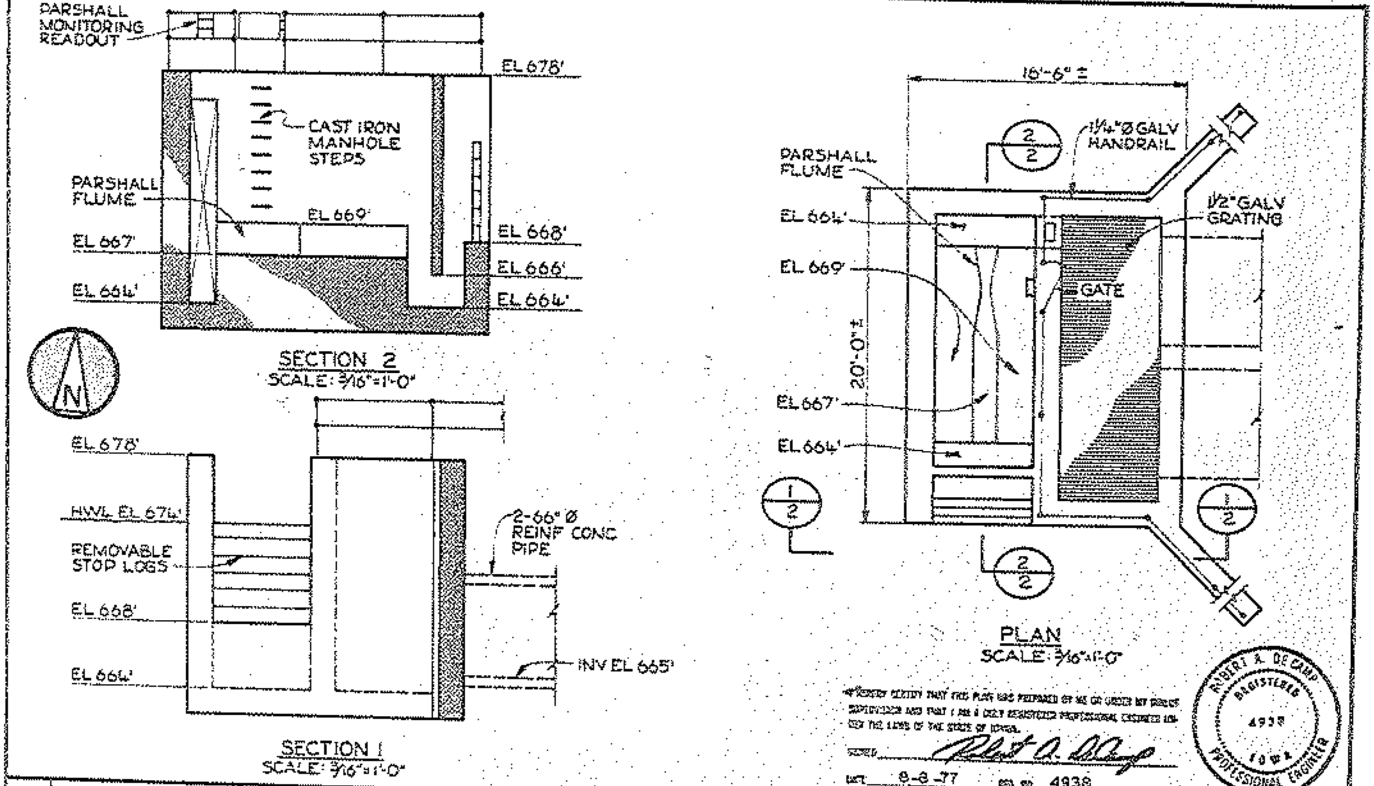
Page 3 of 3

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

APPENDIX B – Impoundment Outfall Details

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

Structural Stability Assessment



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 8-8-77 REG. NO. 4938

ROBERT A. DECAMP 4938

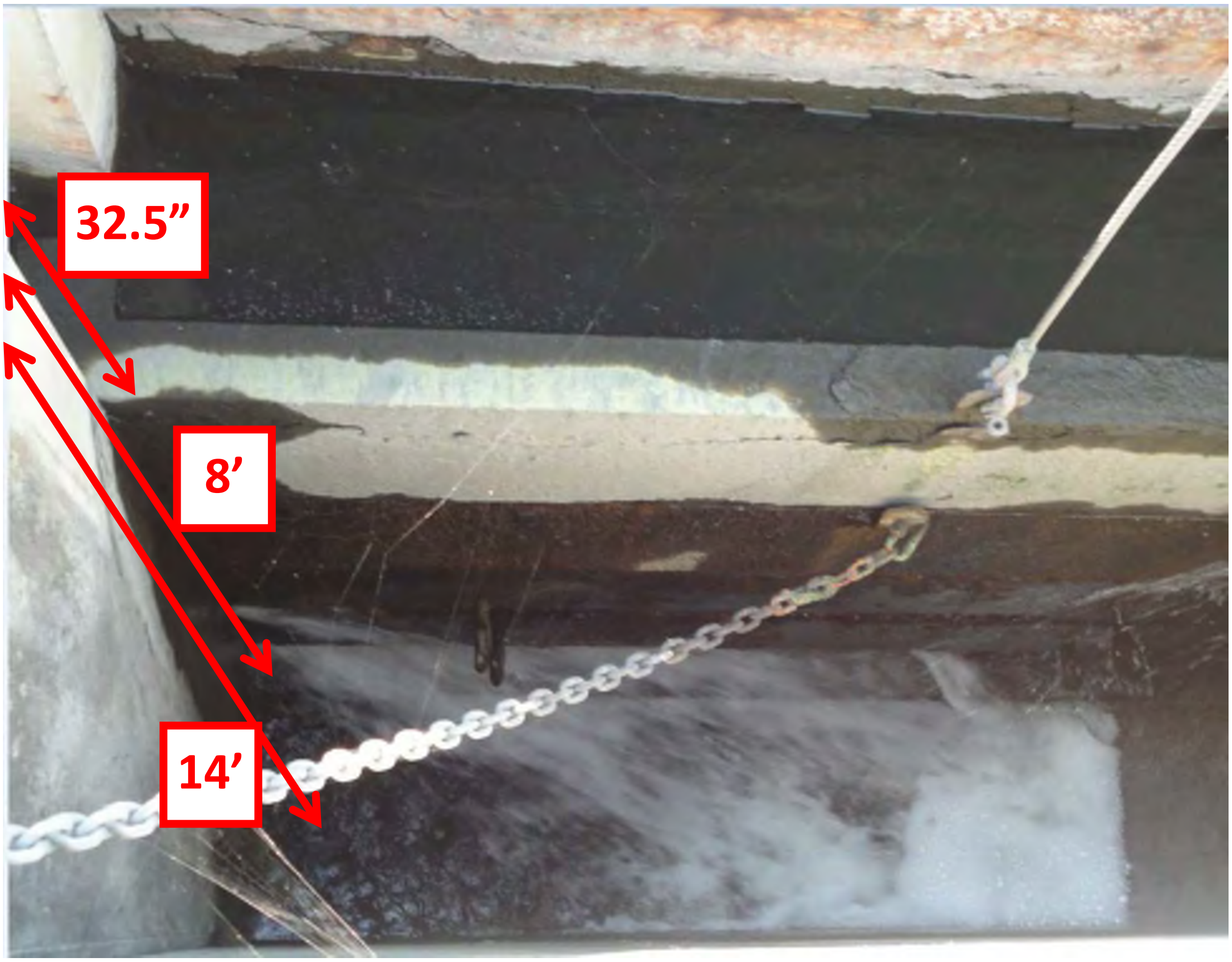
DATE	REVISION OR ISSUE	RE.	BY	CK	APP

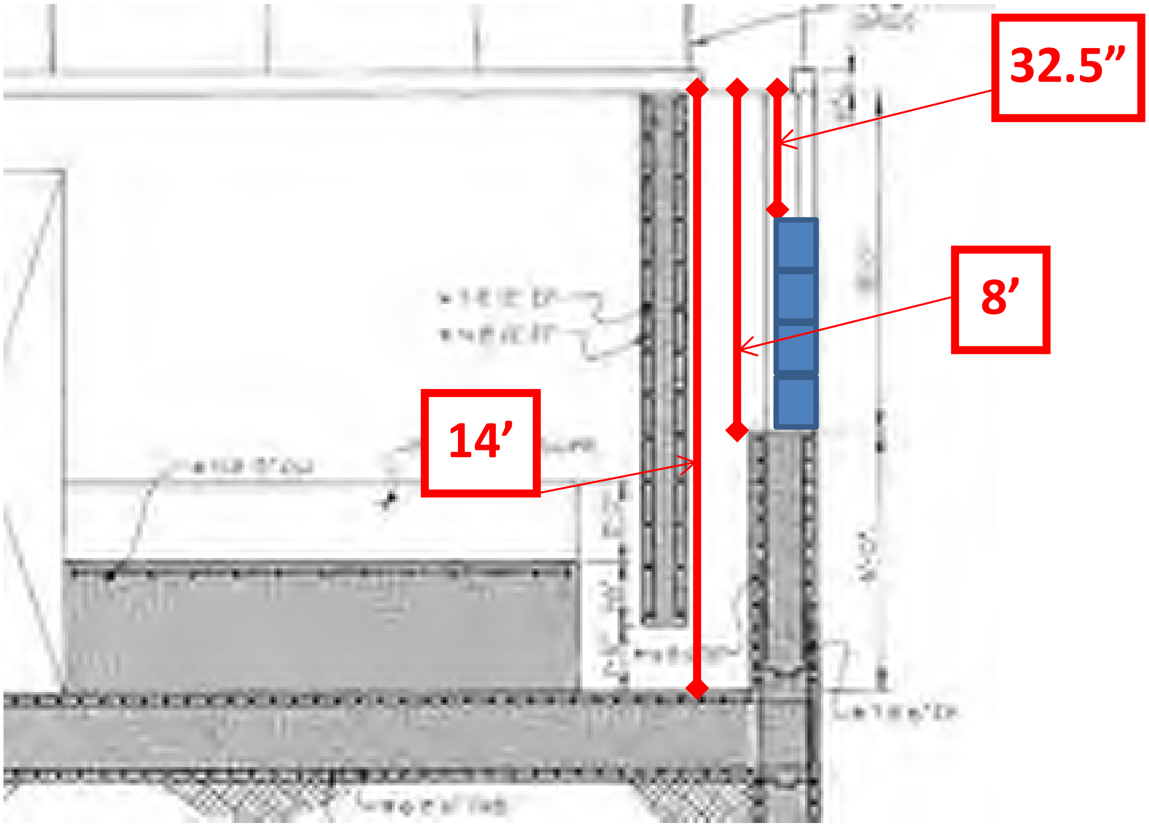
BLACK & VEATCH
CONSULTING ENGINEERS
PROJECT
6713

Iowa Southern Utilities Company
Ottumwa Generating Station - Unit 1

ASH POND
OUTFALL STRUCTURE

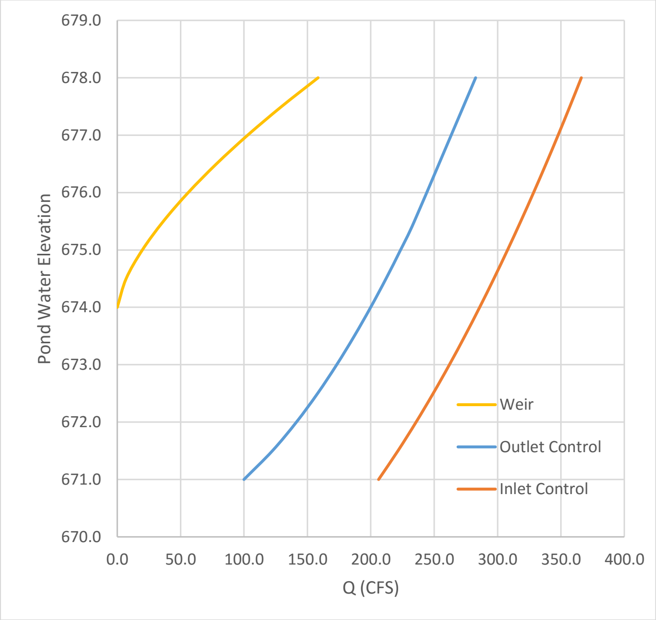
SK-S-080877-2


32.5”
8’
14’


32.5”
8’
14’

OSG - Slag Pond Outlet Discharge Curve

SINGLE OUTLET PIPE !!!!!
SUMMERGED OUTLET
5.5 FT = Pipe Diameter Steel
1.375 FT = Hydraulic Radius
3.636 k in Q outlet control equation
665 FT = Pipe Inlet Invert Elevation
180 FT = Length
0.025 = n for RCP
0.6 = Co for Inlet Control
670 FT = Tail Water Elevation
6 FT = Weir Width
3.3 = Weir Coefficient



OUTLET CONTROL / BARROW CONTROL

Q	Elevation	Head
CFS		Ft
99.947	671.0	1.0
122.41	671.5	1.5
141.35	672.0	2.0
158.03	672.5	2.5
173.11	673.0	3.0
186.98	673.5	3.5
199.89	674.0	4.0
212.02	674.5	4.5
223.49	675.0	5.0
234.4	675.5	5.5
282.69	678.0	8.0

Weir Equation
Q = Cw * L * H^1.5

H	Q
Ft	CFS
674.0	0.0
674.5	7.0
675.0	19.8
675.5	36.4
676.0	56.0
676.5	78.3
677.0	102.9
677.5	129.6
678.0	158.4

INLET CONTROL

Q	Elevation	Head (to pipe middle)
CFS		Ft
206.15	671.0	3.25
221.44	671.5	3.75
235.74	672.0	4.25
249.22	672.5	4.75
262.01	673.0	5.25
274.2	673.5	5.75
285.87	674.0	6.25
297.09	674.5	6.75
307.9	675.0	7.25
318.34	675.5	7.75
328.44	676.0	8.25
338.25	676.5	8.75
347.78	677.0	9.25
357.06	677.5	9.75
366.1	678.0	10.25

The two Wier outlet pipes can easily handle high flows even if one pipe is plugged and the outlet submerged (15' + above the flood plain).

APPENDIX C9– SAFETY FACTOR ASSESSMENT

ALLIANT ENERGY
Interstate Power and Light Company
Ottumwa Generating Station

CCR SURFACE IMPOUNDMENT

SAFETY FACTOR ASSESSMENT

Report Issued: October 5, 2020
Revision 1

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EXECUTIVE SUMMARY

This Structural Stability Assessment (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 from Electric Utilities (40 CFR Parts 257 and 261, also known as the CCR Rule) published on April 17, 2015 (effective October 19, 2015) and subsequent amendments.

This Report serves as the first periodic review since the initial report dated September 29, 2016. It assesses the safety factors of each CCR unit at Ottumwa Generating Station in Ottumwa, Iowa in accordance with §257.73(b) and §257.73(e) of the CCR Rule. For purposes of this Report, "CCR unit" refers to an existing or inactive CCR surface impoundment.

Primarily, this Report is focused on assessing if each CCR surface impoundment achieves the minimum safety factors, which include:

- Static factor of safety under long-term, maximum storage pool loading condition,
- Static factor of safety under the maximum surcharge pool loading condition,
- Seismic factor of safety; and,
- Post-Liquefaction factor of safety for embankments constructed of soils that have susceptibility to liquefaction.

Table of Contents

Figures

Appendices

1 Introduction

The owner or operator of the Coal Combustion Residual (CCR) unit must conduct an initial and periodic safety factor assessments to determine if each CCR surface impoundment achieves the minimum safety factors, which include:

- Static factor of safety under long-term, maximum storage pool loading condition,
- Static factor of safety under the maximum surcharge pool loading condition,
- Seismic factor of safety; and,
- Post-Liquefaction factor of safety for embankments constructed of soils that have susceptibility to liquefaction.

This Report serves as the first periodic review from the initial dated September 29, 2016 and has been prepared in accordance with the requirements of §257.73(b) and §257.73(e) of the CCR Rule.

1.1 CCR Rule Applicability

The CCR Rule requires a periodic safety factor assessment by a qualified professional engineer (PE) for existing CCR surface impoundments with a height of 5 feet or more and a storage volume of 20 acre-feet or more; or the existing CCR surface impoundment has a height of 20 feet or more.

1.2 Safety Factor Assessment Applicability

The Ottumwa Generating Station (OGS) in Ottumwa, Iowa (Figure 1) has one existing and one inactive CCR surface impoundments, identified as follows:

- OGS Ash Pond (existing)
- OGS Zero Liquid Discharge Pond (inactive)

Each of the identified CCR surface impoundments meet the requirements of §257.73(b)(1) and/or §257.73(b)(2), they are subject to the periodic safety factor assessment requirements of §257.73(e) of the CCR Rule.

2 FACILITY DESCRIPTION

OGS is located approximately ten miles northwest of Ottumwa, Iowa on the western shore of the Des Moines River in Wapello County, at 20775 Power Plant Road, Ottumwa, Iowa (Figure 1). The McNeese Wildlife Area is located to the southeast of OGS. Middle Avery Creek, which flows to the northeast into the Des Moines River, is located to the south and east of OGS.

OGS is a fossil-fueled electric generating station consisting of one steam electric generating unit. Sub-bituminous coal is the primary fuel for producing steam. The burning of coal produces a by-product of CCR. The CCR at OGS is categorized into three types; bottom ash, fly ash, and flue gas desulfurization (scrubber) byproducts. The fly ash also can be subdivided into two types, economizer fly ash and precipitator fly ash.

The majority of precipitator fly ash is collected by the electrostatic precipitators and sent to the on-site storage silo located on the west side of the generating plant. Historically, the precipitator fly ash has then either been transported off-site for beneficial reuse or was placed in the fly ash reclamation processing area adjacent to the coal pile storage area for the purposes of producing hydrated fly ash. In the fly ash reclamation processing area, the fly ash was rolled out, compacted, hydrated, and allowed to dry into a very hard, cement-like material that was stored in this area until transported off-site. Although this fly ash hydrating process has occurred in the past, this process ceased prior to October 19, 2015.

The precipitator fly ash that is not collected by the electrostatic precipitators becomes part of the flue gas desulfurization pollution control process at OGS. Activated carbon is injected into the flue gas stream and binds with mercury. This flue gas stream travels to the spray dry desulfurization towers. From there, a water-based slurry of hydrated (slaked) lime is injected into the spray dry desulfurization towers. The hydrated lime reacts with the sulfur compounds in the flue gas and the water evaporates. A precipitate is left that consists of activated carbon bound to mercury, calcium sulfate, calcium sulfite, unreacted slaked lime, and some unreacted fly ash. This flue gas stream is directed to the bag house where the particulate matter is removed. A portion of the solids are recycled back to the process and the rest of the scrubber byproducts are sent to the air quality control system byproduct silo. The material from the byproduct silo is mixed with water in a pin mixer to reduce dust, loaded into trucks, and transported to the off-site Ottumwa-Midland CCR landfill for disposal.

The bottom ash and economizer fly ash at OGS were sluiced to a surface impoundment identified as the OGS Ash Pond (Figure 2) until September 2020 when OGS initiated an outage to install a new dry ash handling system. The OGS Ash Pond is located east of the generating plant and is presently the only existing CCR surface impoundment at OGS.

In addition to the OGS Ash Pond, OGS has one inactive CCR surface impoundment identified as the OGS Zero Liquid Discharge (ZLD) Pond. The OGS ZLD Pond is located northeast of the generating plant and north of the OGS Ash Pond. The OGS ZLD Pond, presently, only receives surface water runoff from the surrounding area.

General Facility Information:

- Date of Initial Facility Operations:	1981
- NPDES Permit Number:	IA90-001-01
- Latitude / Longitude:	41°5′53″N 92°33′17″W
- Nameplate Ratings:	Unit 1 (1981) 725 MW

2.1 OGS Ash Pond

The OGS Ash Pond is located east of the generating plant on the eastern portion of the site. The OGS Ash Pond receives influent flows from the generating plant floor drains, oil/water separator, boiler blow down water, solid contact unit sludge, recirculating media sanitary treatment plant, and surface water runoff from the generating site proper.

Sluiced CCR was discharged into the west end of the OGS Ash Pond until September 2020. The sluiced CCR was discharged into a collection pad area where the majority of CCR was recovered. As of September 2020, a dozer continues to be used to scrape the collection pad and push the CCR into a stockpile for dewatering. Once dewatered, the CCR is then loaded into over-the-road haul trucks for transporting off-site. The sluiced water from the CCR previously drained into a narrow channel that flows into the southwest portion of the OGS Ash Pond. Routine maintenance dredging of the narrow channel occurred as the CCR settled out in the channel. Process water from the OGS Ash Pond is recirculated back into OGS for reuse or discharged as described below.

Water in the OGS Ash Pond from other sources flows to the east and discharges through the facility's National Pollution Discharge Elimination System (NPDES) Outfall 001, located in the northeast corner of the OGS Ash Pond. NPDES Outfall 001 consists of a concrete discharge structure with a six-foot-wide overflow weir and includes a Parshall flume and instrumentation to measure the flow of the discharged water. The water flows through the NPDES Outfall 001 and discharges into an unnamed creek at an average rate of 1.54 MGD. The water flows through the NPDES Outfall 001 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.

The surface area of the OGS Ash Pond is approximately 18 acres and has an embankment height of approximately 25 feet from the crest to the toe of the downstream slope. The interior storage depth of the OGS Ash Pond is approximately 20 feet. Currently, the total volume of impounded CCR and water within the OGS Ash Pond is approximately 556,000 cubic yards.

2.2 OGS Zero Liquid Discharge Pond

The OGS Zero Liquid Discharge (ZLD) Pond is located northeast of the generating plant on the eastern portion of the site and north of the OGS Ash Pond. The OGS ZLD Pond historically received influent flows from the generating plant that consisted of boiler wash water, air heater wash, turbine chemical cleaning water, and boiler chemical cleaning water. Presently, the OGS ZLD Pond only receives storm water runoff from the surrounding area, which includes the inactive hydrated fly ash area located west of the surface impoundment, as well as occasional excess storm water runoff from the coal pile storage area. One 24-inch diameter high-density polyethylene culvert connects the coal pile runoff pond to the OGS ZLD Pond. The culvert is used as an emergency overflow to route storm water from the coal pile runoff pond into the OGS ZLD Pond.

The OGS ZLD Pond does not currently discharge. Two 48-inch diameter concrete culverts, located along the south embankment, previously connected the OGS ZLD Pond to the OGS Ash Pond prior to being permanently sealed off with concrete.

The OGS ZLD Pond covers a surface area of approximately 19 acres and has an embankment height of approximately 29 feet from crest to toe of the downstream slope. The interior storage depth of the OGS ZLD Pond is approximately 25 feet. Based on readily available information, the OGS ZLD Pond has a total storage capacity of approximately 515,000 cubic yards.

3 SAFETY FACTOR ASSESSMENT- §257.73(e)

This Report documents if each CCR surface impoundment achieves the minimum safety factors, which are identified on the table below.

Safety Factor Assessment	Minimum Safety Factor
Static Safety Factor Under Maximum Storage Pool Loading	1.50
Static Safety Factor Under Maximum Surcharge Pool Loading	1.40
Seismic Safety Factor	1.00
Post-Liquefaction Safety Factor	1.20

3.1 Safety Factor Assessment Methods

The safety factor assessment is completed with the two-dimensional limit-equilibrium slope stability analyses program STABL5M (1996)[1]. The program analyzes many potential failure circles or block slides by random generation of failure surfaces using the toe and crest search boundaries set for each analysis. The solution occurs by balancing the resisting forces along the failure plane due to the Mohr-Columb failure strength parameters of friction angle and cohesion. The gravity driving forces are divided by the resisting forces to produce a safety factor for the slope. The minimum of hundreds of searches is presented as the applicable safety factor.

There are both total stress and effective stress friction angle and cohesion values for clay. For the total stress case clay has only cohesion. For effective stress clay has both cohesion and friction angle. When clay receives a load that is applied only briefly (i.e., earthquake or high water), it responds as a total stress soil. For long term loadings such as normal water elevation, the clay resistance to failure is based on effective stress parameters. The total stress parameters for compacted and stiff clay yield a conservative answer for safety

---

[1] STABL User Manual by Ronald A. Siegal, Purdue University, June 4, 1975 and STABL5 – The Spencer Method of Slices: Final Report by J. R. Carpenter, Purdue University, August 28, 1985

factor, and the static analysis with normal operating water elevation is performed with the total stress parameters for the clay components in the embankments.

3.1.1 Soil Conditions in and under the impoundments

The subsurface soil conditions have not changed since Revision 0 of this Report. The embankment soils were documented by SCS Engineers[2] boring logs MW-304 and MW-305, Figure 2. The results indicate that the embankments of both impoundments 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. The boring logs are shown in Appendix A.

During the design phase, before the plant was constructed, a 1974 subsurface investigation was completed which included borings and testing of the native soils. These borings showed that 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 B 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.

Information on the compacted clay and river valley sand is available from the SCS soil boring standard split spoon (SPT) blowcount information, Appendix A. The Terzaghi and Peck relationship of SPT blowcount to clay cohesion for the average blowcounts in each clay layer yields a value of cohesion of 1,000 psf for the native clay and 1,600 psf for the embankment clay, Appendix C. The very dense sand is assigned a friction angle of

---

[2] SCS Engineers, "Ottumwa Generating Station – Monitoring Well Construction Documentation", April 15, 2016

38˚, based on the correlation of cohesionless soil strength to density provided in NAVFACs DM-7[3], Appendix C.

The analysis was completed with a cohesion value of 1,600 psf for the embankment clay, 1,000 psf for the native clay and a friction angle of 38˚ for the very dense sand.

3.1.2 Design water surface in impoundments maximum normal pool and maximum pool under design inflow storm

The flows have not been significantly modified since the initial Report. The OGS Ash Pond receives both circulating sluicing water and other process water sources from the facility. The sluicing water is recirculated back into facility. The other sources of water discharge at an average rate of 1.54 MGD. The impoundment discharge is controlled by a six-foot-wide weir with its top elevation at approximately 675.5 feet making the normal impoundment water elevation approximately 676 feet. During the design inflow storm the water elevation increases to elevation 677.25 feet.

The OGS ZLD Pond only receives water from storm flows and its normal water elevation is determined by the balance of rainfall and evaporation. The impoundment has a clay bottom and embankment, so exfiltration seepage is not significant. The normal water elevation based on topographic surveys is approximately elevation 673 feet. During the design inflow storm the water elevation rises to 675.25 feet.

The water elevation in the embankment is assumed to conservatively exit at the toe of the embankment and saturated the native clay and river sand at the toe. This provides a conservative strength projection for the soils at the toe of the embankment.

3.1.3 Selection of Seismic Design Parameters and Description of Method

The design earthquake ground acceleration is selected from the United States Geologic Survey (USGS) detailed seismic design maps based on the latitude and longitude of the OGS. The peak ground acceleration (PGA) value is selected for a 2% probability of

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[3] Naval Facilities Engineering Command, Soil Mechanics, Foundations, and Earth Structures, Figure 3-7, NAVFAC DM-7, January 1971

exceedance in 50 years (2,500-year return period) as required by §257.53. Since the site soils are clay with cohesion greater than 1,000 psf, or very dense sand and extend to bedrock at elevation 625 feet[4], the site class as defined in the 2009 International Building Code 1613.5.5 is Site Class D. For Site Class D the ground surface Peak Ground Acceleration (PGA) for slope stability and liquefaction assessment is 0.058g, Appendix D.

3.1.4 Liquefaction Assessment Method and Parameters

Certain soils may have zero effective stress (liquefaction) during an earthquake or from static shear of a saturated embankment slope. Soils that will liquefy include loose or very loose uniform fine sand or silt, and low plasticity clay (plastic index (PI) of less than 12). The native clay and embankment both have PI higher than 12 and are stiff and medium stiff in consistency. The river valley sand is very dense.

None of the soil types at OGS is susceptible to liquefaction and no analysis of liquefaction potential is required for the embankments.

3.2 OGS Ash Pond

The OGS Ash Pond has not significantly changed or been modified since the initial Report, Revision 0. The critical cross-section for the impoundment is the location where the embankment toe is closest to Middle Avery Creek, just upstream of the railroad embankment, Figure 2. At this location, top of the creek bank is approximately 25 feet from the toe of the embankment. For determination of safety factors, the bottom of Middle Avery Creek was taken to be in the very dense sand and the water elevation in the creek was set at the same elevation.

3.2.1 Static Safety Factor Assessment Under Maximum Storage Pool Loading - §257.73(e)(1)(i)

The OGS Ash Pond receives 2.4 cubic feet per second of process water flow that discharges over the outlet weir. The process flow maintains a maximum average storage pool of 676 feet in the impoundment. Analysis of both circular and block sliding surfaces,

---

[4] Cross Section KK, Appendix B

Appendix E, show a minimum factor of safety of 2.1 for the circular failure surface passing through the foundation soil and exiting in Middle Avery Creek.

3.2.2 Static Safety Factor Assessment Under Maximum Surcharge Pool Loading - §257.73(e)(1)(ii)

The OGS Ash Pond will contain the 100-year return period design storm through a combination of storage in the impoundment and discharge to the Middle Avery Creek. The maximum surcharge pool elevation is 677.25 at the peak of the storm. Analysis for both circular and block sliding surface, Appendix E, show a minimum factor of safety of 2.1 for the circular surface passing through the foundation soil and exiting in Middle Avery Creek.

3.2.3 Seismic Safety Factor Assessment - §257.73(e)(1)(iii)

The OGS Ash Pond was assigned a pseudo-static earthquake coefficient equal to 0.058 g acceleration and a vertical downward component equal to $^2/_3$ of the horizontal component (0.039 g) as recommended by Newmark[5]. Analysis for both a circular and block sliding surface, Appendix E, show a minimum factor of safety of 1.7 for the circular sliding surface through the foundation soil and into Middle Avery Creek.

3.2.4 Liquefaction Safety Factor Assessment - §257.73(e)(1)(iv)

The OGS Ash Pond foundation and embankment soils are not susceptible to liquefaction, Section 3.1.4.

3.3 OGS Zero Liquid Discharge Pond

The OGS ZLD Pond has not significantly changed or been modified since the initial Report, Revision 0. The critical cross-section for the impoundment is the location where the embankment is highest in the southern part of the embankment, Figure 2. At this location, the Des Moines River bank is approximately 500 feet to the northeast from the toe of the embankment. For determination of safety factors, the water elevation in the

---

[5] Newmark, N. M. and W. J. Hall, "Earthquake Spectra and Design", EERI Monograph, Earthquake Engineering Research Institute, Berkeley, California, 1982

embankment was set at the toe with the native clay in the river valley assumed to be saturated.

3.3.1 Static Safety Factor Assessment Under Maximum Storage Pool Loading - §257.73(e)(1)(i)

The OGS ZLD Pond receives only storm water inflow. Its normal water elevation is control by the balance between storm water inflow and evaporation. A normal water elevation of 673 feet was selected as representative of measurements taken on the impoundment water elevation. Analysis of both circular and block sliding surfaces, Appendix E, show a minimum factor of safety of 3.0 for the circular failure surface passing through the foundation soil.

3.3.2 Static Safety Factor Assessment Under Maximum Surcharge Pool Loading - §257.73(e)(1)(ii)

The OGS ZLD Pond will contain the 100-year return period design storm through storage in the impoundment without discharge. The maximum surcharge pool elevation is 677.25 feet at the conclusion of the storm. Analysis for both circular and block sliding surface, Appendix E, show a minimum factor of safety of 2.9 for the block slide surface passing through the foundation clay.

3.3.3 Seismic Safety Factor Assessment - §257.73(e)(1)(iii)

The OGS ZLD Pond was assigned a pseudo-static earthquake coefficient equal to 0.058 g acceleration and a vertical downward component equal to $^2/_3$ of the horizontal component (0.039 g) as recommended by Newmark[6]. Analysis for both a circular and block sliding surface, Appendix E, show a minimum factor of safety of 2.5 for the circular sliding surface through the foundation soil.

3.3.4 Liquefaction Safety Factor Assessment - §257.73(e)(1)(iv)

The OGS ZLD Pond foundation and embankment soils are not susceptible to liquefaction,

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[6] Newmark, N. M. and W. J. Hall, "Earthquake Spectra and Design", EERI Monograph, Earthquake Engineering Research Institute, Berkeley, California, 1982

4 RESULTS SUMMARY

The results of the safety factor assessment indicate that the OGS embankments meet the requirements of §257.73(e). The results are:

	Static Stability Normal Water Elevation	Static Stability Flood Water Elevation	Pseudo Static Earthquake with Normal Water Elevation	Liquefaction Potential	Post-Earthquake Static Stability Normal Water Elevation
Required Safety Factor	1.5	1.4	1.0		1.2
OGS Ash Pond	2.1	2.1	1.7	no	
OGS ZLD Pond	3.0	2.9	2.5	no	

5 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

To meet the requirements of 40 CFR 257.73(e)(2), I Mark W. Loerop hereby certify that I am a licensed professional engineer in the State of Iowa; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in 40 CFR 257.73(b) and 40 CFR 257.73(e).

MARK W. LOEROP
22197

By:

Name: MARK LOEROP

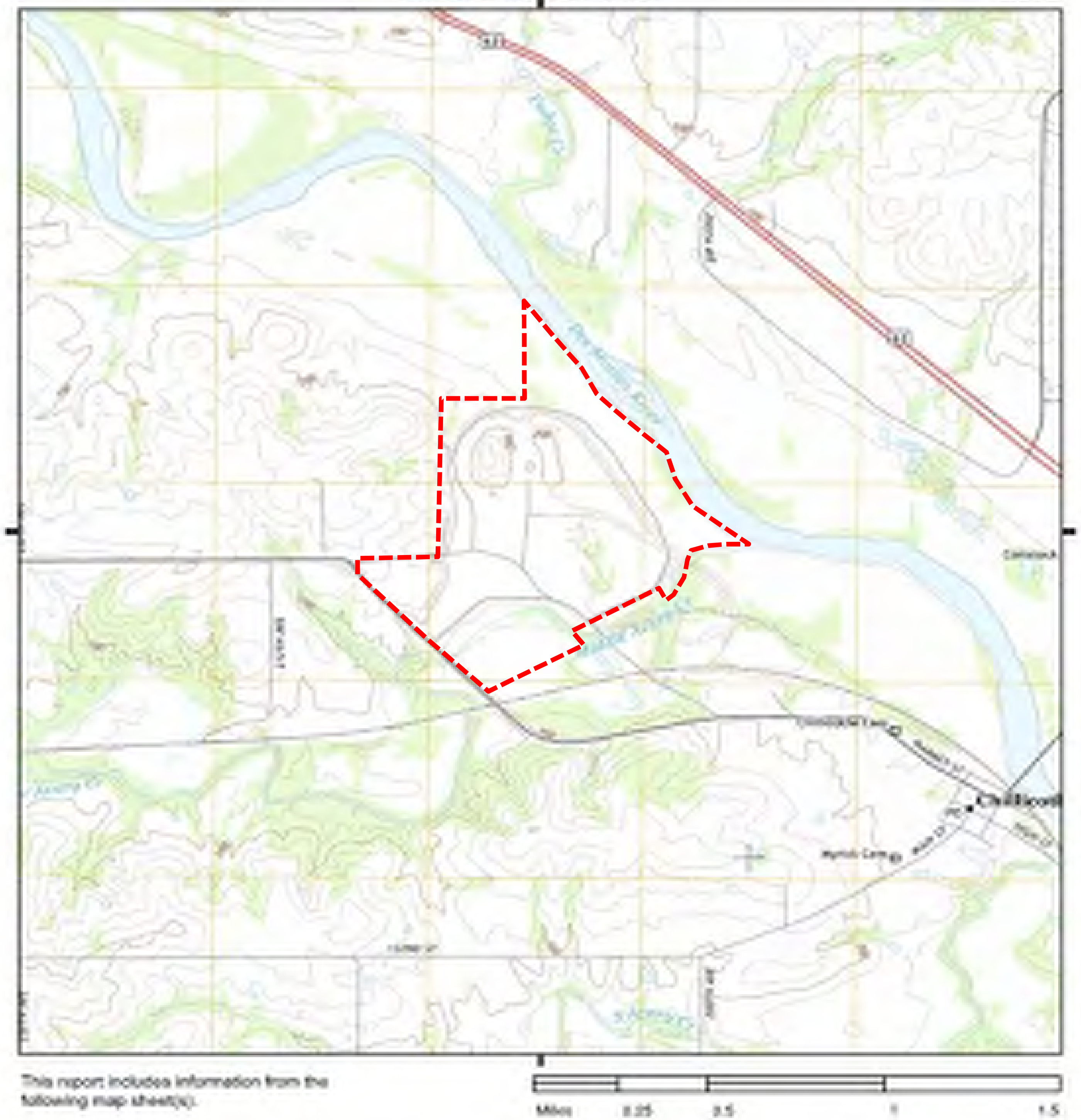
Date: OCTOBER 5, 2020

FIGURES

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

Safety Factor Assessment

Historical Topo Map 2013



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

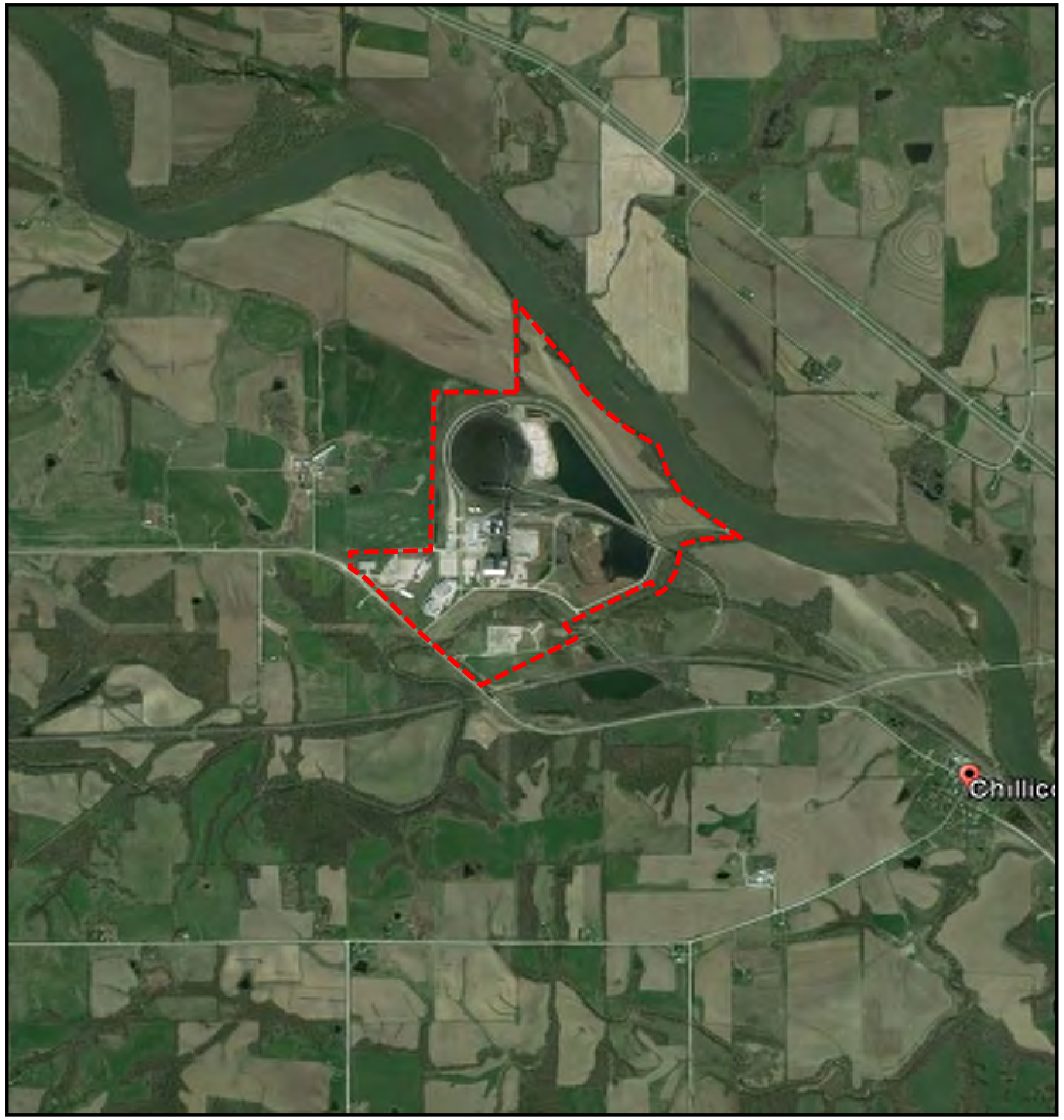
NW N NE
W E
SW S SE

TP, Chillicothe, 2013, 7.5-minute

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

[illegible] - 5 page 4

Historical Aerial Photo 4/13/2016



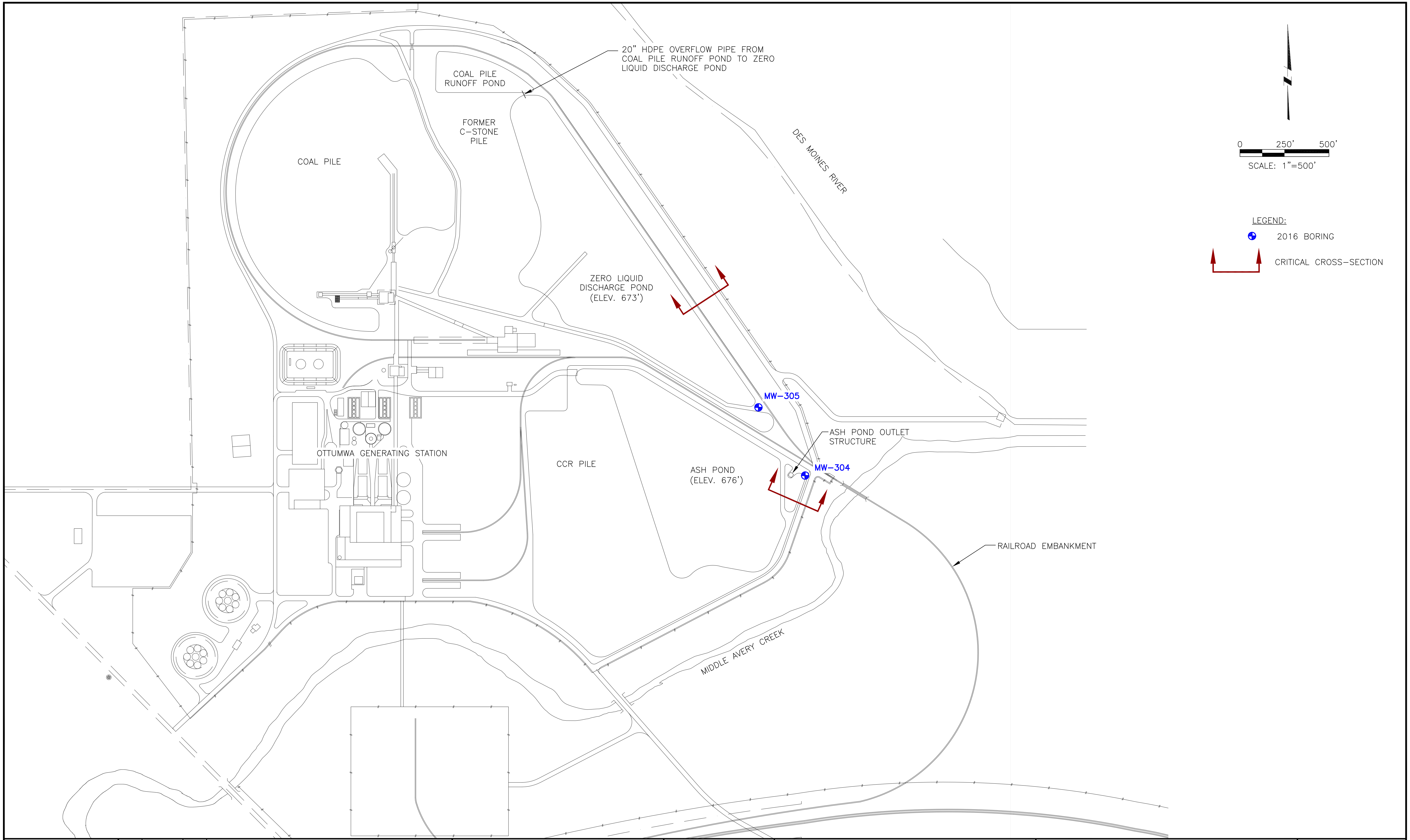
▬ ▬ ▬ Approximate Property Boundary

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



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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
SAFETY FACTOR ASSESSMENT
CRITICAL CROSS–SECTION LOCATION

JOB 154.018.002.003
SHT. FIGURE 2
DWG. 154.018.002.003–D2

APPENDIX A – 2016 Soil Borings

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

Safety Factor Assessment

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

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

Page 1 of 3

Facility/Project Name IPL- Ottumwa Generating Station SCS#: 25215135.40	License/Permit/Monitoring Number		Boring Number MW-304	
Boring Drilled By: Name of crew chief (first, last) and Firm Todd Schmalfeld Cascade Drilling	Date Drilling Started 11/11/2015	Date Drilling Completed 11/11/2015	Drilling Method 4-1/4 hollow stem auger	
Unique Well No.	DNR Well ID No.	Common Well Name MW-304	Final Static Water Level Feet	Surface Elevation 680.1 Feet
Borehole Diameter 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
Feet ☐ N ☐ S
Feet ☐ E ☐ 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	U S C S	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
			0–1	TOPSOIL.	TOPSOIL									
			1–12.5	FAT CLAY, black (10YR 2/1).	CH									
S1	23	4 5 4 5	11							M				
S2	19.5	4 4 5 5	12.5–15	FAT CLAY, yellowish brown (10YR 5/4).	CH					M				
			15–16	FAT CLAY, yellowish brown (10YR 3/4).	CH									

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 SUPPLEMENT
Form 4400-122A

Boring Number MW-304 Page 2 of 3

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	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 20							M				
S5	23	2 7 8 9	21 22							M				
S6	23	3 4 8 6	23 24 25							M				
S7	23	5 11 15 11	26 27		CH					M				
S8	15	4 4 5 6	28 29 30							M				
S9	18	4 6 9 9	31 32							M				
S10	24	4 6 7 6	33 34							M				
S11	16	2 2 4 6	35 36 37	FAT CLAY, DARK OLIVE BROWN (2.5Y 3/3).						M				
S12	24	4 3 5 5	38 39 40		CH					M				
S13	18	2 3 3 3	41 42							M				

Boring Number MW-304

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

Page 1 of 3

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

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

Unique Well No.	DNR Well ID No.	Common Well Name MW-305	Final Static Water Level Feet	Surface Elevation 681.5 Feet	Borehole Diameter 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
Feet ☐ N ☐ S
Feet ☐ E ☐ W

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

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

Page 2 of 3

Sample		Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties					RQD/ Comments
Number and Type	Length Att. & Recovered (in)								Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	
S3	22	5 15 14 15	17	FAT CLAY *(continued)*										
S4	20	3 5 13 15	18 19		CH									
			20	FAT CLAY WITH SILT, dark gray (10YR 4/1).										
S5	24	4 5 7 11	21 22							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 30							M				
S9	13	4 4 7 12	31 32							M				
S10	24	5 6 9	33 34 35	LEAN CLAY, very dark brown (10YR 2/2).						W				
S11	24	4 4 5 7	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.

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number MW-305

Page 3 of 3

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

APPENDIX B – 1974 Soil Laboratory Results

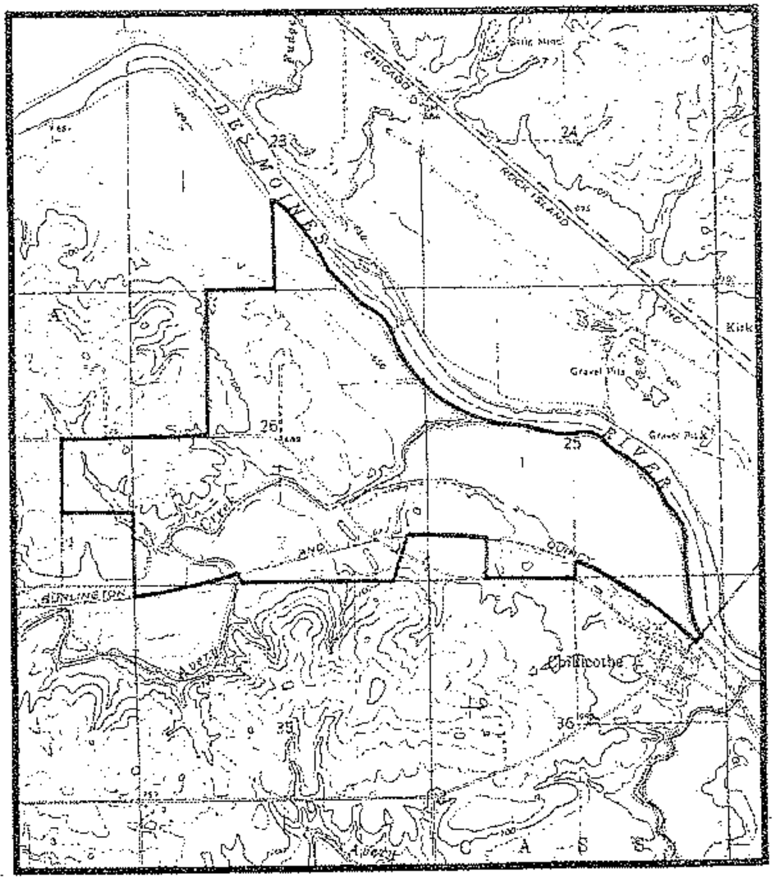
Alliant Energy
Interstate Power and Light Company
Ottumwa Generating Station
Ottumwa, Iowa

Safety Factor Assessment

APPENDICES

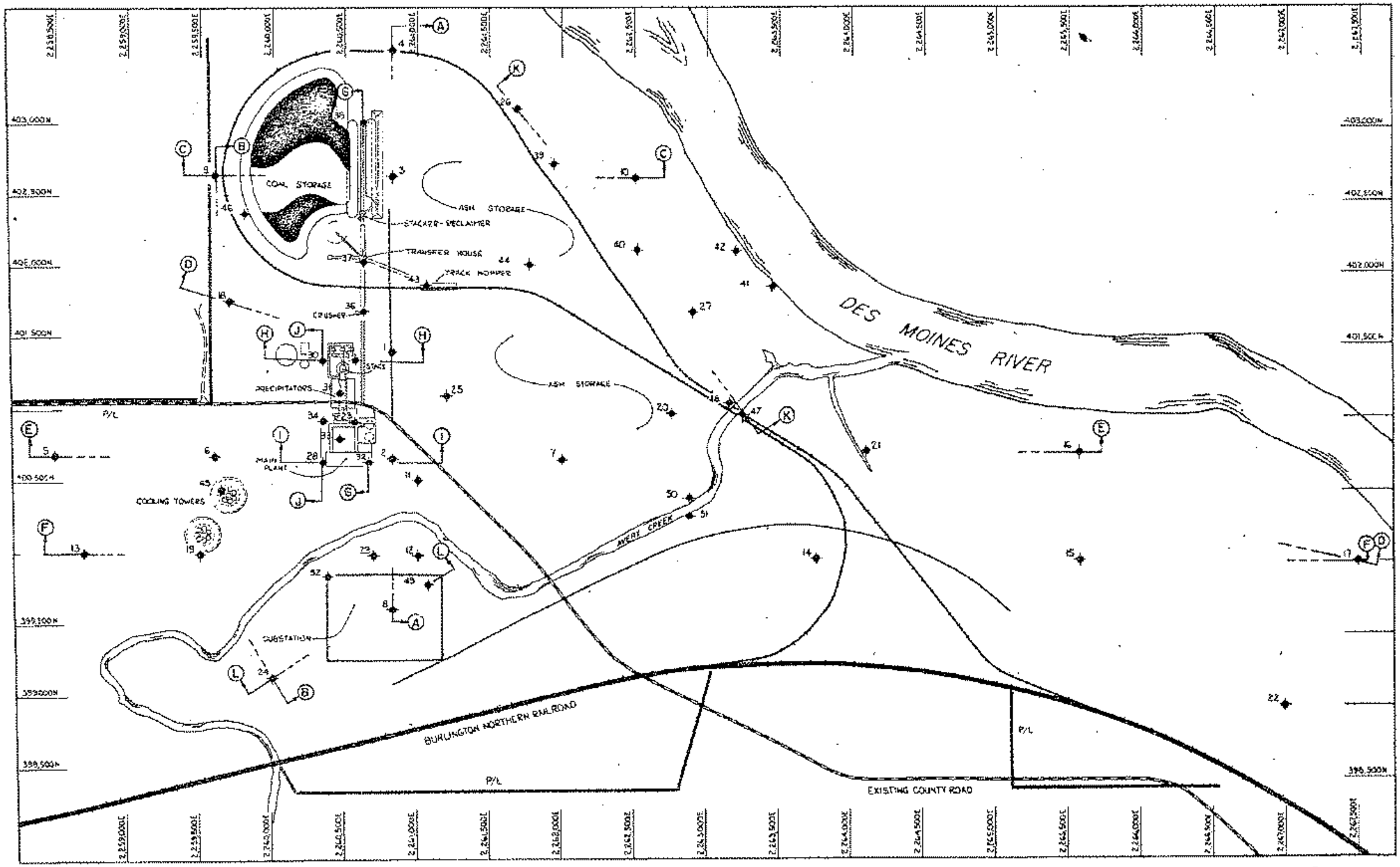
APPENDIX A

MAPS



VICINITY MAP
OTTUMWA GENERATING STATION-UNIT I
CHILLICOTHE, IOWA

FIGURE I



SCALE 1 INCH=600 FEET

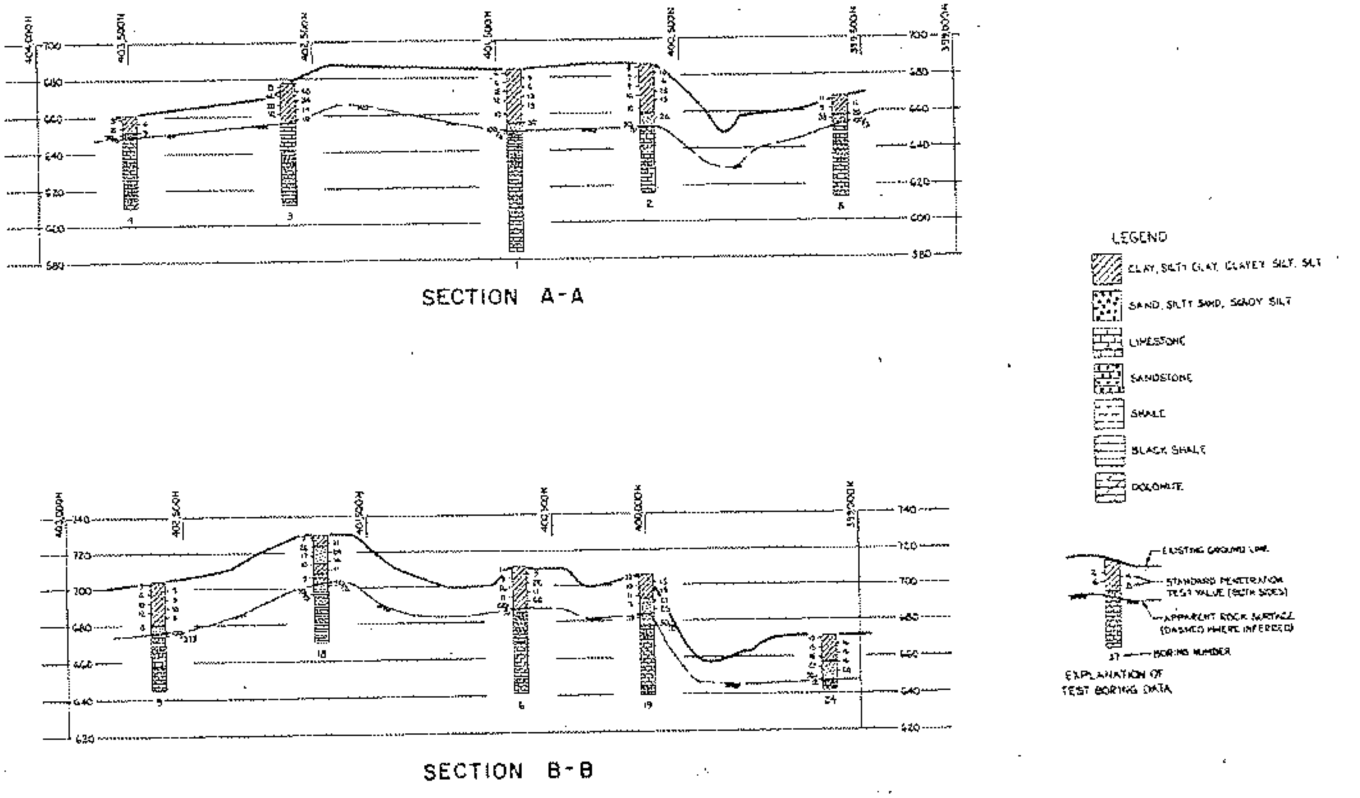
0 500 1000 1500

FEET

ATEC ASSOCIATES

PLAN OF BORINGS

OTTUMWA GENERATING STATION-UNIT 1
CHILLICOTHE, IOWA FIGURE 2



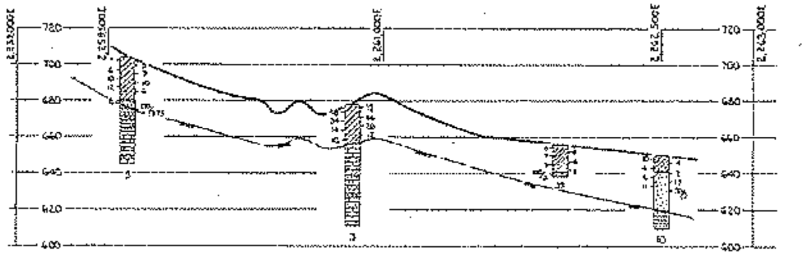
HORIZONTAL SCALE 1 INCH=600 FEET
VERTICAL EXAGGERATION 10:1
0 500 1000 1500
FEET

GENERALIZED SOIL AND ROCK PROFILES

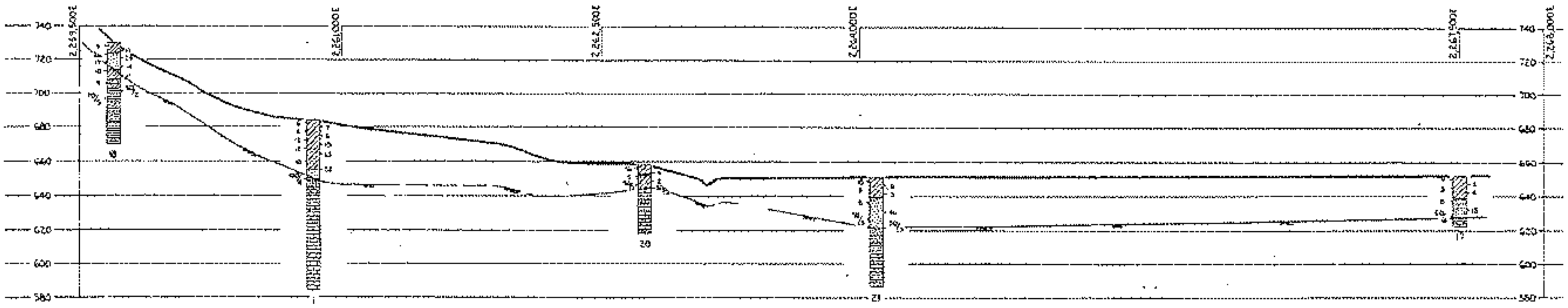
OTTUMWA GENERATING STATION-UNIT I
CHILLICOTHE, IOWA

FIGURE 3

ATEC ASSOCIATES

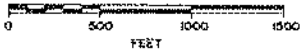


SECTION C-C



SECTION D-D

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

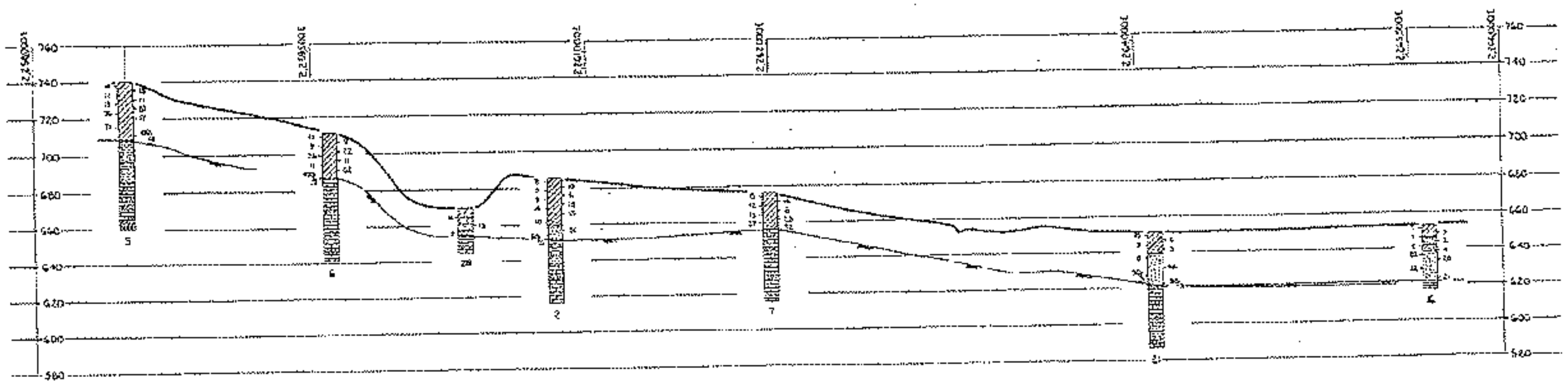


ATEC ASSOCIATES

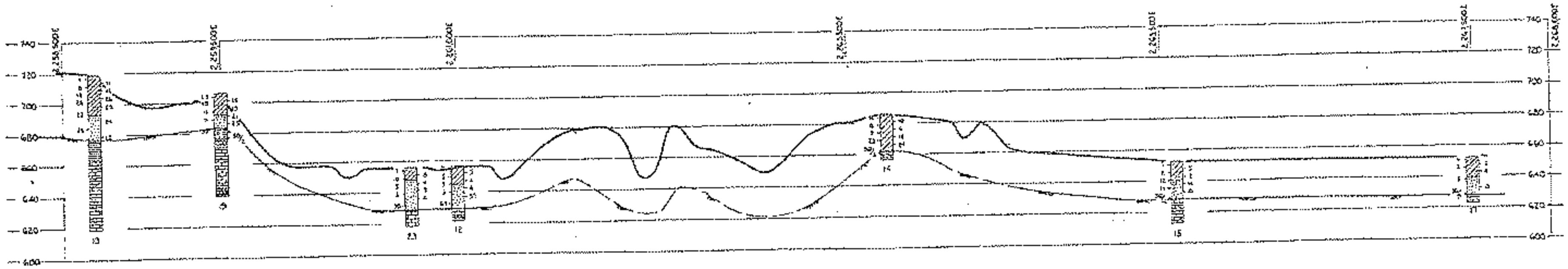
GENERALIZED SOIL AND ROCK PROFILES

OTTUMWA GENERATING STATION-UNIT I
CHILLICOTHE, IOWA

FIGURE 4



SECTION E-E



SECTION F-F

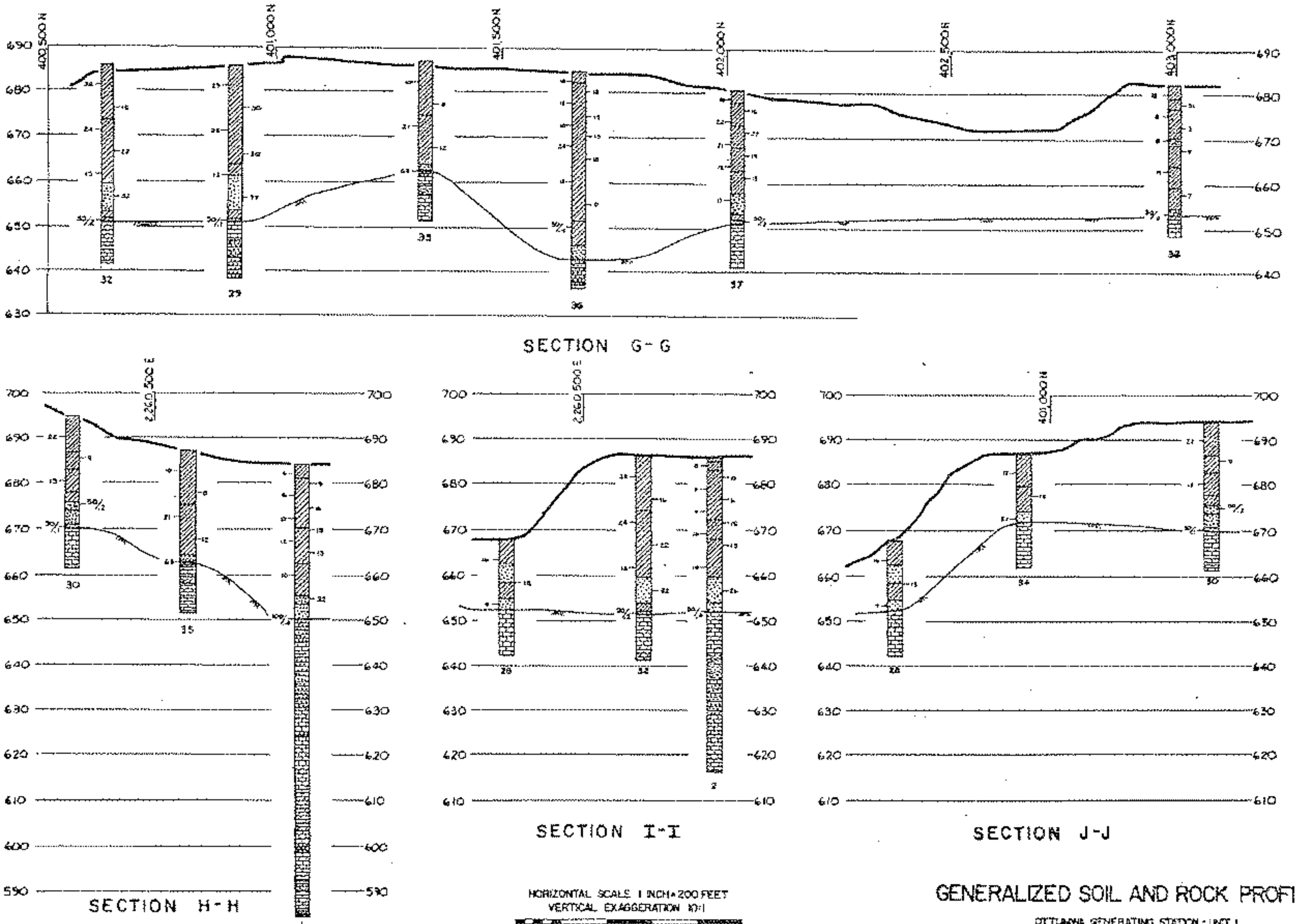
HORIZONTAL SCALE 1 INCH=600 FEET
VERTICAL EXAGGERATION 10:1
0 500 1000 1500
FEET

ATEC ASSOCIATES

GENERALIZED SOIL AND ROCK PROFILES

OTTUMWA GENERATING STATION-UNIT I
CHILLICOTHE, IOWA

FIGURE 5

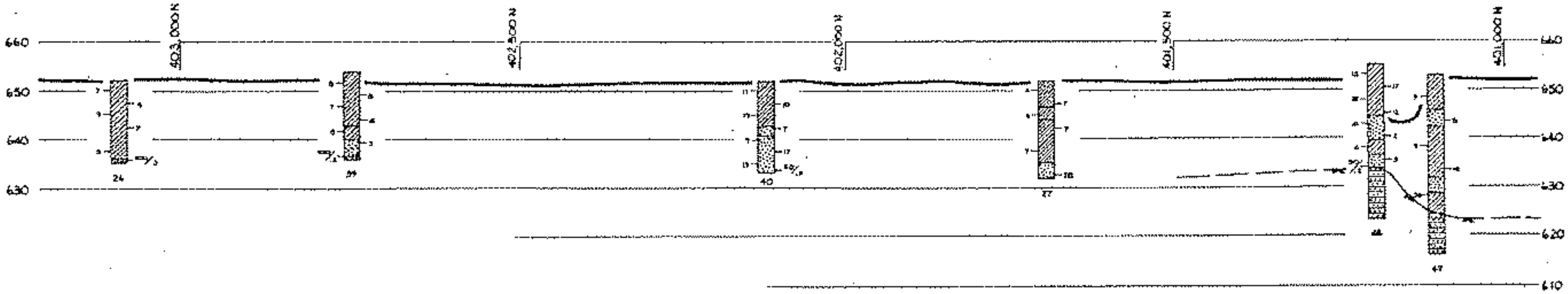


ATEC ASSOCIATES

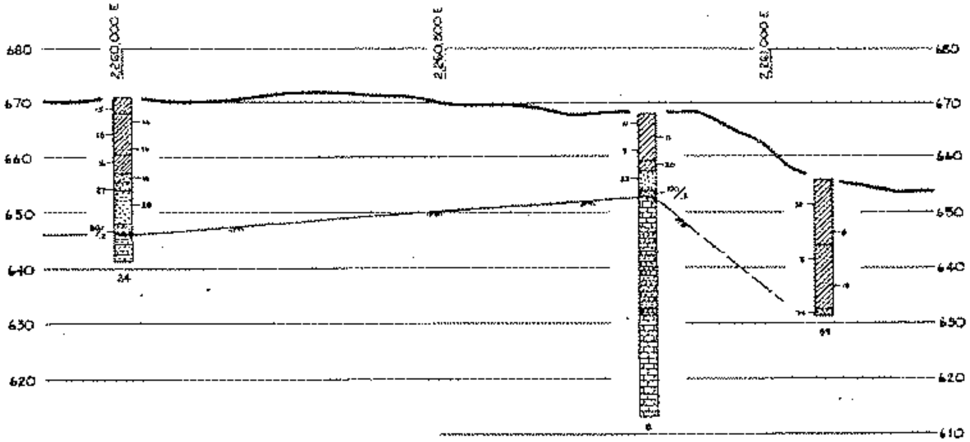
GENERALIZED SOIL AND ROCK PROFILES

OTTUMWA GENERATING STATION - UNIT 1
CHILLICOTHE, IOWA

FIGURE 6

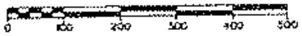


SECTION K-K



SECTION L-L

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



GENERALIZED SOIL AND ROCK PROFILES

OTTUMWA GENERATING STATION - UNIT 1
CHILLICOTHE, IOWA

FIGURE 7

ATEC ASSOCIATES

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.

Ottumwa Generating Station-Unit 1
(E-7566)

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	100.2	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.

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 %
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	98.6	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		26.0				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.

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.

Ottumwa Generating Station-Unit 1
(E-7566)

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		22.3				
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				

Ottumwa Generating Station-Unit 1
(E-7566)

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		23.9				
35	3.5-5.0		27.6				
35	8.5-10.0		27.5				
36	1.0-2.5		20.7				3.1
36	3.5-5.0		25.3				
36	6.0-7.5		24.2				
36	9.5-10.0		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	

Ottumwa Generating Station-Unit 1
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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	

Ottumwa Generating Station-Unit 1
(E-7566)

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	19	
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 %			Unconfined Compressive Strength,tsf
				LL	PL	PI	
1A	6.0-8.0	96.4	29.2				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	26.5				**
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	23.7				
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.

Ottumwa Generating Station-Unit 1
(E-7566)

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 %			Unconfined Compressive Strength,tsf
				LL	PL	PI	
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	0.68 *
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.

Ottumwa Generating Station-Unit 1
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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	
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	95.6	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	8030	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

Ottumwa Generating Station-Unit 1
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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
(E-7566)

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
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	5.10×10^{-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	0.86×10^{-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	4.40×10^{-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^{-5}
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	1.64×10^{-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.

Ottumwa Generating Station-Unit I
(E-7566)

SUMMARY OF CONSOLIDATION TEST RESULTS

Table D-1

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	0.262	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

COEFFICIENT OF CONSOLIDATION SUMMARY

Table D-2

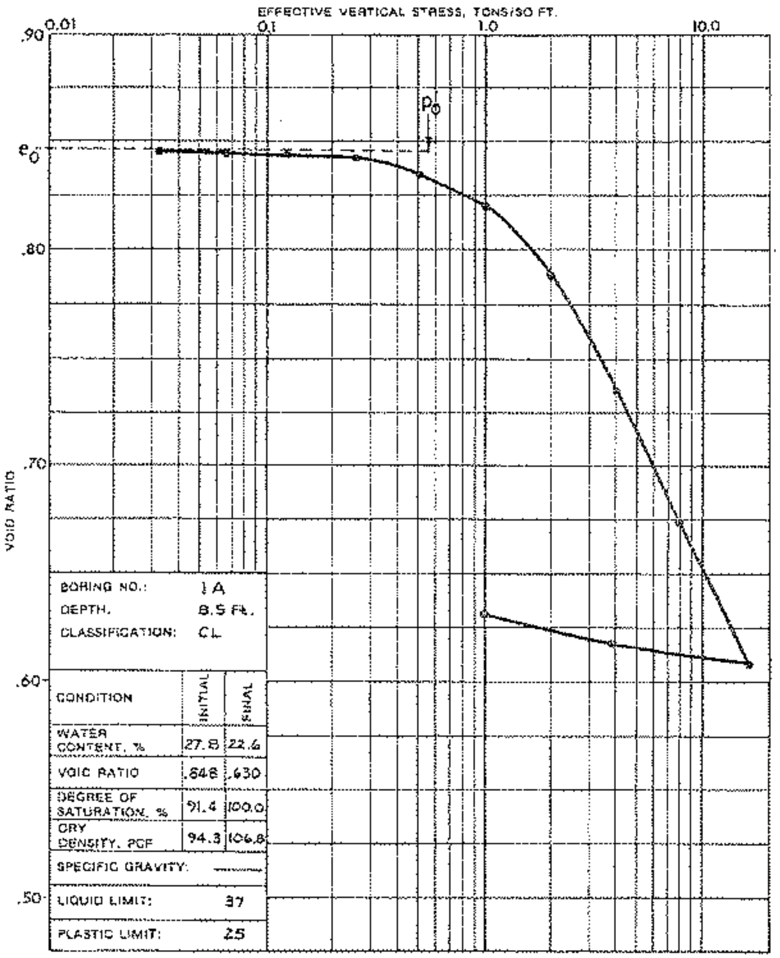
Boring No.	Depth, ft	Load Increment, tons/aq.ft	Coefficient of Consolidation cm²/sec.	Coefficient of Compressibility, cm²/kg	Average Void Ratio	Estimated Coefficient of Permeability, cm/sec
27A	7.0	0.25 to 0.5	1.55×10^{-3}	0.060	0.931	4.81×10^{-5}
27A	7.0	0.5 to 1.0	0.84×10^{-3}	0.050	0.912	2.19×10^{-5}
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	0.634	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	$2.9 \times 10{-4}$	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 t- 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

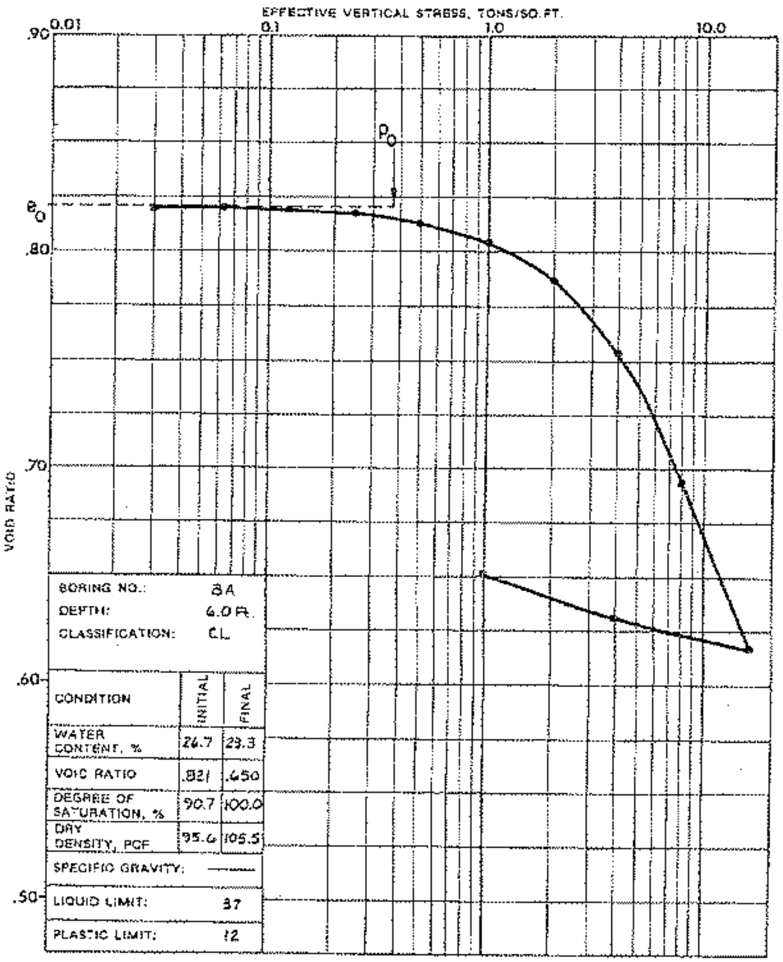
Table D-2

Boring No.	Depth, ft	Load Increment, tons/sq.ft	Coefficient of Consolidation cm²/sec.	Coefficient of Compressibility, cm²/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^{-5}
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}



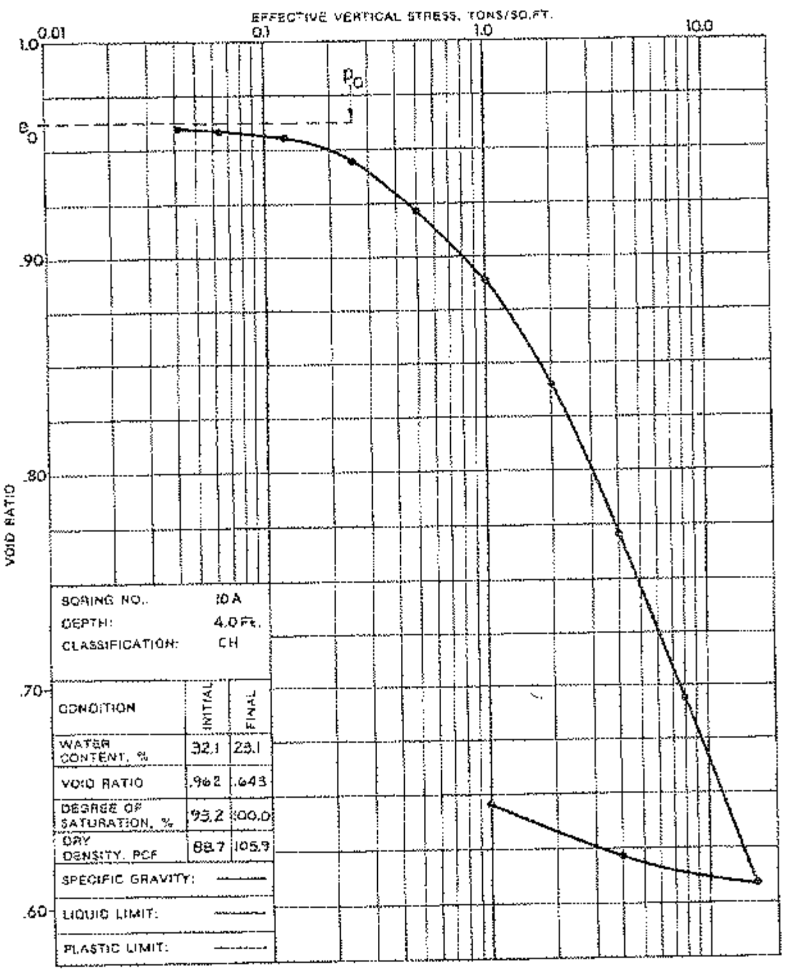
BORING NO.:	1 A	
DEPTH.	8.5 Ft.	
CLASSIFICATION:	CL	
CONDITION	INITIAL	FINAL
WATER CONTENT, %	27.8	22.6
VOID RATIO	.848	.630
DEGREE OF SATURATION, %	91.4	100.0
DRY DENSITY, PCF	94.3	106.8
SPECIFIC GRAVITY:	—	
LIQUID LIMIT:	37	
PLASTIC LIMIT:	25	

CONSOLIDATION TEST RESULTS



BORING NO.:	3A	
DEPTH:	6.0 Ft.	
CLASSIFICATION:	CL	
CONDITION	INITIAL	FINAL
WATER CONTENT, %	26.7	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

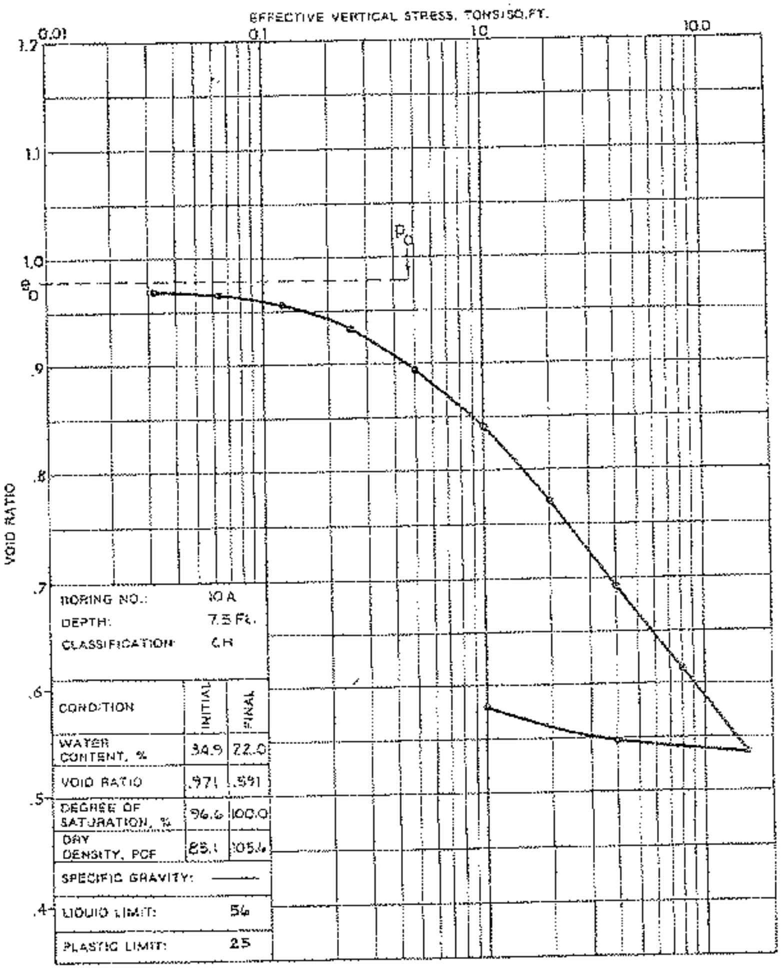


BORING NO.:	10 A	
DEPTH:	4.0 Ft.	
CLASSIFICATION:	CH	
CONDITION	INITIAL	FINAL
WATER CONTENT, %	32.1	23.1
VOID RATIO	.962	.643
DEGREE OF SATURATION, %	93.2	100.0
DRY DENSITY, PCF	88.7	105.9
SPECIFIC GRAVITY:	—	
LIQUID LIMIT:	—	
PLASTIC LIMIT:	—	

CONSOLIDATION TEST RESULTS

ATEC ASSOCIATES

CN-1

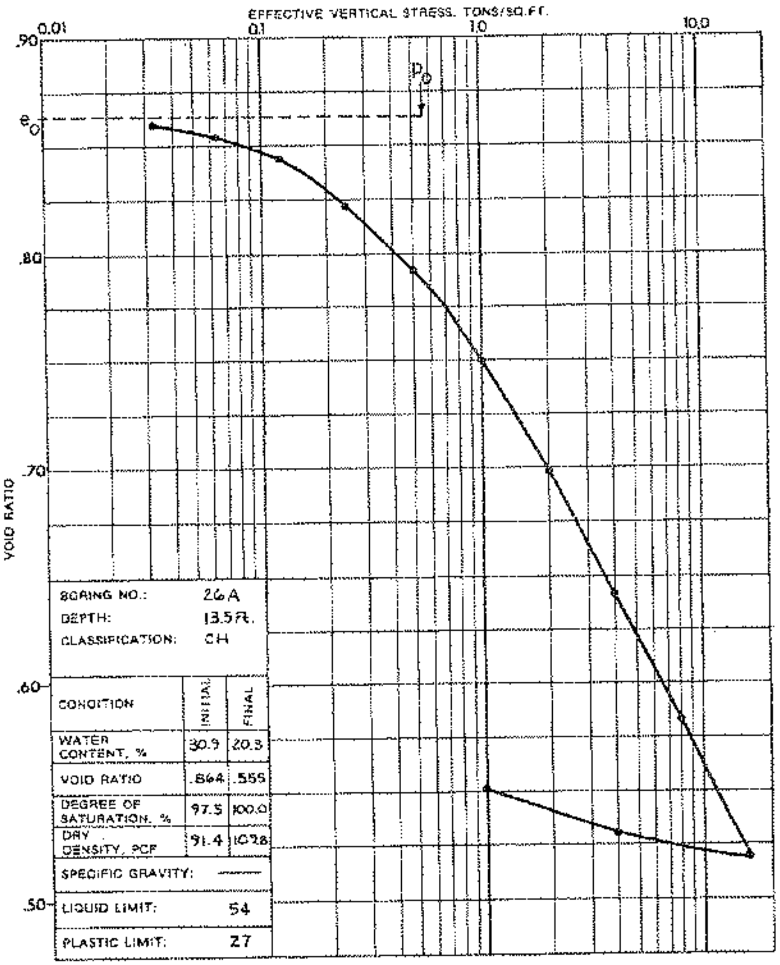


BORING NO.:	10 A	
DEPTH:	7.5 Ft.	
CLASSIFICATION:	CH	
CONDITION	INITIAL	FINAL
WATER CONTENT, %	34.9	22.0
VOID RATIO	.971	.591
DEGREE OF SATURATION, %	96.6	100.0
DRY DENSITY, PCF	85.1	105.6
SPECIFIC GRAVITY:	—	
LIQUID LIMIT:	56	
PLASTIC LIMIT:	25	

CONSOLIDATION TEST RESULTS

ATEC ASSOCIATES

CN-1



BORING NO.: 26 A
DEPTH: 13.5 Ft.
CLASSIFICATION: CH

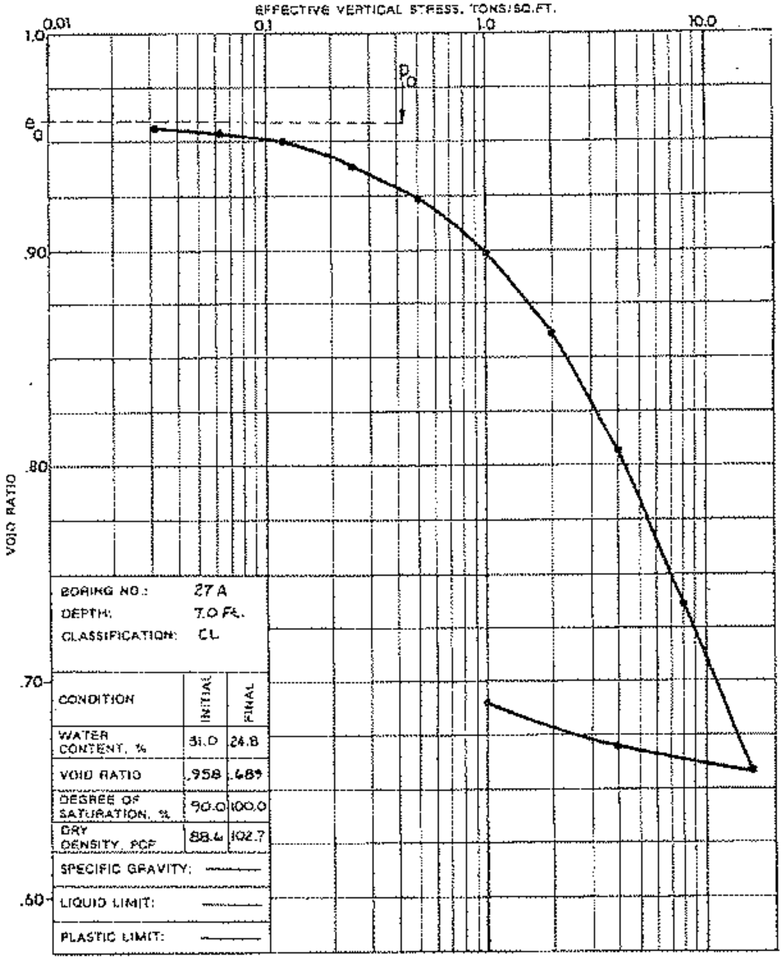
CONDITION	INITIAL	FINAL
WATER CONTENT, %	30.9	20.3
VOID RATIO	.864	.555
DEGREE OF SATURATION, %	97.5	100.0
DRY DENSITY, PCF	91.4	102.8

SPECIFIC GRAVITY: ———
LIQUID LIMIT: 54
PLASTIC LIMIT: 27

CONSOLIDATION TEST RESULTS

ATEC ASSOCIATES

CN-1



BORING NO.: 27 A
DEPTH: 7.0 Ft.
CLASSIFICATION: CL

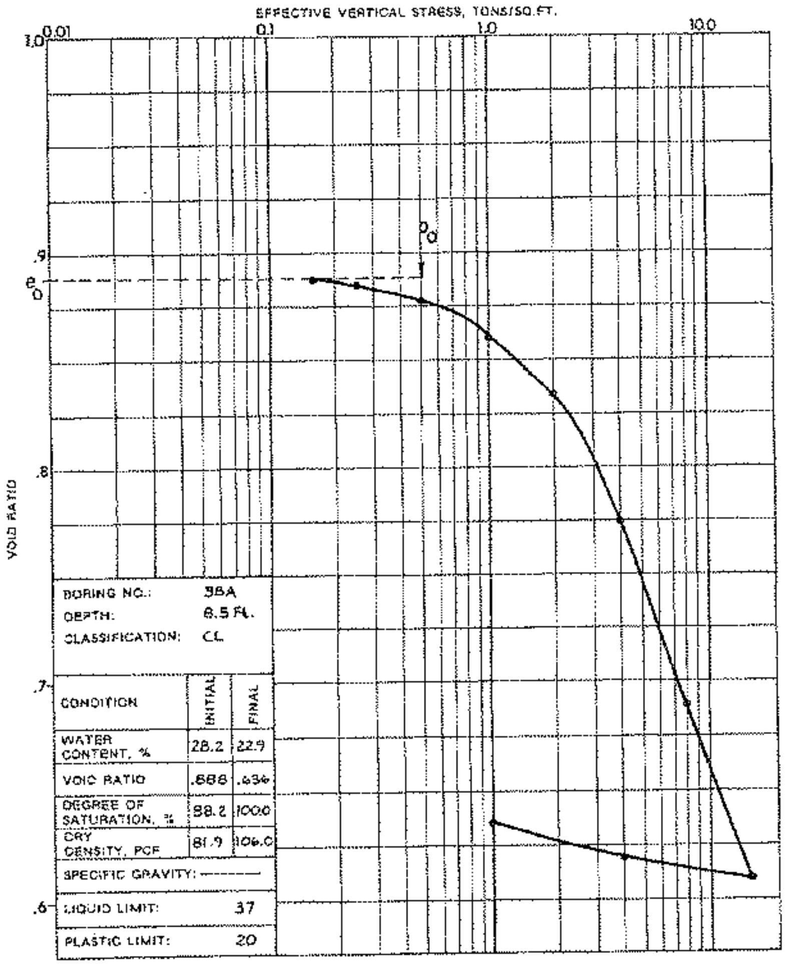
CONDITION	INITIAL	FINAL
WATER CONTENT, %	31.0	24.8
VOID RATIO	.958	.689
DEGREE OF SATURATION, %	90.0	100.0
DRY DENSITY, PCF	88.4	102.7

SPECIFIC GRAVITY: ———
LIQUID LIMIT: ———
PLASTIC LIMIT: ———

CONSOLIDATION TEST RESULTS

ATEC ASSOCIATES

CN-1



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

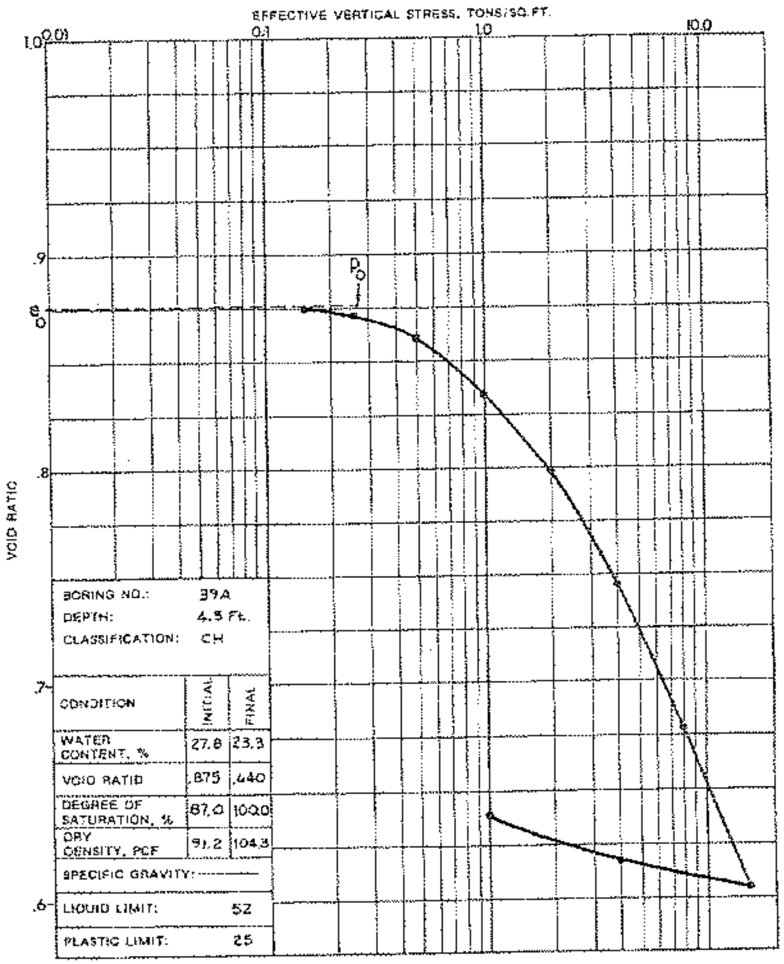
CONDITION	INITIAL	FINAL
WATER CONTENT, %	28.2	22.9
VOID RATIO	.888	.636
DEGREE OF SATURATION, %	88.2	100.0
DRY DENSITY, PCF	81.9	106.0

SPECIFIC GRAVITY: ———
LIQUID LIMIT: 37
PLASTIC LIMIT: 20

CONSOLIDATION TEST RESULTS

ATEC ASSOCIATES

CN-1



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

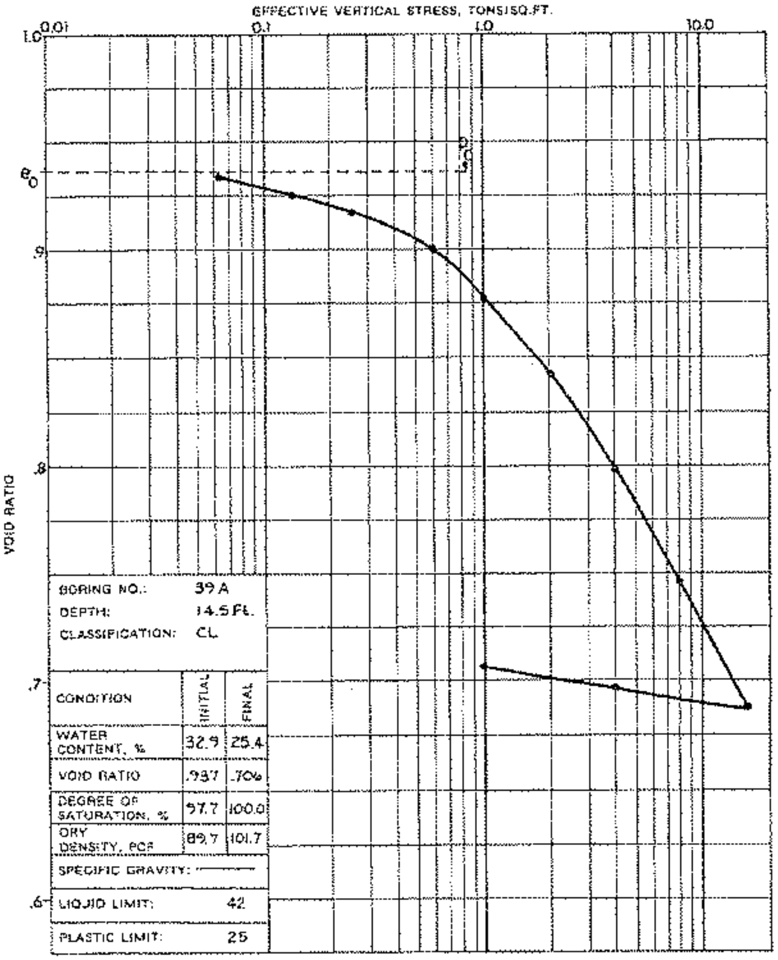
CONDITION	INITIAL	FINAL
WATER CONTENT, %	27.8	23.3
VOID RATIO	.875	.440
DEGREE OF SATURATION, %	87.0	100.0
DRY DENSITY, PCF	91.2	104.3

SPECIFIC GRAVITY: ———
LIQUID LIMIT: 52
PLASTIC LIMIT: 25

CONSOLIDATION TEST RESULTS

ATEC ASSOCIATES

CN-1



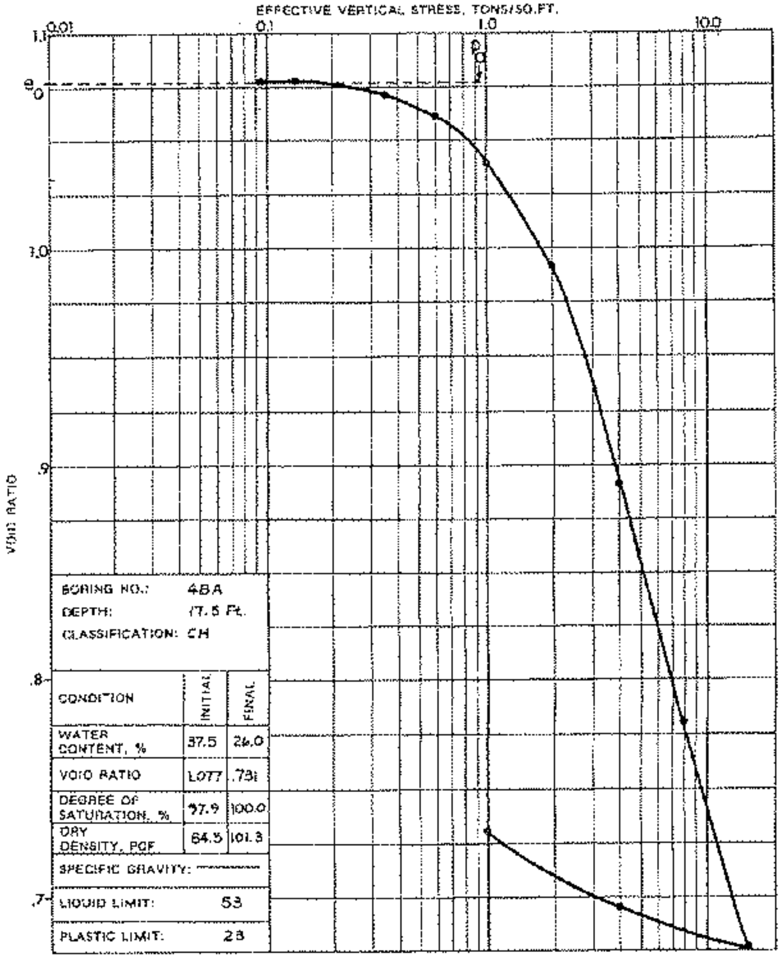
BORING NO.: 39 A
DEPTH: 14.5 Ft.
CLASSIFICATION: CL

CONDITION	INITIAL	FINAL
WATER CONTENT, %	32.9	25.4
VOID RATIO	.937	.706
DEGREE OF SATURATION, %	97.7	100.0
DRY DENSITY, PCF	89.7	101.7

SPECIFIC GRAVITY: ———
LIQUID LIMIT: 42
PLASTIC LIMIT: 25

CONSOLIDATION TEST RESULTS

ATEC ASSOCIATES



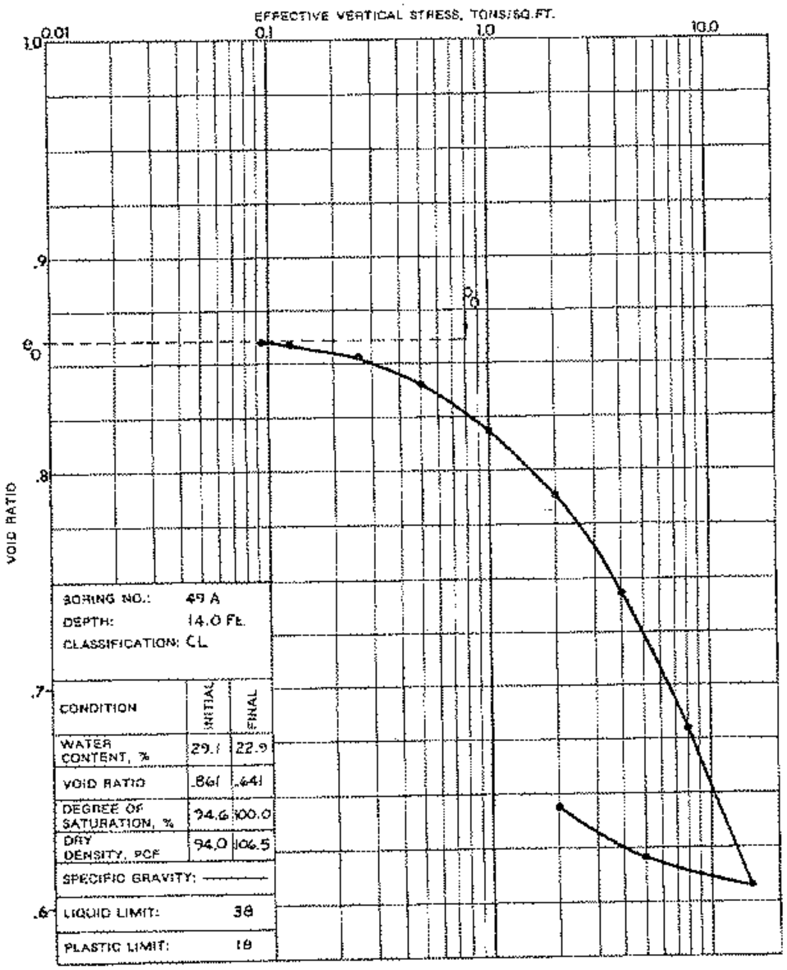
BORING NO.: 48A
DEPTH: 17.5 Ft.
CLASSIFICATION: CH

CONDITION	INITIAL	FINAL
WATER CONTENT, %	37.5	26.0
VOID RATIO	1.077	.731
DEGREE OF SATURATION, %	97.9	100.0
DRY DENSITY, PCF	64.5	101.3

SPECIFIC GRAVITY: ———
LIQUID LIMIT: 53
PLASTIC LIMIT: 28

CONSOLIDATION TEST RESULTS

ATEC ASSOCIATES



BORING NO.: 49 A
DEPTH: 14.0 Ft.
CLASSIFICATION: CL

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: ———

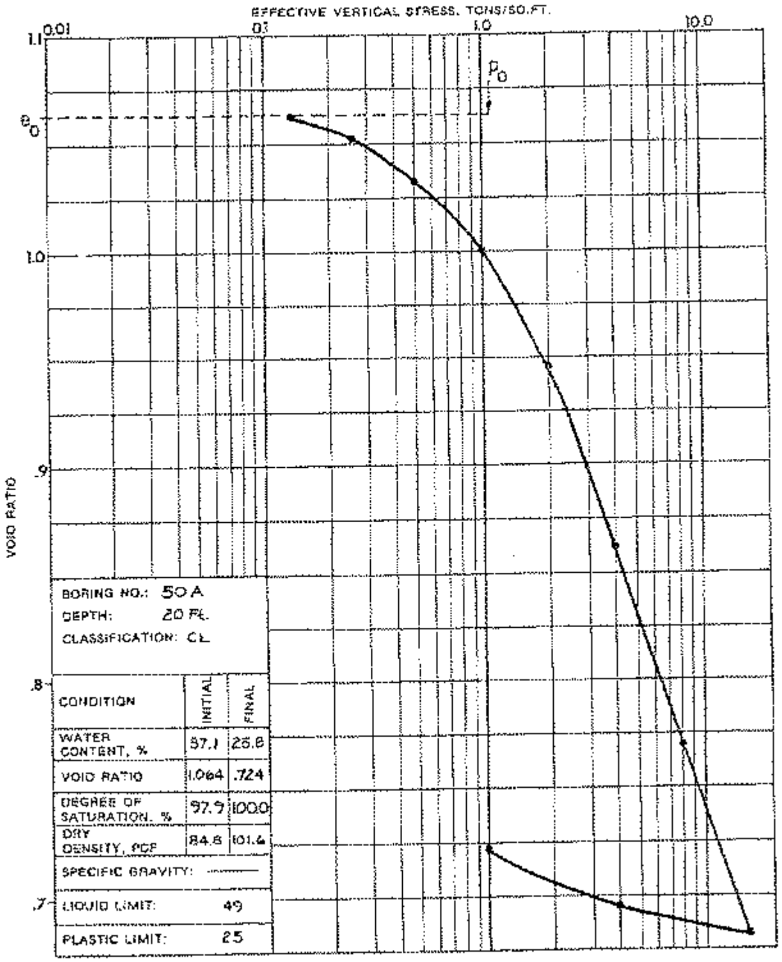
LIQUID LIMIT: 38

PLASTIC LIMIT: 18

CONSOLIDATION TEST RESULTS

ATEC ASSOCIATES

CN-1



BORING NO.: 50 A
DEPTH: 20 Ft.
CLASSIFICATION: CL

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	101.4

SPECIFIC GRAVITY: ———

LIQUID LIMIT: 49

PLASTIC LIMIT: 25

CONSOLIDATION TEST RESULTS

ATEC ASSOCIATES

CN-1

APPENDIX E

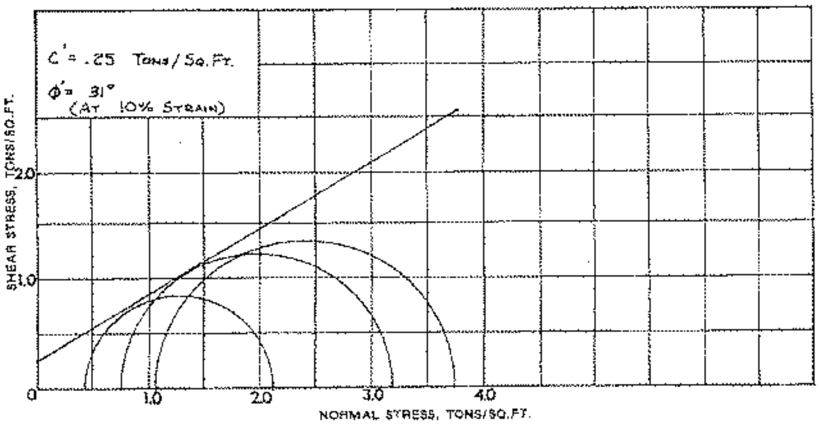
TRIAXIAL TESTS

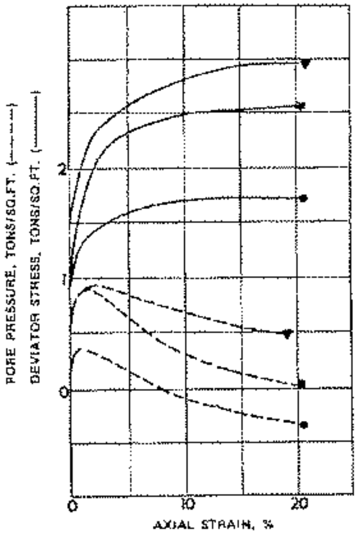
Ottumwa Generating Station-Unit 1
(E-7566)

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.

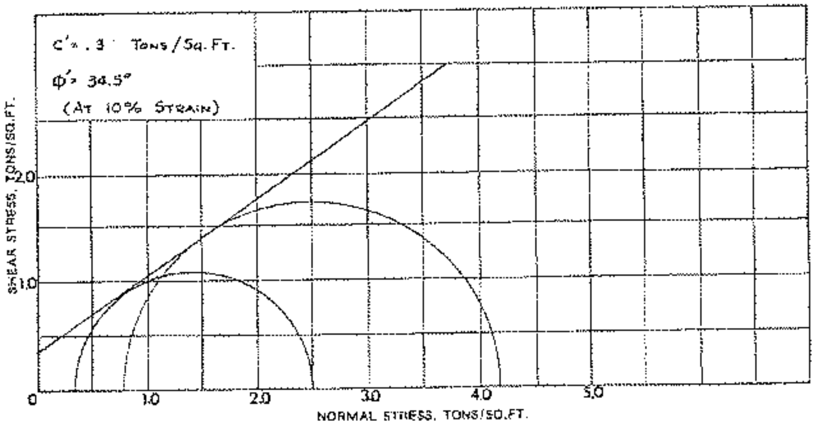
TEST DESIGNATION		●	■	▼	○
INITIAL	WATER CONTENT, %	24.9	21.0	24.9	
	DRY DENSITY, PCF	101.2	107.7	101.1	
	SAMPLE HEIGHT, IN.	2.80	2.80	2.80	
	SAMPLE DIAMETER, IN.	1.40	1.40	1.40	
FINAL BACK PRESSURE, TSF		1.97	4.08	1.62	
TOTAL CONSOLIDATION PRESSURE, TSF		2.32	5.14	3.38	
EFFECTIVE CONFINING PRESSURE, TSF		0.35	1.06	1.76	
FINAL WATER CONTENT, %		26.2	20.4	23.8	

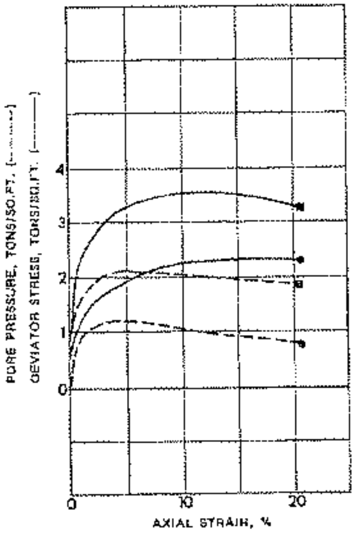
REMARKS:

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.

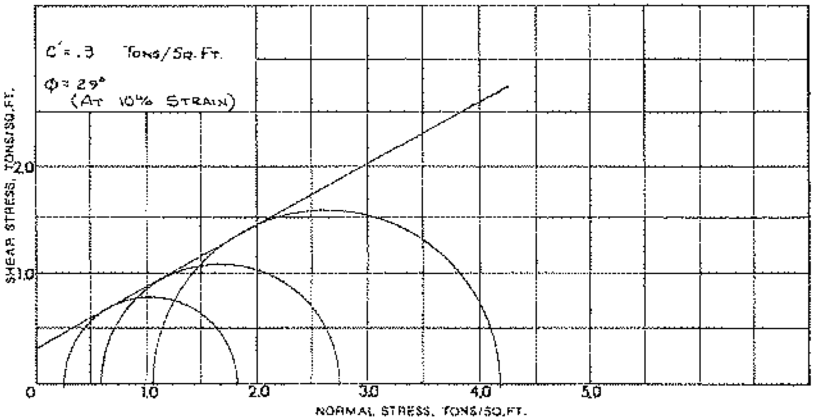
TEST DESIGNATION		●	■	▼	○
INITIAL	WATER CONTENT, %	28.5	30.7		
	DRY DENSITY, PCF	94.4	91.6		
	SAMPLE HEIGHT, IN.	2.80	2.80		
	SAMPLE DIAMETER, IN.	1.40	1.40		
FINAL BACK PRESSURE, TSF		1.62	1.97		
TOTAL CONSOLIDATION PRESSURE, TSF		3.03	4.79		
EFFECTIVE CONFINING PRESSURE, TSF		1.41	2.82		
FINAL WATER CONTENT, %		25.8	27.0		

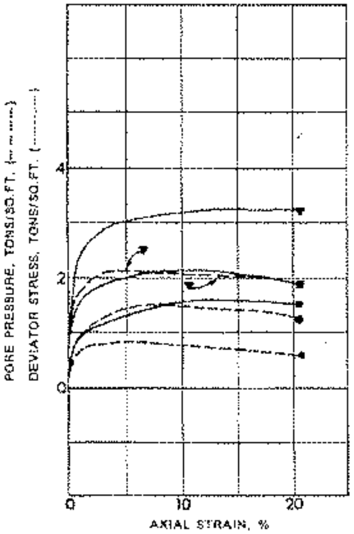
REMARKS:

TRIAXIAL TEST RESULTS

ATEC ASSOCIATES

TX-1





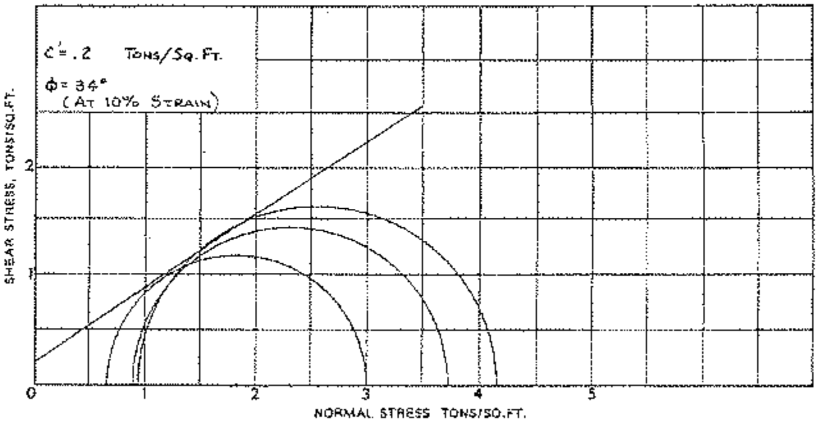
PROJECT NO.: E-7566
BORING NO.: 10 A
DEPTH: 7.0 - 9.0
LIQUID LIMIT: 56
PLASTIC LIMIT: 25
SOIL CLASSIFICATION: CH
TYPE OF TEST: Consolidated - Undrained
RATE OF STRAIN: 1.0 %/Min.

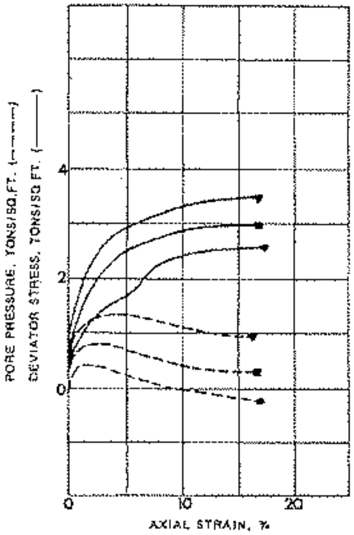
TEST DESIGNATION		●	■	▼	○
INITIAL	WATER CONTENT, %	32.1	32.7	27.5	
	DRY DENSITY, PCF	91.3	88.1	96.3	
	SAMPLE HEIGHT, IN.	2.80	2.80	2.80	
	SAMPLE DIAMETER, IN.	1.40	1.40	1.40	
FINAL BACK PRESSURE, TSF		2.32	2.68	1.62	
TOTAL CONSOLIDATION PRESSURE, TSF		3.38	4.79	4.79	
EFFECTIVE CONFINING PRESSURE, TSF		1.06	2.11	3.17	
FINAL WATER CONTENT, %		27.7	28.5	22.8	

REMARKS:

TRIAXIAL TEST RESULTS

ATEC ASSOCIATES





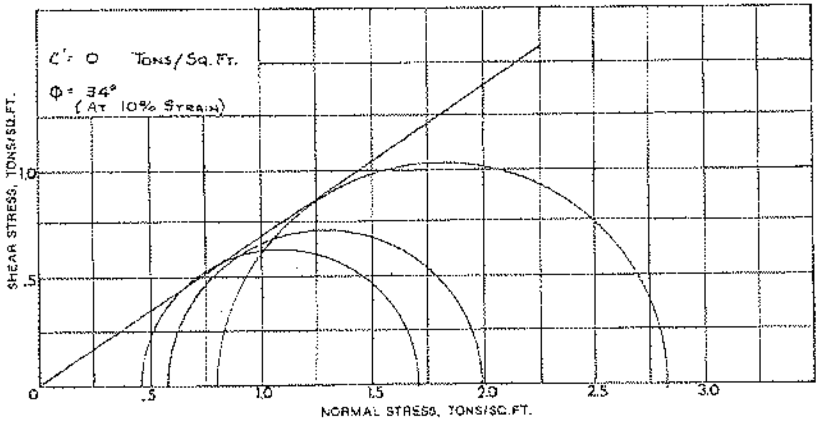
PROJECT NO.: E-7566
BORING NO.: 18 A
DEPTH: 19.0 - 21.0
LIQUID LIMIT: 47
PLASTIC LIMIT: 24
SOIL CLASSIFICATION: CL
TYPE OF TEST: Consolidated - Undrained
RATE OF STRAIN: 0.5%/Min.

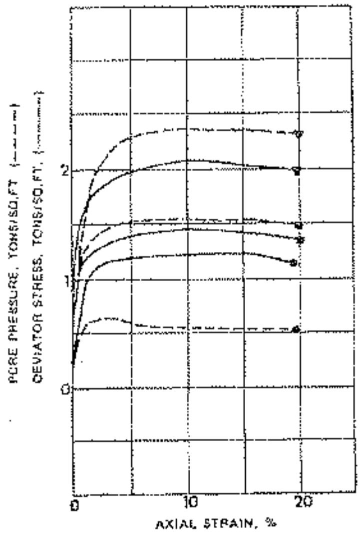
TEST DESIGNATION		●	■	▼	○
INITIAL	WATER CONTENT, %	20.6	23.0	20.9	
	DRY DENSITY, PCF	107.8	104.5	105.7	
	SAMPLE HEIGHT, IN.	5.60	5.60	5.60	
	SAMPLE DIAMETER, IN.	2.86	2.87	2.87	
FINAL BACK PRESSURE, TSF		1.62	1.62	2.68	
TOTAL CONSOLIDATION PRESSURE, TSF		2.32	3.03	4.79	
EFFECTIVE CONFINING PRESSURE, TSF		0.70	1.41	2.11	
FINAL WATER CONTENT, %		22.2	19.9	21.3	

REMARKS:

TRIAXIAL TEST RESULTS

ATEC ASSOCIATES



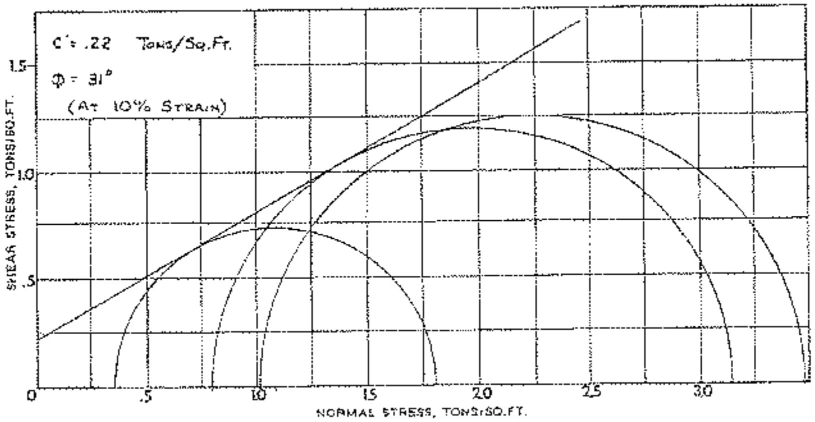


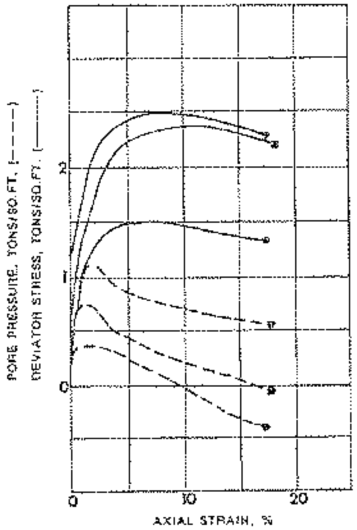
PROJECT NO. E-7566					
BORING NO.: 39A		DEPTH: 13.0 - 15.0			
LIQUID LIMIT: 42		PLASTIC LIMIT 25			
SOIL CLASSIFICATION: CL					
TYPE OF TEST Consolidated - Undrained					
RATE OF STRAIN: 0.074% / Min.					
TEST DESIGNATION		●	■	▼	○
INITIAL	WATER CONTENT, %	32.8	38.4	33.9	
	DRY DENSITY, PCF	89.1	82.9	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	29.4	27.1	
REMARKS:					

TRIAXIAL TEST RESULTS

ATEC ASSOCIATES

TX-1



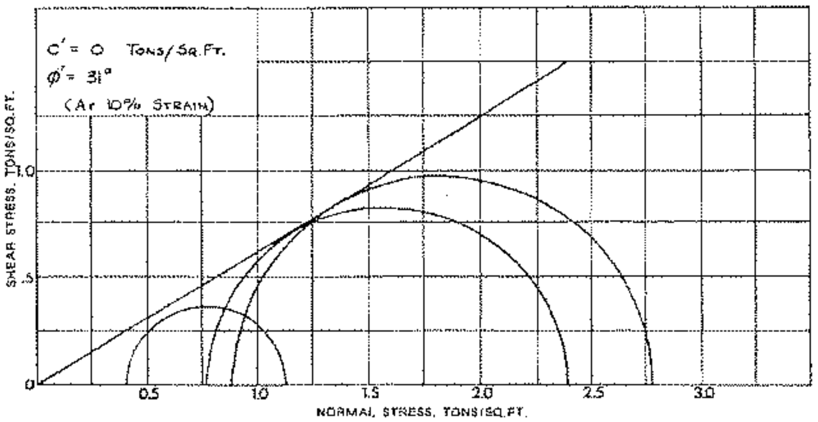


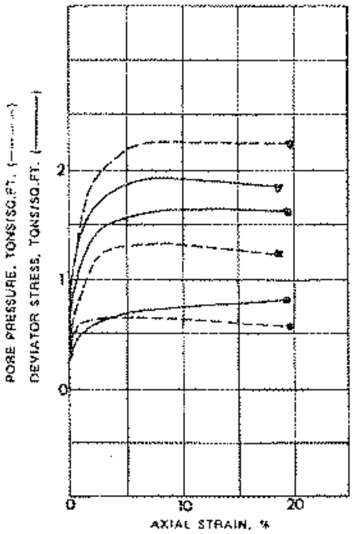
PROJECT NO.: E-7566					
BORING NO.: 43A		DEPTH: 18.0 - 20.0			
LIQUID LIMIT: 32		PLASTIC LIMIT: 15			
SOIL CLASSIFICATION: CL					
TYPE OF TEST: Consolidated - Undrained					
RATE OF STRAIN: 0.5% / Min.					
TEST DESIGNATION		●	■	▼	○
INITIAL	WATER CONTENT, %	22.2	22.2	21.1	
	DRY DENSITY, PCF	104.1	105.0	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	1.57	2.32	
TOTAL CONSOLIDATION PRESSURE, TSF		1.62	3.03	4.05	
EFFECTIVE CONFINING PRESSURE, TSF		0.35	1.06	1.76	
FINAL WATER CONTENT, %		23.6	22.3	21.6	
REMARKS:					

TRIAXIAL TEST RESULTS

ATEC ASSOCIATES

TX-1





PROJECT NO.: E-7566

BORING NO.: 48A | DEPTH: 16.0-17.9

LIQUID LIMIT: 53 | PLASTIC LIMIT: 23

SOIL CLASSIFICATION. CH

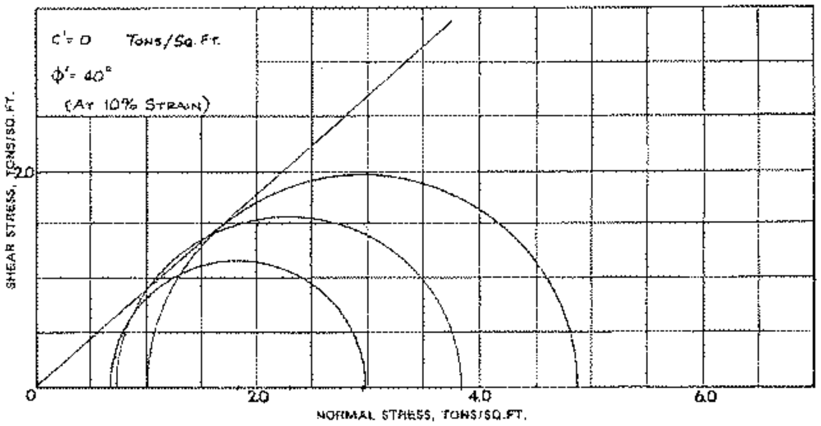
TYPE OF TEST: Consolidated – Undrained

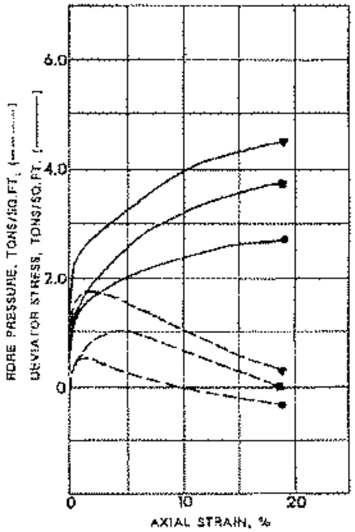
RATE OF STRAIN: 0.071% / Min.

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		2.48	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	102.6	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

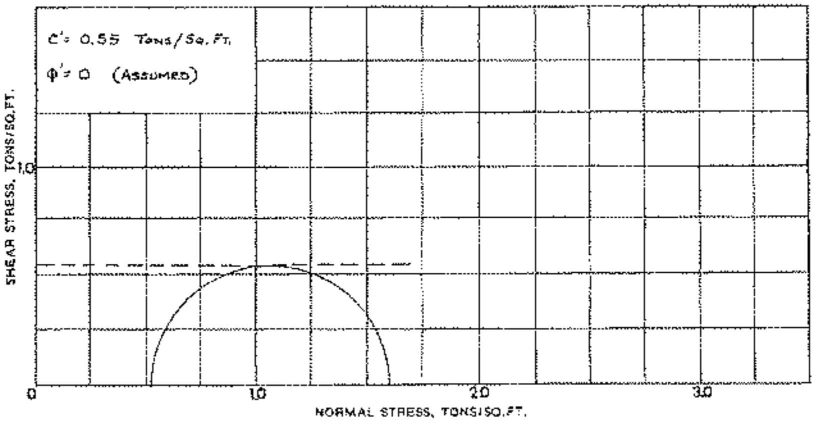
SUMMARY OF UNCONSOLIDATED-UNDRAINED TRIAXIAL TEST RESULTS

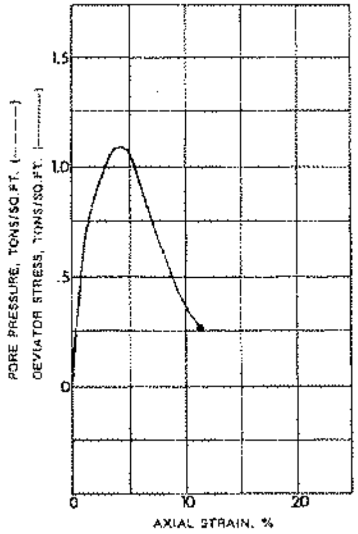
Boring No.	Depth, ft	Total Confining Pressure, tsf	Dry Density, lbs/cu.ft	Moisture Content, %	c (For Ø=0), tons/sq.ft	Remarks
41A	8.0-10.0	0.53	102.6	20.9	0.55	Small hole noted in membrane after test
43A	8.0-10.0	0.53	93.1	25.6	0.54	
45A	9.0-11.0	0.60	113.1	16.9	1.05	
46A	18.0-19.9	0.95	96.8	26.6	0.56	
50A	19.0-21.0	0.90	89.6	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.: 41 A		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

APPENDIX C – Conversion of Blowcount to Soil Strength

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

Safety Factor Assessment

nt and procedure

ocedure of ASTM D-1586
revisions:
h 20-in.-long split bar-
g 30 blows per foot, 12-
of drive is permissible.
ch 6 in. of penetration.
ith water or drilling

s pumped from a central
d while the drawdown or
g from the well is ob-
piezometers or obser-
le 3 to 5 observation
easing intervals along
arated by 90° central

is raised or lowered
position and readings
vels at periodic inter-
equilibrium. Observa-
head and time elapsed
n in Figure 4-3.

cased, open-end bore-
orehole with double
ch water flows out of
constant head is meas-
and procedures of

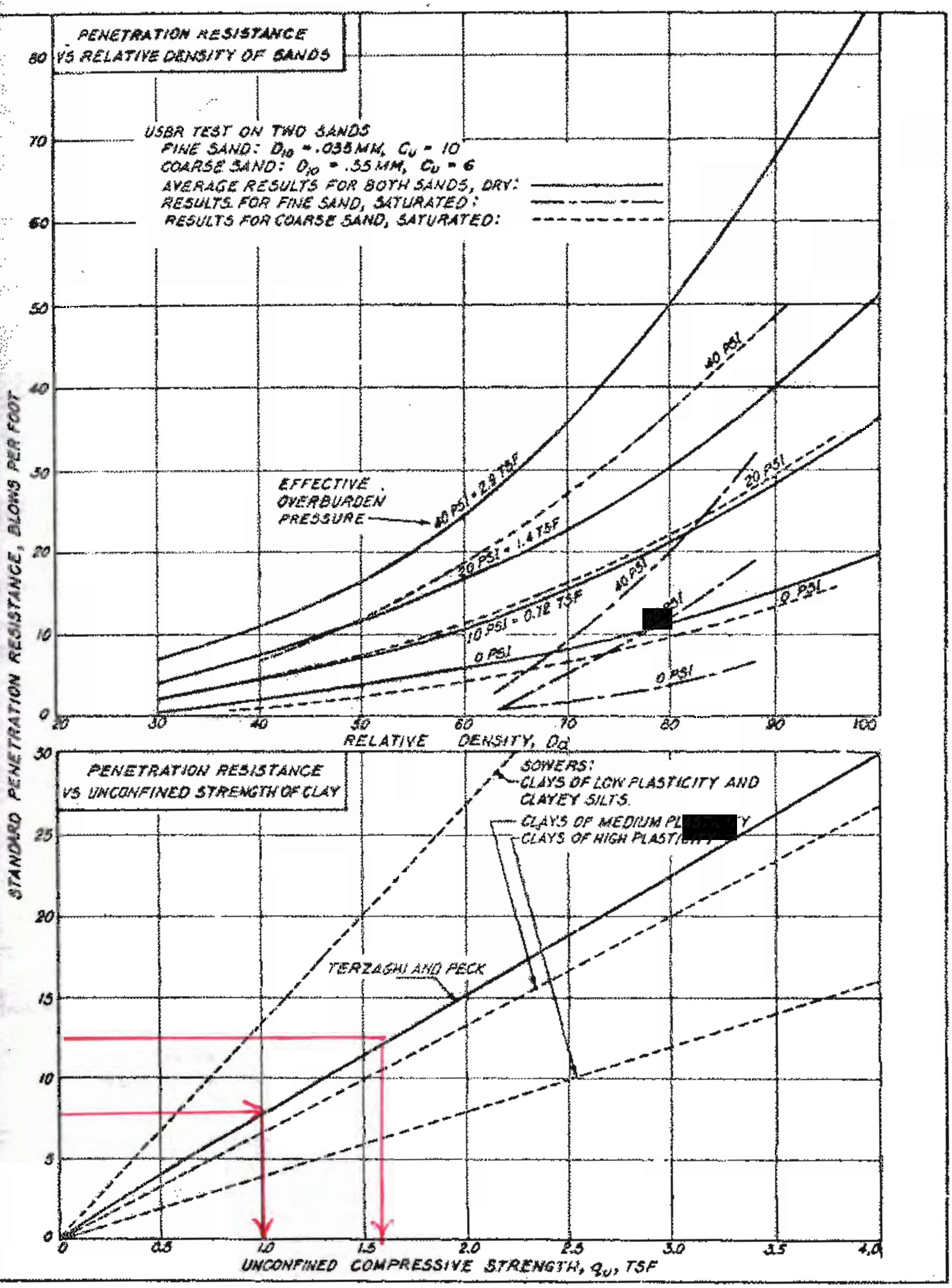
ws out of the uncased
taining a constant wa-
Use equipment and
lethod E-19.

sture content of soil
avated hole is deter-
me of hole by sand
uipment and proce-
0-45-302, Appendix

sture content is deter-
ted from a thin-wall
pressed into the
d procedure of USCE
dix III.

ncased boreholes.

hole to determine
ectangular test pits



NATIVE CLAY SPT 8
EMBANKMENT CLAY SPT 12

FIGURE 4-2
Correlations of Standard Penetration Resistance

isticated shear tests
satisfactorily approxi
ication (Table 1-3 and
ction can be obtained
the laboratory. As fo
l conditions, triaxial

disturbed samples pro
n as one-half the unc
n made between uncon
t (Section 3, Chapter
y disturbed in samplin
further useful when the

se soils are not well f
load. A practical,
cohesion is substanti
can be treated as a
shear tests. The acti
minations. Where the
rformed under drainag
rine deposits, the
gth and its increase

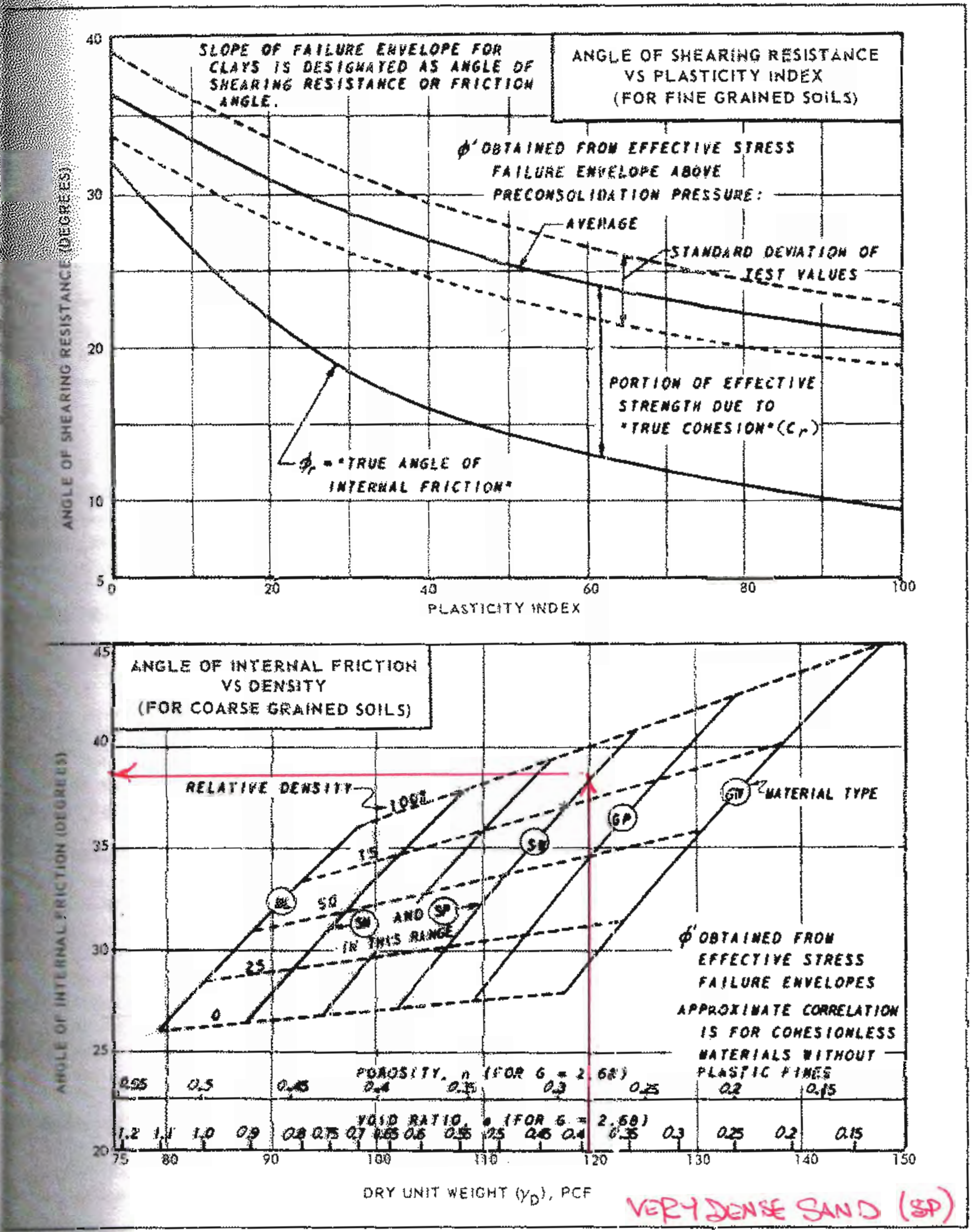
nployed in determinin
ohesionless soils.

t compaction control.
al borrow materials.

ed base course or a
ss earthwork, when
isture content that,

t free draining cohesi
than those provided b
niversally accepted.

s classified in the



VERY DENSE SAND (SP)

FIGURE 3-7
Correlations of Strength Characteristics

APPENDIX D – USGS Earthquake Design PGA

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

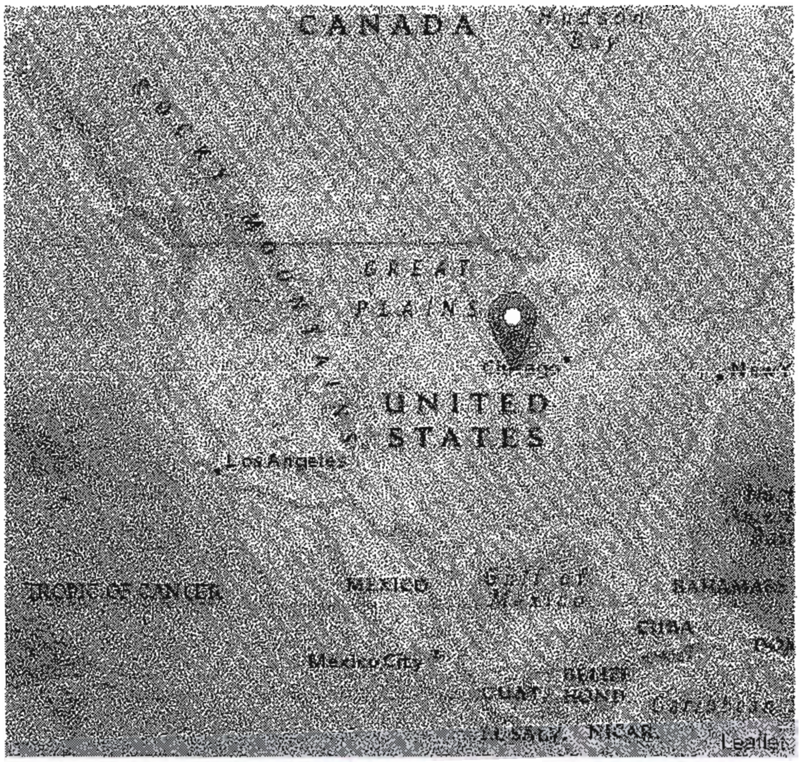
Safety Factor Assessment

U.S. Geological Survey - Earthquake Hazards Program

Ottumuwa [redacted]nerating Station

Latitude = 41.000°N, Longitude = 92.543°W

Location



Reference Document

2015 NEHRP Provisions

Site Class

D (determined): Stiff Soil

Risk Category

I or II or III

S_S = 0.078 g

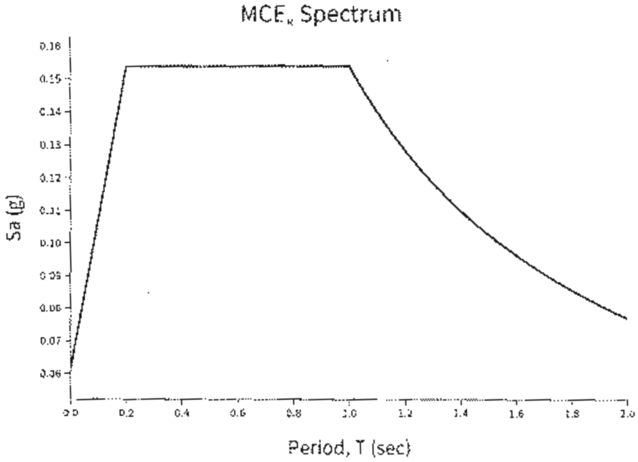
S_{MS} = 0.124 g

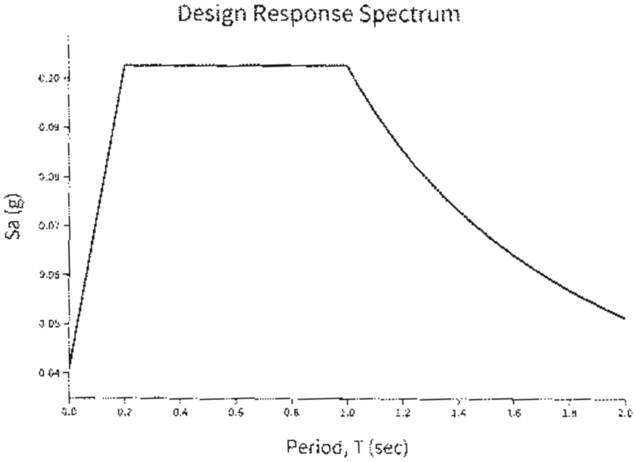
S_{DS} = 0.083 g

S_1 = 0.064 g

S_{M1} = 0.154 g

S_{D1} = 0.103 g





Since $S_{MS} < S_{M1}$, for this response spectrum S_{MS} has been set equal to S_{M1} (and hence S_{DS} has

Mapped Acceleration Parameters, Long-Period Transition Periods, and Risk Coefficients

Note: The S_S and S_1 ground motion maps provided below are for the direction of maximmum horizontal spectral response acceleration. They have been converted from corresponding geometric mean ground motions computed by the USGS by applying factors of 1.1 (to obtain S_S) 1.3 (to obtain S_1).

- FIGURE 22-1 S_S Risk-Targeted Maximum Considered Earthquake (MCE_R) Ground Motion Parameter for the Conterminous United States for 0.2 s Spectral Response Acceleration (5% of Critical Damping), Site Class B
- FIGURE 22-2 S_1 Risk-Targeted Maximum Considered Earthquake (MCE_R) Ground Motion Parameter for the Conterminous United States for 1.0 s Spectral Response Acceleration (5% of Critical Damping), Site Class B
- FIGURE 22-9 Maximum Considered Earthquake Geometric Mean (MCE_G) PGA, %g, Site Class B for the Conterminous United States
- FIGURE 22-14 Mapped Long-Period Transition Period, T_L (s), for the Conterminous United States
- FIGURE 22-18 Mapped Risk Coefficient at 0.2 s Spectral Response Period, C_{RS}
- FIGURE 22-19 Mapped Risk Coefficient at 1.0 s Spectral Response Period, C_{R1}

Site Class

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site class as Site Class , based on the site soil properties in accordance with Chapter 20.

Table 20.3-1 Site Classification

Site Class	$\bar{v}_s$	$\bar{N}$ or $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard Rock	>5,000 ft/s	N/A	N/A
B. Rock	2,500 to 5,000 ft/s	N/A	N/A
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff Soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the characteristics: • Plasticity index PI > 20 • Moisture content $w \geq 40\%$, and • Undrained shear strength $\bar{s}_u < 500$ psf		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		

For SI: 1ft/s = 0.3048 m/s 1lb/ft^2 = 0.0479 kN/m^2

Additional Geotechnical Investigation Report Requirements for Seismic Design Categories D through F

Table 11.8-1: Site Coefficient for F_{PGA}

	Mapped MCE Geometric Mean (MCE_G) Peak Ground Acceleration					
Site Class	PGA ≤ 0.10	PGA = 0.20	PGA = 0.30	PGA = 0.40	PGA = 0.50	PGA ≥ 0.60
A	0.8	0.8	0.8	0.8	0.8	0.8
B (measured)	0.9	0.9	0.9	0.9	0.9	0.9
B (unmeasured)	1.0	1.0	1.0	1.0	1.0	1.0
C	1.3	1.2	1.2	1.2	1.2	1.2
D (determined)	1.6	1.4	1.3	1.2	1.1	1.1
D (default)	1.6	1.4	1.3	1.2	1.2	1.2
E	2.4	1.9	1.6	1.4	1.2	1.1
F	See Section 11.4.7					

Note: Use straight-line interpolation for intermediate values of PGA

Note: Where Site Class D is selected as the default site class per Section 11.4.2, the value of F_{pga} shall not be less than 1.2.

For Site Class = D (determined) and PGA = 0.037 g, F_{PGA} = 1.600

Mapped MCE_G

$PGA = 0.037$ g

Site-adjusted MCE_G

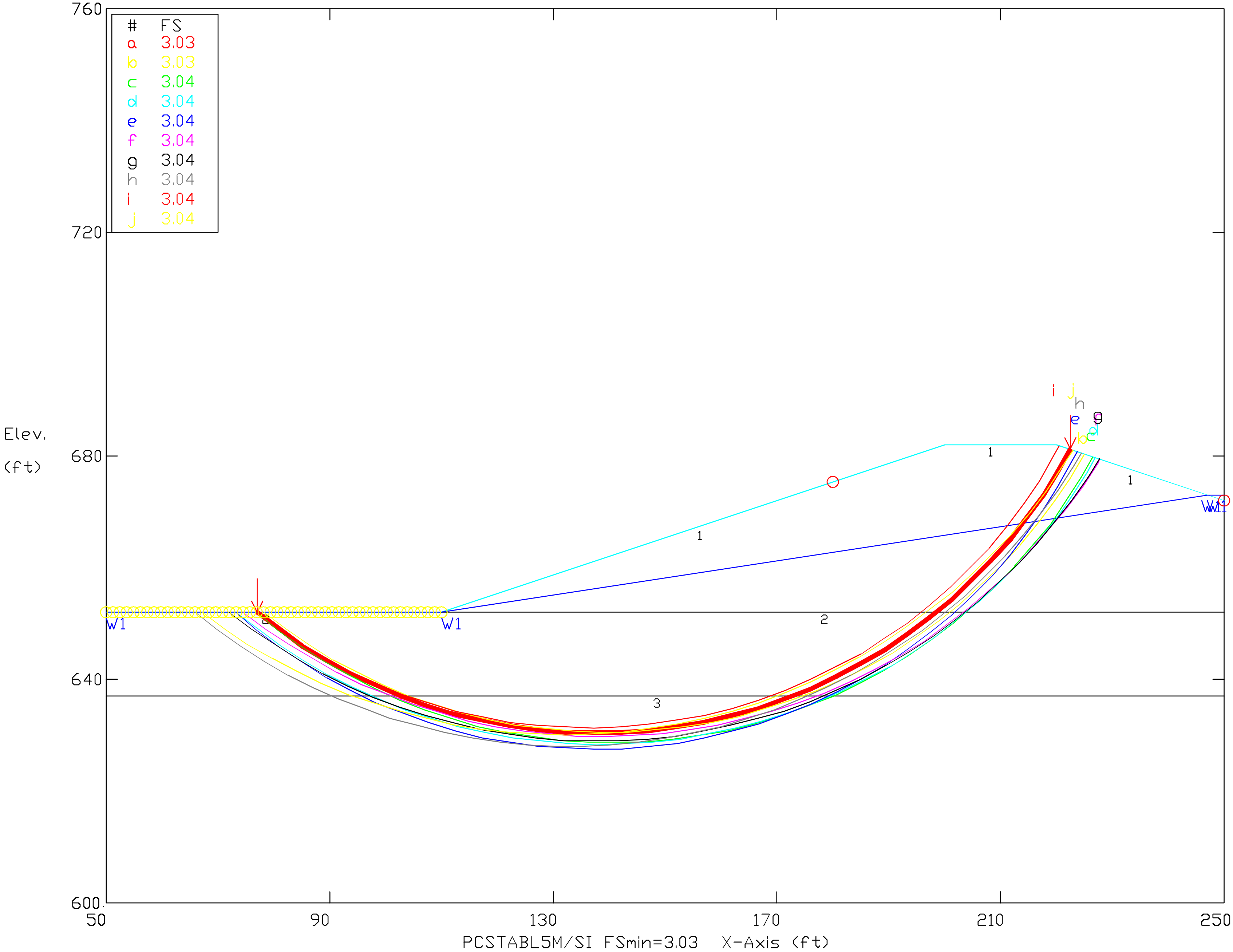
$PGA_M = F_{PGA}PGA = 1.600 \times 0.037 = 0.058$ g

APPENDIX E – Slope Stability Analysis

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

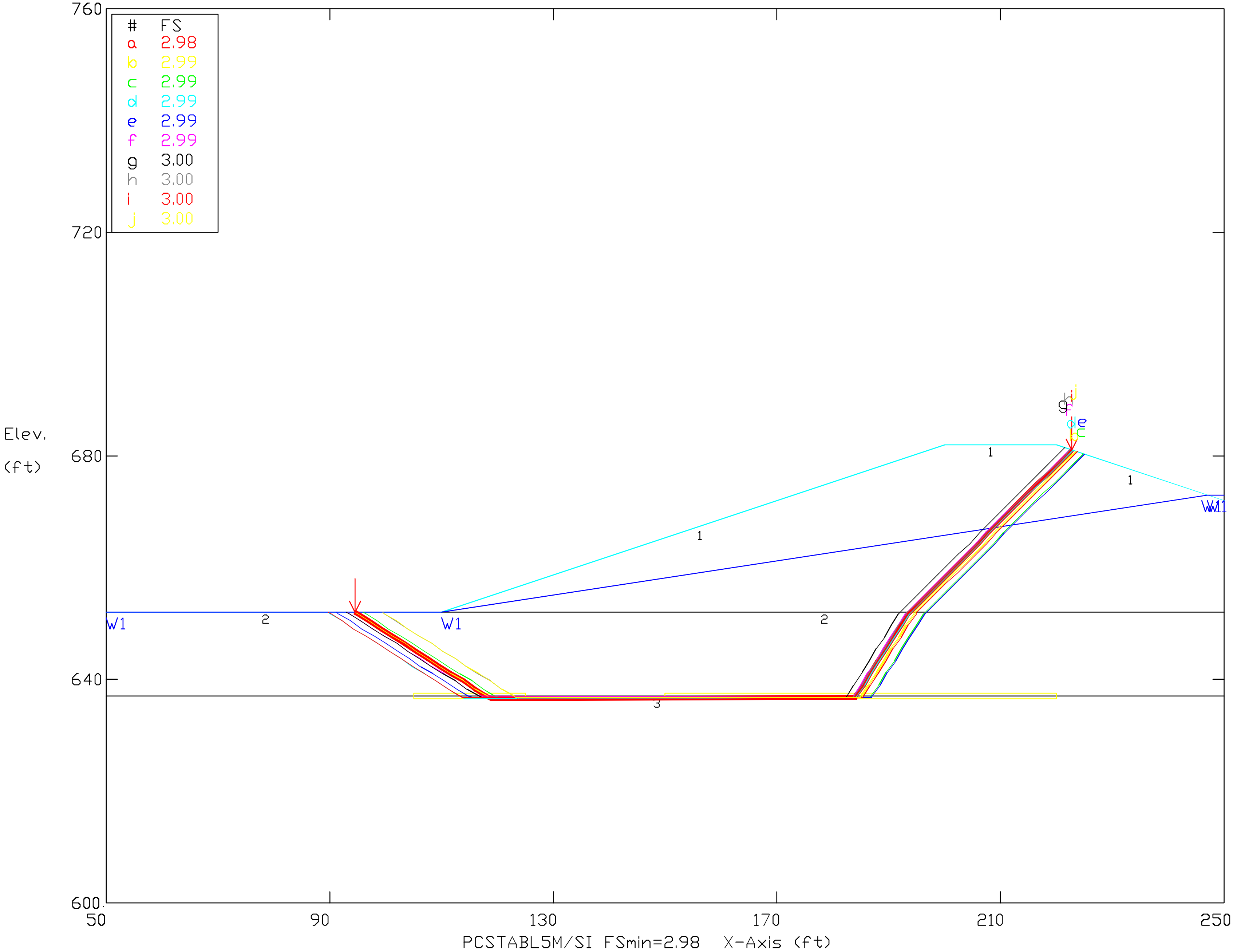
Safety Factor Assessment

□GS ZLD Impoundment □uter Dike Static Case & Normal Water Levels
Ten Most Critical. E:□GS11C.PLT 08-24-16 4:42pm



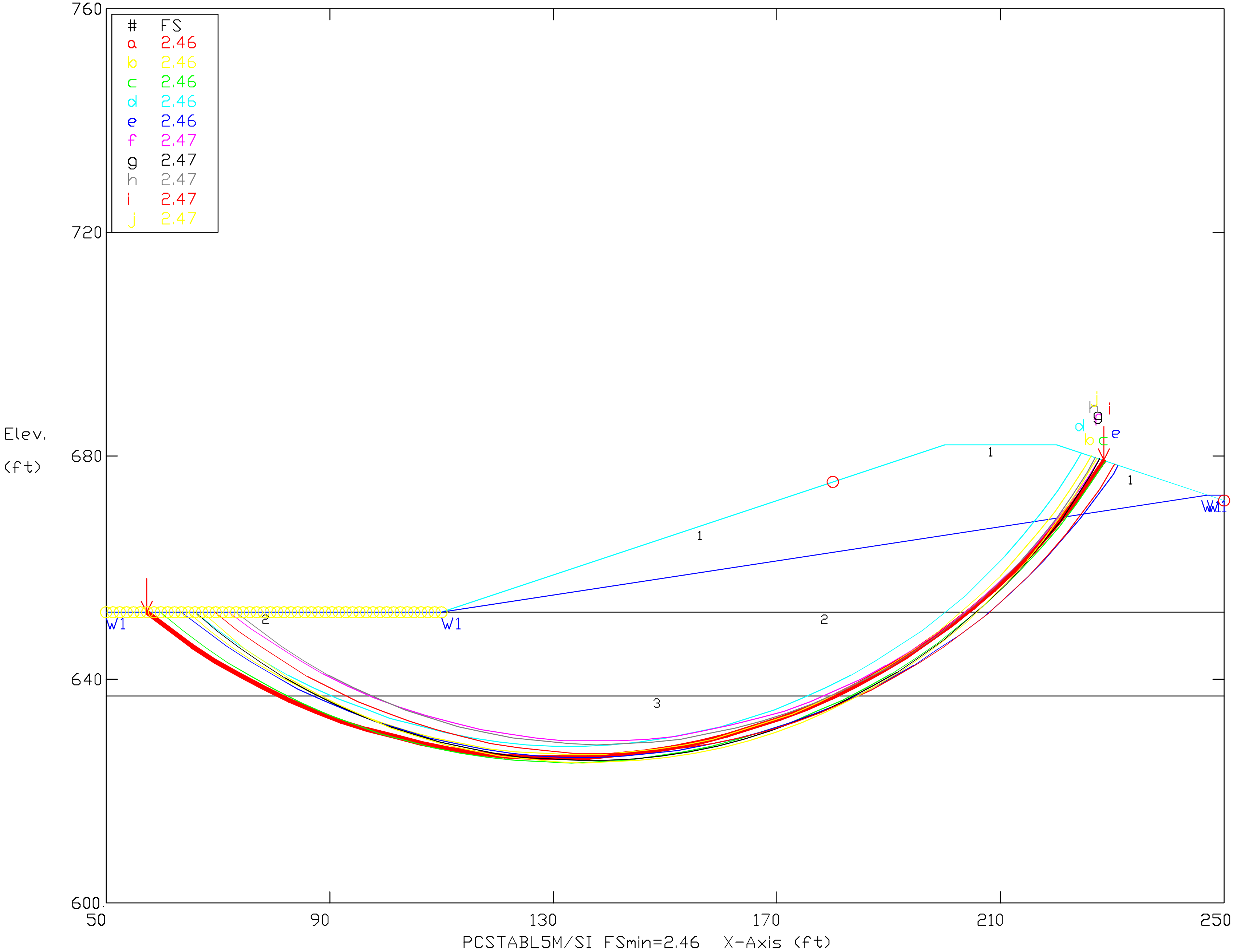
Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	Dike	125	125	1600	0	0	0	W1
2	Clay	115	115	1000	[illegible]	0	0	W1
3	Sand	125	125	0	38	0	0	W1

OGS ZLD Impoundment Outer Dike Static Case & Normal Water Levels
Ten Most Critical. E:OGS11B.PLT   08-24-16   4:52pm



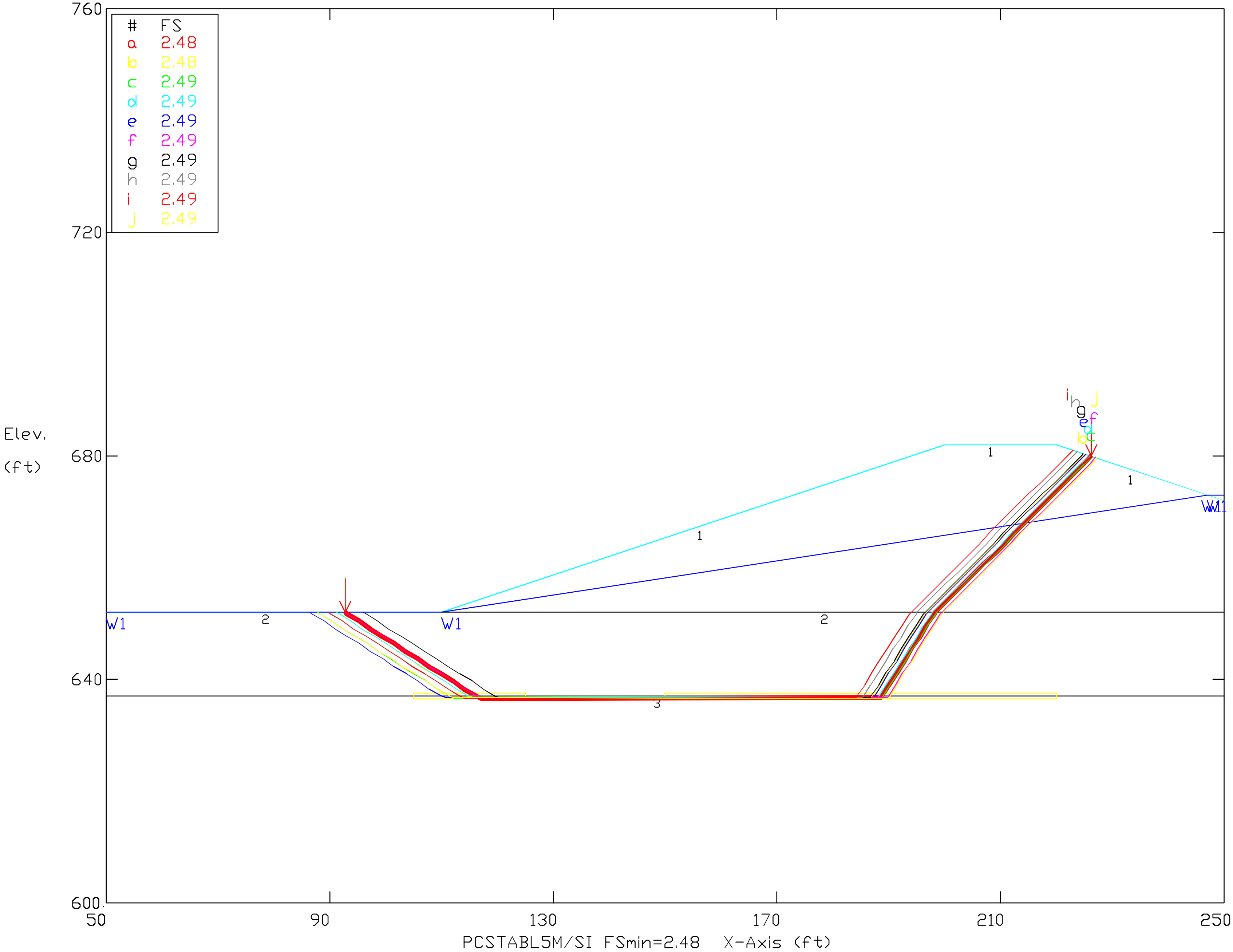
Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	Dike	125	125	1600	0	0	0	W1
2	Clay	115	115	1000	[illegible]	0	0	W1
3	Sand	125	125	0	38	0	0	W1

OGS ZLD Impoundment Outer Dike Earthquake Case & Normal Water Levels
Ten Most Critical. E:OGS11CEQ.PLT 08-24-16 5:14pm



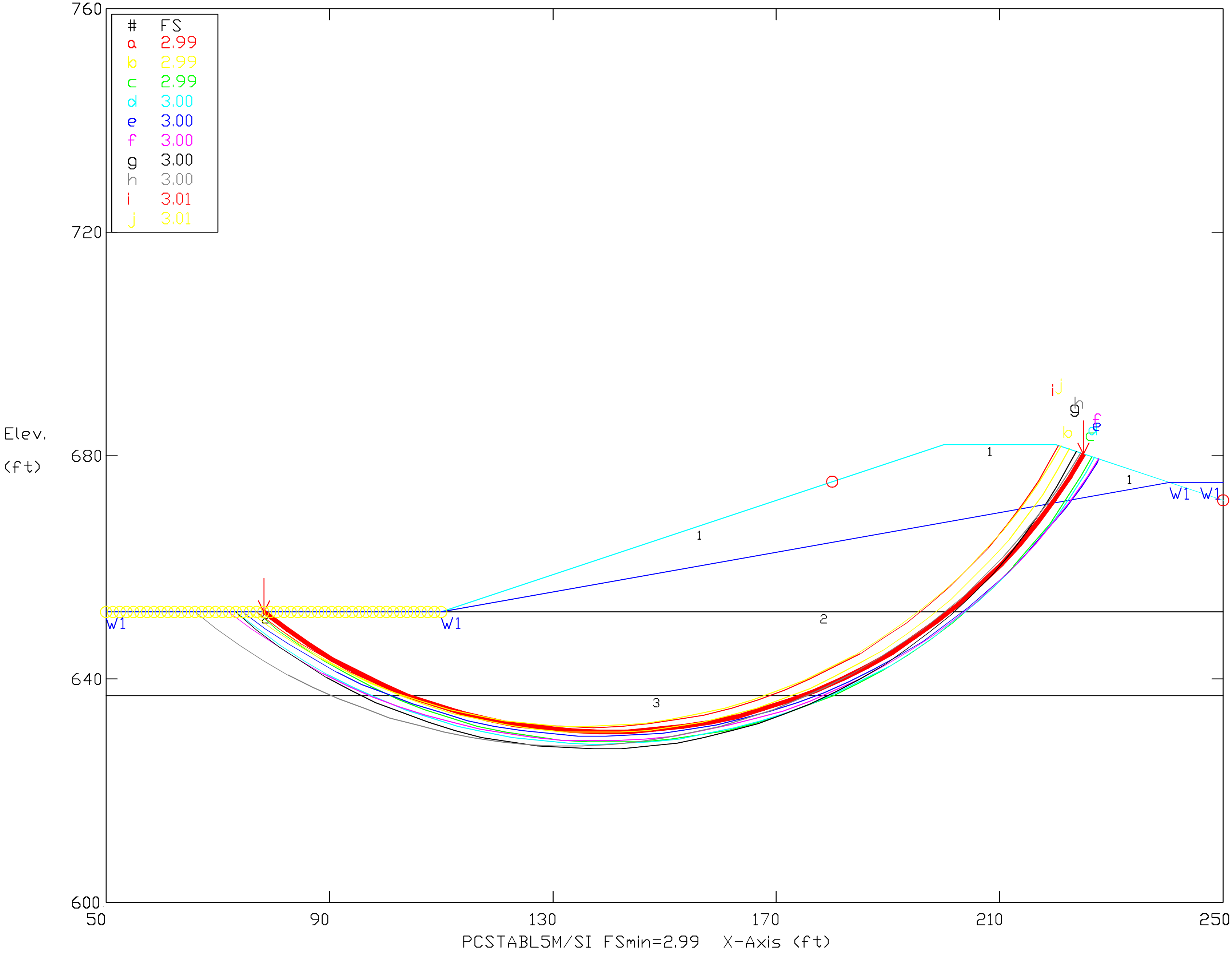
Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	Dike	125	125	1600	0	0	0	W1
2	Clay	115	115	1000	[illegible]	0	0	W1
3	Sand	125	125	0	38	0	0	W1

OGS ZLD Impoundment Outer Dike Earthquake Case & Normal Water Lev
Ten Most Critical. E:OGS11BEQ.PLT 08-24-16 5:15pm



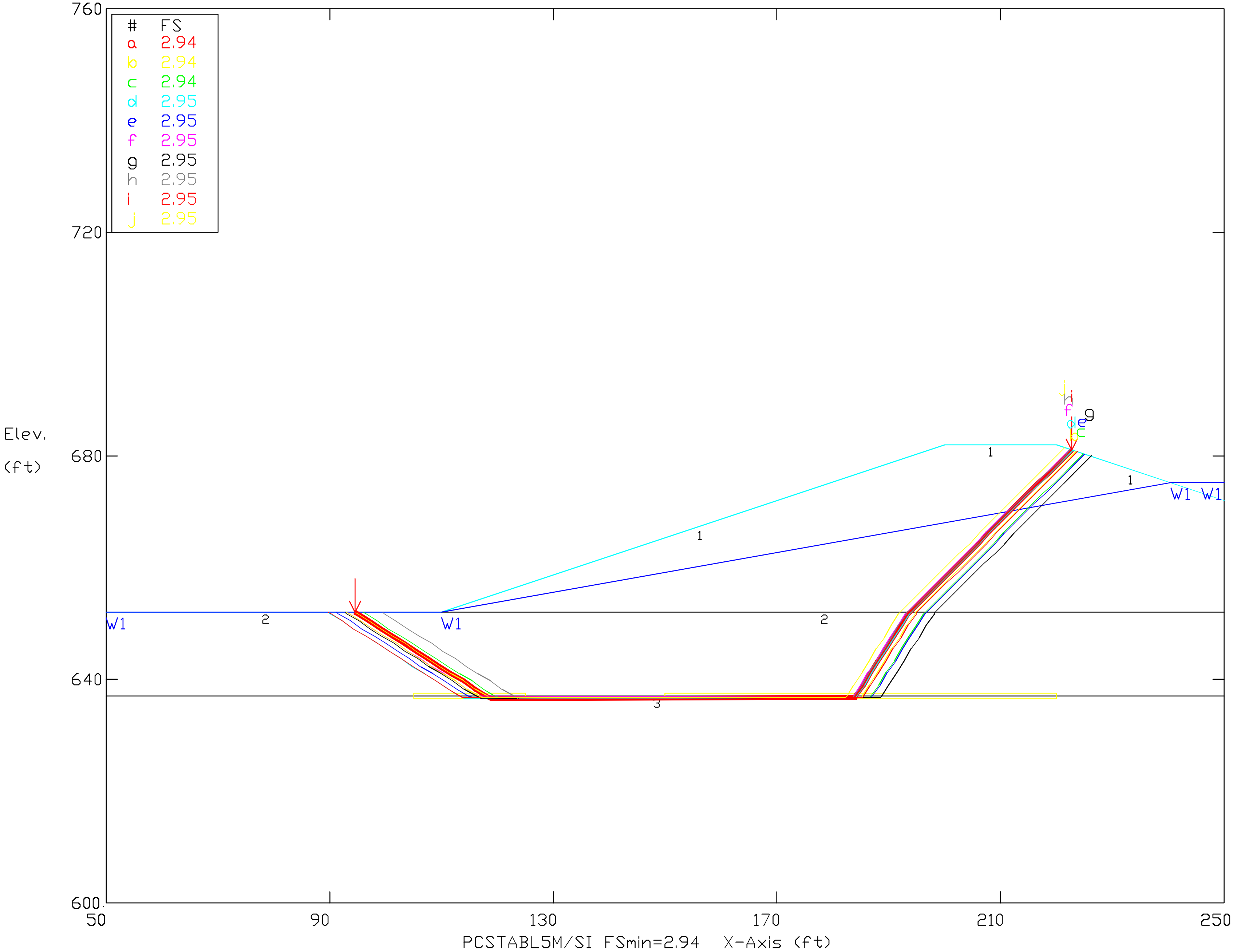
Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	Dike	125	125	1600	0	0	0	W1
2	Clay	115	115	1000	[illegible]	0	0	W1
3	Sand	125	125	0	38	0	0	W1

□GS ZLD Impoundment □uter Dike Static Case & 100-Year Water Levels
Ten Most Critical. E:□GS12C.PLT 08-24-16 5:29pm



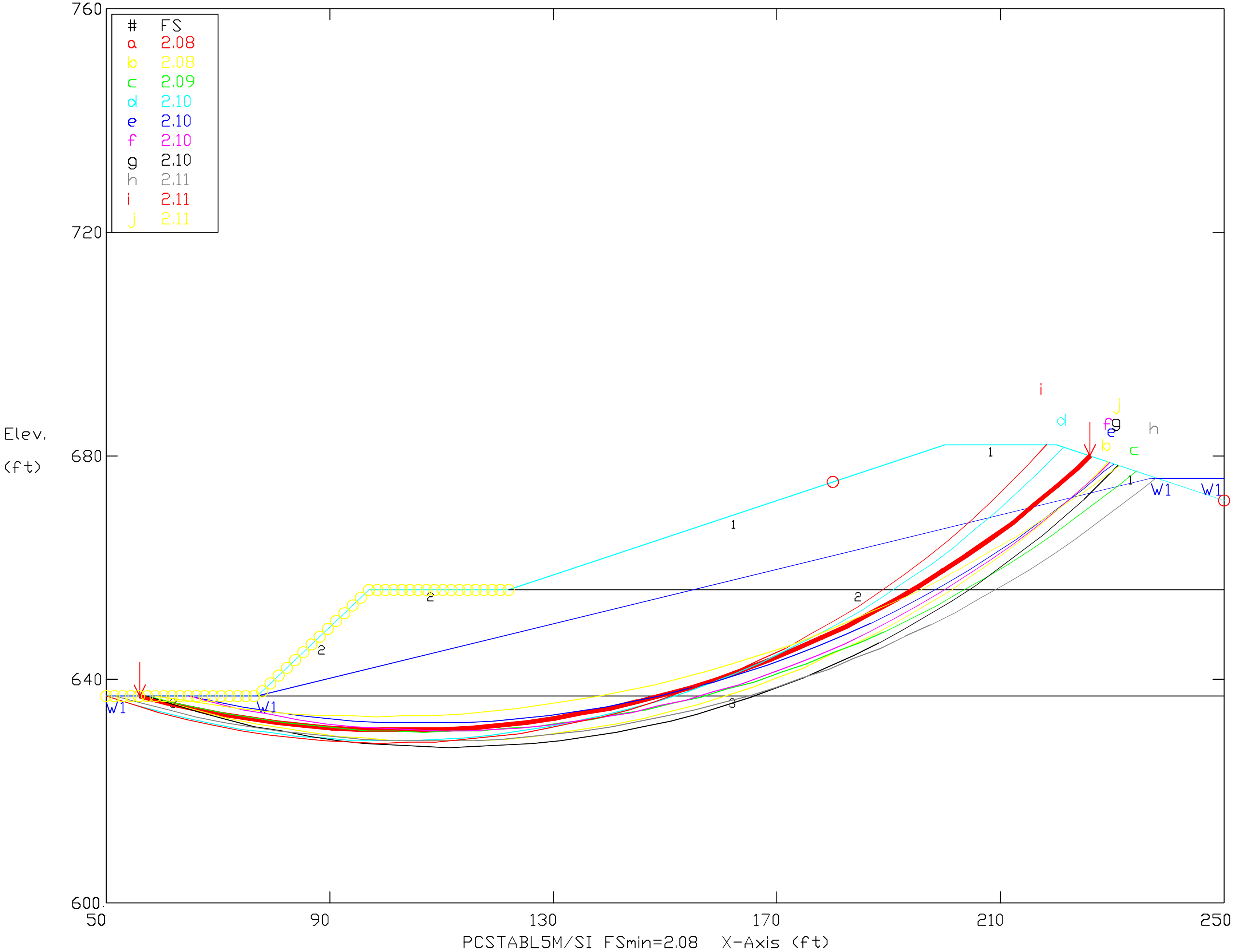
Soil Type No. Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1 Dike	125	125	1600	0	0	0	W1
2 Clay	115	115	1000	[illegible]	0	0	W1
3 Sand	125	125	0	38	0	0	W1

□GS ZLD Impoundment □uter Dike Static Case & 100-Year Water Levels
Ten Most Critical. E:□GS12B.PLT 08-24-16 5:33pm



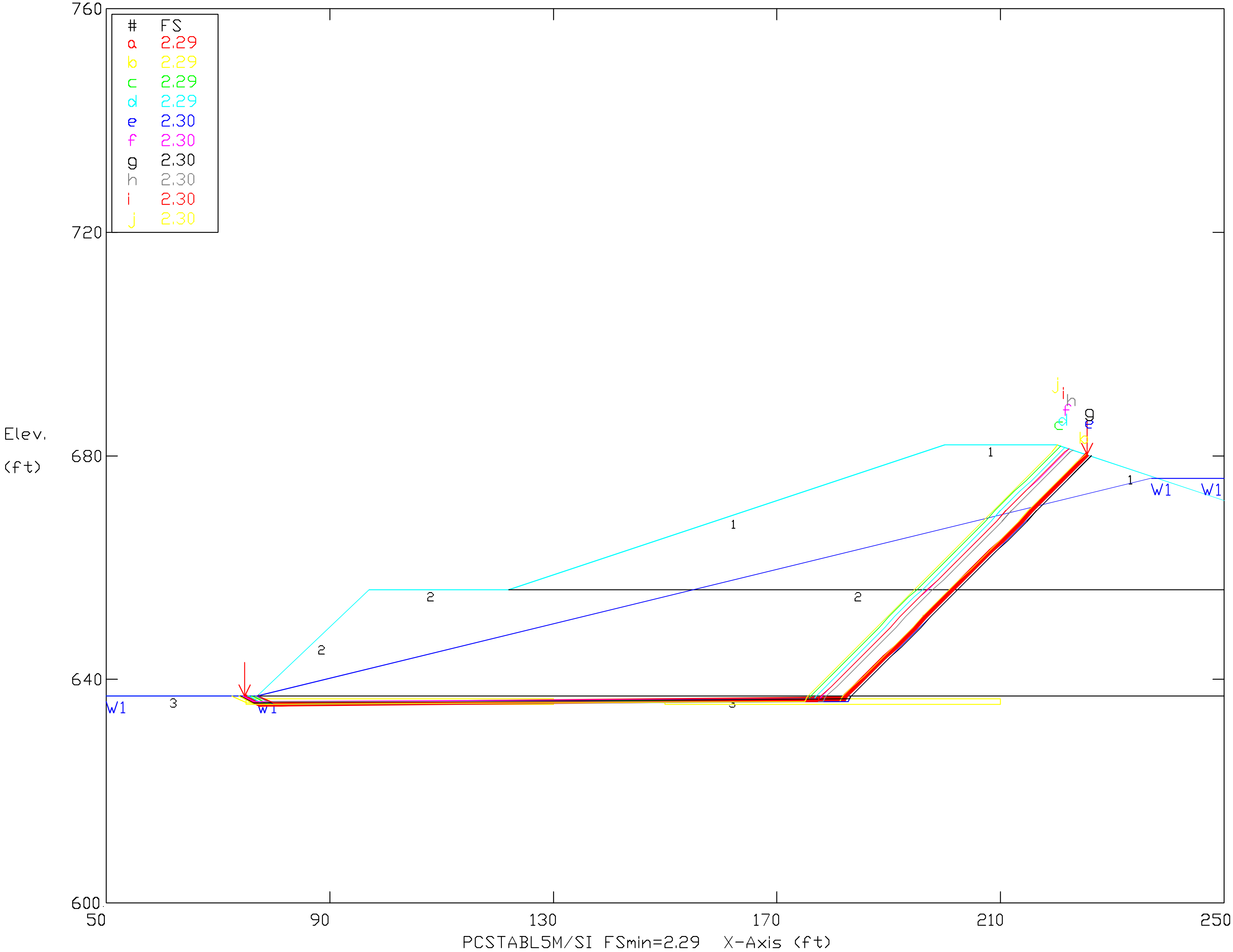
Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	Dike	125	125	1600	0	0	0	W1
2	Clay	115	115	1000	[illegible]	0	0	W1
3	Sand	125	125	0	38	0	0	W1

OGS Settling Impoundment Outer Dike Static Case & Normal Water Levels
Ten Most Critical. E:OGS21C.PLT 08-24-16 5:35pm



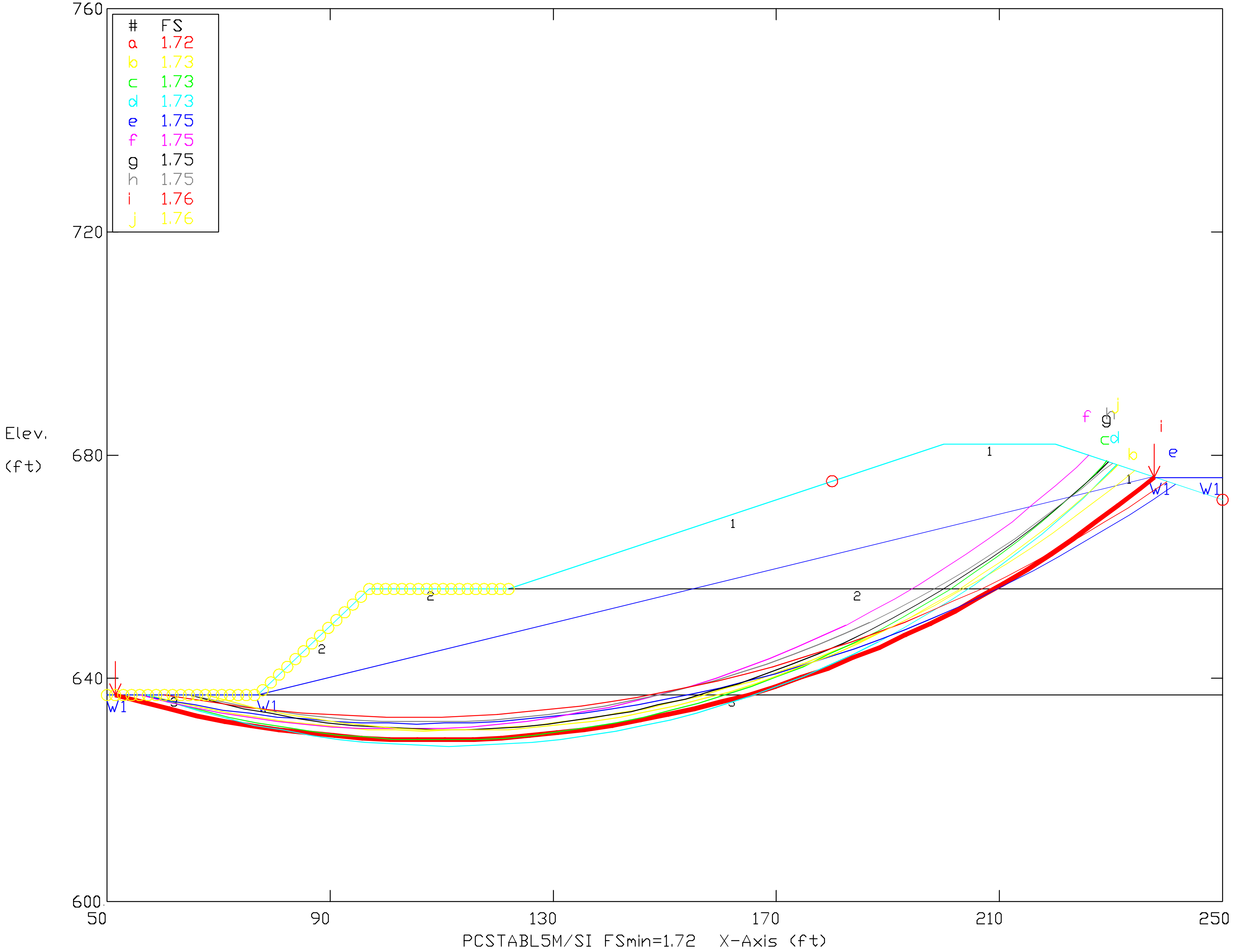
Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	Clay	125	125	1600	0	0	0	W1
2	[illegible]	115	115	[illegible]	[illegible]	0	0	W1
3	Sand	125	125	0	38	0	0	W1

OGS Settling Impoundment Outer Dike Static Case & Normal Water Levels
Ten Most Critical. E:OGS21B.PLT 08-24-16 7:10pm



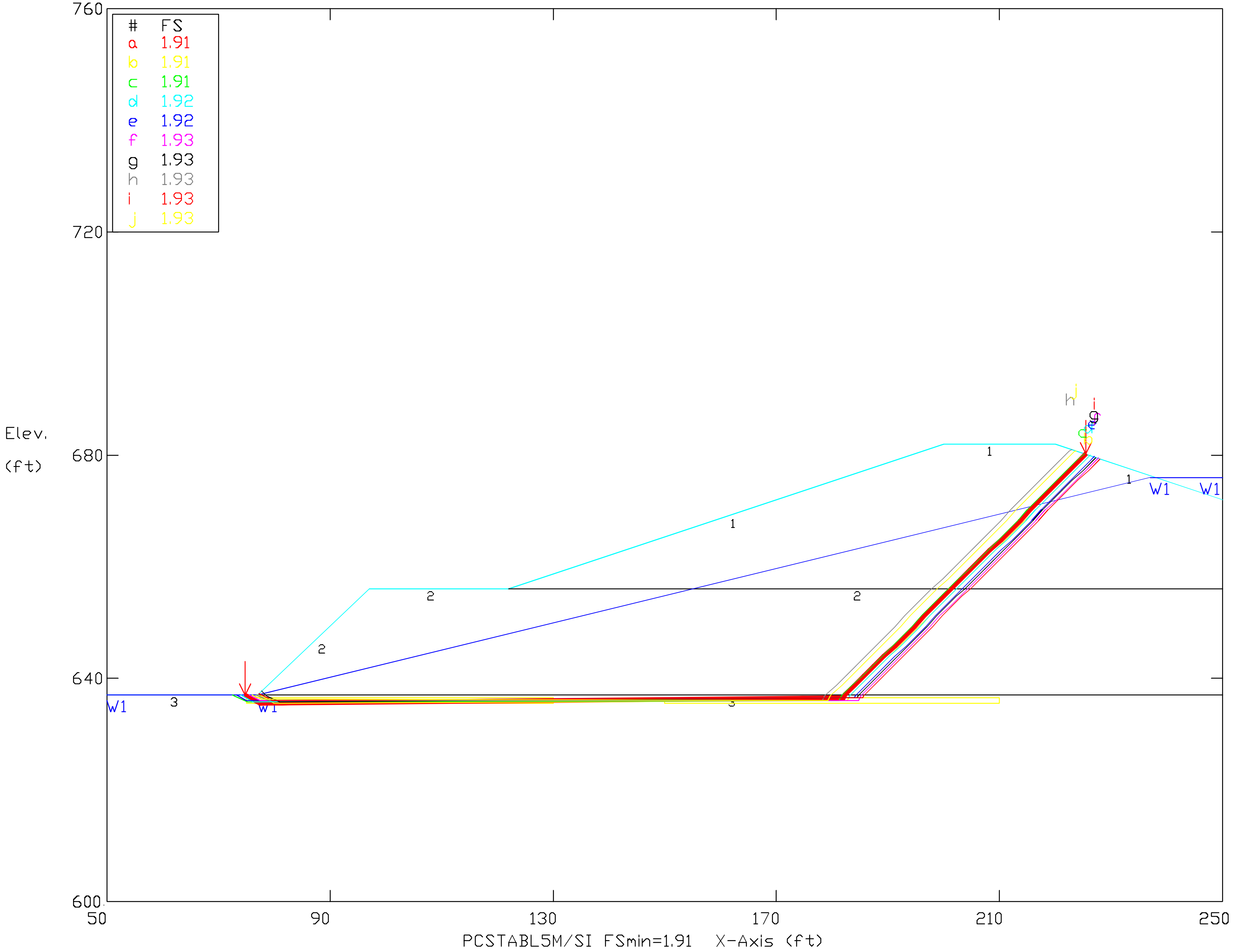
Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	Clay	125	125	1600	0	0	0	W1
2	Clay	115	115	1000	[illegible]	0	0	W1
3	Sand	125	125	0	38	0	0	W1

OGS Settling Impoundment Outer Dike Earthquake Case & Normal Water Levels
Ten Most Critical. E:OGS21CEQ.PLT 08-24-16 7:19pm



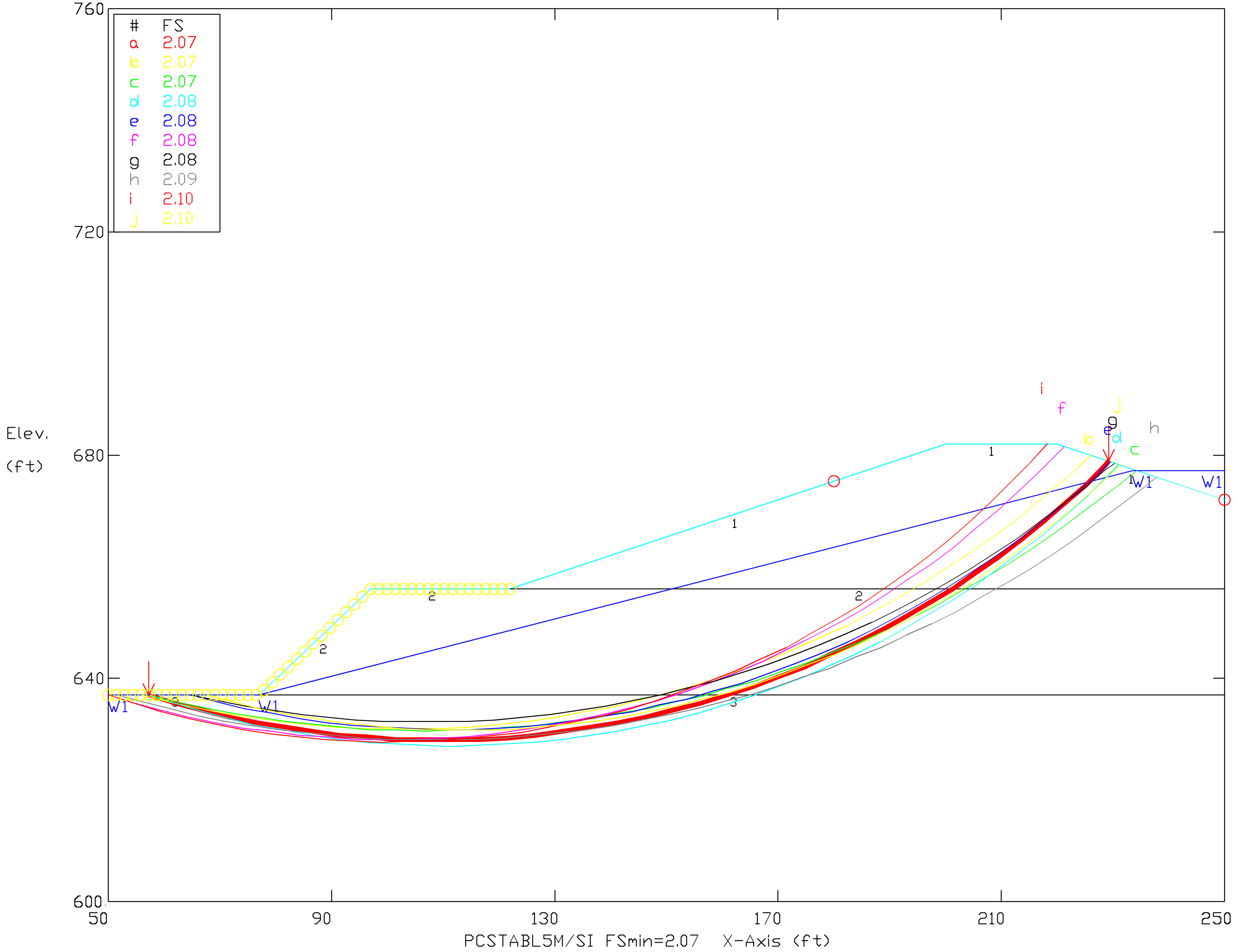
Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	Clay	125	125	1600	0	0	0	W1
2	Clay	115	115	1000	[illegible]	0	0	W1
3	Sand	125	125	0	38	0	0	W1

OGS Settling Impoundment Outer Dike Earthquake Case & Normal Water Levels
Ten Most Critical. E:OGS21BEQ.PLT 08-24-16 7:15pm



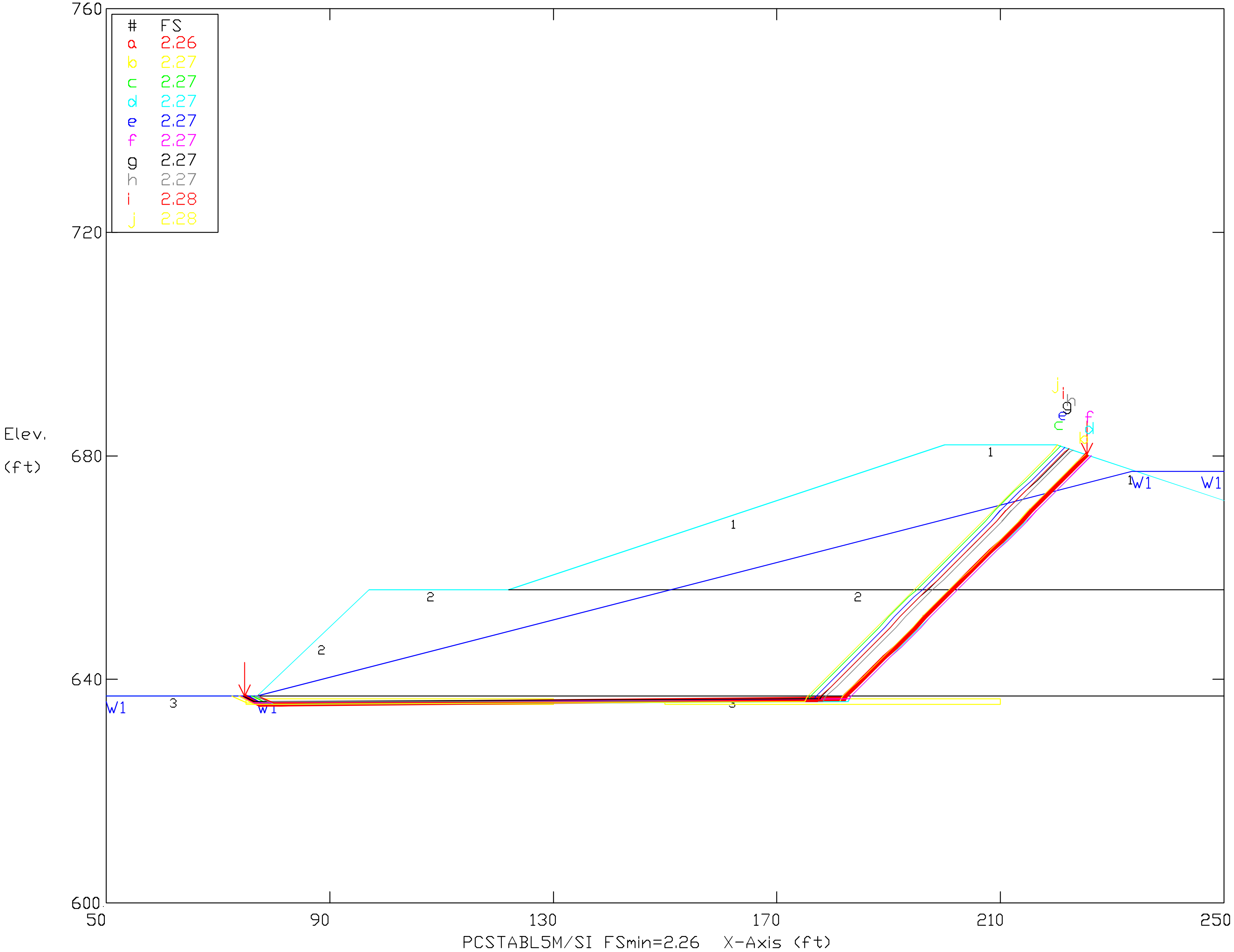
Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	Clay	125	125	1600	0	0	0	W1
2	Clay	[illegible]	115	1000	[illegible]	0	0	W1
3	Sand	125	125	0	38	0	0	W1

OGS Settling Impoundment Outer Dike Static Case & 100-Year Water Levels
Ten Most Critical. E:OGS22C.PLT 08-24-16 7:23pm



Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	Clay	125	125	1600	0	0	0	W1
2	[illegible]	115	115	[illegible]	[illegible]	0	0	W1
3	Sand	125	125	0	38	0	0	W1

OGS Settling Impoundment Outer Dike Static Case & 100-Year Water Levels
Ten Most Critical. E:OGS22B.PLT 08-24-16 7:27pm



Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	Clay	125	125	1600	0	0	0	W1
2	Clay	115	115	1000	[illegible]	0	0	W1
3	Sand	125	125	0	38	0	0	W1

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